SEMESTER I

M. Sc (Information Technology)		Semester – I	
Course Name: Research in Computing		**Course Code: PSIT101**	
Periods per week **1 Period is 60 minutes**	**Lectures**	**4**	
	Credits	**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2½**	**60**
	Theory Internal	**--**	**40**

Objectives	• To be able to conduct business research with an understanding of all the latest theories. • To develop the ability to explore research techniques used for solving any real world or innovate problem.

Pre requisites	Basic knowledge of statistical methods. Analytical and logical thinking.

Unit	Details	Lectures
I	**Introduction:** Role of Business Research, Information Systems and Knowledge Management, Theory Building, Organization ethics and Issues	**12**
II	**Beginning Stages of Research Process:** Problem definition, Qualitative research tools, Secondary data research	**12**
III	**Research Methods and Data Collection:** Survey research, communicating with respondents, Observation methods, Experimental research	**12**
IV	**Measurement Concepts, Sampling and Field work:** Levels of Scale measurement, attitude measurement, questionnaire design, sampling designs and procedures, determination of sample size	**12**
V	**Data Analysis and Presentation:** Editing and Coding, Basic Data Analysis, Univariate Statistical Analysis and Bivariate Statistical analysis and differences between two variables. Multivariate Statistical Analysis.	**12**

Books and References:					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Business Research Methods	William G.Zikmund, B.J Babin, J.C. Carr,	Cengage	8e	2016

		Atanu Adhikari, M.Griffin			
2.	Business Analytics	Albright Winston	Cengage	5e	2015
3.	Research Methods for Business Students Fifth Edition	Mark Saunders			2011
4.	Multivariate Data Analysis	Hair	Pearson	7e	2014

M. Sc (Information Technology)		**Semester – I**	
Course Name: Research in Computing Practical		**Course Code: PSIT1P1**	
Periods per week **1 Period is 60 minutes**	**Lectures**	**4**	
	Credits	**2**	
		Hours	**Marks**
Evaluation System	**Practical Examination**	**2**	**40**

Practical No	**Details**
1 - 10	10 Practical based on above syllabus, covering entire syllabus

Course Outcome	A learner will be able to: □ solve real world problems with scientific approach. □ develop analytical skills by applying scientific methods. □ recognize, understand and apply the language, theory and models of the field of business analytics □ foster an ability to critically analyze, synthesize and solve complex unstructured business problems □ understand and critically apply the concepts and methods of business analytics □ identify, model and solve decision problems in different settings □ interpret results/solutions and identify appropriate courses of action for a given managerial situation whether a problem or an opportunity □ create viable solutions to decision making problems

M. Sc (Information Technology)		Semester – I	
Course Name: Data Science		**Course Code: PSIT102**	
Periods per week **1 Period is 60 minutes**	**Lectures**	**4**	
	Credits	**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2½**	**60**
	Theory Internal	**--**	**40**

Objectives	• Develop in depth understanding of the key technologies in data science and business analytics: data mining, machine learning, visualization techniques, predictive modeling, and statistics. • Practice problem analysis and decision-making. • Gain practical, hands-on experience with statistics programming languages and big data tools through coursework and applied research experiences.

Pre requisites	Basic understanding of statistics

Unit	Details	Lectures
I	**Data Science Technology Stack:** Rapid Information Factory Ecosystem, Data Science Storage Tools, Data Lake, Data Vault, Data Warehouse Bus Matrix, Data Science Processing Tools ,Spark, Mesos, Akka , Cassandra, Kafka, Elastic Search, R ,Scala, Python, MQTT, The Future **Layered Framework:** Definition of Data Science Framework, Cross-Industry Standard Process for Data Mining (CRISP-DM), Homogeneous Ontology for Recursive Uniform Schema, The Top Layers of a Layered Framework, Layered Framework for High-Level Data Science and Engineering **Business Layer:** Business Layer, Engineering a Practical Business Layer **Utility Layer:** Basic Utility Design, Engineering a Practical Utility Layer	**12**
II	**Three Management Layers:** Operational Management Layer, Processing-Stream Definition and Management, Audit, Balance, and Control Layer, Balance, Control, Yoke Solution, Cause-and-Effect, Analysis System, Functional Layer, Data Science Process **Retrieve Superstep :** Data Lakes, Data Swamps, Training the Trainer Model, Understanding the Business Dynamics of the Data Lake, Actionable Business Knowledge from Data Lakes, Engineering a Practical Retrieve Superstep, Connecting to Other Data Sources,	**12**
III	**Assess Superstep:** Assess Superstep, Errors, Analysis of Data, Practical Actions, Engineering a Practical Assess Superstep,	**12**

IV	**Process Superstep :** Data Vault, Time-Person-Object-Location-Event Data Vault, Data Science Process, Data Science, **Transform Superstep :** Transform Superstep, Building a Data Warehouse, Transforming with Data Science, Hypothesis Testing, Overfitting and Underfitting, Precision-Recall, Cross-Validation Test.	**12**
V	**Transform Superstep:** Univariate Analysis, Bivariate Analysis, Multivariate Analysis, Linear Regression, Logistic Regression, Clustering Techniques, ANOVA, Principal Component Analysis (PCA), Decision Trees, Support Vector Machines, Networks, Clusters, and Grids, Data Mining, Pattern Recognition, Machine Learning, Bagging Data,Random Forests, Computer Vision (CV) , Natural Language Processing (NLP), Neural Networks, TensorFlow. **Organize and Report Supersteps :** Organize Superstep, Report Superstep, Graphics, Pictures, Showing the Difference	**12**

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Practical Data Science	Andreas François Vermeulen	APress		2018
2.	Principles of Data Science	Sinan Ozdemir	PACKT		2016
3.	Data Science from Scratch	Joel Grus	O'Reilly		2015
4.	Data Science from Scratch first Principle in python	Joel Grus	Shroff Publishers		2017
5.	Experimental Design in Data science with Least Resources	N C Das	Shroff Publishers		2018

M. Sc (Information Technology)		**Semester – I**	
Course Name: Data Science Practical		**Course Code: PSIT1P2**	
Periods per week **1 Period is 60 minutes**	**Lectures**	**4**	
	Credits	**2**	
		Hours	**Marks**
Evaluation System	**Practical Examination**	**2**	**40**

Practical No	Details
1 - 10	10 Practical based on above syllabus, covering entire syllabus

Course Outcome	• Apply quantitative modeling and data analysis techniques to the solution of real world business problems, communicate findings, and effectively present results using data visualization techniques. • Recognize and analyze ethical issues in business related to intellectual property, data security, integrity, and privacy.

- Apply ethical practices in everyday business activities and make well-reasoned ethical business and data management decisions.
- Demonstrate knowledge of statistical data analysis techniques utilized in business decision making.
- Apply principles of Data Science to the analysis of business problems.
- Use data mining software to solve real-world problems.
- Employ cutting edge tools and technologies to analyze Big Data.
- Apply algorithms to build machine intelligence.
- Demonstrate use of team work, leadership skills, decision making and organization theory.

M. Sc (Information Technology)		Semester – I	
Course Name: Cloud Computing		**Course Code: PSIT103**	
Periods per week **1 Period is 60 minutes**	**Lectures**	**4**	
	Credits	**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2½**	**60**
	Theory Internal	**--**	**40**

Objectives	• To learn how to use Cloud Services. • To implement Virtualization. • To implement Task Scheduling algorithms. • Apply Map-Reduce concept to applications. • To build Private Cloud. • Broadly educate to know the impact of engineering on legal and societal issues involved.

Unit	Details	Lectures
I	**Introduction to Cloud Computing:** Introduction, Historical developments, Building Cloud Computing Environments, **Principles of Parallel and Distributed Computing:** Eras of Computing, Parallel v/s distributed computing, Elements of Parallel Computing, Elements of distributed computing, Technologies for distributed computing. **Virtualization:** Introduction, Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization, Technology examples. Logical Network Perimeter, Virtual Server, Cloud Storage Device, Cloud usage monitor, Resource replication, Ready-made environment.	**12**
II	**Cloud Computing Architecture:** Introduction, Fundamental concepts and models, Roles and boundaries, Cloud Characteristics, Cloud Delivery models, Cloud Deployment models, Economics of the cloud, Open challenges. **Fundamental Cloud Security:** Basics, Threat agents, Cloud security threats, additional considerations. **Industrial Platforms and New Developments:** Amazon Web Services, Google App Engine, Microsoft Azure.	**12**
III	**Specialized Cloud Mechanisms:** Automated Scaling listener, Load Balancer, SLA monitor, Pay-per-use monitor, Audit monitor, fail over system, Hypervisor, Resource Centre, Multidevice broker, State Management Database. **Cloud Management Mechanisms:** Remote administration system, Resource Management System, SLA Management System, Billing Management System, **Cloud Security Mechanisms:** Encryption, Hashing, Digital Signature, Public Key Infrastructure (PKI), Identity and Access Management (IAM), Single	**12**

	Sign-On (SSO), Cloud-Based Security Groups, Hardened Virtual Server Images	
IV	**Fundamental Cloud Architectures:** Workload Distribution Architecture, Resource Pooling Architecture, Dynamic Scalability Architecture, Elastic Resource Capacity Architecture, Service Load Balancing Architecture, Cloud Bursting Architecture, Elastic Disk Provisioning Architecture, Redundant Storage Architecture. **Advanced Cloud Architectures:** Hypervisor Clustering Architecture, Load Balanced Virtual Server Instances Architecture, Non-Disruptive Service Relocation Architecture, Zero Downtime Architecture, Cloud Balancing Architecture, Resource Reservation Architecture, Dynamic Failure Detection and Recovery Architecture, Bare-Metal Provisioning Architecture, Rapid Provisioning Architecture, Storage Workload Management Architecture	**12**
V	**Cloud Delivery Model Considerations:** Cloud Delivery Models: The Cloud Provider Perspective, Cloud Delivery Models: The Cloud Consumer Perspective, **Cost Metrics and Pricing Models**: Business Cost Metrics, Cloud Usage Cost Metrics, Cost Management Considerations, **Service Quality Metrics and SLAs:** Service Quality Metrics, SLA Guidelines	**12**

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Mastering Cloud Computing Foundations and Applications Programming	Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi	Elsevier	-	2013
2.	Cloud Computing Concepts, Technology & Architecture	Thomas Erl, Zaigham Mahmood, and Ricardo Puttini	Prentice Hall	-	2013
3.	Distributed and Cloud Computing, From Parallel Processing to the Internet of Things	Kai Hwang, Jack Dongarra, Geoffrey Fox	MK Publishers	--	2012

M. Sc (Information Technology)		Semester – I	
Course Name: Cloud Computing Practical		**Course Code: PSIT1P3**	
Periods per week **1 Period is 60 minutes**	**Lectures**	**4**	
	Credits	**2**	
		Hours	**Marks**
Evaluation System	**Practical Examination**	**2**	**40**

Practical No	Details
1 - 10	10 Practical based on above syllabus, covering entire syllabus

Course Outcome	• Analyze the Cloud computing setup with its vulnerabilities and applications using different architectures. • Design different workflows according to requirements and apply map reduce programming model. • Apply and design suitable Virtualization concept, Cloud Resource Management and design scheduling algorithms. • Create combinatorial auctions for cloud resources and design scheduling algorithms for computing clouds • Assess cloud Storage systems and Cloud security, the risks involved, its impact and develop cloud application • Broadly educate to know the impact of engineering on legal and societal issues involved in addressing the security issues of cloud computing.

