MATHEMATICAL FOUNDATION OF COMPUTER SCIENCE
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER – I

Subject Code	18SFC11 / **18LNI11** / 18SCE11 / 18SCS11 / 18SCN11 / 18SSE11 / 18SIT11	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- To acquaint the students with mathematical/logical fundamentals including numerical techniques,
- To understand probability, sampling and graph theory that serve as an essential tool for applications of computer and information sciences.

Module 1	**Contact Hours**
Numerical Methods: Significant figures, Error definitions, Approximations and round off errors, accuracy and precision. Roots of Equations: Bairstow-Lin's Method, Graeffe's Root Squaring Method. Computation of eigen values of real symmetric matrices: Jacobi and Givens method. **RBT: L1, L2, L3**	**10 Hours**
Module 2	
Statistical Inference: Introduction to multivariate statistical models: Correlation and Regression analysis, Curve fitting (Linear and Non linear) **RBT: L1, L2, L3**	**10 Hours**
Module 3	
Probability Theory: Probability mass function (p.m.f), density function (p.d.f), Random variable: discrete and continuous, Mathematical expectation, Sampling theory: testing of hypothesis by t-test and chi - square distribution. **RBT: L1, L2, L3**	**10 Hours**
Module 4	
Graph Theory: Isomorphism, Planar graphs, graph coloring, Hamilton circuits and Euler cycle. Specialized techniques to solve combinatorial enumeration problems. **RBT: L1, L2, L3**	**10 Hours**
Module 5	
Vector Spaces: Vector spaces; subspaces; Linearly independent and dependent vectors ; Bases and dimension; coordinate vectors-Illustrative examples. Linear transformations; Representation of transformations by matrices; linear functional; Non singular Linear transformations; inverse of a linear transformation- Problems. **RBT: L1, L2, L3**	**10 Hours**

Course Outcomes

- Understand the numerical methods to solve and find the roots of the equations.
- Utilize the statistical tools in multi variable distributions.
- Use probability formulations for new predictions with discrete and continuous RV's.
- To understand various graphs in different geometries related to edges.
- Understand vector spaces and related topics arising in magnification and rotation of images.

Question paper pattern:
The question paper will have ten questions.

There will be 2 questions from each module.
Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Steven C. Chapra and Raymond P Canale: " Numerical Methods for Engineers, 7th Edition, McGraw-Hill Publishers, 2015.
2. T.Veerarajan: "Probability, Statistics and Random Process",3rdEdition,Tata Mc-Graw Hill Co.,2016.
3. David C.Lay, Steven R.Lay and J.J.McDonald: Linear Algebra and its Applications, 5th Edition, Pearson Education Ltd., 2015.

Reference Books:

1. **B.S. Grewal**: Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2017.
2. **John Vince :** "Foundation Mathematics for Computer Science", Springer International Publishing, Switzerland, 2015
3. **M.K.Jain, S.R.K.Iyengar and R.K.Jain:** Numerical Methods for Scientific and Engineering Computation. 6thEd.,New Age Int.Publishers.2012.
4. **Norman L.Biggs**: Discrete Mathematics, 2nd Ed., Oxford University Press, 2017.

Web links and Video Contacts:

1. *http://nptel.ac.in/courses.php?disciplineId=111*
2. *http://www.class-central.com/subject/math(MOOCs)*
3. *http://ocw.mit.edu/courses/mathematics/*

SEMANTIC WEB AND SOCIAL NETWORKS
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER – I

Subject Code	**18LNI12**	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Explain the fundamentals of Semantic Web technologies.
- Implementation of semantic web applications and the architectures of social networking
- Social network performance analysis

Module 1	**Contact Hours**
Web Intelligence Thinking and Intelligent Web Applications, The Information Age ,The World Wide Web, Limitations of Today's Web, The Next Generation Web, Machine Intelligence, Artificial Intelligence, Ontology, Inference engines, Software Agents, Berners-Lee www, Semantic Road Map, Logic on the semantic Web. **RBT: L1, L2, L3**	**10 Hours**
Module 2	
Knowledge Representation for the Semantic Web Ontologies and their role in the semantic web, Ontologies Languages for the Semantic Web – Resource Description Framework(RDF) / RDF Schema, Ontology Web Language(OWL), UML, XML/XML Schema. **RBT: L1, L2, L3**	**10 Hours**
Module 3	
Ontology Engineering, Ontology Engineering, Constructing Ontology, Ontology Development Tools, Ontology Methods, Ontology Sharing and Merging, Ontology Libraries and Ontology Mapping, Logic, Rule and Inference Engines. **RBT: L1, L2, L3**	**10 Hours**
Module 4	
Semantic Web Applications, Services and Technology Semantic Web applications and services, Semantic Search, e-learning, Semantic Bioinformatics, Knowledge Base, XML Based Web Services, Creating an OWL-S Ontology for Web Services, Semantic Search Technology, Web Search Agents and Semantic Methods. **RBT: L1, L2, L3**	**10 Hours**
Module 5	
Social Network Analysis and semantic web What is social Networks analysis, development of the social networks analysis, Electronic Sources for Network Analysis – Electronic Discussion networks, Blogs and Online Communities, Web Based Networks. Building Semantic Web Applications with social network features. **RBT: L1, L2, L3**	**10 Hours**

Course Outcomes

The students should be able to:

- Demonstrate the semantic web technologies like RDF Ontology and others
- Learn the various semantic web applications
- Identify the architectures and challenges in building social networks
- Analyze the performance of social networks using electronic sources

Question paper pattern:

The question paper will have ten questions. There will be 2 questions from each module. Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.
Text Books: 1. Thinking on the Web - Berners Lee, Godel and Turing, Wiley inter science, 2008. Social Networks and the Semantic Web, Peter Mika, Springer, 2007.
Reference Books: 1. Semantic Web Technologies, Trends and Research in Ontology Based Systems. 2. Semantic Web and Semantic Web Services -Liyang Lu Chapman and Hall/CRC Publishers, (Taylor & Francis Group). 3. Programming the Semantic Web, T.Segaran, C.Evans, J.Taylor, O'Reilly.

INFORMATION AND NETWORK SECURITY
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER – I

Subject Code	**18LNI13** / 18SCN13 / 18SCS322	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Explain standard algorithms used to provide confidentiality, integrity and authenticity.
- Distinguish key distribution and management schemes.
- Deploy encryption techniques to secure data in transit across data networks
- Implement security applications in the field of Information technology

Module 1	**Contact Hours**
Classical Encryption Techniques Symmetric Cipher Model, Cryptography, Cryptanalysis and Brute-Force Attack, Substitution Techniques, Caesar Cipher, Mono-alphabetic Cipher, Playfair Cipher, Hill Cipher, Poly alphabetic Cipher, One Time Pad. **Block Ciphers and the data encryption standard:** Traditional block Cipher structure, stream Ciphers and block Ciphers, Motivation for the feistel Cipher structure, the feistel Cipher, The data encryption standard, DES encryption, DES decryption, A DES example, results, the avalanche effect, the strength of DES, the use of 56-Bit Keys, the nature of the DES algorithm, timing attacks, Block cipher design principles, number of rounds, design of function F, key schedule algorithm **RBT: L1, L2, L3**	**10 Hours**
Module 2	
Public-Key Cryptography and RSA: Principles of public-key cryptosystems. Public-key cryptosystems. Applications for public-key cryptosystems, requirements for public-key cryptosystems. Public-key cryptanalysis. The RSA algorithm, description of the algorithm, computational aspects, the security of RSA. **Other Public-Key Cryptosystems:** Diffie-hellman key exchange, The algorithm, key exchange protocols, man in the middle attack, Elgamal Cryptographic systems, Elliptic curve arithmetic, abelian groups, elliptic curves over real numbers, elliptic curves over Zp, elliptic curves overGF(2m), Elliptic curve cryptography, Analog of Diffie-hellman key exchange, Elliptic curve encryption/ decryption, security of Elliptic curve cryptography, Pseudorandom number generation based on an asymmetric cipher, PRNG based on RSA. **RBT: L1, L2, L3**	**10 Hours**
Module 3	
Key Management and Distribution: Symmetric key distribution using Symmetric encryption, A key distribution scenario, Hierarchical key control, session key lifetime, a transparent key control scheme, Decentralized key control, controlling key usage, Symmetric key distribution using asymmetric encryption, simple secret key distribution, secret key distribution with confidentiality and authentication, A hybrid scheme, distribution of public keys, public announcement of public keys, publicly available directory, public key authority, public keys certificates, X-509 certificates. Certificates, X-509 version 3, public key infrastructure. **User Authentication:** Remote user Authentication principles, Mutual Authentication, one way Authentication, remote user Authentication using Symmetric encryption, Mutual Authentication, one way Authentication, Kerberos, Motivation , Kerberos version 4, Kerberos version 5, Remote user Authentication using Asymmetric encryption,	**10 Hours**

Mutual Authentication, one way Authentication, federated identity management, identity management, identity federation, personal identity verification. **RBT: L1, L2, L3**	
Module 4	
Wireless network security: Wireless security, Wireless network threats, Wireless network measures, mobile device security, security threats, mobile device security strategy, IEEE 802.11 Wireless LAN overview, the Wi-Fi alliance, IEEE 802 protocol architecture. Security, IEEE 802.11i services, IEEE 802.11i phases of operation, discovery phase, Authentication phase, key management phase, protected data transfer phase, the IEEE 802.11i pseudorandom function. W**eb Security Considerations:** Web Security Threats, Web Traffic Security Approaches. **Secure Sockets Layer: SSL** Architecture, SSL Record Protocol, Change Cipher Spec Protocol, Alert Protocol, and shake Protocol, Cryptographic Computations. **Transport Layer Security:** Version Number, Message Authentication Code, Pseudorandom Functions, Alert Codes, Cipher Suites, Client Certificate Types, Certificate Verify and Finished Messages, Cryptographic Computations, and Padding. **HTTPS** Connection Initiation, Connection Closure. **Secure Shell(SSH)** Transport Layer Protocol, User Authentication Protocol, Connection Protocol **RBT: L1, L2, L3**	**10 Hours**
Module 5	
Electronic Mail Security: Pretty good privacy, notation, operational; description, S/MIME, RFC5322, Multipurpose internet mail extensions, S/MIME functionality, S/MIME messages, S/MIME certificate processing, enhanced security services, Domain keys identified mail, internet mail architecture, E-Mail threats, DKIM strategy, DKIM functional flow. **IP Security:** IP Security overview, applications of IPsec, benefits of IPsec, Routing applications, IPsec documents, IPsec services, transport and tunnel modes, IP Security policy, Security associations, Security associations database, Security policy database, IP traffic processing, Encapsulating Security payload, ESP format, encryption and authentication algorithms, Padding, Anti replay service, transport and tunnel modes, combining security associations, authentication plus confidentiality, basic combinations of security associations, internet key exchange, key determinations protocol, header and payload formats, cryptographic suits. **RBT: L1, L2, L3**	**10 Hours**
Course Outcomes	
The students should be able to: • Analyze the vulnerabilities in any computing system and hence be able to design a security solution. • Identify the security issues in the network and resolve it. • Evaluate security mechanisms using rigorous approaches, including theoretical.	
Question paper pattern: The question paper will have ten questions. There will be 2 questions from each module. Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.	
Text Books: 1. William Stallings, Cryptography and Network Security, Pearson 6th edition.	
Reference Books: 1. V K Pachghare: Cryptography and Information Security.	

NETWORK PROGRAMMING
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER – I

Subject Code	**18LNI14** / 18SCE333 / 18SCN22	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Define Network Programming.
- Demonstrate programming with TCP and SCTP.
- Explain key management and routing sockets.
- Evaluate advanced Socket Programming APIs.

