NITTE MEENAKSHI INSTITUTE OF TECHNOLOGY, BANGLORE
SCHEME OF TEACHING AND EXAMINATION FOR
DEPT. OF ISE
M.Tech - CNE 2018 Scheme

SEMESTER:I

Sl no	Subject Code	Subject Name	Course Type	Teaching Dept.	Teaching Hours/Week			Examination			Credits
					L	T	P/S	CIE	SEE	Total	
1	18CNE101	Mathematical Foundation for Computer Networks	M	ISE	4	0	0	50	50	100	4
2	18CNE102	Computer Networks	PC	ISE	3	0	0	50	50	100	3
3	18CNE103	Wireless Sensor & Adhoc Networks	PC	ISE	3	0	0	50	50	100	3
4	18CNE104	Software Defined Networks	PC	ISE	3	0	0	50	50	100	3
5	18CNE105EX	Programme Elective 1	PE	ISE	3	0	0	50	50	100	3
6	18CNE106L	Network Programming Lab	PL	ISE	0	0	4	50	50	100	2
7	18CNE107S	Seminar / Term Work-I	PS	ISE	0	0	8	50	50	100	2
					Total			**350**	**350**	**700**	**20**

SEMESTER:II

Sl no	Subject Code	Subject Name	Course Type	Teaching Dept.	Teaching Hours/Week			Examination			Credits
					L	T	P/S	CIE	SEE	Total	
1	18CNE201	Network Security	PC	ISE	3	0	0	50	50	100	3
2	18CNE202	Analytical Approach for Data Networks	PC	ISE	3	0	0	50	50	100	3
3	18CNE203EX	Programme Elective 2	PE	ISE	3	0	0	50	50	100	3
4	18CNE204EX	Programme Elective 3 (Industry Driven Elective)	PE	ISE	3	0	0	50	50	100	3
5	18CNE205R	Research Methodology & IPR	PR	ISE	3	0	0	50	50	100	3
6	18CNE206L	Information Security Lab	PL	ISE	0	0	4	50	50	100	2
7	18CNE207S	Seminar/ Term Work-II	PS	ISE	0	0	8	50	50	100	2
					Total			**350**	**350**	**700**	**19**

SEMESTER:III

Sl no	Subject Code	Subject Name	Course Type	Teaching Dept.	Teaching Hours/Week			Examination			Credits
					L	T	P/S	CIE	SEE	Total	
1	18CNE301I	Internship*	PI	ISE	0	0	6	50	50	100	3
2	18CNE302P	Project Phase 1	PP	ISE	0	0	24	50	50	100	12
					Total			**100**	**100**	**200**	**15**
***To be Completed during summer vacation after Ist Year for a period of 8 to 12 Weeks.**											

SEMESTER:IV

Sl no	Subject Code	Subject Name	Course Type	Teaching Dept.	Teaching Hours/Week			Examination			Credits
					L	T	P/S	CIE	SEE	Total	
1	18CNE401P	Project Phase 2 Thesis Assessment	PP	ISE	0	0	12	50	50	100	6
2	18CNE402P	Project Phase 2 Internal Evaluation and Viva/Voce	PP	ISE	0	0	24	50	50	100	12
					Total			**100**	**100**	**200**	**18**

Program Elective1

Sl No	Subject Code	Subject Name
1	18CNE105E1	Internet of Things
2	18CNE105E2	Cloud Computing
3	18CNE105E3	Distributed Systems

Program Elective 2

Sl No	Subject Code	Subject Name
1	18CNE203E1	Big Data and Data Analytics
2	18CNE203E2	Parallel Computing
3	18CNE203E3	Machine Learning

SEMESTER I

Department: Information Science & Engineering	**Course Type**: Core
Course Title: Mathematical Foundation for Computer Networks	**CourseCode:18CNE101**
L-T-P:4-0-0	**Credits:04**
TotalContactHours:52hrs	**DurationofSEE:3hrs**
SEEMarks:50	**CIEMarks:50**

Prerequisite

- Knowledge of Engineering mathematics, fundamentals of Statistics & Probability.
- Fundamentals of Computer Network.

Course Outcomes

- Student will be able to describe advanced mathematical, statistical and probabilistic concepts and theories.
- Student will be able to apply Eigen values, Eigen vectors and probability theory in the analysis of web page ranking algorithm and in the evaluation of performance of networks.
- Student will be able to design network models for optimal use of network resources.
- Students will be able to plan for the quality of services in networks and solve complex network problems using Markov chain and queuing theory.

Delivery methods

- Lectures
- Power Point Presentations
- Assignments
- Case study

Assessment Methods

- Three internals assessment tests for 30 marks each will be conducted and the average of best two performances will be considered.
- Rubrics of assignment for 10 marks.
- Rubrics of case study 10 marks.
- Final examination will be conducted for 100 Marks and will be reduced to a weight of 50 marks.

COs to POs Mapping

POs/COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**PSO1**	**PSO2**
CO1	3	3	3	3		3			3			3	
CO2	3	3	3	3		3			3			3	
CO3		3	3	3		3			3			3	
CO4	3	3	3	3		3			3			3	
C.Level	3	3	3	3		3			3			3	

Course Content

Unit-1: Linear algebra **12 hrs**

Eigen values and eigenvectors, Importance of Eigen values, The role of the principal Eigen value, finding Eigen values and eigenvectors, Power method to compute the dominant Eigen value and Eigen vector, Principal Component Analysis (PCA), Eigen decomposition of a matrix, LU Decomposition, QR Decomposition/Factorization, Symmetric Matrices, Orthogonalization & Orthonormalization, Vector Spaces and Norms, Computing state transitions using a stochastic matrix, Eigen values of a stochastic matrix, GOOGLE Page Rank Algorithm.