M. Sc (Information Technology)		Semester – I	
Course Name: Soft Computing Techniques		**Course Code: PSIT104**	
Periods per week **1 Period is 60 minutes**	**Lectures**	**4**	
	Credits	**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2½**	**60**
	Theory Internal	**--**	**40**

Objectives	• Soft computing concepts like fuzzy logic, neural networks and genetic algorithm, where Artificial Intelligence is mother branch of all. • All these techniques will be more effective to solve the problem efficiently

Pre requisites	Basic concepts of Artificial Intelligence. Knowledge of Algorithms

Unit	Details	Lectures
I	Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, Fuzzy Computing, Neural Computing, Genetic Algorithms, Associative Memory, Adaptive Resonance Theory, Classification, Clustering, Bayesian Networks, Probabilistic reasoning, applications of soft computing.	**12**
II	Artificial Neural Network: Fundamental concept, Evolution of Neural Networks, Basic Models, McCulloh-Pitts Neuron, Linear Separability, Hebb Network. Supervised Learning Network: Perceptron Networks, Adaptive Linear Neuron, Multiple Adaptive Linear Neurons, Backpropagation Network, Radial Basis Function, Time Delay Network, Functional Link Networks, Tree Neural Network. Associative Memory Networks: Training algorithm for pattern Association, Autoassociative memory network, hetroassociative memory network, bi-directional associative memory, Hopfield networks, iterative autoassociative memory networks, temporal associative memory networks.	**12**
III	UnSupervised Learning Networks: Fixed weight competitive nets, Kohonen self-organizing feature maps, learning vectors quantization, counter propogation networks, adaptive resonance theory networks. Special Networks: Simulated annealing, Boltzman machine, Gaussian Machine, Cauchy Machine, Probabilistic neural net, cascade correlation network, cognition network, neo-cognition network, cellular neural network, optical neural network Third Generation Neural Networks: Spiking Neural networks, convolutional neural networks, deep learning neural networks, extreme learning machine model.	**12**

IV	Introduction to Fuzzy Logic, Classical Sets and Fuzzy sets: Classical sets, Fuzzy sets. Classical Relations and Fuzzy Relations: Cartesian Product of relation, classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets. Membership Function: features of the membership functions, fuzzification, methods of membership value assignments. Defuzzification: Lambda-cuts for fuzzy sets, Lambda-cuts for fuzzy relations, Defuzzification methods. Fuzzy Arithmetic and Fuzzy measures: fuzzy arithmetic, fuzzy measures, measures of fuzziness, fuzzy integrals.	**12**
V	Fuzzy Rule base and Approximate reasoning: Fuzzy proportion, formation of rules, decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning, fuzzy inference systems, Fuzzy logic control systems, control system design, architecture and operation of FLC system, FLC system models and applications of FLC System. Genetic Algorithm: Biological Background, Traditional optimization and search techniques, genetic algorithm and search space, genetic algorithm vs. traditional algorithms, basic terminologies, simple genetic algorithm, general genetic algorithm, operators in genetic algorithm, stopping condition for genetic algorithm flow, constraints in genetic algorithm, problem solving using genetic algorithm, the schema theorem, classification of genetic algorithm, Holland classifier systems, genetic programming, advantages and limitations and applications of genetic algorithm. Differential Evolution Algorithm, Hybrid soft computing techniques – neuro – fuzzy hybrid, genetic neuro-hybrid systems, genetic fuzzy hybrid and fuzzy genetic hybrid systems.	**12**

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Artificial Intelligence and Soft Computing	Anandita Das Battacharya	SPD	3rd	2018
2.	Principles of Soft computing	S.N.Sivanandam S.N.Deepa	Wiley	3rd	2019
3.	Neuro-Fuzzy and Soft Computing	J.S.R.Jang, C.T.Sun and E.Mizutani	Prentice Hall of India		2004
4.	Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications	S.Rajasekaran, G. A. Vijayalakshami	Prentice Hall of India		2004
5.	Fuzzy Logic with Engineering Applications	Timothy J.Ross	McGraw-Hill		1997

6.	Genetic Algorithms: Search, Optimization and Machine Learning	Davis E.Goldberg	Addison Wesley		1989
7.	Introduction to AI and Expert System	Dan W. Patterson	Prentice Hall of India		2009

M. Sc (Information Technology)		**Semester – I**	
Course Name: Soft Computing Techniques Practical		**Course Code: PSIT1P4**	
Periods per week **1 Period is 60 minutes**	**Lectures**	**4**	
	Credits	**2**	
		Hours	**Marks**
Evaluation System	**Practical Examination**	**2**	**40**

Practical No	**Details**
1 - 10	10 Practical based on above syllabus, covering entire syllabus

Course Outcome	• Identify and describe soft computing techniques and their roles in building intelligent machines • Recognize the feasibility of applying a soft computing methodology for a particular problem • Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems • Apply genetic algorithms to combinatorial optimization problems • Apply neural networks for classification and regression problems • Effectively use existing software tools to solve real problems using a soft computing approach • Evaluate and compare solutions by various soft computing approaches for a given problem.

SEMESTER II

M. Sc (Information Technology)		Semester – II	
Course Name: BigData Analytics		**Course Code: PSIT201**	
Periods per week **1 Period is 60 minutes**	**Lectures**	**4**	
	Credits	**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2½**	**60**
	Theory Internal	**--**	**40**

Objectives	• To provide an overview of an exciting growing field of big data analytics. • To introduce the tools required to manage and analyze big data like Hadoop, NoSql MapReduce. • To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability. • To enable students to have skills that will help them to solve complex real-world problems in for decision support.

Unit	Details	Lectures
I	Introduction to Big Data, Characteristics of Data, and Big Data Evolution of Big Data, Definition of Big Data, Challenges with big data, Why Big data? Data Warehouse environment, Traditional Business Intelligence versus Big Data. State of Practice in Analytics, Key roles for New Big Data Ecosystems, Examples of big Data Analytics. Big Data Analytics, Introduction to big data analytics, Classification of Analytics, Challenges of Big Data, Importance of Big Data, Big Data Technologies, Data Science, Responsibilities, Soft state eventual consistency. Data Analytics Life Cycle	**12**
II	Analytical Theory and Methods: Clustering and Associated Algorithms, Association Rules, Apriori Algorithm, Candidate Rules, Applications of Association Rules, Validation and Testing, Diagnostics, Regression, Linear Regression, Logistic Regression, Additional Regression Models.	**12**
III	Analytical Theory and Methods: Classification, Decision Trees, Naïve Bayes, Diagnostics of Classifiers, Additional Classification Methods, Time Series Analysis, Box Jenkins methodology, ARIMA Model, Additional methods. Text Analysis, Steps, Text Analysis Example, Collecting Raw Text, Representing Text, Term Frequency-Inverse Document Frequency (TFIDF), Categorizing Documents by Topics, Determining Sentiments	**12**
IV	Data Product, Building Data Products at Scale with Hadoop, Data Science Pipeline and Hadoop Ecosystem, Operating System for Big Data, Concepts, Hadoop Architecture, Working with Distributed file system, Working with Distributed Computation, Framework for Python and Hadoop Streaming, Hadoop Streaming, MapReduce with Python,	**12**

	Advanced MapReduce. In-Memory Computing with Spark, Spark Basics, Interactive Spark with PySpark, Writing Spark Applications,	
V	Distributed Analysis and Patterns, Computing with Keys, Design Patterns, Last-Mile Analytics, Data Mining and Warehousing, Structured Data Queries with Hive, HBase, Data Ingestion, Importing Relational data with Sqoop, Injesting stream data with flume. Analytics with higher level APIs, Pig, Spark's higher level APIs.	**12**

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Books and References:					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Big Data and Analytics	Subhashini Chellappan Seema Acharya	Wiley	First	
2.	Data Analytics with Hadoop *An Introduction for Data Scientists*	*Benjamin Bengfort and Jenny Kim*	O'Reilly		2016
3.	Big Data and Hadoop	V.K Jain	Khanna Publishing	First	2018

M. Sc (Information Technology)		**Semester – II**	
Course Name: BigData Analytics Practical		**Course Code: PSIT2P1**	
Periods per week **1 Period is 60 minutes**	**Lectures**	**4**	
	Credits	**2**	
		Hours	**Marks**
Evaluation System	**Practical Examination**	**2**	**40**

Practical No	**Details**
1 - 10	10 Practical based on above syllabus, covering entire syllabus

Course Outcome	• Understand the key issues in big data management and its associated applications in intelligent business and scientific computing. • Acquire fundamental enabling techniques and scalable algorithms like Hadoop, Map Reduce and NO SQL in big data analytics. • Interpret business models and scientific computing paradigms, and apply software tools for big data analytics. • Achieve adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc.

M. Sc (Information Technology)		Semester – I	
Course Name: Modern Networking		**Course Code: PSIT202**	
Periods per week **1 Period is 60 minutes**	**Lectures**	**4**	
	Credits	**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2½**	**60**
	Theory Internal	**--**	**40**

Objectives	• To understand the state-of-the-art in network protocols, architectures and applications. • Analyze existing network protocols and networks. • Develop new protocols in networking • To understand how networking research is done • To investigate novel ideas in the area of Networking via term-long research projects.