Module 1	**Contact Hours**
Introduction to network application, client/server communication, OSI Model, BSD Networking history, Test Networks and Hosts, Unix Standards, 64-bit architectures, Transport Layer: TCP, UDP and SCTP. **RBT: L1, L2**	**10 Hours**
Module 2	
Sockets Introduction – socket address structures, value-result arguments, byte ordering and manipulation functions, address conversion functions, Elementary TCP Sockets – socket, connect, bind, listen, accept , fork and concurrent server design, getcsockname and getpeername functions and TCP Client/Server Example- client/server programming through TCP sockets, Normal startup, termination, POSIX signal handling, Signal handling in server, Crashing, rebooting of server host, shutdown **RBT: L1, L2, L3**	**10 Hours**
Module 3	
I/O Multiplexing and Socket Options, Elementary SCTP Sockets- Interface Models, sctp_xx functions, shutdown function, Notifications, SCTP Client/Server Examples – One-to-Many, Head–of-Line Blocking, Controlling number of streams and Termination, IPv4 and IPv6 Interoperability–different interoperability scenarios. **RBT: L1, L2, L3**	**10 Hours**
Module 4	
Daemon Processes, syslogd, daemonizing functions and the inetd super server, Advanced I/O functions- readv, writev, sendmsg and recvmsg, Ancillary data, Advanced polling, Unix domain protocols- socket address structure, functions and communication scenarios, Nonblocking I/O – connect and accept examples. **RBT: L1, L2, L3**	**10 Hours**
Module 5	
ioctl operations- socket, file, interface configuration information, ARP cache and routing table operations, Routing sockets- data link socket address structure, reading and writing, sysctl operations, interface name and index functions, Key Management functions – reading, writing, SADB, SA, Dynamically Maintaining SA's, Out-of-Band data, Threads-basic thread functions, TCP echo server using threads, Mutexes and Conditional variables. **RBT: L1, L2, L3**	**10 Hours**

Course Outcomes

The students should be able to:

- Develop applications that communicate with each other using TCP and SCTP.

- Identify the IPv4 and IPv6 compatibility.
- Evaluate socket programming APIs.

Question paper pattern:

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. W. Richard Stevens, Bill Fenner, Andrew M. Rudoff: "UNIX Network Programming". Volume 1, Third Edition, Pearson 2004.

Reference Books:

1. Barry Nance: "Network Programming in C", PHI 2002 3.Bob Quinn, Dave Shute: "Windows Socket Network Programming", Pearson 2003.
2. Richard Stevens: "UNIX Network Programming". Volume 2, Second Edition.

CLOUD COMPUTING
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER – I

Subject Code	**18LNI151** / 18SCE14 / 18SCN31 / 18SCS23 / 18SIT22 / 18SSE251	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Define and Cloud, models and Services.
- Compare and contrast programming for cloud and their applications
- Explain virtuaization, Task Scheduling algorithms.
- Apply ZooKeeper, Map-Reduce concept to applications.

Module 1	**Contact Hours**
Introduction, Cloud Infrastructure: Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open-source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Energy use and ecological impact, Service level agreements, User experience and software licensing. Exercises and problems. **RBT: L1, L2**	**10 Hours**
Module 2	
Cloud Computing: Application Paradigms.: Challenges of cloud computing, Architectural styles of cloud computing, Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce programming model, A case study: The Gre The Web application, Cloud for science and engineering, High-performance computing on a cloud, Cloud computing for Biology research, Social computing, digital content and cloud computing. **RBT: L1, L2, L3**	**10 Hours**
Module 3	
Cloud Resource Virtualization: Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and paravirtualization, Hardware support for virtualization, Case Study: Xen a VMM based paravirtualization, Optimization of network virtualization, vBlades, Performance comparison of virtual machines, The dark side of virtualization, Exercises and problems **RBT: L1, L2, L3**	**10 Hours**
Module 4	
Cloud Resource Management and Scheduling: Policies and mechanisms for resource management, Application of control theory to task scheduling on a cloud, Stability of a two-level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers, A utility-based model for cloud-based Web services, Resourcing bundling: Combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling MapReduce applications subject to deadlines, Resource management and dynamic scaling, Exercises and problems.	**10 Hours**

RBT: L1, L2, L3	
Module 5	
Cloud Security, Cloud Application Development: Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, Operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, A trusted virtual machine monitor, Amazon web services: EC2 instances, Connecting clients to cloud instances through firewalls, Security rules for application and transport layer protocols in EC2, How to launch an EC2 Linux instance and connect to it, How to use S3 in java, Cloud-based simulation of a distributed trust algorithm, A trust management service, A cloud service for adaptive data streaming, Cloud based optimal FPGA synthesis .Exercises and problems. **RBT: L1, L2, L3**	**10 Hours**
Course Outcomes	
The students should be able to: • Compare the strengths and limitations of cloud computing • Identify the architecture, infrastructure and delivery models of cloud computing • Apply suitable virtualization concept. • Choose the appropriate cloud player • Address the core issues of cloud computing such as security, privacy and interoperability • Design Cloud Services • Set a private cloud	
Question paper pattern: The question paper will have ten questions. There will be 2 questions from each module. Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.	
Text Books: 1. Dan C Marinescu: Cloud Computing Theory and Practice. Elsevier(MK) 2013.	
Reference Books: 1. RajkumarBuyya , James Broberg, Andrzej Goscinski: Cloud Computing Principles and Paradigms, Willey 2014. 2. John W Rittinghouse, James F Ransome:Cloud Computing Implementation, Management and Security, CRC Press 2013.	

MULTIMEDIA COMMUNICATIONS
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER – I

Subject Code	**18LNI152** / 18SCE322 / 18SCN21	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Define the Multimedia Communication Models
- Explain Multimedia Transport in Wireless Networks
- Solve the Security issues in multimedia networks
- Illustrate real-time multimedia network applications.
- Explain different network layer based application.

Module 1	**Contact Hours**
Introduction, multimedia information representation, multimedia networks, multimedia applications, Application and networking terminology, network QoS and application QoS, Digitization principles,.Text, images, audio and video. **RBT: L1, L2, L3**	**10 Hours**
Module 2	
Text and image compression,, compression principles, text compression- Runlength, Huffman, LZW, Document Image compression using T2 and T3 coding, image compression- GIF, TIFF and JPEG **RBT: L1, L2, L3**	**10 Hours**
Module 3	
Audio and video compression, audio compression – principles, DPCM, ADPCM, Adaptive and Linear predictive coding, Code-Excited LPC, Perceptual coding, MPEG and Dolby coders video compression, video compression principles. **RBT: L1, L2, L3**	**10 Hours**
Module 4	
Video compression standards: H.261, H.263, MPEG, MPEG 1, MPEG 2, MPEG-4 and Reversible VLCs, MPEG 7 standardization process of multimedia content description, MPEG 21 multimedia framework. **RBT: L1, L2, L3**	**10 Hours**
Module 5	
Notion of synchronization, presentation requirements, reference model for synchronization, Introduction to SMIL, Multimedia operating systems, Resource management, process management techniques. **RBT: L1, L2, L3**	**10 Hours**

Course Outcomes

The students should be able to:

- Deploy the right multimedia communication models.
- Apply QoS to multimedia network applications with efficient routing techniques.
- Solve the security threats in the multimedia networks.
- Develop the real-time multimedia network applications

Question paper pattern:
The question paper will have ten questions.

There will be 2 questions from each module.
Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Fred Halsall, “Multimedia Communications”, Pearson education, 2001.
2. Raif Steinmetz, KlaraNahrstedt, “Multimedia: Computing, Communications and Applications”, Pearson education, 2002.

Reference Books:

1. K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, “Multimedia Communication Systems”, Pearson education, 2004.
2. John Billamil, Louis Molina, “Multimedia : An Introduction”, PHI, 2002.

ETHERNET TECHNOLOGY
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER – I

Subject Code	**18LNI153**	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Define with the basics of Ethernet
- Explain concepts of different types of Ethernet
- Analyze building an Ethernet system
- Acquire knowledge of hubs and repeaters

Module 1	**Contact Hours**
Introduction: Introduction to Ethernet, The Evolution of Ethernet, The Ethernet System, The Media Access Control Protocol The media Access Control Protocol Full Duplex Ethernet Auto-Negotiation **RBT: L1, L2**	**10 Hours**
Module 2	
Ethernet Media Systems: Ethernet Media Fundamentals Twisted-Pair Media System(10Base-T) Fiber Optic Media System(10Base-F) Fast Ethernet Twisted-Pair Media System(100Base-TX) **RBT: L1, L2, L3**	**10 Hours**
Module 3	
Fast Ethernet Fiber Optic Media System(100Base-FX) Gigabit Ethernet Twisted-Pair Media System(1000Base-T) Gigabit Ethernet Fiber Optic Media System (1000Base-X) **RBT: L1, L2, L3**	**10 Hours**
Module 4	
Multi-Segment Configuration Guidelines **Building Your Ethernet System: s**tructured Cabling Twisted-Pair Cables and Connectors Fiber Optic Cables and Connectors **RBT: L1, L2, L3**	**10 Hours**
Module 5	
Ethernet Repeater Hubs Ethernet Switching Hubs **Performance and troubleshooting:** Ethernet Performance Troubleshooting. **RBT: L1, L2, L3**	**10 Hours**

Course Outcomes

The students should be able to:

- Classify different types of Ethernet systems
- Contrast Ethernet Media systems
- Evaluate a complete Ethernet system

Question paper pattern:

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Charles E. Spurgeon: “Ethernet – The Definitive Guide”, O’Reilly 2004.

Reference Books:

1. Rich Seifert: “Gigabit Ethernet”, Addison-Wesley 1998.

NETWORK MANAGEMENT
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER – I

Subject Code	**18LNI154** / 18SCN253	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Evaluate need for interoperable network management.
- Explain the concepts and architecture behind standards based network management.
- Illustrate the concepts and terminology associated with SNMP and TMN
- Demonstrate network management as a typical distributed application

Module 1	**Contact Hours**
Introduction: Analogy of Telephone Network Management, Data and Telecommunication Network Distributed computing Environments, TCP/IP-Based Networks: The Internet and Intranets, Communications Protocols and Standards- Communication Architectures, Protocol Layers and Services; Case Histories of Networking and Management – The Importance of topology , Filtering Does Not Reduce Load on Node, Some Common Network Problems; Challenges of Information Technology Managers, Network Management: Goals, Organization, and Functions- Goal of Network Management, Network Provisioning, Network Operations and the NOC, Network Installation and Maintenance; Network and System Management, Network Management System platform, Current Status and Future of Network Management. **RBT: L1, L2, L3**	**10 Hours**
Module 2	
Basic Foundations: Standards, Models, and Language: Network Management Standards, Network Management Model, Organization Model, Information Model – Management Information Trees, Managed Object Perspectives, Communication Model; ASN.1- Terminology, Symbols, and Conventions, Objects and Data Types, Object Names, An Example of ASN.1 from ISO 8824; Encoding Structure; Macros, Functional Model. **RBT: L1, L2, L3**	**10 Hours**
Module 3	
SNMPv1 Network Management: Managed Network: The History of SNMP Management, Internet Organizations and standards, Internet Documents, The SNMP Model, The Organization Model, System Overview. The Information Model – Introduction, The Structure of Management Information, Managed Objects, Management Information Base. The SNMP Communication Model – The SNMP Architecture, Administrative Model, SNMP Specifications, SNMP Operations, SNMP MIB Group, Functional Model SNMP Management – RMON: Remote Monitoring, RMON SMI and MIB, RMONI1- RMON1 Textual Conventions, RMON1 Groups and Functions, Relationship Between Control and Data Tables, RMON1 Common and Ethernet Groups, RMON Token Ring Extension Groups, RMON2 – The RMON2 Management Information Base, RMON2 Conformance Specifications. **RBT: L1, L2, L3**	**10 Hours**
Module 4	
Broadband Network Management: Broadband Access Networks and Technologies: Broadband Access Networks, Broadband Access Technology; HFCT Technology: The Broadband LAN, The Cable Modem, The Cable Modem Termination System, The HFC	**10 Hours**

Plant, The RF Spectrum for Cable Modem; Data Over Cable, Reference Architecture; HFC Management – Cable Modem and CMTS Management, HFC Link Management, RF Spectrum Management, DSL Technology; Asymmetric Digital Subscriber Line Technology – Role of the ADSL Access Network in an Overall Network, ADSL Architecture, ADSL Channeling Schemes, ADSL Encoding Schemes; ADSL Management – ADSL Network Management Elements, ADSL Configuration Management, ADSL Fault Management, ADSL Performance Management, SNMP-Based ADSL Line MIB, MIB Integration with Interfaces Groups in MIB-2, ADSL Configuration Profiles **RBT: L1, L2, L3**	
Module 5	
Network Management Applications: Configuration Management- Network Provisioning, Inventory Management, Network Topology, Fault Management- Fault Detection, Fault Location and Isolation 24 Techniques, Performance Management – Performance Metrics, Data Monitoring, Problem Isolation, Performance Statistics; Event Correlation Techniques – Rule-Based Reasoning, Model-Based Reasoning, Case Based Reasoning, Codebook correlation Model, State Transition Graph Model, Finite State Machine Model, Security Management – Policies and Procedures, Security Breaches and the Resources Needed to Prevent Them, Firewalls, Cryptography, Authentication and Authorization, Client/Server Authentication Systems, Messages Transfer Security, Protection of Networks from Virus Attacks, Accounting Management, Report Management, Policy- Based Management, Service Level Management. **RBT: L1, L2, L3**	**10 Hours**
Course Outcomes	
The students should be able to: • Analyze the issues and challenges pertaining to management of emerging network technologies such as wired/wireless networks and high-speed internets. • Apply network management standards to manage practical networks • Formulate possible approaches for managing OSI network model. • Use on SNMP for managing the network • Use RMON for monitoring the behavior of the network • Identify the various components of network and formulate the scheme for the managing them	
Question paper pattern: The question paper will have ten questions. There will be 2 questions from each module. Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.	
Text Books: 1. Mani Subramanian: Network Management- Principles and Practice, 2nd Pearson Education, 2010.	
Reference Books: 1. J. Richard Burke: Network management Concepts and Practices: a Hands-On Approach, PHI, 2008.	