Unit-2: Probability theory and statistics **10 hrs**

Combinatorics, Probability Rules & Axioms, Bayes' Theorem, Random Variables, Variance and Expectation, Conditional and Joint Distributions, Standard Distributions (Bernoulli, Binomial,Uniform and Gaussian), Moment Generating Functions, Maximum Likelihood Estimation (MLE), Prior and Posterior, Maximum a Posteriori Estimation (MAP).

Unit-3: Optimization **10 hrs**

System modelling and optimization, An introduction to optimization-Optimising a system with two control parameters, Optimising a system with three variables, Optimizing linear systems (Resource allocation models),Graphical method, Simplex method- maximisation model and minimisation model.

Unit-4: Markov process and Queuing theory **10 hrs**

Markov chain, $P^{(n)}$ for a two state Markov chain, Three state Markov chain, Markov property, Absorption probabilities, Gambler's Ruin survival probability for birth-death chains, Discrete time Markov chain, continuous time Markov chain.

Unit-5: Information Theory **10 hrs**

Discrete time birth-death process, the M/M/1 queue, M/M/1/K queue. A mathematical model for communication, Source coding- coding digit sequence, coding letters, Optimal codes- Huffman code, Capacity of a communication channel- Noiseless channel, Noisy channel, the Gaussian channel.

Text Books

1. Srinivasan Keshav, Mathematical Foundations of Computer Networking, Addison-Wesley Professional Computing Series,2011.
2. Allen gut, an intermediate course in probability, Springer, 2008.
3. G.Strang, Linear Algebra and applications, Thomson-Brook, 4th Edition, 2006.

References

1. Discrete –Event system simulation, by Jerry Banks, Fourth Edition, Pearson,2013.
2. Applied statistics and Probability for Engineers, Douglas C. Montgomery, George C.Runger, Third Edition, John Wiely& Sons, Inc. 2014.
3. Leon Garcia A, A Probability, Statistics and Random processes for Electrical Engineers, Pearson Prentice Hall, 2008.

Reference of Research Publications

[1] Okoro Otonritse Joshua, "On Markovian Queueing Model as BirthDeath Process", Global Journal of Science Frontier Research Mathematics and Decision Sciences, 2015.

[2] Fabrice Guillemin · Bruno Sericola, "Stationary Analysis of a Fluid Queue Driven by Some Countable State Space Markov Chain", Methodol Comput Appl Probab (20014) 9:521–540, Springer.

[3] Yang Wang a , Chuang Lin, " A queueing analysis for the denial of service (DoS) attacks in computer networks", Computer Networks 51, 3564–3573, ELSEVIER, 2007.

[4] János Sztrik, "Queueing Theory and its Applications", Proceedings of the 8th International Conference on Applied Informatics Eger, Hungary, January 27–30, Vol. 1. pp. 9–30, 2010.

[5] Manuel Alberto M. Ferreira , Marina Andrade, " Statistical Queuing Theory with Some Applications", Int. J Latest Trends Fin. Eco. Sc., Vol-1 No. 4 December, 2013.

Department: Information Science & Engineering	**Course Type:** Core
Course Title: **Computer Networks**	**Course Code:** 18CNE102
L-T-P: 3-0-0	**Credits:** 03
Total Contact Hours: 39 hours	**Duration of SEE:** 3 hours
SEE Marks: 50	**CIE Marks:** 50

PREREQUISITE:

1. Basic Electronics
2. Computer Organization

Delivery Methods

1. Black Board Teaching
2. Course project using NS3

Course Outcome:

By the completion of this course student will be able to.

1. Analyze the requirements for building a computer network.
2. Design a network by using concepts like sub netting, addressing, host configuration and error reporting.
3. Analyze the network, transport and application layer protocols used in Internet.
4. Analyze the QoS provisioning in networks through congestion control and resource allocation.

Course Outcome to Programme Outcome Mapping

PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**PSO1**	**PSO2**
CO1	3	1											
CO2	2	1	2		1			1	1		1		
CO3	2	1	2	1	1			1	1		1		
CO4	2	2		2									
	3	2	2	2	1								

Course Content

UNIT I **10 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. Ethernets and Multiple Access Networks: Physical Properties, Access Control, Experience with Ethernet.

T1: Chapter 1.1, 1.2, 1.5.1, 1.5.2., 2.1, 2.5, 2.6 T2: Chapter 4

UNIT II **08 Hours**

Internetworking- I Switching and Bridging, Datagrams, Virtual Circuit Switching, Source Routing, Bridges and LAN Switches, Basic Internetworking (IP), What is an Internetwork ?, Service Model, Global Addresses, Datagram Forwarding in IP, subnetting and classless addressing, Address Translation(ARP), Host Configuration(DHCP), Error Reporting(ICMP), Virtual Networks and Tunnels.

T1: Chapter 3.1, 3.2.

UNIT III **07 Hours**

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, Private Network Interconnection

T1: Chapter3.3, 4.1.1, 4.1.3 T2:Chapter 13.1 to 13.18 , Chapter 18, 19

UNIT IV **07 Hours**

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

UNIT V **07 Hours**

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(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

Text books:

1. T1: Larry Peterson and Bruce S Davis “Computer Networks: A System Approach” 5th Edition, Elsevier -2014 2.
2. T2: Douglas E Comer, “Internetworking with TCP/IP, Principles, Protocols and Architecture” 6th Edition, PHI - 2014

Semester-I **Year: 2018-19**

Department: Information Science & Engineering	**Course Type:** Elective
Course Title: Wireless Sensor & Adhoc Networks	**CourseCode:18CNE103**
L-T-P:3-0-0	**Credits:**03
TotalContactHours:39hrs	**DurationofSEE:**3hrs
SEEMarks:50	**CIEMarks:**50

Prerequisites:

- Statistics, Probability and fundamentals of Computer Networks.