Pre requisites	Fundamentals of Networking

Unit	Details	Lectures
I	Modern Networking Elements of Modern Networking The Networking Ecosystem ,Example Network Architectures,Global Network Architecture,A Typical Network Hierarchy Ethernet Applications of Ethernet Standards Ethernet Data Rates Wi-Fi Applications of Wi-Fi,Standards Wi-Fi Data Rates 4G/5G Cellular First Generation Second Generation, Third Generation Fourth Generation Fifth Generation, Cloud Computing Cloud Computing Concepts The Benefits of Cloud Computing Cloud Networking Cloud Storage, Internet of Things Things on the Internet of Things, Evolution Layers of the Internet of Things, Network Convergence Unified Communications, Requirements and Technology Types of Network and Internet Traffic,Elastic Traffic,Inelastic Traffic, Real-Time Traffic Characteristics Demand: Big Data, Cloud Computing, and Mobile TrafficBig Data Cloud Computing,,Mobile Traffic, Requirements: QoS and QoE,,Quality of Service,Quality of Experience, Routing Characteristics, Packet Forwarding, Congestion Control ,Effects of Congestion,Congestion Control Techniques, SDN and NFV Software-Defined Networking,Network Functions Virtualization Modern Networking Elements	**12**
II	Software-Defined Networks SDN: Background and Motivation, Evolving Network Requirements Demand Is Increasing,Supply Is IncreasingTraffic Patterns Are More ComplexTraditional Network Architectures are Inadequate, The SDN Approach Requirements SDN Architecture Characteristics of Software-	**12**

	Defined Networking, SDN- and NFV-Related Standards Standards-Developing Organizations Industry Consortia Open Development Initiatives, SDN Data Plane and OpenFlow SDN Data Plane, Data Plane Functions Data Plane Protocols OpenFlow Logical Network Device Flow Table Structure Flow Table Pipeline, The Use of Multiple Tables Group Table OpenFlow Protocol, SDN Control Plane SDN Control Plane Architecture Control Plane Functions, Southbound Interface Northbound InterfaceRouting, ITU-T Model, OpenDaylight OpenDaylight Architecture OpenDaylight Helium, REST REST Constraints Example REST API, Cooperation and Coordination Among Controllers, Centralized Versus Distributed Controllers, High-Availability Clusters Federated SDN Networks, Border Gateway Protocol Routing and QoS Between Domains, Using BGP for QoS Management IETF SDNi OpenDaylight SNDi SDN Application Plane SDN Application Plane Architecture Northbound Interface Network Services Abstraction Layer Network Applications, User Interface, Network Services Abstraction Layer Abstractions in SDN, Frenetic Traffic Engineering PolicyCop Measurement and Monitoring Security OpenDaylight DDoS Application Data Center Networking, Big Data over SDN Cloud Networking over SDN Mobility and Wireless Information-Centric Networking CCNx, Use of an Abstraction Layer	
III	Virtualization, Network Functions Virtualization: Concepts and Architecture, Background and Motivation for NFV, Virtual Machines The Virtual Machine Monitor, Architectural Approaches Container Virtualization, NFV Concepts Simple Example of the Use of NFV, NFV Principles High-Level NFV Framework, NFV Benefits and Requirements NFV Benefits, NFV Requirements, NFV Reference Architecture NFV Management and Orchestration, Reference Points Implementation, NFV Functionality, NFV Infrastructure,Container Interface,Deployment of NFVI Containers,Logical Structure of NFVI Domains,ComputeDomain, Hypervisor Domain,Infrastructure Network Domain, Virtualized Network Functions, VNF Interfaces,VNFC to VNFC Communication,VNF Scaling, NFV Management and Orchestration, Virtualized Infrastructure Manager,Virtual Network Function Manager,NFV Orchestrator, Repositories, Element Management, OSS/BSS, NFV Use Cases Architectural Use Cases, Service-Oriented Use Cases, SDN and NFV Network Virtualization, Virtual LANs ,The Use of Virtual LANs,Defining VLANs, Communicating VLAN Membership,IEEE 802.1Q VLAN Standard, Nested VLANs, OpenFlow VLAN Support, Virtual Private Networks, IPsec VPNs,MPLS VPNs, Network Virtualization, Simplified Example, Network Virtualization Architecture, Benefits of Network Virtualization, OpenDaylight's Virtual Tenant Network, Software-Defined Infrastructure,Software-Defined Storage, SDI Architecture	**12**

IV	Defining and Supporting User Needs, Quality of Service, Background, QoS Architectural Framework, Data Plane, Control Plane, Management Plane, Integrated Services Architecture, ISA Approach ISA Components, ISA Services, Queuing Discipline, Differentiated Services, Services, DiffServ Field, DiffServ Configuration and Operation, Per-Hop Behavior, Default Forwarding PHB, Service Level Agreements, IP Performance Metrics, OpenFlow QoS Support, Queue Structures, Meters, QoE: User Quality of Experience, Why QoE?,Online Video Content Delivery, Service Failures Due to Inadequate QoE Considerations QoE-Related Standardization Projects, Definition of Quality of Experience, Definition of Quality, Definition of Experience Quality Formation Process, Definition of Quality of Experience, QoE Strategies in Practice, The QoE/QoS Layered Model Summarizing and Merging the ,QoE/QoS Layers, Factors Influencing QoE, Measurements of QoE, Subjective Assessment, Objective Assessment, End-User Device Analytics, Summarizing the QoE Measurement Methods, Applications of QoE Network Design Implications of QoS and QoE Classification of QoE/ QoS Mapping Models, Black-Box Media-Based QoS/QoE Mapping Models, Glass-Box Parameter-Based QoS/QoE Mapping Models,Gray-Box QoS/QoE Mapping Models, Tips for QoS/QoE Mapping Model Selection,IP-Oriented Parameter-Based QoS/QoE Mapping Models,Network Layer QoE/QoS Mapping Models for Video Services, Application Layer QoE/QoS Mapping Models for Video Services Actionable QoE over IP-Based Networks, The System-Oriented Actionable QoE Solution, The Service-Oriented Actionable QoE Solution, QoE Versus QoS Service Monitoring, QoS Monitoring Solutions, QoE Monitoring Solutions, QoE-Based Network and Service Management, QoE-Based Management of VoIP Calls, QoE-Based Host-Centric Vertical Handover, QoE-Based Network-Centric Vertical Handover	**12**
V	Modern Network Architecture: Clouds and Fog, Cloud Computing, Basic Concepts, Cloud Services, Software as a Service, Platform as a Service, Infrastructure as a Service, Other Cloud Services, XaaS, Cloud Deployment Models, Public Cloud Private Cloud Community Cloud, Hybrid Cloud, Cloud Architecture, NIST Cloud Computing Reference Architecture,ITU-T Cloud Computing Reference Architecture, SDN and NFV, Service Provider Perspective Private Cloud Perspective, ITU-T Cloud Computing Functional Reference Architecture, The Internet of Things: Components The IoT Era Begins, The Scope of the Internet of Things Components of IoT-Enabled Things, Sensors, Actuators, Microcontrollers, Transceivers, RFID, The Internet of Things: Architecture and Implementation, IoT Architecture,ITU-T IoT Reference Model, IoT World Forum Reference Model, IoT Implementation, IoTivity, Cisco IoT System, ioBridge, Security Security Requirements, SDN Security Threats to SDN, Software-Defined Security, NFV Security, Attack Surfaces, ETSI Security Perspective, Security Techniques, Cloud Security, Security Issues and Concerns, Cloud Security Risks and Countermeasures, Data Protection	**12**

	in the Cloud, Cloud Securityas a Service, Addressing Cloud Computer Security Concerns, IoT Security, The Patching Vulnerability, IoT Security and Privacy Requirements Defined by ITU-TAn IoT Security Framework, Conclusion	

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud	William Stallings	Addison-Wesley Professional		October 2015
2.	SDN and NFV Simplified A Visual Guide to Understanding Software Defined Networks and Network Function Virtualization	**Jim Doherty**	Pearson Education, Inc		
3.	Network Functions Virtualization (NFV) with a Touch of SDN	Rajendra Chayapathi Syed Farrukh Hassan	Addison-Wesley		
4.	CCIE and CCDE Evolving Technologies Study Guide	Brad dgeworth, Jason Gooley, Ramiro Garza Rios	Pearson Education, Inc		2019

M. Sc (Information Technology)		**Semester – II**	
Course Name: Modern Networking Practical		**Course Code: PSIT2P2**	
Periods per week **1 Period is 60 minutes**	**Lectures**	**4**	
	Credits	**2**	
		Hours	**Marks**
Evaluation System	**Practical Examination**	**2**	**40**

Practical No	Details
1 - 10	10 Practical based on above syllabus, covering entire syllabus

Course Outcome	• Demonstrate in-depth knowledge in the area of Computer Networking. • To demonstrate scholarship of knowledge through performing in a group to identify, formulate and solve a problem related to Computer Networks • Prepare a technical document for the identified Networking System Conducting experiments to analyze the identified research work in building Computer Networks

M. Sc (Information Technology)		Semester – I	
Course Name: Microservice Architecture		**Course Code: PSIT203**	
Periods per week **1 Period is 60 minutes**	**Lectures**	**4**	
	Credits	**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2½**	**60**
	Theory Internal	**--**	**40**

Objectives	• Gain a thorough understanding of the philosophy and architecture of Web applications using ASP.NET Core MVC; • Gain a practical understanding of.NET Core; • Acquire a working knowledge of Web application development using ASP.NET Core MVC 6 and Visual Studio • Persist data with XML Serialization and ADO.NET with SQL Server • Create HTTP services using ASP.NET Core Web API; • Deploy ASP.NET Core MVC applications to the Windows Azure cloud.

Unit	Details	Lectures
I	**Microservices:** Understanding Microservices, Adopting Microservices, The Microservices Way. **Microservices Value Proposition:** Deriving Business Value, defining a Goal-Oriented, Layered Approach, Applying the Goal-Oriented, Layered Approach. **Designing Microservice Systems:** The Systems Approach to Microservices, A Microservices Design Process, **Establishing a Foundation:** Goals and Principles, Platforms, Culture.	**12**
II	**Service Design:** Microservice Boundaries, API design for Microservices, Data and Microservices, Distributed Transactions and Sagas, Asynchronous Message-Passing and Microservices, dealing with Dependencies, **System Design and Operations:** Independent Deployability, More Servers, Docker and Microservices, Role of Service Discovery, Need for an API Gateway, Monitoring and Alerting. **Adopting Microservices in Practice:** Solution Architecture Guidance, Organizational Guidance, Culture Guidance, Tools and Process Guidance, Services Guidance.	**12**
III	**Building Microservices with ASP.NET Core:** Introduction, Installing .NET Core, Building a Console App, Building ASP.NET Core App. **Delivering Continuously:** Introduction to Docker, Continuous integration with Wercker, Continuous Integration with Circle CI, Deploying to Dicker Hub. **Building Microservice with ASP.NET Core:** Microservice, Team Service, API First Development, Test First Controller, Creating a CI pipeline, Integration Testing, Running the team service Docker Image. **Backing Services:**	**12**

	Microservices Ecosystems, Building the location Service, Enhancing Team Service.	
IV	**Creating Data Service:** Choosing a Data Store**,** Building a Postgres Repository, Databases are Backing Services, Integration Testing Real Repositories, Exercise the Data Service.**Event Sourcing and CQRS:** Event Sourcing, CQRS pattern, Event Sourcing and CQRS, Running the samples. **Building an ASP.NET Core Web Application:** ASP.NET Core Basics, Building Cloud-Native Web Applications. **Service Discovery:** Cloud Native Factors, Netflix Eureka, Discovering and Advertising ASP.NET Core Services. DNS and Platform Supported Discovery.	**12**
V	**Configuring Microservice Ecosystems:** Using Environment Variables with Docker, Using Spring Cloud Config Server, Configuring Microservices with etcd, **Securing Applications and Microservices:** Security in the Cloud, Securing ASP.NET Core Web Apps, Securing ASP.NET Core Microservices. **Building Real-Time Apps and Services:** Real-Time Applications Defined, Websockets in the Cloud, Using a Cloud Messaging Provider, Building the Proximity Monitor. **Putting It All Together:** Identifying and Fixing Anti-Patterns, Continuing the Debate over Composite Microservices, The Future.	**12**