INFORMATION NETWORK SECURITY AND NETWORK PROGRAMMING LAB
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER – I

Subject Code	**18LNIL16**	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 02

Course objectives: This course will enable students to

- Evaluate of Cryptography through practical implementation.
- To implement standard algorithms used to provide confidentiality, integrity and authenticity.
- To implement the various key distribution and management schemes.
- How to use cutting edge simulation tools
- Design security applications in the field of Information technology

PART – A INFORMATION AND NETWORK SECURITY LABORATORY WORK:

1. Consider a file with composite data, substitute the content and transpose the ciphers.
2. Apply the RSA algorithm on a text file to produce cipher text file.
3. Develop a mechanism to setup a security channel using Diffie-Hellman Key Exchange between client and server.
4. Implementation of Message Authentication Code using cryptography HMAC function.
5. Implement secure hash algorithm for Data Integrity. Implement MD5 and SHA-1 algorithm, which accepts a string input, and produce a fixed size number - 128 bits for MD5; 160 bits for SHA-1, this number is a hash of the input. Show that a small change in the input results in a substantial change in the output

PART – B NETWORK PROGRAMMING LABORATORY WORK:

1. Write a C program to implement daytime client/server program using TCP sockets
2. Write a TCP client/server program in which client sends three numbers to the server in a single message. Server returns sum, difference and product as a result single message. Client program should print the results appropriately.
3. Write a C program that prints the IP layer and TCP layer socket options in a separate file

Course Outcomes

The students should be able to:

- Implement various encryption techniques
- Generate and test message digest
- Perform interprocess communication between two machines in a network.

Conduction of Practical Examination:

All laboratory experiments (nos) aretobeincludedforpracticalexamination.
Studentsare allowed to pick one experimentfrom **each part and execute both**
Strictlyfollow theinstructions as printed on the cover page of answer script for breakup of marks
Change of experiment is allowed only once and marks allotted to the procedure part to be made zero.

NETWORK PROTOCOL DESIGN
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER – II

Subject Code	**18LNI21**	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Examine designing Network Protocols
- Define Abstract Protocol Notation
- Compare and contrast routing and congestion control protocols
- Analyze working in the Internet

Module -1	**Contact Hours**
How to specify network protocols? Semantics of traditional protocol specifications, syntax of traditional protocol. Network processes constants, inputs, and variables. Specifications in new protocol, A vending machine protocol, a request/reply protocol, a Manchester encoding protocol. Current internet **RBT: L1, L2, L3**	**10Hours**
Module -2	
Protocol execution processes in the internet. Nondeterministic assignment process arrays, protocol process communication in the internet, Types of transmission errors. Error occurrence. Normal timeout actions implementing transmission errors in the internet connections: using timeouts connections, using identifiers full-duplex and half-duplex connections. Connections in the internet. **RBT: L1, L2, L3**	**10 Hours**
Module – 3	
Detection of message corruption. Detection of message loss, detection of message reorder, error detection in the internet. Error recovery-forward & backward error recovery. Cumulative acknowledgment, individual acknowledgment, blocks acknowledgment error recovery in the internet flow control. Window size control, rate control, circular buffer control, flow control in the internet. **RBT: L1, L2, L3**	**10 Hours**
Module-4	
Local and global topology information, maintaining local topology information, hierarchical topology information topology information in the internet, Abstraction of perfect channel in the internet, Hierarchical routing, random routing. **RBT: L1, L2, L3**	**10 Hours**
Module-5	

Asymmetric and symmetric keys authentication. Privacy and integrity non-repudiation authorization. Message digest security in the internet data compression. Huffman coding, static Huffman compression, dynamic Huffman compression. Context sensitive compression, lossy compression, data compression in the internet. **RBT: L1, L2**	**10 Hours**
Course outcomes:	
The students should be able to: • Evaluate networking protocols in AP notation • Compare and contrast on routing, security and compression protocols • Designing various error and congestion and multiplexing protocols	
Question paper pattern: The question paper will have ten questions. There will be 2 questions from each module. Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.	
Text Books: 1. Mohamed G. Gouda, "**Elements of Network Protocol Design**", John Wiley & Sons 2004.	
Reference Books: 1. Douglas E Comer, "**Computer Networks and Internet with Internet Applications**", Fourth Edition, Pearson 2004	

INTERNET OF THINGS
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER – II

Subject Code	**18LNI22** / 18SCE23 / 18SCN14 / 18SCS14 / 18SSE321	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Define and explain basic issues, policy and challenges in the IoT
- Illustrate Mechanism and Key Technologies in IoT
- Explain the Standard of the IoT
- Explain resources in the IoT and deploy of resources into business
- Demonstrate data analytics for IoT

Module -1	**Contact Hours**
What is The Internet of Things? Overview and Motivations, Examples of Apllications, IPV6 Role, Areas of Development and Standardization, Scope of the Present Investigation.Internet of Things Definitions and frameworks-IoT Definitions, IoT Frameworks, Basic Nodal Capabilities. Internet of Things Apjplication Examples-Overview, Smart Metering/Advanced Metering Infrastructure-Health/Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Tracking, Over-The-Air-Passive Surveillance/Ring of Steel, Control Application Examples, Myriad Other Applications. **RBT: L1, L2, L3**	**10 Hours**
Module -2	
Fundamental IoT Mechanism and Key Technologies-Identification of IoT Object and Services, Structural Aspects of the IoT, Key IoT Technologies. Evolving IoT Standards-Overview and Approaches, IETF IPV6 Routing Protocol for RPL Roll, Constrained Application Protocol, Representational State Transfer, ETSI M2M,Third Generation Partnership Project Service Requirements for Machine-Type Communications, CENELEC, IETF IPv6 Over Low power WPAN, Zigbee IP(ZIP),IPSO **RBT: L1, L2, L3**	**10 Hours**
Module – 3	
Layer ½ Connectivity: Wireless Technologies for the IoT-WPAN Technologies for IoT/M2M, Cellular and Mobile Network Technologies for IoT/M2M,Layer 3 Connectivity :IPv6 Technologies for the IoT: Overview and Motivations. Address Capabilities,IPv6 Protocol Overview, IPv6 Tunneling, IPsec in IPv6,Header Compression Schemes, Quality of Service in IPv6, Migration Strategies to IPv6. **RBT: L1, L2, L3**	**10 Hours**
Module-4	
Case Studies illustrating IoT Design-Introduction, Home Automation, Cities, Environment, Agriculture, Productivity Applications. **RBT: L1, L2, L3**	**10 Hours**
Module-5	
Data Analytics for IoT – Introduction, Apache Hadoop, Using Hadoop MapReduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Real-time Data Analysis, Structural Health Monitoring Case Study. **RBT: L1, L2, L3**	**10 Hours**

Course outcomes:

At the end of this course the students will be able to:

- Develop schemes for the applications of IOT in real time scenarios
- Manage the Internet resources
- Model the Internet of things to business
- Understand the practical knowledge through different case studies
- Understand data sets received through IoT devices and tools used for analysis

Question paper pattern:

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module.
The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Daniel Minoli, ”Building the Internet of Things with IPv6 and MIPv6:The Evolving World of M2M Communications”, Wiley, 2013.
2. ArshdeepBahga, Vijay Madisetti, ”Internet of Things: A Hands on Approach” Universities Press., 2015

Reference Books:

1. Michael Miller,” The Internet of Things”, First Edition, Pearson, 2015.
2. Claire Rowland,Elizabeth Goodman et.al.,” Designing Connected Products”, First Edition,O’Reilly, 2015.

PROTOCOL ENGINEERING
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER - II

Subject Code	**18LNI23** / 18SCN332	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS - 04

Course objectives: This course will enable students to

- Explain Protocol Engineering fundamentals
- Define SDL notations
- Demonstrate various protocol conformance testing schemes
- Explain Protocol Synthesis and Protocol Re-synthesis

Module -1	**Contact Hours**
Introduction: Communication Model, Communication Software, Communication Subsystems, Communication Protocol, Communication Protocol Development Methods, Protocol Engineering Process. Layered Architecture, Network Services and Interfaces, Protocol Function, OSI Model, TCP/IP Protocol Suite, Application Protocols, Protocol Specification: Components of Protocol to be Specified, Communication Service Specification, Protocol Entity Specification, Interface Specifications, Multimedia Protocol Specifications, Internet Protocol Specifications: Examples **RBT: L1, L2**	**10Hours**
Module -2	
SDL: Examples of SDL Based Protocol Specifications Introduction to Other Protocol Specification Languages. **RBT: L1, L2, L3**	**10 Hours**
Modue – 3	
Protocol Verification/Validation: Protocol Verification, Verification of a Protocol Using Finite State Machines, Protocol Validation, Protocol Design Errors, Protocol Validation Approaches, and SDL based Protocol Verification, SDL based Protocol Validation **RBT: L1, L2, L3**	**10 Hours**
Module-4	
Protocol Conformance Testing: Conformance Testing, Conformance Testing Methodology and Framework, Conformance Test Architectures, Test Sequence Generation Methods, Distributed Architecture by Local Methods, Conformance Testing with TTCN, Conformance Testing in Systems with Semi-controllable Interfaces, Conformance Testing of RIP, Multimedia Applications Testing, SDL Based Tools for Conformance Testing, SDL Based Conformance Testing of MPLS. **RBT: L1, L2, L3**	**10 Hours**
Module-5	
Protocol Synthesis:Protocol Synthesis, Interactive Synthesis Algorithm, Automatic Synthesis Algorithm, Automatic Synthesis of SDL from MSC, Protocol Re-synthesis. Protocol Implementation: Requirements of Protocol Implementation, Object based approach to Protocol Implementation, Protocol Compilers, and Tools for Protocol Engineering. **RBT: L1, L2, L3**	**10 Hours**
Course outcomes:	
The students should be able to:	

- Describe the requirements for protocol engineering systems
- Explain the challenges in designing protocol engineering systems
- Implement the design using SDL

Question paper pattern:

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module.
The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Venkataram&Manvi, PallapaVenkataramSunilkumar S. Manvi, "Communication Protocol Engineering", PHI Learning Pvt. Ltd., 2004.

Reference Books:

1. MiroslavPopovic, "Communication Protocol Engineering", CRC Press, 2006.
2. Konig, Hartmut, "Protocol Engineering", Springer, 2012.