Course outcomes:

- Students will be able to describe the performance of sensor networks, and associated protocols.
- Students will be able to analyze the performance of various unicast and multicast routing protocols.
- Students will be able to simulate different MAC layer protocols .
- Students will be able to describe the problems of MAC and network layer to provide QoS.

Teaching Methodology:

- Blackboard teaching
- PowerPoint presentations
- Practical Component

Assessment Methods:

- Three internals, 30 Marks each will be conducted and the Average of best of two will be taken.
- Rubrics for evaluation of practical component 20 Marks
- Final examination, of 100 Marks will be conducted and will be evaluated for 50 Marks.

Course Outcome to Programme Outcome Mapping:

	PO 1	**PO** 2	**PO** 3	**PO** 4	**PO** 5	**PO** 6	**PO** 7	**PO** 8	**PO** 9	**PO** 10	**PO** 11	**PSO** 1	**PSO2**
CO1	3											3	
CO2	2	1										3	
CO3		2		2	1			1		1	1	3	
CO4	3											3	
18CNE103	3	2		2	1			1		1	1	3	

Course Contents

UNIT - I 10 hrs

Introduction: Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Mobile Adhoc NETworks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks

UNIT - II 07 hrs

Sensor Node Hardware and Network Architecture: Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to TinyOS and nesC, Network architecture, Optimization goals and figures of merit, Design principles for WSNs, Service interfaces of WSNs, Gateway concepts. Multiple Access Techniques, Voice Coding, Error Control, IEEE 802 Networking Standard,

UNIT – III 08 hrs

Hybrid Wireless Networks: Introduction, Next-generation Hybrid wireless architectures, routing in hybrid wireless networks, Pricing in Multi-Hop wireless networks, Power control schemes in Hybrid wireless networks, Load balancing in Hybrid wireless networks.

UNIT – IV 07 hrs

Data Storage and Manipulation: Data centric and content based routing, storage and retrieval in network, compression technologies for WSN, Data aggregation technique. Applications: Detecting unauthorized activity using a sensor network, WSN for Habitat Monitoring.

UNIT - V 07 hrs

Quality Of Service In Ad Hoc Wireless Networks: Introduction, Issues and Challenges in Providing QoS in Ad Hoc Wireless Networks, Classifications of QoS Solutions, MAC Layer Solutions, Network Layer Solutions.

Text books:

1. Ad Hoc Wireless Networks Architecture and Protocols: C. Siva Ram Murthy, B. S Manoj, 2nd edition, Pearson education (Chapters of the book: 5, 6, 7, 9, and 10)
2. Holger Kerl, Andreas Willig, "Protocols and Architectures for Wireless Sensor Network", John Wiley and Sons, 2005 (ISBN: 978-0-470-09511-9)
3. Raghavendra, Cauligi S, Sivalingam, Krishna M., Zanti Taieb, "Wireless Sensor Network", Springer 1st Ed. 2004 (ISBN: 978-4020-7883-5).

Reference Books:

1. Guide to Wireless Adhoc networks, Misra,sudip, Woungang, Isaac, Springer publisher
2. Adhoc Networking, C E Perkins, Addison Wesley,2001.
3. Wireless Communications, Principles and Practice, second edition, Theodore S Rappaport, Pearson Education Asia, 2002.

Semester: I Year: 2018-19

Department: Information Science & Engineering	**Course Type:** Elective
Course Title: Software Defined Networks	**CourseCode:18CNE104**
L-T-P:3-0-0	**Credits:**03
TotalContactHours:39hrs	**DurationofSEE:**3hrs
SEEMarks:50	**CIEMarks:**50

Prerequisite:

- Students should have the knowledge of Computer networks.
- Have programming experience in C++, JAVA and Python.
- Experience with virtual machines and other virtual networking environments is added advantages.

Course Outcomes:

- Student will be able to explain and build virtualized Software defined networks.
- Students will have knowledge of the technology evolution leading to SDN as well as the Open Source role in SDN.
- Students will be able to explore OpenFlow specifications to build Software defined networks.
- Acquire, investigate, analyze and synthesize information, concepts and theories relating to Network Management and SDN.
- Demonstrate knowledge software defined networking and its applications, including network programmability and virtualization.

Teaching Methodology:

- Black board teaching
- Power point presentation
- Programming Assignments
- Case Studies

Assessment Methods:

- Three internals, 30 Marks each will be conducted and the Average of best of two will be taken.
- Rubrics for evaluation of Course Project and case studies.
- Final examination, of 100Markswill be conducted and will be evaluated for 50Marks.

Course Outcome to Programme Outcome Mapping

PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1	*	*		*					*	*		*		
CO2	*	*	*	*	*				*	*		*		
CO3	*	*	*	*	*				*	*		*		
CO4	*	*	*	*	*				*	*		*		
CO5	*	*	*	*	*				*	*		*		
	3	3	2	2	2				1	2		2		

Course Contents

Unit-1 **10hours**

Virtualization : Introduction, Virtual Memory, Virtual Memory Operation, Virtual and Physical Memory Mapping, Server Virtualization, Importance of Virtualizing Servers, Hypervisor Role in Server Virtualization, Types of Virtualization, Server Virtualization in Operation, Storage Virtualization, Computer Storage Operation, Network-Attached Storage, Storage-Area Networks, Server-Based Storage Virtualization, Storage-Network-Based Storage Virtualization Storage-Controller-Based Storage Virtualization.