Books and References:

Sr. No.	Title	Author/s	Publisher	Edition	Year
1.	Microservice Architecture: *Aligning Principles, Practices, and Culture*	Irakli Nadareishvili, Ronnie Mitra, Matt McLarty, and Mike Amundsen	O'Reilly	First	2016
2.	Building Microservices with ASP.NET Core	Kevin Hoffman	O'Reilly	First	2017
3.	Building Microservices: Designing Fine-Grained Systems	Sam Newman	O'Reilly	First	
4.	Production-ready Microservices	Susan J. Fowler	O'Reilly		2016

M. Sc (Information Technology)		Semester – II	
Course Name: Microservices Architecture Practical		**Course Code: PSIT2P3**	
Periods per week **1 Period is 60 minutes**	**Lectures**	**4**	
	Credits	**2**	
		Hours	**Marks**
Evaluation System	**Practical Examination**	**2**	**40**

Practical No	Details
1 - 10	10 Practical based on above syllabus, covering entire syllabus

Course Outcome	Develop web applications using Model View Control. Create MVC Models and write code that implements business logic within Model methods, properties, and events. Create Views in an MVC application that display and edit data and interact with Models and Controllers. Boost your hire ability through innovative and independent learning. Gaining a thorough understanding of the philosophy and architecture of .NET Core Understanding packages, metapackages and frameworks Acquiring a working knowledge of the .NET programming model Implementing multi-threading effectively in .NET applications

M. Sc (Information Technology)		Semester – II	
Course Name: Image Processing		**Course Code: PSIT204**	
Periods per week **1 Period is 60 minutes**	**Lectures**	**4**	
	Credits	**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**2½**	**60**
	Theory Internal	**--**	**40**

Objectives	• Review the fundamental concepts of a digital image processing system. • Analyze images in the frequency domain using various transforms. • Evaluate the techniques for image enhancement and image restoration. • Categorize various compression techniques. • Interpret Image compression standards. • Interpret image segmentation and representation techniques.

Unit	Details	Lectures
I	**Introduction:** Digital Image Processing, Origins of Digital Image Processing, Applications and Examples of Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, **Digital Image Fundamentals:** Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Basic Relationships Between Pixels, Basic Mathematical Tools Used in Digital Image Processing, **Intensity Transformations and Spatial Filtering:** Basics, Basic Intensity Transformation Functions, Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing (Lowpass) Spatial Filters, Sharpening (Highpass) Spatial Filters, Highpass, Bandreject, and Bandpass Filters from Lowpass Filters, Combining Spatial Enhancement Methods, Using Fuzzy Techniques for Intensity Transformations and Spatial Filtering	**12**
II	**Filtering in the Frequency Domain:** Background, Preliminary Concepts, Sampling and the Fourier Transform of Sampled Functions, The Discrete Fourier Transform of One Variable, Extensions to Functions of Two Variables, Properties of the 2-D DFT and IDFT, Basics of Filtering in the Frequency Domain, Image Smoothing Using Lowpass Frequency Domain Filters, Image Sharpening Using Highpass Filters, Selective Filtering, Fast Fourier Transform **Image Restoration and Reconstruction:** A Model of the Image Degradation/Restoration Process, Noise Models, Restoration in the Presence of Noise Only-----Spatial Filtering, Periodic Noise Reduction Using Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering, Geometric Mean Filter, Image Reconstruction from Projections	**12**
III	**Wavelet and Other Image Transforms:** Preliminaries, Matrix-based Transforms, Correlation, Basis Functions in the Time-Frequency Plane, Basis	**12**

	Images, Fourier-Related Transforms, Walsh-Hadamard Transforms, Slant Transform, Haar Transform, Wavelet Transforms **Color Image Processing:** Color Fundamentals, Color Models, Pseudocolor Image Processing, Full-Color Image Processing, Color Transformations, Color Image Smoothing and Sharpening, Using Color in Image Segmentation, Noise in Color Images, Color Image Compression. **Image Compression and Watermarking:** Fundamentals, Huffman Coding, Golomb Coding, Arithmetic Coding, LZW Coding, Run-length Coding, Symbol-based Coding, 8 Bit-plane Coding, Block Transform Coding, Predictive Coding, Wavelet Coding, Digital Image Watermarking,	
IV	**Morphological Image Processing:** Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transform, Morphological Algorithms, Morphological Reconstruction, Morphological Operations on Binary Images, Grayscale Morphology **Image Segmentation I: Edge Detection, Thresholding, and Region Detection:** Fundamentals, Thresholding, Segmentation by Region Growing and by Region Splitting and Merging, Region Segmentation Using Clustering and Superpixels, Region Segmentation Using Graph Cuts, Segmentation Using Morphological Watersheds, Use of Motion in Segmentation	**12**
V	**Image Segmentation II: Active Contours: Snakes and Level Sets:** Background, Image Segmentation Using Snakes, Segmentation Using Level Sets. **Feature Extraction:** Background, Boundary Preprocessing, Boundary Feature Descriptors, Region Feature Descriptors, Principal Components as Feature Descriptors, Whole-Image Features, Scale-Invariant Feature Transform (SIFT)	**12**

Books and References:					
Sr. No.	**Title**	**Author/s**	**Publisher**	**Edition**	**Year**
1.	Digital Image Processing	Gonzalez and Woods	Pearson/Prentice Hall	Fourth	2018
2.	Fundamentals of Digital Image Processing	A K. Jain	PHI		
3.	The Image Processing Handbook	J. C. Russ	CRC	Fifth	2010

M. Sc (Information Technology)		**Semester – II**	
Course Name: Image Processing Practical		**Course Code: PSIT2P4**	
Periods per week **1 Period is 60 minutes**	**Lectures**	**4**	
	Credits	**2**	
		Hours	**Marks**
Evaluation System	**Practical Examination**	**2**	**40**

Practical No	**Details**
1 - 10	10 Practical based on above syllabus, covering entire syllabus

Course Outcome	• Understand the relevant aspects of digital image representation and their practical implications. • Have the ability to design pointwise intensity transformations to meet stated specifications. • Understand 2-D convolution, the 2-D DFT, and have the abitilty to design systems using these concepts. • Have a command of basic image restoration techniques. • Understand the role of alternative color spaces, and the design requirements leading to choices of color space. • Appreciate the utility of wavelet decompositions and their role in image processing systems. • Have an understanding of the underlying mechanisms of image compression, and the ability to design systems using standard algorithms to meet design specifications.

CLASS: M. Sc (Information technology)		Semester - III	
COURSE: Embedded Systems (PSIT301)			
Periods per week **1 Period is 60 minutes**	**Lecture**	**4**	
	TW/Tutorial/ Practical	**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**3**	**60**
	Internal		**40**
	Practical	**--**	**50**

Unit – I	**Introduction** What is an Embedded System, Embedded System Vs, General Computing System. **The Typical Embedded System** Core of Embedded System, Memory, Sensors and Actuators, Communication Interface, Embedded Firmware. **Characteristic and quality attributes of Embedded System** Characteristics of an Embedded System, Quality Attributes of Embedded System. **Embedded product development life cycle** What is EDLC, Why EDLC? Objectives of EDLC, Different Phases of EDLC.	**12 Lectures**
Unit- II	**Hardware Software Co-design and Program Modelling** Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design, Introduction to Unified Modelling Language (UML), Hardware Software Trade-offs. **Embedded Hardware design and development** Analog Electronic Components, Digital Electronic Components, Electronic design Automation (EDA) Tools, The PCB Layout design. **Embedded Firmware design and development** Embedded Firmware Design Approaches, Embedded Firmware Development Languages **Real Time Operating System(RTOS)** Operating System Basics, Types of Operating Systems, Device Drivers, How to choose an RTOS	**12 Lectures**
Unit-III	**Memories and Memory Subsystem** Introduction, Classifying Memory, A general Memory Interface, ROM Overview, Static RAM Overview, Dynamic RAM Overview, Chip Organization, A SRAM Design, A DRAM Design, The DRAM Memory Interface, The Memory Map,	**12 Lectures**

	Memory Subsystem Architecture, Basic Concepts of Caching, Design a cache system, Dynamic Memory Allocation, Testing Memories.	
Unit-IV	**Programming Concept and Embedded Programming in C/ C++ and Java** Software programming in Assembly Language (ALP) and in High-level Language 'C'., C program Elements: Header and Source Files and Pre-processor Directives, Program Elements: Macros and Functions, Program Elements: Types, Data Structures, Modifiers, Statements, Loops and Pointers, Object-Oriented Programming, Embedded Programming in C++, Embedded Programming in Java.	**12 Lectures**
Unit -V	**Trends in the Embedded Industry** Processor trends in Embedded System, Embedded OS Trends, Development Language Trends, Introduction of PIC Family of Microcontrollers, Introduction of ARM Family of Microcontrollers, Introduction of AVR Family of Microcontrollers.	**12 Lectures**

Books / References

Title	Author/s	Edition	Publisher
Introduction to embedded systems	Shibu K. V	2nd Edition	Tata McGraw-Hill
Embedded Systems Architecture, Programming and Design	Raj Kamal	2nd Edition	Tata McGraw-Hill
Embedded Systems: A Contemporary Design Tool.	James K. Peckol	1st Edition	Wiley Edition

Practicals (PSIT3P1):

1 (Compulsory)	Study of hardware components 1. 8051 Microcontroller 2. Resistors (color code, types) 3. Capacitors 4. ADC, DAC 5. Operational Amplifiers 6. Transistors, Diode, Crystal Oscillator 7. Types of Relays 8. Sensors 9. Actuator 10. Types of connectors
2	WAP to blink an LED
3	WAP block transfer of data
4	WAP to serial data interface
5	WAP for the keypad and LCD interface

6	Implement mouse driver program using MSDOS interrupt
7	WAP to implement ADC0808 with 8051 microcontroller
8	WAP to simulate elevator functions
9	WAP to interface stepper motor controller
10	WAP to simulate traffic signals

CLASS: M. Sc (Information technology)		**Semester - III**	
COURSE: Information Security Management (PSIT302)			
Periods per week **1 Period is 60 minutes**	**Lecture**	**4**	
	TW/Tutorial/ Practical	**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**3**	**60**
	Internal		**40**
	Practical	**--**	**50**