WIRELESS AD-HOC NETWORKS
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER - II

Subject Code	**18LNI241** / 18SCN23	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Explain fundamental principles of Ad-hoc Networks
- Discuss a comprehensive understanding of Ad-hoc network protocols
- Outline current and emerging trends in Ad-hoc Wireless Networks.
- Analyze energy management in ad-hoc wireless networks.

Module -1	**Contact Hours**
Ad-hoc Wireless Networks Introduction, Issues in Ad-hoc Wireless Networks, Ad-hoc Wireless Internet; MAC Protocols for Ad-hoc Wireless Networks: Introduction, Issues in Designing a MAC Protocol, Design Goals of MAC Protocols, Classification of MAC protocols, Contention-Based Protocols, Contention-Based Protocols with Reservation Mechanisms, Contention-Based Protocols with Scheduling Mechanisms, MAC Protocols that Use Directional Antennas. **RBT: L1, L2**	**10 Hours**
Module -2	
Routing Protocols for Ad-hoc Wireless Networks Introduction, Issues in Designing a Routing Protocol for Ad-hoc Wireless Networks; Classification of Routing Protocols; Table Driven Routing Protocols; On-Demand Routing Protocols, Hybrid Routing Protocols, Hierarchical Routing Protocols and Power-Aware Routing Protocols. **RBT: L1, L2, L3**	**10 Hours**
Module – 3	
Multicast Routing in Ad-hoc Wireless Networks Introduction, Issues in Designing a Multicast Routing Protocol, Operation of Multicast Routing Protocols, An Architecture Reference Model for Multicast Routing Protocols, Classifications of Multicast Routing Protocols, Tree-Based Multicast Routing Protocols and Mesh-Based Multicast Routing Protocols. **RBT: L1, L2, L3**	**10 Hours**
Module-4	
Transport Layer and Security Protocols for Ad-hoc Networks: Introduction, Issues in Designing a Transport Layer Protocol; Design Goals of a Transport Layer Protocol; Classification of Transport Layer Solutions; TCP over Transport Layer Solutions; Other Transport Layer Protocols for Ad-hoc Networks; Security in Ad-hoc Wireless Networks, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management and Secure Touting Ad-hoc Wireless Networks. **RBT: L1, L2, L3**	**10 Hours**
Module-5	
Quality of Service and Energy Management in Ad-hoc Wireless Networks: Introduction, Issues and Challenges in Providing QoS in Ad-hoc Wireless Networks, Classification of QoS Solutions, MAC Layer Solutions, Network Layer Solutions; Energy Management in Ad-hoc Wireless Networks: Introduction, Need for Energy Management in Ad-hoc Wireless Networks, Classification of Energy Management Schemes, Battery Management Schemes,	**10 Hours**

Transmission Management Schemes, System Power Management Schemes. **RBT: L1, L2, L3**	

Course outcomes:

The students shall able to:

- Design their own wireless network
- Evaluate the existing network and improve its quality of service
- Choose appropriate protocol for various applications
- Examine security measures present at different level
- Analyze energy consumption and management

Question paper pattern:

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module.
The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. C. Siva Ram Murthy & B. S. Manoj: Ad-hoc Wireless Networks, 2nd Edition, Pearson Education, 2011

Reference Books:

1. Ozan K. Tonguz and Gianguigi Ferrari: Ad-hoc Wireless Networks, John Wiley, 2007.
2. Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du: Ad-hoc Wireless Networking, Kluwer Academic Publishers, 2004.
3. C.K. Toh: Ad-hoc Mobile Wireless Networks- Protocols and Systems, Pearson Education, 2002

WEB SERVICES
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER – II

Subject Code	**18LNI242** / 18SIT21 / 18SSE154	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Define and explain Web Services.
- Summarize WSDL Web Services.
- Analyze Web service Architecture.
- Explain Building Blocks of Web services.

Module 1	**Contact Hours**
Middleware: Understanding the middle ware, RPC and Related Middle ware, TP Monitors, Object Brokers, Message-Oriented Middleware. **RBT: L1, L2, L3**	**10 Hours**
Module 2	
Web Services: Web Services Technologies, Web Services Architecture. **RBT: L1, L2, L3**	**10 Hours**
Module 3	
Basic Web Services Technology: WSDL Web Services Description Language, UDDI Universal Description Discovery and Integration, Web Services at work interactions between the Specifications, Related Standards. **RBT: L1, L2, L3**	**10 Hours**
Module 4	
Service Coordination Protocols: Infrastructure for Coordination Protocols, WS-Coordination, WS-Transaction, Rosetta Net and Other Standards Related to Coordination Protocols. **RBT: L1, L2, L3**	**10 Hours**
Module 5	
Service Composition: Basic of Service Composition, A New Chance of Success for Composition, Services Composition Models, Dependencies between Coordination and Composition, BPEL: Business Process Execution Language for Web Services, Outlook, Applicability of the Web Services, Web services as a Problem and a Solution : AN Example. **RBT: L1, L2, L3**	**10 Hours**

Course Outcomes

The students should be able to:

- Bind and unbind services in UDDI.
- Develop WSDL document
- Implement web service client to call public service.
- Implement a service and exposing it as public service.

Question paper pattern:

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module. The students will have to

answer 5 full questions, selecting one full question from each module.
Text Books: 1. Gustavo Alonso, Fabio Casati, Harumi Kuno, Vijay Machiraju: Web Services(Concepts ,Architectures and Applications), Springer International Edition 2009.
Reference Books: **NIL**

ADVANCES IN STORAGE AREA NETWORKS
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER – II

Subject Code	**18LNI243** / 18SCE323 / 18SCN241 / 18SCS241 / 18SIT253 / 18SSE153	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Define and contrast storage centric and server centric systems
- Define metrics used for Designing storage area networks
- Illustrate RAID concepts
- Demonstrate, how data centers maintain the data with the concepts of backup mainly remote mirroring concepts for both simple and complex systems.

Module 1	**Contact Hours**
Introduction: Server Centric IT Architecture and its Limitations; Storage – Centric IT Architecture and its advantages. Case study: Replacing a server with Storage Networks The Data Storage and Data Access problem; The Battle for size and access. Intelligent Disk Subsystems: Architecture of Intelligent Disk Subsystems; Hard disks and Internal I/O Channels; JBOD, Storage virtualization using RAID and different RAID levels; Caching: Acceleration of Hard Disk Access; Intelligent disk subsystems, Availability of disk subsystems. **RBT: L1, L2, L3**	**10 Hours**
Module 2	
I/O Techniques: The Physical I/O path from the CPU to the Storage System; SCSI; Fibre Channel Protocol Stack; Fibre Channel SAN; IP Storage. Network Attached Storage: The NAS Architecture, The NAS hardware Architecture, The NAS Software Architecture, Network connectivity, NAS as a storage system. File System and NAS: Local File Systems; Network file Systems and file servers; Shared Disk file systems; Comparison of fibre Channel and NAS. **RBT: L1, L2, L3**	**10 Hours**
Module 3	
Storage Virtualization: Definition of Storage virtualization; Implementation Considerations; Storage virtualization on Block or file level; Storage virtualization on various levels of the storage Network; Symmetric and Asymmetric storage virtualization in the Network. **RBT: L1, L2, L3**	**10 Hours**
Module 4	
SAN Architecture and Hardware devices: Overview, Creating a Network for storage; SAN Hardware devices; The fibre channel switch; Host Bus Adaptors; Putting the storage in SAN; Fabric operation from a Hardware perspective. Software Components of SAN: The switch's Operating system; Device Drivers; Supporting the switch's components; Configuration options for SANs. **RBT: L1, L2, L3**	**10 Hours**
Module 5	
Management of Storage Network: System Management, Requirement of management System, Support by Management System, Management Interface, Standardized	**10 Hours**

Mechanisms, Property Mechanisms, In-band Management, Use of SNMP, CIM and WBEM, Storage Management Initiative Specification (SMI-S), CMIP and DMI, Optional Aspects of the Management of Storage Networks, Summary **RBT: L1, L2, L3**	

Course Outcomes

The students should be able to:

- Identify the need for performance evaluation and the metrics used for it
- Apply the techniques used for data maintenance.
- Realize strong virtualization concepts
- Develop techniques for evaluating policies for LUN masking, file systems

Question paper pattern:

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Ulf Troppens, Rainer Erkens and Wolfgang Muller: Storage Networks Explained, Wiley India,2013.

Reference Books:

1. Robert Spalding: "Storage Networks The Complete Reference", Tata McGraw-Hill, 2011.
2. Marc Farley: Storage Networking Fundamentals – An Introduction to Storage Devices, Subsystems, Applications, Management, and File Systems, Cisco Press, 2005.
3. Richard Barker and Paul Massiglia: "Storage Area Network Essentials A Complete Guide to understanding and Implementing SANs", Wiley India, 2006.

CYBER SECURITY AND CYBER LAW
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER –II

Subject Code	**18LNI244** / 18SCE244 / 18SIT244	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Define the area of cybercrime and forensics.
- Explain the motive and causes for cybercrime , detection and handling.
- Investigate Areas affected by cybercrime.
- Illustrate tools used in cyber forensic
- Infer legal Perspectives in cyber security

Module -1	**Contact Hours**
Introduction to Cybercrime: Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals?, Classifications of Cybercrimes, Cybercrime: The Legal Perspectives, Cybercrimes: An Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes, Cybercrime Era: Survival Mantra for the Netizens. Cyberoffenses: How Criminals Plan Them: How Criminals Plan the Attacks, Social Engineering, Cyberstalking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing. **RBT: L1, L2, L3**	**10 Hours**
Module -2	
Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops **RBT: L1, L2, L3**	**10 Hours**
Module – 3	
Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks. Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft). **RBT: L1, L2, L3**	**10 Hours**
Module-4	
Understanding Computer Forensics: Introduction, Historical Background of Cyberforensics, Digital Forensics Science, The Need for Computer Forensics, Cyberforensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Setting up a Computer Forensics Laboratory: Understanding the Requirements, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and	**10 Hours**

Social Networking Sites: The Security/Privacy Threats, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Antiforensics. **RBT: L1, L2, L3**	
Module-5	
Introduction to Security Policies and Cyber Laws: Need for An Information Security Policy, Information Security Standards – Iso, Introducing Various Security Policies and Their Review Process, Introduction to Indian Cyber Law, Objective and Scope of the it Act, 2000, Intellectual Property Issues, Overview of Intellectual - Property - Related Legislation in India, Patent, Copyright, Law Related to Semiconductor Layout and Design, Software License. **RBT: L1, L2, L3**	**10 Hours**
Course outcomes:	
By the end of this course the student acquire • Define cyber security, cyber law and their roles • Demonstrate cyber security cybercrime and forensics. • Infer legal issues in cybercrime, • Demonstrate tools and methods used in cybercrime and security. • Illustrate evidence collection and legal challenges	
Question paper pattern: The question paper will have ten questions. There will be 2 questions from each module. Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.	
Text Books: 1. SunitBelapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives", Wiley India Pvt Ltd, ISBN: 978-81-265-21791, Publish Date 2013 2. Dr. Surya Prakash Tripathi, RitendraGoyal, Praveen Kumar Shukla, KLSI. "Introduction to information security and cyber laws". Dreamtech Press. ISBN: 9789351194736, 2015	
Reference Books: 1. Thomas J. Mowbray, "Cybersecurity: Managing Systems, Conducting Testing, and Investigating Intrusions", Copyright © 2014 by John Wiley & Sons, Inc, ISBN: 978 -1-118 -84965 -1 2. James Graham, Ryan Olson, Rick Howard, "Cyber Security Essentials", CRC Press, 15-Dec-2010	

MANAGING BIG DATA
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER – IV

Subject Code	**18LNI251** / 18SCE21 / 18SCN252 / 18SCS21 / 18SFC331 / 18SIT31 / 18SSE322	IA Marks	40
Number of Lecture Hours/Week	03	Exam Marks	60
Total Number of Lecture Hours	40	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Deal with Big data using Hadoop and SPARK technologies
- Explain basic concepts of Map and Reduce
- Explain basic concepts of Hadoop Distributed File System
- Develop map-reduce analytics using Hadoop and related tools