Unit -2 **07hours**

Software Defined Networking: Introduction, Network Limitations, Network Control Plane, Forwarding Function, Network State Function, Configuration Function, Separation of Functionality, Applications
SDN Implementation: Introduction, SDN Design, Separation of the Control and Data Planes, Edge-Oriented Networking, SDN Operation.

Unit 3 **07hours**

Service Providers and SDN: Introduction, Telecommunication SDN Attributes, Telecommunication SDN Services. **SDN Development :** Introduction, Existing Network Limitations, Programmable Networks, Network/Application Information, Legacy to SDN, SDN Application Services, Service-Engineered Path, Service Appliance Pooling, Content Request Routing, Bandwidth Calendaring, Social Networking.

Unit 4 **08hours**

Network Vendors and SDN: Introduction, Cisco, VMware, Juniper, OpenDaylight, Big Switch Networks.**Google and SDN:** Introduction, Earlier Network Management, Motivation for Solution, Network Testing, Simulating the Google WAN, Google and SDN, Google's G-Scale Network, Google's G-Scale Network Hardware, Google SDN Deployment, Implementation Challenges Lessons Learned.

Unit 5 **07hours**

OpenFlow : Introduction, Overview of the OpenFlow Switch Specification, OpenFlow Ports, OpenFlow Packet-Processing Pipeline, OpenFlow Channel, Message Handling, OpenFlow Channel Connections, Controller Modes, Auxiliary Connection Use for Performance and Reliability, Flow Table Synchronization, Bundle Messages, OpenFlow Configuration-and-Management Protocol, Remote Configuration, Connection Establishment Between Switch and Controller. **OF-CONFIG Transport Protocol** The Conformance Test Specification for OpenFlow Switch Specification 1.0.1, The OpenFlow™ Conformance Testing Program.

Text books 1. Software Defined Networking: Design and Deployment by Patricia A. Morreale, James M. Anderson December 3, 2014 by CRC Press

Reference books

1. SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies, By Thomas D. Nadeau, Ken Gray Publisher: O'Reilly Media, August 2013, ISBN: 978-1-4493-4230-2, ISBN 10: 1-4493-4230-2.
2. Software Defined Networks: A Comprehensive Approach, by Paul Goransson and Chuck Black, Morgan Kaufmann, June 2014, Print Book ISBN: 9780124166752, eBook ISBN: 9780124166844.
3. SDN and Open Flow for Beginners by Vivek Tiwari, Sold by: Amazon Digital Services, Inc., ASIN:, 2013.
4. Network Innovation through Open Flow and SDN: Principles and Design, Edited by Fei Hu,

CRC Press, ISBN-10: 1466572094, 2014.

Research material

[1] Software-Defined Networking: A Comprehensive Survey By Diego Kreutz, Fernando M. V. Ramos, Paulo Esteves Verı´ssimo, Christian , Esteve Rothenberg, Member IEEE, Siamak Azodolmolky and Steve Uhlig, 2016 2nd IEEE International Conference on Computer and Communications, Vol. 103, No. 1, 2015.

[2] The controller placement problem for software-defined networks by Hu Bo; Wu Youke; Wang Chuan'an; Wang Ying, 2016 2nd IEEE International Conference on Computer and Communications (ICCC) Year: 2016 Pages: 2435 - 2439, DOI: 10.1109/CompComm.2016.7925136

[3] A greedy power-aware routing algorithm for software-defined networks by Mohamad Khattar Awad; Yousef Rafique; Sarah Alhadlaq; Dunya Hassoun; Asmaa Alabdulhadi; Sheikha Thani 2016 IEEE International Symposium on Signal Processing and Information Technology (ISSPIT) Year: 2016 Pages: 268 - 273, DOI: 10.1109/ISSPIT.2016.7886047

.

[4] Inferring OpenFlow rules by active probing in software-defined networks
Po-Ching Lin; Ping-Chung Li; Van Linh Nguyen 2017 19th International Conference on Advanced Communication Technology (ICACT) Year: 2017 Pages: 415 - 420, DOI: 10.23919/ICACT.2017.7890123.

[5] Toward Highly Available and Scalable Software Defined Networks for Service Providers
Dongeun Suh; Seokwon Jang; Sol Han; Sangheon Pack; Myung-Sup Kim; Taehong Kim; Chang-Gyu Lim IEEE Communications Magazine Year: 2017, Volume: 55, Issue: 4
Pages: 100 - 107, DOI: 10.1109/MCOM.2017.1600170.

[6] Topology Discovery in Software Defined Networks: Threats, Taxonomy, and State-of-the-Art Suleman Khan; Abdullah Gani; Ainuddin Wahid Abdul Wahab; Mohsen Guizani; Muhammad Khurram Khan IEEE Communications Surveys & Tutorials.
Year: 2017, Volume: 19, Issue: 1 Pages: 303 - 324, DOI: 10.1109/COMST.2016.2597193

Lab component for SDN

1. Program to SDN floodlight using north bound REST APIs.
2. Create virtual machines in Hyper-V Manager.
3. Programs using the OpenDaylight SDN Controller with the Mininet Network Emulator

Program Elective-1

Department: Information Science and Engineering	**Course Type:** Elective Core
Course Title: **Internet of Things**	**Course Code:** 18CNE105E1
L-T-P: 3-0-0	**Credits:** 03
Total Contact Hours: 39 hrs	**Duration of SEE:** 3 hrs
SEE Marks: 50	**CIE Marks:** 50

Prerequisite:

- Programming knowledge in C Language
- Basic knowledge of Electronics and Logic Design

Course Outcomes:

- Students will be able to understand the basic concept of IoT, protocols and different IoT levels for deployment.
- Students will be able to differentiate between M2M and IoT communication and will be able to understand steps involve IoT design Methodology and basic programming with python.
- Students will be able understand the Raspberry Pi architecture, upload the code on the board and will be able to communicate to Cloud
- Students will be able to perform data analytics using different analytics platforms and understand ethics behind the IoT Development.