Unit – I	Security Risk Assessment and Management: Introduction to Security Risk Management. Reactive and proactive approaches to risk management. Risk assessment, quantitative and qualitative approaches and asset classification - Security Assurance Approaches: Introduction to OCTAVE and COBIT approaches.	**12 Lectures**
Unit- II	Security Management of IT Systems: Network security management. Firewalls, IDS and IPS configuration management. Web and wireless security management. General server configuration guidelines and maintenance. Information Security Management Information classification. Access control models, role-based and lattice models. Mandatory and discretionary access controls. Linux and Windows case studies. Technical controls, for authentication and confidentiality. Password management and key management for users. Case study: Kerberos.	**12 Lectures**
Unit-III	Key Management in Organizations: Public-key Infrastructure. PKI Applications, secure email case study(S/ MIME or PGP). Issues in public-key certificate issue and lifecycle management - Management of IT Security Infrastructure; Computer security log management, malware handling and vulnerability management programs. Specifying and enforcing security policies.	**12 Lectures**
Unit-IV	Auditing and Business continuity Planning: Introduction to information security audit and principles of audit. Business continuity planning and disaster recovery. Case study: 9/11 tragedy. Backup and recovery techniques for applications and storage.	**12 Lectures**

Unit -V	Computer forensics: techniques and tools. Audit Tools: NESSUS and NMAP. Information Security Standards and Compliance: Overview of ISO 17799 Standard. Legal and Ethical issues.	**12 Lectures**

Books / References

Title	Author/s	Edition	Publisher
IT Security and Risk Management (Main reference)	Slay, J. and Koronios, A.,	2006	Wiley
Incident Response and Computer Forensics.	Chris Prosise and Kevin Mandia,	2003.	McGraw-Hill
Information Systems Security-Security Management, Metrics, Frameworks and Best Practices,	Nina Godbole		Wiley, 2009
Information Security Policies, Procedures, and Standards: Guidelines for Effective Information Security Management (Paperback)		1st edition	Auerbach, 2001

Practicals (PSIT3P2):

1. Working with Sniffers for monitoring network communication (Ethereal)
2. Using open SSL for web server - browser communication
3. Using GNU PGP
4. Performance evaluation of various cryptographic algorithms
5. Using IP TABLES on Linux and setting the filtering rules
6. Configuring S/MIME for e-mail communication
7. Understanding the buffer overflow and format string attacks
8. Using NMAP for ports monitoring
9. Implementation of proxy based security protocols in C or C++ with features like confidentiality, integrity and authentication
10. Socket programming
11. Exposure to Client Server concept using TCP/IP, blowfish, Pretty Good Privacy.

CLASS: M. Sc. (Information technology)		Semester - III	
COURSE: Virtualization (PSIT303a) Elective 1			
Periods per week 1 Period is 60 minutes	Lecture	4	
	TW/Tutorial/ Practical	4	
		Hours	Marks
Evaluation System	Theory Examination	3	60
	Internal		40
	Practical	--	50

Unit – I	OVERVIEW OF VIRTUALIZATION Basics of Virtualization - Virtualization Types – Desktop Virtualization – NetworkVirtualization – Server and Machine Virtualization – Storage Virtualization – System-level or Operating Virtualization – Application Virtualization- Virtualization Advantages – Virtual Machine Basics – Taxonomy of Virtual machines - Process Virtual Machines – System Virtual Machines – Hypervisor - Key Concepts	**12 Lectures**
Unit- II	SERVER CONSOLIDATION Hardware Virtualization – Virtual Hardware Overview - Sever Virtualization – Physicaland Logical Partitioning - Types of Server Virtualization – Business cases for SeverVirtualization – Uses of Virtual server Consolidation – Planning for Development –Selecting server Virtualization Platform	**12 Lectures**
Unit-III	NETWORK VIRTUALIZATION Design of Scalable Enterprise Networks - Virtualizing the Campus WAN Design – WAN Architecture - WAN Virtualization - Virtual Enterprise Transport Virtualization– VLANs and Scalability - Theory Network Device Virtualization Layer 2 - VLANs Layer 3 VRF Instances Layer 2 - VFIs Virtual Firewall Contexts Network Device Virtualization - Data-Path Virtualization Layer 2: 802.1q - Trunking Generic Routing Encapsulation - IPsecL2TPv3 Label	**12 Lectures**

	Switched Paths - Control-Plane Virtualization–Routing Protocols-VRF - Aware Routing Multi-Topology Routing.	
Unit-IV	VIRTUALIZING STORAGE SCSI- Speaking SCSI- Using SCSI buses – Fiber Channel – Fiber Channel Cables –Fiber Channel Hardware Devices – iSCSI Architecture – Securing iSCSI – SAN backupand recovery techniques – RAID – SNIA Shared Storage Model – Classical Storage Model – SNIA Shared Storage Model – Host based Architecture – Storage based architecture – Network based Architecture – Fault tolerance to SAN – PerformingBackups – Virtual tape libraries.	**12 Lectures**
Unit -V	Blades and Virtualization — Building Blocks for Next-Generation Data Centers,Evolution of Computing Technology — Setting the Stage,Evolution of Blade and Virtualization Technologies,Blade Architecture,Assessing Needs — Blade System Hardware Considerations	**12 Lectures**

Books / References

Title	Author/s	Edition	Publisher
Mastering_VMware_vSphere_5.5			Sybex Publication
Configuring Windows Server Virtualization			Microsoft Press
Citrix.XenServer.6.0.Administration.Essential.Guide		Feb.2007	Packtpub.
Blade.Servers.and.Virtualization.			Wiley.
Virtualization:A Beginner's Guide			
Professional Xen Virtualization	William von Hagen	January, 2008.	Wrox Publications
Virtualization: From the Desktop to the Enterprise	Chris Wolf , Erick M. Halter	2005.	APress
VMware and Microsoft Platform in the Virtual Data Center		2006	Auerbach
Network virtualization	. Kumar Reddy, Victor Moreno	July, 2006	Cisco Press

PSIT3P3a: Practicals

1. Implement vmwareESXi for server virtualization
2. Implement XEN for server virtualization
3. Implement Hyper-V server virtualization
4. Manage vmwareESXi with vCentre server
5. Manage xen server Xen center
6. Understanding blade server with cisco UCS/HP eva simulator
7. Implement vlan concept with L2/L3 switches/nexus virtual switching
8. Simulating SAN with navisphere/netapps

CLASS: M. Sc. (Information technology)		**Semester - III**	
COURSE: Artificial Neural Networks(PSIT303b) Elective 1			
Periods per week **1 Period is 60 minutes**	**Lecture**	**4**	
	TW/Tutorial/ Practical	**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**3**	**60**
	Internal		**40**
	Practical	**--**	**50**

Unit – I	The Brain Metaphor, Basics of Neuroscience, Artificial Neurons, Neural Networks and Architectures	**12 Lectures**
Unit- II	Geometry of Binary Threshold Neurons and Their Networks , Supervised Learning I: Perceptrons and LMS, Supervised Learning II: Backpropagation and Beyond	**12 Lectures**
Unit-III	Neural Networks: A Statistical Pattern Recognition Perspective , Statistical Learning Theory, Support Vector Machines and Radial Basis Function Networks	**12 Lectures**
Unit-IV	Dynamical Systems Review, Attractor Neural Networks, Adaptive Resonance Theory	**12 Lectures**
Unit -V	Towards the Self-organizing Feature Map, Fuzzy Sets and Fuzzy Systems , Evolutionary Algorithms	**12 Lectures**

Books / References

Title	Author/s	Edition	Publisher
Neural Networks, A Classroom Approach	Satish Kumar	2nd Edition	**McGraw Hill**
Artificial Neural Networks	Robert Schalkoff		**McGraw Hill**
Introduction to Neural Networks using MATLAB	S Sivanandam,SSumathi		**McGraw Hill**

PracticalsPSIT3P3b:

1.	Show the functioning of Artificial Neural Networks

	(Implement all the Hidden Layer Functions)
2.	Demonstrate that non separable two input perceptron cannot be classified using P=[-0.8 -0.8 0.3 1.0 0.7; -0.8 0.8 -0.4 -1.0 -0.7]; and Target T=[1 0 1 0 1]
3.	Use perceptron learning rule to find final weights of a neural network using fixed input vectors and a fixed target vector.
4.	Prediction using neural network.
5.	Implement Radial Basis Function.
6.	Implement Least Mean Square Algorithm.
7.	Implement Support Vector Machine Algorithm.
8.	Create and train a feed forward back propagation network with a supplied Input P and Target T.
9.	Design a Hopfield network consisting of two neurons with two stable equilibrium points.
10.	Perform defuzzification using the following methods • Centroid • Bisector • Middle of Maximum • Smallest of Maximum • Largest of Maximum
All Practicals can be done using R / MATLAB.	

CLASS: M. Sc. (Information technology)			**Semester - III**	
COURSE: Digital Image Processing(PSIT304a) Elective 2				
Periods per week **1 Period is 60 minutes**		**Lecture**	**4**	
		TW/Tutorial/ Practical	**4**	
			Hours	**Marks**
Evaluation System		**Theory Examination**	**3**	**60**
		Internal		**40**
		Practical	**--**	**50**
Unit – I	**Introduction to image processing**, Example of fields that uses image processing, Steps of image processing, Components, Applications, Image sensors and image formats **Visual Preliminaries** Brightness adaptation and contrast, Acuity and contour, Texture and pattern discrimination, Shape detection and recognition, perception of colour, Computational model of perceptual processing, Image sampling and quantization, Basic relationships between pixels			**12 Lectures**
Unit- II	**Intensity transformations** Introduction, Some basic intensity transformation functions, Histogram equalization, local histogram processing, Using histogram statistics for image enhancement, **Spatial filtering**			**12 Lectures**

	Fundamentals of spatial filtering, Smoothing and Sharpening spatial filters, Combining spatial enhancement methods, Using fuzzy techniques for intensity transformations and spatial filtering	
Unit-III	**Colour image processing** Colour fundamentals, Colour models, Pseudocolour image processing, Basic of full-colour image processing, Colour transformations, Smoothing and Sharpening, Image segmentation bases on colour, Noise in colour images, Colour image compression **Image Compression** Fundamentals, Some basic methods, Digital image watermarking, Full motion video compression	**12 Lectures**
Unit-IV	**Morphological Image Processing** Introduction, Erosion and Dilation, Opening and Closing, The Hit-or-Miss transformation, Some basic morphological algorithms, Gray scale morphology **Segmentation** Fundamentals, Point, Line, and Edge detection, Thresholding, Region based segmentation, Segmentation using morphological watersheds, The use of motion in segmentation- Spatial techniques.	**12 Lectures**
Unit –V	**Representation and Description** Representation, Boundary Descriptors, Regional Descriptors, Use of Principal Components for Description, Relational Descriptors **Object Recognition** Patterns and pattern classes, Recognition based on decision theoretic methods, Structural methods	**12 Lectures**

Books / References

Title	Author/s	Edition	Publisher
Digital Image Processing	Gonzalez and Woods	**3rd Edition**	**Pearson Education**
Digital Image Processing and Analysis	BhabatoshChanda, Dwijesh Dutta Majumder	**2nd Edition**	**PHI**
Fundamentals of Digital Image Processing	Anil K. Jain	**1st Edition**	**PHI**

PracticalsPSIT3P4a:

Note:

1. **All the practical can be done in C, C++, Java or Matlab, R**
2. **The use of built-in functions in image processing toolbox in Matlab except the following is not allowed.**
   Imshow, Imread, Imdilate, Imerode
3. **The use of all other built-in functions for matrix operations and mathematical operations are allowed.**
4. **Use grey level and color images or image matrices as input to all the programs.**

1		WAP to study the effects of reducing the quantization values and spatial resolution
2		Image enhancement
	A	Thresholding

	B	Contrast adjustment
	C	Brightness adjustment
	D	Gray level slicing
3		Basic Transformations
	A	Log transformation
	B	Power law transformation
	C	Negation
4		Different Filters (LPF,HPF, Lapalcian, LOG etc.) To generate mask for LOG use the following formula. $h_g(n_1, n_2) = e^{-(n_1^2+n_2^2)/(2\sigma^2)}$ $h(n_1, n_2) = \frac{(n_1{}^2 + n_2{}^2 - 2\sigma^2)h_g(n_1, n_2)}{2\pi\sigma^6 \sum_{n_1}\sum_{n_2} h_g}$
	A	Write a program to apply a mask on the image.
		a. Accept the size of mask from the user. b. Check whether the mask is of odd size. c. The program should work for any high pass and low pass mask. d. Check the sum of all the elements of the mask. For low pass filter the sum should be one and zero for high pass filter. e. Compare the output for different size of masks.
5		a. Write a program to plot a Histogram.
		b. Write a program to apply Histogram equalization.
6		Write a program to apply Gaussian filter on an image. a. Write a code to generate a Gaussian mask and then apply the mask on the image. b. Accept the size of mask and the sigma value from the user to generate a mask. c. Use the following formula to generate Gaussian mask. $h_g(n_1, n_2) = e^{-(n_1^2+n_2^2)/(2\sigma^2)}$ $h(n_1, n_2) = \frac{h_g(n_1, n_2)}{\sum_{n_1}\sum_{n_2} h_g}$
7		d. Apply following morphological operations on the image: a. Opening b. Closing c. Morphological gradient d. Top-hat transformation 2. Write a program for boundary detection.

8		1.WAP to show RGB planes 2. WAP to convert a. RGB to NTSC b. RGB to YCbCr c. RGB to CMY d. RGB to HIS
9		WAP to achieve Pseudo coloring

CLASS: M. Sc. (Information technology)		**Semester – III**	
COURSE: Ethical Hacking (PSIT304b) Elective 2			
Periods per week **1 Period is 60 minutes**	**Lecture**	**4**	
	TW/Tutorial/ Practical	**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**3**	**60**
	Internal		**40**
	Practical	**--**	**50**

Unit–I	Introduction to Ethical Hacking, Footprinting and Reconnaissance, Scanning Networks, Enumeration	**12 Lectures**
Unit–II	System Hacking, Trojans and Backdoors, Viruses and Worms, Sniffing	**12 Lectures**
Unit–III	Social Engineering, Denial of Service, Session Hijacking, Hacking Webservers	**12 Lectures**
Unit–IV	Hacking Web Applications, SQL Injection, Hacking Wireless Networks, Hacking Mobile Platforms	**12 Lectures**
Unit–V	Evading IDS, Firewalls and Honeypots, Buffer Overflows, Cryptography, Penetration Testing	**12 Lectures**

Books / References

Title	Author/s	Edition	Publisher
Ethical Hacking Review Guide	Kimberly Graves		**Wiley Publishing**
Ethical Hacking	AnkitFadia	2nd Edition	Macmillan India Ltd, 2006
Insider Computer Fraud	Kenneth C.Brancik	2008	Auerbach Publications

			Taylor & Francis Group,

PSIT3P4b: Practicals

1. Using the tools for whois, traceroute, email tracking, google hacking.
2. Using the tools for scanning network, IP fragmentation, war dialing countermeasures, SSL Proxy, Censorship circumvention.
3. Using NETBIOS Enumeration tool, SNMP Enumeration tool, LINUX/ UNIX.enumeration tools, NTP Enumeration tool, DNS analyzing and enumeration tool.
4. Using System Hacking tools.
5. Study of backdoors and Trojan tools
6. Study of sniffing tools
7. Study of Denial of Service attack tools
8. Study of Hijacking tools
9. Study of webserver attack tools.
10. Study of SQL injection and Web server tools
11. Study of wireless hacking tools
12. Using cryptanalysis tool.
13. Study of different security tools.

CLASS: M. Sc. (Information technology)		Semester - IV	
COURSE: Artificial Intelligence (PSIT401)			
Periods per week **1 Period is 60 minutes**	**Lecture**	**4**	
	TW/Tutorial/ Practical	**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**3**	**60**
	Internal		**40**
	Practical	**--**	**50**
Unit – I	**Introduction:** AI,Components of AI,History of AI, Salient Points, Knowledge and Knowledge Based Systems, AI in Future, Applications. **Logic and Computation:** Classical Concepts, Computational Logic, FOL, Symbol Tableau, Resolution, Unification, Predicate Calculus in Problem Solving, Model Logic, Temporal Logic. **Heuristic Search:** Search-Based Problems, Informed Search, Water Jug Problem, TSP, Branch and Bound Method, TSP Algorithm. **[Reference I]**		**12 Lectures**
Unit- II	**Game Playing:** AND/OR Graph, Minimax Problem, Alpha-Beta Search, Puzzle Solving, AI versus Control Robot. **Knowledge Representation:** Structure of an RBS, Merit, Demerit and Applicability of RBS, Semantic Nets, Frames, Conceptual Graphs, Conceptual Dependency, Scripts. **Automated Reasoning:** Default Logic, Problem for Default Reasoning, Closed World Assumption, Predicate Completion, Circumscription, Default Reasoning, Model Based Reasoning, Case Based Reasoning, Reasoning Models, Multimodels, Multimodal Reasoning. **[Reference I]**		**12 Lectures**
Unit-III	**Probabilistic Reasoning:** Bayes Theorem, Bayesian Network, Dempster and Shafer Theory of Evidence, Confidence Factor, Probabilistic Logic. **Knowledge Acquisition:** Knowledge Acquisition process, Automatic Knowledge Acquisition, Machine Learning, Induction, Analogical Reasoning, Explanation-Based Learning, Inductive Learning, Knowledge Acquisition Tools. **[Reference I]**		**12 Lectures**
Unit-IV	**Planning:** Necessity of planning, Planning Agents, Planning generating schemes, Non-hierarchical planning, Hierarchical planning, Script-based		**12 Lectures**

	planning, Oppurtunistic planning, Algorithm for planning, planning representation with STRIPS an example. **Constraint Satisfaction Problem:** Constraints and Satisfiabillity, Basic search strategies for solving CSP, Representation of CSP problem, Examples of constraint satisfaction problem. **[Reference II]**	
Unit –V	**Knowledge-Based Systems:** Structure of an Expert System, Expert Systems in different Areas, Expert System Shells, Comparison of Expert Systems, Comparative View, Ingredients of Knowledge-Based Systems, Web-based Expert Systems. **[Reference I]** **Prolog:** Prolog programming features, Syntax, Syntax of Rules, LIST, Structure, Some Solutions using TURBO PROLOG. **[Reference II]**	**12 Lectures**

Books / References

Title	Author/s	Edition	Publisher
Artificial Intelligence	R. B. Mishra	**EEE**	**PHI**
Artificial Intelligence & Soft Computing for Beginners	Anandita Das Bhattacharjee		**SPD**
Artificial Intelligence	E.Rich and K.Knight	**2002**	**TMH**
Artificial Intelligence: A Modern Approach	S.Russel, P.Norvig	**2002**	**Pearson Education**

CLASS: M. Sc. (Information technology)			**Semester – IV**	
COURSE: IT Infrastructure Management(PSIT402)				
Periods per week **1 Period is 60 minutes**		**Lecture**	**4**	
		TW/Tutorial/ Practical	**4**	
			Hours	**Marks**
Evaluation System		**Theory Examination**	**3**	**60**
		Internal		**40**
		Practical	**--**	**50**
Unit – I	**Introduction:** The four perspectives (attributes) of IT service management, benefits of IT service management, business and IT alignment, What is ITIL?, What are services?, Service Management as a practice,The concept of Good Practice, Concept of a Service, Concept of Service Management, Functions and Processes, The process model and the characteristics of processes. **The Service Lifecycle:** Mapping the Concepts of ITIL to the Service Lifecycle, How does the Service Lifecycle work? **Service Strategy:** Objectives, Creating Service Value, Service Packages and Service Level Packages, Service Strategy Processes, Service Portfolio Management, Financial Management, Demand Management, Service Strategy Summary,			**12 Lectures**

	Interfaces with the Service Design Phase, Interfaces with the Service Transition Phase, Interfaces with the Service Operation Phase, Interfaces with the Continual Service Improvement Phase, Service Strategy Service Scenario, Overall Service Strategy, Service Portfolio Management Considerations, Financial Management Considerations	
Unit- II	**Service Design:** Objectives, Major Concepts, Five Major Aspects of Service Design, Service Design Packages, Service Design Processes, Service Level Management, Supplier Management, Service Catalogue Management, Capacity Management, Availability Management, IT Service Continuity Management, Information Security Management, Service Design Scenario, Service Level Management Considerations, Capacity Management Considerations, Availability Management Considerations, Information Security Management Considerations, Service Catalogue Management Considerations, ITSCM Considerations, Supplier Management Considerations	**12 Lectures**
Unit-III	**Service Transition:** Objectives, Service Transition Processes, Knowledge Management, Service Asset and Configuration Management, Change Management, Release and Deployment Management, Service Validation and Testing, Service Transition Summary, Service Transition Scenario, Knowledge Management Considerations, Service Asset and Configuration Management Considerations, Change Management Considerations, Release and Deployment Management Considerations, Service Validation and Testing Considerations	**12 Lectures**
Unit-IV	**Service Operation:** Objectives, Major Concepts, Service Operation Functions, The Service Desk, Technical Management, IT Operations Management, Application Management, Service Operation Processes, Event Management, Incident Management, Problem Management, Request Fulfillment, Access Management, Service Operation Summary, Service Operation Scenario, Functions, Processes	**12 Lectures**
Unit –V	**Continual Service Improvement:** Objectives, Major Concepts Continual Service Improvement Processes, Service Level Management, Service Measurement and Reporting , CSI (7 Step) Improvement Process, Continual Service Improvement Summary, Continual Service Improvement Scenario, Service Level Management Service Measurement and Reporting, CSI Process	**12 Lectures**

Books / References

Title	Author/s	Edition	Publisher
ITIL V3 Foundation Complete Certification Kit			
Foundations of IT Service	Brady Orand	**2nd**	

Management - The Unofficial ITIL® v3 Foundations Course		**Edition**	
ITILv3 Foundation Exam, The Study Guide	Arjen de Jong Axel Kolthof Mike Pieper Ruby Tjassing Annelies van der Veen TienekeVerheijen		**Van Harren**