Module -1	**Teaching Hours**
Meet Hadoop: Data!, Data Storage and Analysis, Querying All Your Data, Beyond Batch, Comparison with Other Systems: Relational Database Management Systems, Grid Computing, Volunteer Computing Hadoop Fundamentals MapReduce A Weather Dataset: Data Format, Analyzing the Data with Unix Tools, Analyzing the Data with Hadoop: Map and Reduce, Java MapReduce, Scaling Out: Data Flow, Combiner Functions, Running a Distributed MapReduce Job, Hadoop Streaming **The Hadoop Distributed Filesystem** The Design of HDFS, HDFS Concepts: Blocks, Namenodes and Datanodes, HDFS Federation, HDFS High-Availability, The Command-Line Interface, Basic Filesystem Operations, Hadoop Filesystems Interfaces, The Java Interface, Reading Data from a Hadoop URL, Reading Data Using the FileSystem API, Writing Data, Directories, Querying the Filesystem, Deleting Data, Data Flow: Anatomy of a File Read, Anatomy of a File Write. **RBT: L1, L2, L3**	**10 Hours**
Module -2	
YARN Anatomy of a YARN Application Run: Resource Requests, Application Lifespan, Building YARN Applications, YARN Compared to MapReduce, Scheduling in YARN: The FIFO Scheduler, The Capacity Scheduler, The Fair Scheduler, Delay Scheduling, Dominant Resource Fairness **Hadoop I/O** Data Integrity, Data Integrity in HDFS, LocalFileSystem, ChecksumFileSystem, Compression, Codecs, Compression and Input Splits, Using Compression in MapReduce, Serialization, The Writable Interface, Writable Classes, Implementing a Custom Writable, Serialization Frameworks, File-Based Data Structures: SequenceFile **RBT: L1, L2, L3**	**10 Hours**
Module – 3	
Developing a MapReduce Application The Configuration API, Combining Resources, Variable Expansion, Setting Up the Development Environment, Managing Configuration, GenericOptionsParser, Tool, and ToolRunner, Writing a Unit Test with MRUnit: Mapper, Reducer, Running Locally on Test Data, Running a Job in a Local Job Runner, Testing the Driver, Running on a Cluster, Packaging a Job, Launching a Job, The MapReduce Web UI, Retrieving the Results, Debugging a Job, Hadoop Logs, Tuning a Job, Profiling Tasks,	**10 Hours**

MapReduce Workflows: Decomposing a Problem into MapReduce Jobs, JobControl, Apache Oozie **How MapReduce Works** Anatomy of a MapReduce Job Run, Job Submission, Job Initialization, Task Assignment, Task Execution, Progress and Status Updates, Job Completion, Failures: Task Failure, Application Master Failure, Node Manager Failure, Resource Manager Failure, Shuffle and Sort: The Map Side, The Reduce Side, Configuration Tuning, Task Execution: The Task Execution Environment, Speculative Execution, Output Committers **RBT: L1, L2, L3**	
Module-4	
MapReduce Types and Formats: MapReduce Types, Input Formats: Input Splits and Record,s Text Input, Binary Input, Multiple Inputs, Database Input (and Output) Output Formats: Text Output, Binary Output, Multiple Outputs, Lazy Output, Database Output, **Flume** Installing Flume, An Example,Transactions and Reliability, Batching, The HDFS Sink, Partitioning and Interceptors, File Formats, Fan Out, Delivery Guarantees, Replicating and Multiplexing Selectors, Distribution: Agent Tiers, Delivery Guarantees, Sink Groups, Integrating Flume with Applications, Component Catalog **RBT: L1, L2, L3**	**10 Hours**
Module-5	
Pig Installing and Running Pig, Execution Types, Running Pig Programs, Grunt, Pig Latin Editors, An Example: Generating Examples, Comparison with Databases, Pig Latin: Structure, Statements, Expressions, Types, Schemas, Functions, Data Processing Operators: Loading and Storing Data, Filtering Data, Grouping and Joining Data, Sorting Data, Combining and Splitting Data. **Spark** An Example: Spark Applications, Jobs, Stages and Tasks, A Java Example, A Python Example, Resilient Distributed Datasets: Creation, Transformations and Actions, Persistence, Serialization, Shared Variables, Broadcast Variables, Accumulators, Anatomy of a Spark Job Run, Job Submission, DAG Construction, Task Scheduling, Task Execution, Executors and Cluster Managers: Spark on YARN **RBT: L1, L2, L3**	**10 Hours**
Course outcomes:	
The students shall able to: • Understand managing big data using Hadoop and SPARK technologies • Explain HDFS and MapReduce concepts • Install, configure, and run Hadoop and HDFS. • Perform map-reduce analytics using Hadoop and related tools • Explain SPARK concepts	
Question paper pattern: The question paper will have ten questions. There will be 2 questions from each module. Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.	
Text Books: 1. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.	
Reference Books: 1. MateiZaharia and Bill Chambers, SPARK: The Definitive Guide, Oreilly, 2018 2. S. D'Souza and Steve Hoffman, Apache Flume: Distributed Log Collection for Hadoop, Oreilly. 2014	

SOFTWARE AGENTS
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER – I1

Subject Code	**18LNI252**	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Explain the principles and fundamentals of designing agents
- Define the architecture design of different agents.
- Demonstrate design of the agents
- Illustrate user interaction with agents
- Discover the role of agents in assisting the users in day to day activities

Module -1	**Contact Hours**
An introduction to Software Agents Why Software Agents? Simplifying Computing, Barriers to Intelligent Interoperability, Incorporating Agents as Resource Managers, Overcoming user Interface Problems, Toward Agent-Enabled System Architectures. Agents: From Direct Manipulation to Delegation Introduction, Intelligent Interfaces, Digital Butlers, Personal Filters, Digital sisters-in-Law, Artificial Intelligence, Decentralization, Why Linking works, The Theatrical Metaphor, Conclusion: Direct Manipulation and Digital Butlers, Acknowledgements. Interfaces Agents Metaphors with Character Introduction, Objections to Agents, In Defense of Anthropomorphism, Key Characteristics of Interface Agents, Agency, Responsiveness, Competence, Accessibility, Design and Dramatic Character, An R & D Agenda **RBT: L1, L2**	**10 Hours**
Module -2	
Designing Agents as if People Mattered: What does "Agents" Mean?, Adaptive Functionality: Three Design Issues, The Agent Metaphor: Reactions and Expectations The Agent Conceptual Model. Direct Manipulation versus Agents: Paths to Predict able, Controllable, and Comprehensible Interfaces: Introduction, General Concerns About Intelligent Interfaces, Learning From History, What Is an Agent?, Looking at the Components, Realizing a New Vision, Tree Maps, Dynamic Queries, Back to a Scientific Approach, Acknowledgements. Agents for Information Sharing and Coordination: A History and some Reflections: Information, Lens: An Intelligent Tool for Managing Electronic Messages, Semiformal Systems an d Radical Tailorability, Oval: A Radically Tailorable Tool for Information Management and Cooperative Work, Examples of Application and Agents in Oval, Conclusions: An Addendum: The Relationship between Oval and Objects Lens **RBT: L1, L2, L3**	**10 Hours**
Module – 3	
Agents that Reduce Work and Information Overload Introduction, Approaches to Building Agents, Training a Personal Digital Assistant, Some Example of Existing Agents, Electronic Mail Agents, Meeting Scheduling Agent, News Filtering Agent, Entertainment Selection Agent, Discussion, Acknowledgements Software Agents for Cooperative Learning: Computer-Supported Cooperative Learning, Examples of Software Agents for Cooperative Learning, Examples of Software Agents for Cooperative Learning, Developing an Example, Discussion and Perspectives.	**10 Hours**

RBT: L1, L2, L3	
Module-4	
An Overview of Agent-Oriented Programming: Agent-Oriented Programming: Software with Mental State, Two Scenarios, On the Mental state of agents, Generic Agent Interpreter, AGENT-0: A Simple Language and its Interpreter, KQML as an Agent Communication Language: The approach of knowledge sharing effort(KSE), The Solution of the knowledge sharing efforts, knowledge Query Manipulation Language (KQML),Implementation, Application of KQML , Other Communication Language, The Approach of Knowledge-Sharing Effect,(KSE),The Solutions of the Sharing Effect. **RBT: L1, L2, L3**	**10 Hours**
Module-5	
Agent for Information Gathering: Agent Organization, The Knowledge of an Agent, The Domain Model of an Agent, Modeling other Agent, communication language and protocol, query processing, an information goal, information source selection, generating a query access plan, interleaving planning and execution , semantic query optimization, learning, caching retrieved data, related work, discursion, acknowledgement. Mobile Agents: Enabling Mobile Agents, Programming Mobile Agents, Using Mobile Agents. **RBT: L1, L2, L3**	**10 Hours**
Course outcomes:	
The students should be able to: • Identify and explore the advantages of agents and design the architecture for an agent • Analyze the agent in details in a view for the implementation • Analyze communicative actions with agents. • Analyze typical agents using a tool for different types of applications.	
Question paper pattern: The question paper will have ten questions. There will be 2 questions from each module. Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.	
Text Books: 1. Jeffrey M. Bradshaw: Software Agents, PHI (MIT Press) 2012.	
Reference Books: 1. Lin Padgham and Michael Winikoff, "Developing In telligent Agent Systems: A Practical Guide", John Wiley & sons Publication, 2004. 2. Steven F. RailsBack and Volker Grimm, "Agent-Based and Individual Based modeling: A Practical Introduction", Princeton University Press, 2012. 3. Peter Wayner, "Disappearing Cryptography – Information Hiding: Steganography & Watermarking", Morgan Kaufmann Publishers, New York, 2002. 4. Frank Y. Shih, "Multimedia Secuirty, Watermarking, Steganography and Forensics", CRC Press	

BIOINFORMATICS
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER – II

Subject Code	**18LNI253** / 18SIT242	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Explain domain of bioinformatics
- Illustrate role of data warehousing and data mining for bioinformatics
- Compare model bioinformatics based applications
- Demonstrate how to deploy the pattern matching and visualization techniques in bioinformatics
- Define the Microarray technologies for genome expression

Module -1	**Contact Hours**
INTRODUCTION : Need for Bioinformatics technologies – Overview of Bioinformatics technologies – Structural bioinformatics – Data format and processing – secondary resources- Applications – Role of Structural bioinformatics - Biological Data Integration System. **RBT: L1, L2, L3**	**10 Hours**
Module -2	
DATAWAREHOUSING AND DATAMINING IN BIOINFORMATICS: Bioinformatics data – Data ware housing architecture – data quality – Biomedical data analysis – DNA data analysis – Protein data analysis – Machine learning – Neural network architecture- Applications in bioinformatics. **RBT: L1, L2, L3**	**10 Hours**
Module – 3	
MODELING FOR BIOINFORMATICS : Hidden markov modeling for biological data analysis Sequence identification – Sequence classification – multiple alignment generation – Comparative modeling – Protein modeling – genomic modeling – Probabilistic modeling – Bayesian networks – Boolean networks - Molecular modeling – Computer programs for molecular modeling. **RBT: L1, L2, L3**	**10 Hours**
Module-4	
PATTERN MATCHING AND VISUALIZATION: Gene regulation – motif recognition and motif detection – strategies for motif detection – Visualization – Fractal analysis – DNA walk models – one dimension – two dimension – higher dimension – Game representation of Biological sequences – DNA, Protein, Amino acid sequences. **RBT: L1, L2, L3**	**10 Hours**
Module-5	
MICROARRAY ANALYSIS: Microarray technology for genome expression study – image analysis for data extraction – preprocessing – segmentation – gridding, spot extraction, normalization, filtering – cluster analysis – gene network analysis **RBT: L1, L2, L3**	**10 Hours**

Course outcomes:

The students should be able to:

- Deploy the data warehousing and data mining techniques in Bioinformatics

- Model bioinformatics based applications
- Deploy the pattern matching and visualization techniques in bioinformatics
- Work on the protein sequences
- Use the Microarray technologies for genome expression .

Question paper pattern:

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module.
The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Yi-Ping Phoebe Chen (Ed), "Bio Informatics Technologies", Springer Verlag, 2014.