Teaching Methodology:

- Blackboard and Power point presentations
- Course Project/Programming Assignments
- Seminar

Assessment Methods:

- Three internals, 30 Marks each will be conducted and the Average of best of two will be taken.
- Rubrics for evaluation of Course Project and Seminar.
- Final examination, of 100Markswill be conducted and will be evaluated for 50Marks.

Course Content

UNIT I **09Hours**

Introduction& Concepts: Introduction to Internet of Things, Definitions and Characteristics of IoT, Physical Design of IoT, Things in IoT, IoT Protocols, Logical Design of IoT, IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies, Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Enbeedded Systems, IoT levels and Development Templates, IoT Level-1, IoT Level-2, IoT Level-3, IoT Level-4, IoT Level-5, IoT Level-6.
Textbook 1:1.1 – 1.5

UNIT II **08Hours**

IoT and M2M, Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT, Software Defined Networking, Network Function Virtualization, IoT Platform Design Methodology, Introduction, IoT Design Methodology, Step1: Purpose and requirement specification, Step2: Process Specification, Step 3: Domain Model Specification, Step 4: Information Model Specification, Step 5: Service Specification, Step 6: IoT Level Specification, Step 7: Function View Specification, Step 8: Operational View Specification, Step 9: Device and Component Integration, Step 10: Application Development, IoT System Logocal Design Using Python, Introduction, Installing Python, Python Data Types and Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date Time applications, Classes, Python Packages of Interest for IoT.
Textbooks 1:3.1-3.4, 5.1-5.4, 6.1-6.11

UNIT III **08Hours**

IoT Physical Devices and End Points: What is and IoT Device, Exemplary Device Raspberry Pi, About the Board, Linux on Raspberry Pi, Raspberry pi interfaces,programming raspberry pi with python, other IoT devices. IoT physical servers and cloud offerings: introduction to cloud storage models and communication Networks, wamp-autobahn for IoT, xively cloud for IoT, python web application frame work-django, designing a RESTful web API, amazon web services for IoT, SkyNetIoT messaging platforms.
Textbook 1: 7.1-7.7, 8.1-8.7

UNIT IV: **07Hours**

Data Analytics for IoT; Introduction Appache Hadoop, using Hadoop MapReduce for Batch Data Analysis, Apache oozie, Apache Spark, Apache Storm, using Apache Storm for Real-time Data Analysis.
Textbook 1: 10.1 -10.8

UNIT V **07Hours**

Ethics: Characterizing the IoT, Privacy, Control , Distributing Control and Crowd Sourcing, Environment, Physical Thing, Electronics, Internet Service, Solutions, Internet of Things as Part of Solution, Cautious Optimizing, The Open IoT definition. IoT security: trends, problems and challenges
Textbook 2: Chapter 11

TextBooks:

1. **ArshdeepBahga, Vijay Madisetti,** Internet Of Things-A Hands on Approach, University of Penn, http://www.internet-of-things-book.com/
2. **Adrian McEwen & Hakim Cassimally**Designing the Internet of Things, ISBN 978-81-265-5686-1 Wiley Publication.

ReferenceBooks:

1. **OvidiuVermesan,Peter Friess**Internet of Things:Converging Technologiesfor Smart Environmentsand Integrated Ecosystems. River Publishers Series in Communication.

Semester: I **Year: 2018-19**

Department: Information Science and Engineering	**Course Type:** Elective Core
Course Title: **Cloud Computing**	**Course Code:** 18CNE105E2
L-T-P: 3-0-0	**Credits:** 03
Total Contact Hours: 39 hrs	**Duration of SEE:** 3 hrs
SEE Marks: 50	**CIE Marks:** 50

Prerequisites:

Students are expected to have the following topical knowledge upon entering this course:

- Satisfactory understanding of Networking.
- Satisfactory understanding of Engineering Management and Entrepreneurship.

Course outcomes:

The specific course outcomes supporting the program outcomes are:

- Students will understand and describe basic principles of cloud computing.
- Students will be able to understand and demonstrate virtualization technology
- Students will learn and describe Cloud offering and SOA.
- Students will be able to understand and demonstrate available features of cloud environment

Teaching methodology:

- Black Board Teaching
- Power Point Presentation
- Course Project

Assessment methods:

- Three internals, 30 Marks each will be conducted and the Average of best of two will be taken.
- Course Project for 20 marks.
- Rubrics for Course Project.
- Final examination, of 100 Marks will be conducted and will be evaluated for 50 Marks.

Course Outcome to Programme Outcome Mapping

	PO1	**PO2**	**Po3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	*											
CO2	*		*		*				*	*	*	
CO3	*						*					
CO4	*		*		*				*	*	*	

Course contents

Unit-1 **8 Hours**

Introduction: Business and IT perspective, Cloud and virtualization, Cloud services requirements, cloud and dynamic infrastructure, cloud computing characteristics, cloud adoption.

Cloud models: Cloud characteristics, Measured Service, Cloud models, security in a public cloud, public verses private clouds, cloud infrastructure self service.

Unit-2 **8 Hours**

Cloud at a service: Gamut of cloud solutions, principal technologies, cloud strategy, cloud design and implementation using SOA, Conceptual cloud model, and cloud service demand.

Cloud solutions: Cloud ecosystem, cloud business process management, cloud service management, cloud stack, computing on demand, cloud sourcing.