CLASS: M. Sc. (Information technology)		**Semester – IV**	
COURSE: Intelligent Systems(PSIT403a)			
Periods per week **1 Period is 60 minutes**	**Lecture**	**4**	
	TW/Tutorial/ Practical	**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**3**	**60**
	Internal		**40**
	Practical	**--**	**50**

Unit – I	Intelligent Agents: Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, Structure of Agents Problem Solving by searching: Problem-Solving Agents Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed Search and exploration: Informed (Heuristic) Search Strategies, Heuristic Functions, Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces, Searching with Nondeterministic Actions, Searching with Partial Observations, Online Search Agents and Unknown Environments	**12 Lectures**
Unit- II	Games: Optimal Decisions in Games, Alpha—Beta Pruning, Imperfect Real-Time Decisions, Stochastic Games, Partially Observable Games, State-of-the-Art Game Programs Constraint Satisfaction, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems Logical Agents: Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic First-Order Logic: Representation Revisited, Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic, Inference in First-	**12 Lectures**

	Order Logic, Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution,	
Unit-III	Planning: Classical Planning, Algorithms for Planning as State-Space Search, Planning Graphs, Other Classical Planning Approaches, Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Multiagent Planning Uncertain Knowledge and Reasoning: Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Independence, Bayes' Rule and Its Use, The Wumpus World Revisited, Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Exact Inference in Bayesian Networks, Approximate Inference in Bayesian Networks, Relational and First-Order Probability Models, Approaches to Uncertain Reasoning, Probabilistic reasoning over time: Inference in Temporal Models, Hidden Markov Models, Kalman Filters, Dynamic Bayesian Networks, Keeping Track of Many Objects	**12 Lectures**
Unit-IV	Simple Decision Making: Combining Beliefs and Desires under Uncertainty, The Basis of Utility Theory, Utility functions, Multiattribute Utility Functions, Decision Networks, Complex Decision Making: Sequential Decision Problems, Value Iteration, Policy Iteration, Partially Observable MDPs, Decisions with Multiple Agents: Game Theory Knowledge in Learning: Review of Forms and types of Learning, Logical Formulation of Learning, Knowledge in Learning, Explanation-Based Learning, Learning Using Relevance Information, Inductive Logic Programming,	**12 Lectures**
Unit –V	Statistical and Reinforced Learning: Statistical Learning, Learning with Complete Data, Learning with Hidden Variables: The EM Algorithm, Reinforcement Learning, Passive Reinforcement Learning, Active Reinforcement Learning, Generalization in Reinforcement Learning, Applications of Reinforcement Learning Natural Language Processing: Language Models, Text Classification, Information Retrieval, Information Extraction. Robotics: Introduction, Robot Hardware, Robotic Perception, Planning to Move, Planning Uncertain Movements, Moving, Robotic Software Architectures, Applications.	**12 Lectures**

Books / References

Title	Author/s	Edition	Publisher
Artificial Intelligence: A Modern Approach	Staurt Russell, Peter Norvig	**3rd Edition**	**Pearson Education**
Artificial Intelligence: Structures and Strategies for Complex Problem	George F.Luger		**Pearson Education**

Solving			
Artificial Intelligence	Patrick Winston		**Pearson Education**

Practicals (PSIT4P3a):

1.	Write a program using C/C++/Java for implementing the Depth First Search Algorithm. And also write the algorithm for the same.
2.	Write a program using C/C++/Java for implementing the Breadth First Search Algorithm.
3.	Apply domain specific heuristic to generate possible solution for the AI problems using. i. Greedy Best First Search.
4.	Implement the mechanism A^* algorithm.
5.	Implement Recursive Breadth First Search.
6.	Generate succession nodes and check possibility of finding solutions of the specified problems using: i. Steepest Ascent Hill Climbing ii. Simulated Annealing
7.	Optimize the search strategy for the suggested problems using: i. Mini-max algorithm. ii. Alpha Beta Pruning.
8.	Find a solution to map-coloring as a constraint satisfaction problem using: Forward checking.
9.	Show the Implementation of Bayesian Network Classification.
10.	Show the application of Hidden Markov Model.
All Practicals can be done using C++/ R / MATLAB.	

CLASS: M. Sc. (Information technology)		**Semester – IV**	
COURSE: Real-time Embedded Systems (PSIT403b)			
Periods per week **1 Period is 60 minutes**	**Lecture**	**4**	
	TW/Tutorial/ Practical	**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**3**	**60**
	Internal		**40**
	Practical	**--**	**50**

Unit – I	**Introduction-** What is Real Time System, Application of real time system, A Basic Model of Real time system, Characteristics of Real Time System,Safety and Realibility, Types of Real Time Task, Timing Constraints,Modeling Timing Constraints. **Embedded Operating Systems** Fundamental Components, Example: Simple Little Operating System **Caches**	**12 Lectures**

	The Memory Hierarchy and Cache Memory, Cache Architecture, Cache Policy	
Unit- II	**Exception and Interrupt Handling** Exception Handling, Interrupts, Interrupt Handling Schemes **Firmware** Firmware and Bootloader, Example: Sandstone **Memory Management** Moving from an MPU to an MMU, How Virtual Memory Works, Details of the ARM MMU, Page Tables, The Translation Lookaside Buffer, Domains and Memory Access Permission, The Caches and Write Buffer.	**12 Lectures**
Unit-III	**Real Time Task Scheduling** Types of real time task and their characteristics, Task Scheduling, Clock driven scheduling, Hybrid Schedulers, Event Driven Scheduling, Earliest Deadline first scheduling, Rate Monotic Algorithm. **Handling Resource Sharing and Dependencies** Resource sharing among real time task, Priority Inversion, Priorotyinheritenceprotpcol, Highest locker protocol,prioroty ceiling protocol,Different types of priority inversion Under PCP,Important features of PCP, Resource sharing Protocol, Handling Task Dependencies.	**12 Lectures**
Unit-IV	**Real Time Communication** Basic Concept, Real Time Communication in Lan, Soft/Hard Real Time communication in a Lan, Bounded Access Protocol for Lans, Performance comparison, Real time communication over Packet Switched networks, QoS framework, Routing,Resource reservation, Rate Control, QoS Model-Integrated services and Differentiated Services.	**12 Lectures**
Unit –V	**Real Time Databases** Concept and Example of real time databases, Real time databases application design issues, Characteristics of temporal data, Concurrency control in real-time databases. Case study on commercial real time databases.	**12 Lectures**

Books / References

Title	Author/s	Edition	Publisher
Real-Time Systems: Theory and Practice.	Rajib Mall	First	Pearson Publication
ARM system developer's guide: designing and optimizing system. (Ch-8,Ch-9,Ch-12, Ch-14)	software/Andrew N. Sloss, Dominic Symes, Chris Wright.	First	Elsevier Publication

Embedded Systems Design	S. Heath	Second Edition	Newnes Publication
Real-Time Systems: Theory and Practice.	Rajib Mall	First	Pearson Publication

Practicals (PSIT4P3b):

1) Schedule a task periodically; after 5 min xyz task has to perform (Hint JITTER).
2) Schedule a task non periodically; no specific time stamp is set for any task.
3) Shared resources management using SEMAPHORE.
4) Shared resources management using MUTEX.
5) Implement scheduling algorithm FIFO.
6) Implement scheduling algorithm ROUND ROBIN.
7) Implement scheduling algorithm RATE MONOTONIC.
8) Implement Inter process communication (IPC) using NAMED PIPES.
9) IPC using simple PIPES.
10) IPC using MAIL BOXES.
11) Using Client Socket & Server Socket (UDP/TCP) maintain data received from client node.
12) Small demonstration of Kernel Level & User Level Communications

CLASS: M. Sc. (Information technology)		**Semester – IV**	
COURSE: Computer Forensics (PSIT403c)			
Periods per week **1 Period is 60 minutes**	**Lecture**	**4**	
	TW/Tutorial/ Practical	**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**3**	**60**
	Internal		**40**
	Practical	**--**	**50**

Unit – I	Computer Forensics and Investigation Processes, Understanding Computing Investigations, The Investigator's Office and Laboratory, Data Acquisitions.	**12 Lectures**
Unit- II	Processing Crime and Incident Scenes, Working with Windows and DOS Systems, Current Computer Forensics Tools.	**12 Lectures**
Unit-III	Macintosh and Linux Boot Processes and File Systems, Computer Forensics Analysis, Recovering Graphics Files.	**12 Lectures**
Unit-IV	Virtual Machines, Network Forensics, and Live Acquisitions, E-mail Investigations, Cell Phone and Mobile Device Forensics	**12 Lectures**
Unit –V	Report Writing for High-Tech Investigations,	**12**

	Expert Testimony in High-Tech Investigations, Ethics and High-Tech Investigations.	**Lectures**

Books / References

Title	Author/s	Edition	Publisher
Guide to Computer Forensics and Investigations	Bell Nelson, Amelia Phillips,ChristopherSteuart	4th Edition	Cengage Learning
Computer Forensics A Pocket Guide	Nathan Clarke		I.T G.vernance Publishing
1., Computer Forensics: Computer Crime Scene Investigation	John R. Vacca	2nd Edition,	Charles River Media

Practicals (PSIT4P3c):

1. File System Analysis using The Sleuth Kit
2. Using Windows forensics tools
3. Using Data acquisition tools
4. Using file recovery tools
5. Using Forensic Toolkit (FTK)
6. Forensic Investigation using EnCase
7. Using Steganography tools
8. Using Password Cracking tools
9. Using Log Capturing and Analysis tools
10. Using Traffic capturing and Analysis tools
11. Using Wireless forensics tools
12. Using Web attack detection tools
13. Using Email forensics tools
14. Using Mobile Forensics software tools
15. Writing report using FTK

CLASS: M. Sc. (Information technology)		**Semester – IV**	
COURSE: Design of Embedded Control Systems(PSIT404a)			
Periods per week **1 Period is 60 minutes**	**Lecture**	**4**	
	TW/Tutorial/ Practical	**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**3**	**60**
	Internal		**40**
	Practical	**--**	**50**