Reference books : NIL

ADVANCED CRYPTOGRAPHY
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER – II

Subject Code	**18LNI254** / 18SFC153	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- The concepts of principles and practice of cryptography and network security.
- Overview of the Feistel cipher, Distribution of Public Keys, digital signatures and Authentication protocols.
- How to analyze the security of multiple encryption schemes and Triples DES.
- Structure and Building of secure authentication systems using message authentication techniques.
- The concepts of principles and practice of visual cryptography.

Module 1	**Contact Hours**
OSI security architecture: Classical encryption techniques, Cipher principles, Data encryption standard, Block cipher design principles and modes of operation, Evaluation criteria for AES, AES cipher, Triple DES, Placement of encryption function, Traffic confidentiality. **RBT: L1, L2, L3**	**10 Hours**
Module 2	
Key management: Diffie Hellman key exchange, Elliptic curve architecture and cryptography, Introduction to number theory, Confidentiality using symmetric encryption, Public key cryptography and RSA. **RBT: L1, L2, L3**	**10 Hours**
Module 3	
Authentication requirements: Authentication functions, Message authentication codes, Hash functions, Security of hash functions and MACS, MD5 Message Digest algorithm, Secure hash algorithm, Ripend, HMAC digital signatures, Authentication protocols. **RBT: L1, L2, L3**	**10 Hours**
Module 4	
Quantum Cryptography and Quantum Teleportation: Heisenberg uncertainty principle, polarization states of photons, quantum cryptography using polarized photons, local vs. non local interactions, entanglements, EPR paradox, Bell's theorem, Bell basis, teleportation of a single qubit theory and experiments. **RBT: L1, L2, L3**	**10 Hours**
Module 5	
Future trends: Review of recent experimental achievements, studyon technological feasibility of a quantum computer candidate physical systems and limitations imposed by noise. **RBT: L1, L2, L3**	**10 Hours**

Course Outcomes

The students should be able to:

- Explain the concepts of principles and practice of cryptography and network security.
- Present an overview of the Feistel cipher, Distribution of Public Keys, digital signatures and Authentication protocols.

- Analyze the security of multiple encryption schemes and Triples DES.
- Build secure authentication systems by use of message authentication techniques.
- Explain the concepts of principles and practice of visual cryptography.

Question paper pattern:

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

2. William Stallings, "Cryptography and Network Security -Principles and Practices", 3rd Edition, Prentice Hall of India, 2003.
3. AtulKahate, "Cryptography and Network Security", Tata McGraw -Hill, 2003.
4. William Stallings, "Network Security Essentials: Applications and Standards", Pearson Education Asia, 2000.

Reference Books:

4. R. P. Feynman, "Feynman Contacts on computation", Penguin Books, 1996.
5. Gennady P. Berman, Gary D. Doolen, Ronnie Mainiri&ValdmisItriFrinovich, "Introduction to quantum computers", World Scientific, Singapore, 1998.
6. Jonathan Katz, Yehuda Lindell, "Introduction to Modern Cryptography" Principles And Protocols",CRC Press.

CLIENT SERVER PROGRAMMING
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER – III

Subject Code	**18LNI31** / 18SIT151	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Explain Client-Server software**,** Context Switching and Protocol Software, I/o.
- Define System Calls, Basic I/O Functions available in UNIX
- Illustrate socket interface, TCP, UDP in detail.
- Compare various client Software and various algorithms issue related to server software design.

Module 1	**Contact Hours**
The Client Server Model and Software Design: Introduction, Motivation, Terminology and Concepts. **Concurrent Processing in Client-Server software:** Introduction, Concurrency in Networks, Concurrency in Servers, Terminology and Concepts, An example of Concurrent Process Creation, Executing New Code, Context Switching and Protocol Software Design, Concurrency and Asynchronous I/O. **Program Interface to Protocols:** Introduction, Loosely Specified Protocol Software Interface, Interface Functionality, Conceptual Interface Specification, System Calls, Two Basic Approaches to Network Communication, The Basic I/O Functions available in UNIX, Using UNIX I/O with TCP/IP. **RBT: L1, L2, L3**	**10 Hours**
Module 2	
The Socket Interface: Introduction, Berkley Sockets, Specifying a Protocol Interface, The Socket Abstraction, Specifying an End Point Address, A Generic Address Structure, Major System Calls used with Sockets, Utility Routines for Integer Conversion, Using Socket Calls in a Program, Symbolic Constants for Socket Call Parameters. **Algorithms and Issues in Client Software Design:** Introduction, Learning Algorithms instead of Details, Client Architecture, Identifying the Location of a Server, Parsing an Address Argument, Looking up a Domain Name, Looking up a well-known Port by Name, Port Numbers and Network Byte Order, Looking up a Protocol by Name, The TCP Client Algorithm, Allocating a Socket, Choosing a Local Protocol Port Number, A fundamental Problem in choosing a Local IP Address, Connecting a TCP Socket to a Server, Communicating with the Server using TCP, Reading a response from a TCP Connection, Closing a TCP Connection, Programming a UDP Client, Connected and Unconnected UDP Socket, Using Connect with UDP, Communicating with a Server using UDP, Closing a Socket that uses UDP, Partial Close for UDP, A Warning about UDP Unreliability. **RBT: L1, L2, L3**	**10 Hours**
Module 3	
Example Client Software: Introduction, The Importance of Small Examples, Hiding Details, An Example Procedure Library for Client Programs, Implementation of Connect TCP, Implementation of Connect UDP, A Procedure that Forms Connections, Using the Example Library, The DAYTIME Service, Implementation of a TCP Client for DAYTIME, Reading from a TCP Connection, The Time Service, Accessing the TIME Service, Accurate Times and Network Delays, A UDP Client for the TIME Service, The ECHO Service, A TCP Client for the ECHO Service, A UDP Client for the ECHO Service.	**10 Hours**

RBT: L1, L2, L3	
Module 4	
Algorithms and Issues in Server Software Design: Introduction, The Conceptual Server Algorithm, Concurrent Vs Iterative Servers, Connection-Oriented Vs Connectionless Access, Connection-Oriented Servers, Connectionless Servers, Failure, Reliability and Statelessness, Optimizing Stateless Servers, Four Basic Types of Servers, Request Processing Time, Iterative Server Algorithms, An Iterative Connection-Oriented Server Algorithm, Binding to a Well Known Address using INADDR_ANY, Placing the Socket in Passive Mode, Accepting Connections and using them. An Iterative Connectionless Server Algorithm, Forming a Reply Address in a Connectionless Server, Concurrent Server Algorithms, Master and Slave Processes, A Concurrent Connectionless Server Algorithm, A concurrent Connection-Oriented Server Algorithm, Using separate Programs as Slaves, Apparent Concurrency using a Single Process, When to use each Server Types, The Important Problem of Server Deadlock, Alternative Implementations. **RBT: L1, L2, L3**	**10 Hours**
Module 5	
Iterative, Connectionless Servers (UDP): Introduction, Creating a Passive Socket, Process Structure, An example TIME Server. **Iterative, Connection-Oriented Servers (TCP):** Introduction, Allocating a Passive TCP Socket, A Server for the DAYTIME Service, Process Structure, An Example DAYTIME Server, Closing Connections, Connection Termination and Server Vulnerability. **Concurrent, Connection-Oriented Servers (TCP):** Introduction, Concurrent ECHO, Iterative Vs Concurrent Implementations, Process Structure, An example Concurrent ECHO Server, Cleaning up Errant Processes. **RBT: L1, L2, L3**	**10 Hours**
Course Outcomes	
The students should be able to: • Explain Client-Server software, Context Switching and Protocol Software, I/O. • Demonstrate programming System Calls, Basic I/O Functions available in UNIX • Implement Socket interface, TCP, UDP in detail. • Compare and contrast Client Software Various applications and their issues	
Question paper pattern: The question paper will have ten questions. There will be 2 questions from each module. Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.	
Text Books: 1. Douglas E.Comer, David L. Stevens: Internetworking with TCP/IP – Vol. 3, Client-Server Programming and Applications, BSD Socket Version with ANSI C, 2nd Edition, Pearson, 2001.	
Reference Books: 1. NIL	

ADVANCES IN COMPUTER NETWORKS
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER – III

Subject Code	**18LNI321** / 18SCN12 / 18SCS151	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Discuss with the basics of Computer Networks.
- Compare various Network architectures.
- Discuss fundamental protocols.
- Define and analyze network traffic, congestion, controlling and resource allocation.

Module 1	**Contact Hours**
Foundation: Building a Network, Requirements, Perspectives, Scalable Connectivity, Cost-Effective Resource sharing, Support for Common Services, Manageability, Protocol layering, Performance, Bandwidth and Latency, Delay X Bandwidth Product, Perspectives on Connecting, Classes of Links, Reliable Transmission, Stop-and-Wait , Sliding Window, Concurrent Logical Channels. **T1**: **Chapter 1.1, 1.2, 1.5.1, 1.5.2**., **2.1, 2.5T2**: **Chapter 4** **RBT: L1, L2, L3**	**10 Hours**
Module 2	
Internetworking I: Switching and Bridging, Datagram's, Virtual Circuit Switching, Source Routing, Bridges and LAN Switches, Basic Internetworking (IP), What is an Internetwork?, Service Model, Global Addresses, Datagram Forwarding in IP, sub netting and classless addressing, Address Translation (ARP), Host Configuration (DHCP), Error Reporting (ICMP), Virtual Networks and Tunnels. **T1:** Chapter 3.1, 3.2, **RBT: L1, L2, L3**	**10 Hours**
Module 3	
Internetworking- II: Network as a Graph, Distance Vector (RIP), Link State (OSPF), Metrics, The Global Internet, Routing Areas, Routing among Autonomous systems (BGP), IP Version 6 (IPv6), Mobility and Mobile IP **T1:** Chapter 3.3, 4.1.1,4.1.3**T2**:Chapter 13.1 to 13.18 , Ch 18. **RBT: L1, L2, L3**	**10 Hours**
Module 4	
End-to-End Protocols: Simple Demultiplexer (UDP), Reliable Byte Stream(TCP), End-to-End Issues, Segment Format, Connecting Establishment and Termination, Sliding Window Revisited, Triggering Transmission, Adaptive Retransmission, Record Boundaries, TCP Extensions, Queuing Disciplines, FIFO, Fair Queuing, TCP Congestion Control, Additive Increase/ Multiplicative Decrease, Slow Start, Fast Retransmit and Fast Recovery **T1:** Chapter 5.1, 5.2.1 to 5.2.8, 6.2, 6.3 **RBT: L1, L2, L3**	**10 Hours**
Module 5	
Congestion Control and Resource Allocation Congestion-Avoidance Mechanisms, DEC bit, Random Early Detection (RED), Source-Based Congestion Avoidance. The Domain Name System (DNS), Electronic Mail (SMTP,POP,IMAP,MIME), World Wide Web	**10 Hours**

(HTTP), Network Management (SNMP) **T1:** Chapter 6.4 **T2**: Chapter 23.1 to 23.16, Chapter 24, Chapter 25, Chapter 27.1 to 27.8 **RBT: L1, L2, L3**	

Course Outcomes

The students should be able to:

- List and classify network services, protocols and architectures, explain why they are layered.
- Choose key Internet applications and their protocols, and apply to develop their own applications (e.g. Client Server applications, Web Services) using the sockets API.
- Explain develop effective communication mechanisms using techniques like connection establishment, queuing theory, recovery Etc.
- Explain various congestion control techniques.

Question paper pattern:

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Larry Peterson and Bruce S Davis "Computer Networks :A System Approach" 5th Edition , Elsevier -2014.
2. Douglas E Comer, **"**Internetworking with TCP/IP, Principles, Protocols and Architecture" 6th Edition, PHI – 2014.

Reference Books:

1. Uyless Black, "Computer Networks, Protocols , Standards and Interfaces" 2 nd Edition -PHI.
2. Behrouz A Forouzan, "TCP /IP Protocol Suite" 4th Edition – Tata McGraw-Hill.