Unit-3 **8 Hours**

Cloud offerings: Cloud analytics, testing under cloud, information security, virtual desktop infrastructure, Storage cloud.

Cloud and SOA: SOA journey to infrastructure, SOA and cloud, SOA defined, SOA defined, SOA and IAAS, SOA based cloud infrastructure steps, SOA business and IT services.

Unit-4 **7 Hours**

Cloud management: Resiliency, Provisioning, Asset management, cloud governance, high availability and disaster recovery, charging models, usage reporting, billing and metering.

Unit-5 **8 Hours**

Cloud virtualization technology: Virtualization defined virtualization benefits, server virtualization, virtualization for x 86 architecture, Hypervisor management software, Logical partitioning, VIO server, and Virtual infrastructure requirements**.** Storage virtualization, storage area networks, network attached storage, cloud server virtualization, virtualized data center.

TEXT BOOKS:

1. Cloud Computing by Dr. Kumar Saurabh, Wiley India, 2011.

Reference Books

1. Michael Miller, Cloud Computing: Web based applications that change the way you work and collaborate online, Que publishing , August 2009

2. Haley Beard, Cloud Computing Best Practices for Managing and Measuring Processes for On Demand computing applications and data Centers in the Cloud with SLAs, Emereo Pty Limited, July 2008.

Department: Information Science & Engineering	**Course Type:** Elective
Course Title: Network Programming lab	**CourseCode:18CNE16L**
L-T-P:0-0-4	**Credits:**02
TotalContactHours:24hrs	**DurationofSEE:**3hrs
SEEMarks:50	**CIEMarks:**50

Pre-requisites:

- Basic Knowledge of Computer Networks.

Course Outcomes:

Students will be able to

- Demonstrate the usage of commands such as ifconfig, netstst, ping, arp, telnet, ftp, finger, traceroute, whois etc.
- Design, Analyze and implement TCP & UDP applications on iterative and concurrent servers.
- Design, analyze and Implement the socket level programs for initiation and termination of data transmission services.
- Demonstrate the usage of advanced socket system call

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	1	2	2					2	1		1		
CO2	1	3	3	1				2	1		1		
CO3	1	3	3	1				2	1		1		
CO4	1	2	2					2	1		1		

List of Problem statements

1. Understanding and using of commands like ifconfig, netstst, ping, arp, telnet, ftp, finger, traceroute, whois etc.
1. Implementation of ping service.
2. Design, develop, and execute a program in C under UNIX / LINUX environment to implement simple concurrent and iterative echo servers and compare the performance of the servers.
3. Repeat the above experiment using UDP instead of TCP.
4. Design, develop, and execute a program in C under UNIX / LINUX environment to implement a simple Day / Time Server and demonstrate its functioning.
5. Design TCP and UDP Client and Server application to transfer a file.
6. Build a web server using sockets.
7. Implementation of remote command execution using socket system calls.
8. Demonstrate the use of advanced socket system calls.
10. Implementation of file access using RPC.
11. Build a concurrent multithreaded file transfer server using threads.
12. Implementation of DNS.

II SEMESTER SYLLABUS

Department: Computer Networks And Engineering	**Course Type:** Core
Course Title: Network Security	**CourseCode:**18CNE201
L-T-P: 3-0-0	**Credits:**03
TotalContactHours:39hrs	**DurationofSEE:**3hrs
SEEMarks:50	**CIEMarks:**50

Pre- requisite:

- Basic knowledge of computer networks

Course Outcomes:

Students will 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 approaches like ElipticCurve ,IPS and others.
- Describe the security technologies such as firewall, Intrusion detection and Prevention system.
- Student will be able to analyze security issues and design experiments to solve the given problem & interpret the results

TeachingMethodology:

- Blackboardteaching
- PowerPoint presentations
- Programming Assignment / Case study

AssessmentMethods:

- Threeinternals, 30Marks eachwill beconductedandtheAverage ofbest of twowill be taken.
- Rubricsforevaluating Programming Assignment / Case study
- Final examination, of100 Markswill beconducted andwillbe evaluatedfor50Marks
- Post-assesment feedback on student

CO-PO&PSO Mapping:

PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**PSO1**	**PSO2**
CO1	3	2	1	2									3
CO2	1		2	2									3
CO3			3										3
CO4	3									1			3
CO5		2	2	2	2			1	1	1	1		3
18CNE201	3	2	3	2	2			1	1	1	1		3

Course Contents

UNIT- I **08 hrs**

Introduction: Security Trends, OSI Security Architecture, Security Attacks, Security Services, Security Mechanism, Security Model, **Symmetric Ciphers**: Classical Encryption Technique: Symmetric Cipher Model, Substitution Technique, Transposition Technique, Steganography. **Block Ciphers & Data Encryption Standards**: Block Cipher Principles, DES Algorithm, Strength of DES,

UNIT- II **10 hrs**

Advanced Encryption Standards: AES Structure, AES Transformation Function, AES Key Expansion **Public-Key Cryptography and RSA**: Principles of Public-key Cryptosystems, The RSA Algorithm

UNIT- III

07 hrs

Other Public-Key Cryptosystems :Diffie-Hellman Key Exchange, Elgamal Cryptographic system, Elliptic Curve Arithmetic, Elliptic Curve Cryptography,

Cryptographic Hash Functions: Application, Requirement & Security, Secure Hash Algorithm (SHA), **Message Authentication Code**: Requirement, Message Authentication Function, Requirement for MAC, Security of MAC, **Digital Signatures:** Digital Signatures:

UNIT- IV **07Hrs**

Key Management and Distribution: Symmetric key distribution, KERBEROS, Distribution of public keys, X.509 certificate, Public key infrastructure,

User Authentication: Remote user Authentication principles, Remote user-Authentication using Symmetric encryption, Remote User Authentication Using Asymmetric Encryption

UNIT- V **07Hrs**

Transport Layer Security: Web Security Consideration, Secure Socket Layer, Transport Layer Security, HTTPS, Secure Shell ,**Electronic Mail Security:** Pretty Good Privacy (PGP),S/MIME**Wireless Network Security:** Wireless security, Mobile device security, IEEE 802.11 Wireless LAN overview IEEE 802.11i Wireless LAN security,

More Security Systems: Firewall, VPN, Intrusion Detection & Prevention System

Text Books:

1. William Stallings: Cryptography and Network Security, Pearson 6th edition, 2014.
2. Kaufman, C., Perlman, R. and Speciner, M., "Network Security", Prentice-Hall, 2nd Ed.