Unit – I	**Introduction to microcontrollers** Microprocessors and microcontrollers, History, Embedded vs external memory devices, 8-bit and 16-bit microcontrollers, RISC	**12 Lectures**

	and CISC processors, Harvard and Von Neumann architectures, Commercial microcontroller devices. Industrial applications. **Design with Atmel microcontrollers** Architecture overview of Atmel 89C51, Pin description of 89C51, Using flash memory devices Atmel 89CXX, Power saving options.	
Unit- II	**PIC Microcontrollers** Overview, PIC16C6X/7X, Reset actions, Oscillators, Memory organization, PIC16C6X/7X instructions, Addressing modes, I/O ports, Interrupts PIC16C61/71, PIC16C61/71 timers, PIC16C 71 ADC, **PIC16F8XX Flash microcontrollers** Introduction, pin diagram, status registers, options_reg registers, power control registers, PIC16F8 program memory, PIC16F8 data memory, Data EEPROM, Flash program EEPROM, Interrupts PIC16F877, I/O ports, Timers **More about PIC microcontrollers** Introduction, Capture/compare/PWM modules in PIC16F877, Master synchronous serial port (MSSP) module, USART, ADC	**12 Lectures**
Unit- III	**ARM Embedded Systems** The RISC Design Philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software, **ARM Processor Fundamentals** Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and the Vector Table, Core Extensions, Architecture Revisions**,** ARM Processor Families	**12 Lectures**
Unit- IV	**Introduction to the ARM Instruction Set** Data Processing Instructions, Branch Instructions, Load-Store Instructions, Software Interrupt Instruction, Program Status Register Instructions, Loading Constants, ARMv5E Extensions, Conditional Execution **Introduction to the Thumb Instruction Set** Thumb Register Usage, ARM-Thumb Interworking, Other Branch Instructions, Data Processing Instructions, Single-Register Load-Store Instructions, Multiple-Register Load-Store Instructions, Stack Instructions, Software Interrupt Instruction.	**12 Lectures**
Unit - V	**Writing and Optimizing ARM Assembly Code** Writing Assembly Code, Profiling and Cycle Counting, Instruction Scheduling, Register Allocation, Conditional Execution, Looping Constructs, Bit Manipulation, Efficient Switches, Handling Unaligned Data	**12 Lectures**

Books / References

Title	Author/s	Edition	Publisher
Microcontrollers theory and applications (UnitI and II)	Ajay Deshmukh	First	Tata McGraw-

			Hill
ARM system developer's guide: designing and optimizing system. (Unit III to V)	Andrew N. Sloss, Dominic Symes, Chris Wright.	First	Elsevier Publication

Practicals (PSIT4P4a):

1. Interfacing of LED, relay, Push Button
2. Sending and Receive Data Serially to/from PC.
3. Interfacing Wireless Module using ASK and FSK
4. Interfacing PC Keyboard.
5. Interfacing with EEPROM using I2C BUS.
6. Using a Watchdog Timer.
7. Using an External RTC.
8. Design a 4 bit binary counter.
9. DC Motor Control using PWM module.
10. Interfacing of temperature sensor.
11. Interfacing a 7 segment display.
12. Scrolling text message on LED dot matrix display

COURSE: Advanced Image Processing(PSIT404b)			
Periods per week **1 Period is 60 minutes**	**Lecture**	**4**	
	TW/Tutorial/ Practical	**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**3**	**60**
	Internal		**40**
	Practical	**--**	**50**

Unit – I	**Enhancement in Frequency domain** Introduction, 2-D Discrete Fourier Transform, Properties of Fourier transform, Basic filtering in the frequency domain, Smoothing and Sharpening filters, FFT algorithm. Discrete cosine transform (DCT), KL (PCT) transform, HAAR, Basics of wavelets. **Remote Sensing** Introduction (Passive and Active sensing), Electromagnetic remote sensing process, Physics of radiant energy, Energy source and its characteristics, Atmospheric interactions with electromagnetic radiation, Energy interaction with Earth's surface materials.	**12 Lectures**
Unit- II	**Microwave Remote Sensing** Introduction, The Radar principle, Factors affecting microwave measurements, Radar wavebands, Side looking airborne (SLAR) systems, Synthetic Aperture Radar (SAR), Polarimetric SAR (PolSAR), Interaction between microwaves and Earth's surface, Interpreting SAR images, Geometric characteristics. **Remotes Sensing Platforms and Sensors** Introduction, Satellite system parameters, Spatial Resolution, Spectral Resolution, Radiometric Resolution, Temporal resolution, Imaging sensor systems (thermal, multispectral and microwave imaging), Earth resources satellites, Meteorological satellites, Satellites carrying microwave sensors, OCEASAT-1, IKONOS, Latest trends in remote sensing platforms and sensors (weather, land observation and marine satellites).	**12 Lectures**
Unit-III	**Image Analysis** Introduction, Visual interpretation, Elements of visual interpretation, Digital processing, Pre-processing, Enhancement, Transformations, Classification, Integration, Classification accuracy assessment. **Applications** Introduction, Agriculture, Forestry, Geology, Hydrology, Sea Ice, Land cover, Mapping, Oceans and Costal.	**12 Lectures**
Unit-IV	**Medical Image Processing** Various modalities of medical imaging, Breast cancer imaging, Mammographic imaging, Ultrasound imaging,	**12 Lectures**

	Magnetic resonance imaging (MRI), Breast thermograph imaging, Problems with medical images. Image enhancement, Spatial domain methods, Frequency domain methods, Other modalities of medical imaging, Radiography, Positron emission tomography (PET), Computed tomography angiography (CTA), Echocardiogram.	
Unit –V	**Feature Extraction and Statistical Measurement** Selection of features, Shape related features, Shape representation, Bounding box, Shape matrix, Moments of region and shape, Co-occurrence matrix, Principle feature analysis (PFA), Fourier descriptors, Snake boundary detection, Snake algorithm, Texture analysis, Texture features, Feature extraction using discrete Fourier transform, wavelet transform, Gabor filters for texture analysis, Breast tissue detection, Analysis of tissue structure.	**12 Lectures**

Books / References

Title	Author/s	Edition	Publisher
Text Book of Remote Sensing and Geographical Information Systems	M. Anji Reddy	**4th Edition**	BS publication
Remote Sensing and Image Interpretation	Lillesand, T.M. and Kiefer, R.W.	6th edition.	John Wiley and Sons Inc.
Medical Image Processing Concepts and Applications	Sinha, G.R., Patel, BhagwatiCharan		PHI
Digital Image Processing	Gonzalez and Woods	3rd Edition	Pearson
Digital Image Processing and Analysis	BhabatoshChanda, Dwijesh Dutta Majumder	2nd Edition	PHI

Practicals(PSIT4P4b):

Note:

1. **All the practical can be done in C, C++, Java or Matlab, PolSARPro, Nest, ImageJ, R and ENVI**
2. **Satellite images can be downloaded from**
    a. **http://bhuvan3.nrsc.gov.in/bhuvan/bhuvannew/bhuvan2d.php**
    b. **http://landsat.usgs.gov/Landsat_Search_and_Download.php**
    c. **http://uavsar.jpl.nasa.gov/**
    d. **http://airsar.jpl.nasa.gov/**
3. **Medical images can be downloaded from**
    a. **http://www.barre.nom.fr/medical/samples/**

1	Apply DFT on Image
2	WAP for implementing LPF 1. Ideal LPF on square image 2. Butterworth filter 3. Gaussian filter

3	WAP for implementing HPF 1. Ideal HPF on square image 2. Butterworth filter 3. Gaussian filter
4	1. WAP for high boost filtering on square image 2. WAP for homomorphic filtering on square image
5	Acquire satellite/medical image and apply pre-processing techniques to improve the quality of image (use different low pass filters and compare the results)
6	Apply different image enhancement techniques (to improve contrast, brightness, sharpness) on satellite image
7	Apply different supervised classification techniques to classify the satellite image (minimum distance, maximum likelihood, decision tree, ANN)
8	Apply different clustering algorithms (K-means, ISODATA)
9	Apply compression and decompression algorithm on image (Huffman coding, Arithmetic encoding, LZW encoding)
10	Apply DCT and PCA on image.

CLASS: M. Sc. (Information technology)		**Semester – IV**	
COURSE: Cloud Management (PSIT404c)			
Periods per week **1 Period is 60 minutes**	**Lecture**	**4**	
	TW/Tutorial/ Practical	**4**	
		Hours	**Marks**
Evaluation System	**Theory Examination**	**3**	**60**
	Internal		**40**
	Practical	**--**	**50**

Unit – I	Virtualized Data Center Architecture: Cloud infrastructures; public, private, hybrid. Service provider interfaces; Saas, Paas, Iaas. VDC environments; concept, planning and design, business continuity and disaster recovery principles. Managing VDC and cloud environments and infrastructures	**12 Lectures**
Unit- II	Storage Network Design: Architecture of storage, analysis and planning. Storage network design considerations; NAS and FC SANs, hybrid storage networking technologies (iSCSI, FCIP, FCoE), design for storage virtualization in cloud computing, host system design considerations IP-SAN: Introduction, iSCSI—components of iSCSI, iSCSI host connectivity, topologies for iSCSI connectivity, iSCSI discovery, iSCSI names, iSCSI session, iSCSI PDU, ordering and numbering, iSCSI security and error handling, FCIP—FCIP topology, FCIP performance and security, iFCP—iFCP topology, iFCP	**12 Lectures**

	addressing and routing, iFCP gateway architecture,FCOE architecture.	
Unit-III	Cloud Management: System Center 2012 and Cloud OS, Provisioning Infrastructure: Provisioning Infrastructure with Virtual Machine Designing, Planning and Implementing. Managing Hyper-V Environment with VMM 2012. Provisioning self-service with AppController, AppController essentials, Managing Private, Public, Hybrid clouds. AppControllercmdlets.	**12 Lectures**
Unit-IV	Managing and maintaining with Configuration Manager 2012, Design, Planning, Implementation, Administration, Distributing Applications, Updates, Deploying Operating Systems, Asset Management and reporting. Backup and recovery with Data Protection Manager. Design, Planning, Implementation and Administration.	**12 Lectures**
Unit –V	Implementing Monitoring: Real-time monitoring with Operations Manager, Proactive monitoring with Advisor, Operations Design, Planning, Implementation, Administration, Monitoring, Alerting, Operations and Security reporting.Building private clouds: Standardisation with service manager, Service Manager 2012: Design, Planning, Implementing, Incident Tracking, Automation with orchestrator, System Orchestrator 2012: Design, Planning, Implementing. Windows Azure Pack.	**12 Lectures**

Books / References

Title	Author/s	Edition	Publisher
Introducing Microsoft System Center 2012, Technical Overview	Mitch Tulloch, SymonPerriman and SymonPerriman		**Microsoft**
Microsft System Center 2012 Unleashed	Chris Amaris, Rand Morimoto, Pete Handley, David E. Ross, Technical Edit by Yardeni		Pearson Education
The.Official.VCP5.Certification.Guide		Aug.2012	VMware.Press
VCAP5-DCD Official Cert Guide			VMware.Press
Automating vSphere with VMware vCenter Orchestrator			
VMware Private Cloud Computing with vCloud Director			
Managing and optimizing VMWare VSphere deployment			
Storage Networks: The Complete Reference	Robert Spalding		
Storage Networking Protocol	James Long		

Fundamentals			
Storage Networking Fundamentals: An Introduction to Storage Devices, Subsystems, Applications, Management, and Filing Systems	Marc Farley		

Practicals(PSIT4P4c):

1. Managing Hyper –V environment with SCVVM 2012
2. Provisioning Self-service with AppController
3. Managing Private Cloud with AppController
4. Using Data Protection Manager for Backup and Recovery
5. Using Operations Manager for real-time monitoring
6. Using Advisor for proactive monitoring
7. Using Service Manager to standardize
8. Using Orchestrator for automation
9. Implementing Windows Azure Pack
10. Using Configuration Manager 2012 for managing and maintaining