MACHINE LEARNING TECHNIQUES
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER - III

Subject Code	**18LNI322** / 18SCE321 / 18SCN324 / 18SCS31 / 18SFC254 / 18SIT322 / 18SSE334	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Explain basic concepts of learning and decision trees.
- Compare and contrast neural networks and genetic algorithms
- Apply the Bayesian techniques and instant based learning
- Examine analytical learning and reinforced learning

Module -1	**Contact Hours**
INTRODUCTION, CONCEPT LEARNING AND DECISION TREES Learning Problems – Designing Learning systems, Perspectives and Issues – Concept Learning – Version Spaces and Candidate Elimination Algorithm – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search **RBT: L1, L2, L3**	**10Hours**
Module -2	
NEURAL NETWORKS AND GENETIC ALGORITHMS: Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evolution and Learning. **RBT: L1, L2, L3**	**10 Hours**
Module – 3	
BAYESIAN AND COMPUTATIONAL LEARNINGL Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier– Bayesian Belief Network – EM Algorithm – Probably Learning – Sample Complexity for Finite and Infinite Hypothesis Spaces – Mistake Bound Model. **RBT: L1, L2, L3**	**10 Hours**
Module-4	
INSTANT BASED LEARNING AND LEARNING SET OF RULES: K- Nearest Neighbor Learning – Locally Weighted Regression – Radial Basis Functions –Case-Based Reasoning – Sequential Covering Algorithms – Learning Rule Sets – Learning First Order Rules – Learning Sets of First Order Rules – Induction as Inverted Deduction – Inverting Resolution **RBT: L1, L2, L3**	**10 Hours**
Module-5	
ANALYTICAL LEARNING AND REINFORCED LEARNING: Perfect Domain Theories – Explanation Based Learning – Inductive-Analytical Approaches - FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning **RBT: L1, L2, L3**	**10 Hours**
Course outcomes:	
On Completion of the course, the students will be able to	

- Choose the learning techniques with this basic knowledge.
- Apply effectively neural networks and genetic algorithms for appropriate applications.
- Apply bayesian techniques and derive effectively learning rules.
- Choose and differentiate reinforcement and analytical learning techniques

Question paper pattern:

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module.
The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (INDIAN EDITION), 2013.

Reference Books:

1. EthemAlpaydin, "Introduction to Machine Learning", 2nd Ed., PHI Learning Pvt. Ltd., 2013.
2. T. Hastie, R. Tibshirani, J. H. Friedman, "The Elements of Statistical Learning", Springer; 1st edition, 2001.

MOBILE APPLICATION DEVELOPMENT
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER – III

Subject Code	**18LNI323**/ 18SCN244 18SFC332 / 18SIT241	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Analyze system requirements for mobile applications.
- Apply of mobile development frameworks.
- Demonstrate mobile application design.
- Demonstrate and implement mobile application.

Module -1	**Contact Hours**
Introduction to mobile communication and computing: Introduction to mobile computing, Novel applications, limitations and GSM architecture, Mobile services, System architecture, Radio interface, protocols, Handover and security. Smart phone operating systems and smart phones applications. **RBT: L1, L2, L3**	**10 Hours**
Module -2	
Fundamentals of Android Development: Introduction to Android., The Android 4.1 Jelly Bean SDK, Understanding the Android Software Stack, Installing the Android SDK, Creating Android Virtual Devices, Creating the First Android Project, Using the Text View Control, Using the Android Emulator. **RBT: L1, L2, L3**	**10 Hours**
Module – 3	
The Intent of Android Development, Four kinds of Android Components: Activity, Service, Broadcast Receiver and Content Provider. Building Blocks for Android Application Design, Laying Out Controls in Containers. Graphics and Animation: Drawing graphics in Android, Creating Animation with Android's Graphics API. **RBT: L1, L2, L3**	**10 Hours**
Module-4	
Creating the Activity, Working with views: Exploring common views, using a list view, creating custom views, understanding layout. Using Selection Widgets and Debugging Displaying and Fetching Information Using Dialogs and Fragments. Multimedia: Playing Audio, Playing Video and Capturing Media. Advanced Android Programming: Internet, Entertainment, and Services. **RBT: L1, L2, L3**	**10 Hours**
Module-5	
Displaying web pages and maps, communicating with SMS and emails. Creating and using content providers: Creating and consuming services, publishing android applications **RBT: L1, L2, L3**	**10 Hours**

Course outcomes:

The students should be able to:

- Describe the requirements for mobile applications
- Explain the challenges in mobile application design and development
- Develop design for mobile applications for specific requirements

- Implement the design using Android SDK
- Implement the design using Objective C and iOS
- Deploy mobile applications in Android and iPone marketplace for distribution

Question paper pattern:

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module.
The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Mobile Computing: (technologies and Applications-N. N. Jani S chand
2. B.M.Hirwani- Android programming Pearson publications-2013
3. W. Frank Ableson, Robi Sen and C. E. Ortiz - **Android in Action**, Third Edition-2012 DreamTech Publisher

WIRELESS SENSOR NETWORKS
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER – III

Subject Code	**18LNI324** /18SCE251 / 18SCN251	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Explain sensor networks for various application setups.
- Demonstrate the design space and conduct trade-off analysis between performance and resources.
- Assess coverage and conduct node deployment planning.
- Devise appropriate data dissemination protocols and model links cost.
- Determine suitable medium access protocols and radio hardware.
- Illustrate sensor networks using commercial components.
- Discuss quality of service, fault-tolerance, security and other dependability requirements while coping with resource constraints.

Module -1	**Contact Hours**
Introduction, Overview and Applications of Wireless Sensor Networks Introduction, Basic overview of the Technology, Applications of Wireless Sensor Networks: Introduction, Background, Range of Applications, Examples of Category 2 WSN Applications, Examples of Category 1 WSN Applications, Another Taxonomy of WSN Technology. (Chapter 1: 1.1, 1.2, Chapter2: 2.1-2.6) **RBT: L1, L2, L3**	**10 Hours**
Module -2	
Basic Wireless Sensor Technology and Systems: Introduction, Sensor Node Technology, Sensor Taxonomy, WN Operating Environment, WN Trends, Wireless Transmission Technology and Systems: Introduction, Radio Technology Primer, Available Wireless Technologies (Chapter3: 3.1-3.5, Chapter 4: 4.1-4.3) **RBT: L1, L2, L3**	**10 Hours**
Module – 3	
MAC and Routing Protocols for Wireless Sensor Networks: Introduction, Background, Fundamentals of MAC Protocols, MAC Protocols for WSNs, Sensor-MAC case Study, IEEE 802.15.4 LR-WPANs Standard Case Study. Routing Protocols for Wireless Sensor Networks: Introduction, Background, Data Dissemination and Gathering, Routing Challenges and Design Issues in WSNs, Routing Strategies in WSNs. (Chapter 5: 5.1-5.6, Chapter 6: 6.1-6.5) **RBT: L1, L2, L3**	**10 Hours**
Module-4	
Transport Control and Middleware for Wireless Sensor Networks: Traditional Transport Control Protocols, Transport Protocol Design Issues, Examples of Existing Transport Control Protocols, Performance of Transport Control Protocols. Middleware for Wireless Sensor Networks: Introduction, WSN Middleware Principles, Middleware Architecture, Existing Middleware. (Chapter 7: 7.1-7.4, Chap. 8: 8.1-8.4) **RBT: L1, L2, L3**	**10 Hours**

Module-5	
Network Management and Operating System for Wireless Sensor Networks: Introduction, Network Management Requirements, Traditional Network Management Models, Network Management Design Issues. Operating Systems for Wireless Sensor Networks: Introduction, Operating System Design Issues, Examples of Operating Systems. (Chapter 9: 9.1-9.5, Chapter 10: 10.1-10.3) **RBT: L1, L2, L3**	**10 Hours**
Course outcomes:	
The students shall able to: • Explain existing applications of wireless sensor actuator networks • Apply in the context of wireless sensor networks and explain elements of distributed computing and network protocol design • Contrast Various hardware, software platforms that exist for sensor networks • Summarize various network level protocols for MAC, routing, time synchronization, aggregation, consensus and distributed tracking	
Question paper pattern: The question paper will have ten questions. There will be 2 questions from each module. Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.	
Text Books: 1. KAZEM SOHRABY, DANIEL MINOLI, TAIEB ZNATI, "Wireless Sensor Networks: Technology, Protocols and Applications:, WILEY , Second Edition (Indian) , 2014	
Reference Books: 1. Ian F. Akyildiz, Mehmet Can Vuran "Wireless Sensor Networks", Wiley 2010 2. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.	

WIRELESS NETWORKS AND MOBILE COMPUTING
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER – III

Subject Code	**18LNI331** / 18SCE241 / 18SCN151 / 18SCS323	IA Marks	40
Number of Lecture Hours/	**04**	Exam Marks	60
Total Number of Lecture Hours	**50**	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Define concepts of wireless communication.
- Compare and contrast propagation methods, Channel models, capacity calculations multiple antennas and multiple user techniques used in the mobile communication.
- Explain CDMA, GSM. Mobile IP, WImax and Different Mobile OS
- Illustrate various Markup Languages CDC, CLDC, MIDP; Programming for CLDC, MIDlet model and security concerns

Module -1	**Contact Hours**
Mobile Computing Architecture: Architecture for Mobile Computing, 3-tier Architecture, Design Considerations for Mobile Computing. Emerging Technologies: Wireless broadband (WiMAX), Mobile IP: Introduction, discovery, Registration, Tunneling, Cellular IP, Mobile IP with IPv6. Wireless Networks : Global Systems for Mobile Communication (GSM): GSM Architecture, Entities, Call routing in GSM, PLMN Interface, GSM Addresses and Identities, Network Aspects in GSM, Mobility Management, GSM Frequency allocation. Short Service Messages (SMS): Introduction to SMS, SMS Architecture, SMMT, SMMO, SMS as Information bearer, applications, GPRS and Packet Data Network, GPRS Network Architecture, GPRS Network Operations, Data Services in GPRS, Applications for GPRS, Billing and Charging in GPRS. **RBT: L1, L2, L3**	**10 Hours**
Module -2	
Spread Spectrum technology, IS-95, CDMA versus GSM, Wireless Data, Third Generation Networks, Applications on 3G, Mobile Client: Moving beyond desktop, Mobile handset overview, Mobile phones and their features, PDA, Design Constraints in applications for handheld devices. **RBT: L1, L2, L3**	**10 Hours**
Module – 3	
Mobile OS and Computing Environment: Smart Client Architecture, The Client: User Interface, Data Storage, Performance, Data Synchronization, Messaging. The Server: Data Synchronization, Enterprise Data Source, Messaging. Mobile Operating Systems: WinCE, Palm OS, Symbian OS, Linux, Proprietary OS Client Development: The development process, Need analysis phase, Design phase, Implementation and Testing phase, Deployment phase, Development Tools, Device Emulators **RBT: L1, L2, L3**	**10 Hours**
Module-4	
Building Wireless Internet Applications: Thin client overview: Architecture, the client, Middleware, messaging Servers, Processing a Wireless request, Wireless Applications Protocol (WAP) Overview, Wireless Languages: Markup Languages, HDML, WML,	**10 Hours**

HTML, cHTML, XHTML, VoiceXML. **RBT: L1, L2, L3**	
Module-5	
J2ME: Introduction, CDC, CLDC, MIDP; Programming for CLDC, MIDlet model, Provisioning, MIDlet life-cycle, Creating new application, MIDlet event handling, GUI in MIDP, Low level GUI Components, Multimedia APIs; Communication in MIDP, Security Considerations in MIDP. **RBT: L1, L2, L3**	**10 Hours**
Course outcomes:	
The students shall able to: • Explain state of art techniques in wireless communication. • Discover CDMA, GSM. Mobile IP, WImax • Demonstrate program for CLDC, MIDP let model and security concerns	
Question paper pattern: The question paper will have ten questions. There will be 2 questions from each module. Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.	
Text Books: 1. Ashok Talukder, RoopaYavagal, Hasan Ahmed: Mobile Computing,Technology, Applications and Service Creation, 2nd Edition, Tata McGraw Hill, 2010. 2. Martyn Mallik: Mobile and Wireless Design Essentials, Wiley India, 2003	
Reference Books: 1. Raj kamal: Mobile Computing, Oxford University Press, 2007. 2. ItiSahaMisra: Wireless Communications and Networks, 3G and Beyond, Tata McGraw Hill, 2009.	