References:

1. Forouzan, B.A., "Cryptography and Network Security", Tata McGraw-Hill, 2007.

Department: Information Science & Engineering	**Course Type: Core**
Course Title: Analytical Approach for Data Networks	**Course Code:** 18CNE202
L-T-P:3-0-0	**Credits:** 03
Total Contact Hours:39hrs	**Duration of SEE:** 3hrs
SEE Marks:50	**CIE Marks:** 50

Prerequisite:

- Knowledge of Statistics, Probability, Queuing theory, Markov chain.
- Knowledge of Wired and wireless Networks.

Course Outcomes:

- Student will be able to use probability theory, deterministic and stochastic processes in the study network traffic engineering.
- Student will be able to develop the models to evaluate the performance of networks parameters and packet parameters.
- Student will be able to analyze the network traffic and resolve issues related to congestion and transmissions.
- Student will be able to evaluate the use of network resources optimally and enhance the quality of service.

Teaching Methodology:

- Lectures using blackboard
- Power Point presentations
- Assignments
- Case Study

Assessment Method:

- Three internals assessment tests for 30 marks each will be conducted and the average of best of two performances will be considered.
- Assignment for 10 marks.
- A case study involving modeling a wired/wireless networks scenario and performance analysis, 10 marks.
- Final examination will be conducted for 100 marks and will be calculated for weight of 50 marks.

Course Outcome to Programme Outcome Mapping:

-

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3							3	3	
CO2	3	3	3	3	3	3						3	3	
CO3	3	3	3		3	3			3			3	3	
CO4	3	3	3	3	3	3			3			3	3	

Course Contents

Unit-1: Networking functional elements **10 hrs**

Multiplexing, Switching, Routing, network management, traffic controls and time scale, Two types of traffic- Elastic traffic, stream traffic, Network delay, Delay jitter, playout delay, QoS objectives, Elastic transfer in a packet network- Feedback control, the file transfer abstraction, congestion control, feedback, and bandwidth sharing, Packet multiplexing over wireless networks. Deterministic traffic models and network calculus, Reich's equation and the convolution operator, Service curves for network elements, latency rate service elements.

Unit-2: Stream Session- Stochastic analysis **08 hrs**

stochastic traffic models, models for a single stream source, superposition of several streams, discrete time Markovian batch arrival model, morkov modulated Poisson process, sum of time-varying number of deterministic processes, performance measures, Little's theorem, Invariance of mean system time, Brumelle's theorem, the M/G/1 model: formulation for mean number of bits in a buffer, Multiclass traffic on a single link, the Kaufman-Roberts recursion..

Unit-3: Adaptive Bandwidth sharing for elastic traffic **07 hrs**

Elastic transfer in networks, Network parameters and performance objectives, propagation delay and round-trip time, performance measures-transfer throughput, sharing a control link, Control objectives, rate-based control, explicit-rate-feedback, queue-length based-based feedback, a simple rate adaptation, additive increase, multiplicative decrease ODE model, Window-based control- general principles.TCP: the Internet's adaptive window protocol. Slow-Start and congestion avoidance, relative buffer and cumulative acknowledgements.

Unit-4: Congestion Control **07 hrs**

packet loss recovery and congestion control, single connection-analysis with buffer overflow, analysis of slow-start phase, short transfer throughput, slow start- evaluation after buffer overflow, analysis of congestion avoidance phase, Congestion avoidance: Evolution after buffer overflow, Congestion avoidance- timeout based recovery, congestion avoidance- fast recovery, Stochastic model for a wide area TCP connection, TCP with explicit feedback (RED and ECN), a dynamic system model, Random marking.

Unit-5: Multiple Access -Wireless Networks **07 hrs**

Bits over a wireless link, principles, issues, and trade-offs, simple binary modulation, and detection, Getting higher bit rates, Channel coding and fundamental limit, delay, path loss, shadowing and fading, characterization of the signal attenuation, BER and channel capacity with fading, Bits over a wireless network, TCP performance over wireless links, Performance analysis of wired and wireless networks.

Text Books:

1. Communication Networking an analytical approach by Anurag Kumar, D.Manjunath, Joy Kuri, Margan Kaufmann publisher, an imprint of ELSEVIER, 2012.
2. R.Srikanthand Y.Ling, Communication networks: An Optimisation, Control and Stochastic networks perspective, Cambridge University press, 2014.

References:

1. Larry Peterson and Bruce S Davis "Computer Networks : A System Approach" 5th Edition , Elsevier -2014.
2. Analysis of Computer Networks: Fayez Gebali, 2nd edition.

Reference of Research Publications:

[1] Pavlos Sermpezis and Thrasyvoulos Spyropoulos, “Modeling and analysis of communication traffic heterogeneity in opportunistic networks”, Department of Mobile Communications, EURECOM, France,2015.