SOCIAL NETWORK ANALYSIS
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER – III

Subject Code	**18LNI332** / 18SCN153 /18SFC333	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- The learning objective of the course Social Network Analysis is to discuss essential knowledge of network analysis applicable to real world data, with examples from today's most popular social networks.

Module 1	**Contact Hours**
Introduction to social network analysis and Descriptive network analysis: Introduction to new science of networks. Networks examples. Graph theory basics. Statistical network properties. Degree distribution, clustering coefficient. Frequent patterns. Network motifs. Cliques and k-cores. **RBT: L1, L2, L3**	**10 Hours**
Module 2	
Network structure, Node centralities and ranking on network: Nodes and edges, network diameter and average path length. Node centrality metrics: degree, closeness and betweenness centrality. Eigenvector centrality and PageRank. Algorithm HITS. **RBT: L1, L2, L3**	**10 Hours**
Module 3	
Network communities and Affiliation networks: Networks communities. Graph partitioning and cut metrics. Edge betweenness. Modularity clustering. Affiliation network and bipartite graphs. 1-mode projections. Recommendation systems. **RBT: L1, L2, L3**	**10 Hours**
Module 4	
Information and influence propagation on networks and Network visualization: Social Diffusion. Basic cascade model. Influence maximization. Most influential nodes in network. Network visualization and graph layouts. Graph sampling. Low -dimensional projections **RBT: L1, L2, L3**	**10 Hours**
Module 5	
Social media mining and SNA in real world: FB/VK and Twitter analysis: Natural language processing and sentiment mining. Properties of large social networks: friends, connections, likes, re-tweets. **RBT: L1, L2, L3**	**10 Hours**

Course Outcomes

The students should be able to:

- Define notation and terminology used in network science.
- Demonstrate, summarize and compare networks.
- Explain basic principles behind network analysis algorithms.
- Analyzing real world network.

Question paper pattern:
The question paper will have ten questions.

There will be 2 questions from each module.
Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. David Easley and John Kleinberg. "Networks, Crowds, and Markets: Reasoning About a Highly Connected World." Cambridge University Press 2010.
2. Eric Kolaczyk, Gabor Csardi. “Statistical Analysis of Network Data with R (Use R!)”. Springer, 2014.
3. Stanley Wasserman and Katherine Faust. "Social Network Analysis. Methods and Applications." Cambridge University Press, 1994.

Reference Books:

1. **NIL**

CLOUD SECURITY
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER – III

Subject Code	**18LNI333** / 18SCE331 / 18SCN154 / 18SFC152	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Describe the fundamentals of Cloud Computing.
- Summarize the need of cloud compliance and existing cloud solutions.
- Explain the cloud security concepts.
- Demonstrate the operations of Data Centre.
- Distinguish the concepts of Identity management and virtualization.

Module 1	**Contact Hours**
Cloud Computing Architectural Framework: Cloud Benefits, Business scenarios, Cloud Computing Evolution, cloud vocabulary, Essential Characteristics of Cloud Computing, Cloud deployment models, Cloud Service Models, Multi- Tenancy, Approaches to create a barrier between the Tenants, cloud computing vendors, Cloud Computing threats, Cloud Reference Model, The Cloud Cube Model, Security for Cloud Computing, How Security Gets Integrated. **RBT: L1, L2, L3**	**10 Hours**
Module 2	
Compliance and Audit: Cloud customer responsibilities, Compliance and Audit Security Recommendations. Portability and Interoperability: Changing providers reasons, Changing providers expectations, Recommendations all cloud solutions, IaaS Cloud Solutions, PaaS Cloud Solutions, SaaS Cloud Solutions. **RBT: L1, L2, L3**	**10 Hours**
Module 3	
Traditional Security, Business Continuity, Disaster Recovery, Risk of insider abuse, Security baseline, Customers actions, Contract, Documentation, Recovery Time Objectives (RTOs), Customers responsibility, Vendor Security Process (VSP). **RBT: L1, L2, L3**	**10 Hours**
Module 4	
Data Center Operations: Data Center Operations, Security challenge, Implement Five Principal Characteristics of Cloud Computing, Data center Security Recommendations. Encryption and Key Management: Encryption for Confidentiality and Integrity, Encrypting data at rest, Key Management Lifecycle, Cloud Encryption Standards, Recommendations. **RBT: L1, L2, L3**	**10 Hours**
Module 5	
Identity and Access Management: Identity and Access Management in the cloud, Identity and Access Management functions, Identity and Access Management (IAM) Model, Identity Federation, Identity Provisioning Recommendations, Authentication for SaaS and Paas customers, Authentication for IaaS customers, Introducing Identity Services, Enterprise Architecture with IDaaS , IDaaS Security Recommendations. Virtualization: Hardware Virtualization, Software Virtualization, Memory Virtualization, Storage	**10 Hours**

Virtualization, Data Virtualization, Network Virtualization, Virtualization Security Recommendations. **RBT: L1, L2, L3**	

Course Outcomes

The students should be able to:

- Demonstrate the growth of Cloud computing, architecture and different modules of implementation.
- Evaluate the different types of cloud solutions among IaaS, PaaS, SaaS.
- Access the security implementation flow, actions and responsibilities of stake holders.
- Generalize the Data Centre operations, encryption methods and deployment details.
- Provide recommendations for using and managing the customer's identity and choose the type of virtualization to be used.

Question paper pattern:

The question paper will have ten questions.
There will be 2 questions from each module.
Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. Tim Mather, SubraKumaraswamy, ShahedLatif, "Cloud Security and Privacy, An Enterprise Perspective on Risks and Compliance", Oreilly Media 2009.

Reference Books:

1. Vic (J.R.) Winkler, "Securing the Cloud, Cloud Computer Security Techniques and Tactics", Syngress, April 2011.

NETWORK ROUTING ALGORITHMS
[As per Choice Based Credit System (CBCS) scheme]
(Effective from the academic year 2018 -2019)
SEMESTER - III

Subject Code	**18LNI334** / 18SCN322	IA Marks	40
Number of Contact Hours/Week	04	Exam Marks	60
Total Number of Contact Hours	50	Exam Hours	03

CREDITS – 04

Course objectives: This course will enable students to

- Discuss layered architecture for communication networks and the specific functionality of the network layer.
- Explain the basic principles of routing and the manner, this is implemented in conventional networks and the evolving routing algorithms based on Internetworking requirements, optical backbone and the wireless access part of the network.
- Compare and contrast different routing algorithms existing and their performance characteristics.

Module -1	**Contact Hours**
NETWORK ROUTING: BASICS AND FOUNDATIONS: Networking and Network Routing: An Introduction: Addressing and Internet Service: An Overview, Network Routing: An Overview, IP Addressing, On Architectures, Service Architecture, Protocol Stack Architecture, Router Architecture, Network Topology Architecture, Network Management Architecture, Public Switched Telephone Network, Communication Technologies, Standards Committees, Last Two Bits. **Routing Algorithms: Shortest Path and Widest Path:** Bellman–Ford Algorithm and the Distance Vector Approach, Dijkstra's Algorithm, Comparison of the Bellman–Ford Algorithm and Dijkstra's Algorithm, Shortest Path Computation with Candidate Path Caching, Widest Path Computation with Candidate Path Caching, Widest Path Algorithm, k-Shortest Paths Algorithm **Routing Protocols: Framework and Principles:** Routing Protocol, Routing Algorithm, and Routing Table, Routing Information Representation and Protocol Messages, Distance Vector Routing Protocol, Link State Routing Protocol, Path Vector Routing Protocol, Link Cost **RBT: L1, L2, L3**	**10 Hours**
Module -2	
ROUTING IN IP NETWORKS: IP Routing and Distance Vector Protocol Family : Routers, Networks, and Routing Information: Some Basics, Static Routes, Routing Information Protocol, Version 1 (RIPv1), Routing Information Protocol, Version 2 (RIPv2), Interior Gateway Routing Protocol (IGRP), Enhanced Interior Gateway Routing Protocol (EIGRP), Route Redistribution **OSPF and Integrated IS-IS :**From a Protocol Family to anInstanceof a Protocol, OSPF: Protocol Features, OSPF Packet Format, Examples of Router LSAs and Network LSAs, Integrated IS-IS, Similarities and Differences Between IS-IS and OSPF **Internet Routing Architectures:** Internet Routing Evolution, Addressing and Routing: Illustrations, Current Architectural View of the Internet, Allocation of IP Prefixes and AS Number, Policy-Based Routing, Point of Presence, Traffic Engineering Implications, Internet Routing Instability **RBT: L1, L2, L3**	**10 Hours**

Module – 3	
Router Architectures: Functions of a Router, Types of Routers, Elements of a Router, Packet Flow, Packet Processing: Fast Path versus Slow Path, Router Architectures. **IP Address Lookup Algorithms:** Impact of Addressing on Lookup, Longest Prefix Matching, Naïve Algorithms, Binary Tries, Multibit Tries, Compressing Multibit Tries, Search by Length Algorithms, Search by Value Approaches, Hardware Algorithms, Comparing Different Approaches. **IP Packet Filtering and Classification:** Importance of Packet Classification, Packet Classification Problem, Packet Classification Algorithms, Naïve Solutions, Two-Dimensional Solutions, Approaches ford Dimensions, Extending Two-Dimensional Solutions, Divide and Conquer Approaches, Tuple Space Approaches, Decision Tree Approaches, Hardware-Based Solutions. **RBT: L1, L2, L3**	**10 Hours**
Module-4	
ADVANCED ROUTING PROTOCOLS FOR WIRELESS NETWORKS: Wireless networking basic aspects, Basic routing concepts, AD hoc routing, Mesh routing, Vehicular routing, Sensor routing **RBT: L1, L2, L3**	**10 Hours**
Module-5	
TOWARD NEXT GENERATION ROUTING: Quality of Service Routing: QoS Attributes, Adapting Shortest Path and Widest Path Routing: A Basic Framework, Update Frequency, Information Inaccuracy, and Impact on Routing, Lessons from Dynamic Call Routing in the Telephone Network, Heterogeneous Service, Single-Link Case, A General Framework for Source-Based QoS Routing with Path Caching, Routing Protocols for QoS Routing **MPLS and GMPLS:** Traffic Engineering Extension to Routing Protocols, Multiprotocol Label Switching, Generalized MPLS, MPLS Virtual Private Networks. **Routing and Traffic Engineering with MPLS:** Traffic Engineering of IP/MPLS Networks, VPN Traffic Engineering, Routing/Traffic Engineering for Voice Over MPLS. **VoIP Routing: Interoperability through IP and PSTN :** PSTN Call Routing Using the Internet, PSTN Call Routing: Managed IP Approach, IP-PSTN Interworking for VoIP, IP Multimedia Subsystem, Multiple Heterogeneous Providers Environment and All-IP Environment of VoIP Services. **RBT: L1, L2, L3**	**10 Hours**
Course outcomes:	
• Given the network and user requirements and the type of channel over which the network has to operate, the student would be in a position to apply his knowledge for identifying a suitable routing algorithm, implementing it and analyzing its performance. • The student would also be able to design a new algorithm or modify an existing algorithm to satisfy the evolving demands in the network and by the user applications.	
Question paper pattern: The question paper will have ten questions. There will be 2 questions from each module. Each question will have questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.	
Text Books:	

1. DeepankarMedhiandKarthikeyanRamasamy, "Network Routing: Algorithms, Protocols, and Architectures", (The Morgan Kaufmann Series in Networking), Elsevier Inc 2007
2. Miguel Elias M. Campista and Marcelo G. Rubinstein, "Advanced Routing Protocols for Wireless Networks", John Wiley & Sons, Inc, © ISTE Ltd 2014

Reference Books:

1. William Stallings, "High speed networks and Internets Performance and Quality of Service", 2nd Edition, Pearson Education Asia. Reprint India 2002.
2. M. Steen Strub, "Routing in Communication network," Prentice –Hall International, Newyork, 1995.
3. James D. McCabe, "Network Analysis, Architecture, and Design", 3rd Edition, 2007 Elsevier Inc.