[2] Rabie Barhoun, Abdelwahed Namir and Anas Barhoun, “Analysis of hierarchical scheduling for heterogeneous traffic over network”, International Journal of Computer Networks & Communications, Vol.5, No.3, 2013.

[3] Ruogu Li, AtillaEryilmaz, Lei Ying and Ness B. Shroff, “A Unified Approach to Optimizing Performance in Networks Serving Heterogeneous Flows”, IEEE/ACM Transactions on Networking, 1063-6692, 2010.

[4] Mehri Mehrjoo, Mohamad KhattarAwad, Mehrdad Dianati and Xuemin Shen, “Design of Fair Weights for Heterogeneous Traffic Scheduling in Multichannel Wireless Networks”, IEEE Transactions on Communications, Vol. 58, No. 10, 2010.

[5] Meisam Mirahsan, Rainer Schoenen and Halim Yanikomeroglu,“HetNets: Heterogeneous traffic distribution in heterogeneous wireless cellular networks”, IEEE Global Communications Conference (Globecom), 2015.

[6] Biswajit Bhowmik, “A comparison study on selective traffic models with handoff management schemes for wireless mobile network infrastructure”, International journal of technology and computer science, vol.02, pp. 66-72, 2013.

[7] Biswajit Bhowmik, et al “ Modeling prioritized hard handoff management scheme for wireless mobile networks”, International journal of computer networks and information security , vol.8, pp. 21-32, 2012.

[8] Michael J. Neely, “Delay analysis for maximal scheduling with flow control in wireless networks with bursty traffic”, IEEE Transactions on networking, Vol.17, No.4, pp.1146-1159, 2009.

[9] N.G.Goudru and B.P.Vijaya Kumar, “Performance analysis and enhancement of TCP in presence of jitter in wireless networks”, International Journal of Computer Network and Information Security, Hong Kong, MECS,Vol.8, No.6, PP: 9-21, ISSN: 2074-9090 (Print), 2016.

Department: Information Science and Engineering	**CourseType:** Elective
CourseTitle: **Machine Learning**	**CourseCode:**18CNE203E3
L-T-P:3-0-0	**Credits:**3
TotalContactHours:39 hrs	**DurationofSEE:**3hrs
SEEMarks:50	**CIEMarks:**50

Prerequisite:

- Students should have knowledge of Databases and how they are managed.
- Students should have basic knowledge about graphs, trees and basic mathematical concepts.

Course Outcomes:

Students will be able to:

- Describe the basics of machine learning concepts.
- Analyze the concepts of neural networks, regression models and artificial intelligence.
- Design and inplement PCA for Neural networks.
- Apply SVM for building the mathematical models.
- Apply different modalities in ML framework

Teaching Methodology:

- Black board teaching
- Power Point presentations (if needed)
- Assignment
- Course Project

Assessment Methods:

- Three internals, 30Marks each will be conducted and the Average of best of two will be taken.
- Rubrics for Course Project
- Rubric Evaluation for Assignments
- Final examination, of100 Marks will be conducted and will be evaluatedfor50Marks.
- Post-assessment feedback on student.

Course Outcome to Programme Outcome Mapping:

PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**PSO1**	**PSO2**
CO1	3	2											2
CO2	3	2											2
CO3	3	2	1										2
CO4			1	1	1								2
CO5			1	1	1								2
	3	2	1	1	1								2

Course Contents

Unit-I 10 hrs

Introduction-Learning problems, Designing a learning system, perspectives and issues in Machine Learning. Decision Tree Learning- decision tree representation, appropriate problems for decision tree learning, the basic decision tree learning algorithm, hypothesis space search, issues in decision tree learning.

Unit-II 07 hrs

Supervised Machine Learning: Introduction with logistic regression; Logistic regression. Cost function. Artificial Neural Networks representations, appropriate problems for neural network learning, perceptrons, multilayer networks and the backpropagation algorithm.

Unit-III 07 hrs

Unsupervised machine learning: Basics, K-means clustering. Bayesian Learning-Bayes theorem, concept learning, maximum likelihood, Bayes optimal classifier, Gibbs algorithm, naïve Bayes classifier, Bayesian belief networks, the EM algorithm, PCA.

Unit-IV 08 hrs

Support Vector machine: Margins-Intuition, Notation, functional and geometric margins, optimal margin classifier,Lagrange duality, optimal margin classifiers, kernels, regularization and non-separable case, the SMO algorithm.

Unit-V 07 hrs

Genetic Algorithm,hypothesis space search, genetic programming, models of evolution and learning, Analytical Learning- learning with perfect domain theories:PROLOG-EBG, remarks on explanation-based learning, Inductive- Analytical approaches to Learning.

Text Books:

1. Tom Mitchell, "Machine Learning", McGraw Hill, 1997.
2. Online course materials:Andrew NG's online Course on Machine Learning.

Reference Books:

1. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2007.Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, "An Introduction to Statistical Learning: with Applications in R", Springer, 2016.
2. Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, "An Introduction to Statistical Learning: with Applications in R", Springer, 2016.
3. Trevor Hastie, Robert Tibshirani and Jerome Friedman, "The Elements of Statistical Learning: Data Mining, Inference, and Prediction", Springer, 2016
4. Andreas Muller, "Introduction to Machine Learning with Python: A Guide for Data Scientists", Shroff/O'Reilly; First edition (2016)

Department: Computer Networks And Engineering	**Course Type:** Core
Course Title: Information Security Lab	**CourseCode:**18CNE206L
L-T-P:0-0-4	**Credits:**2
TotalContactHours:24hrs	**DurationofSEE:**3hrs
SEEMarks:50	**CIEMarks:**50

Pre- requisite:

- Basic knowledge of computer networks

Course Outcomes:

Students will be able to:

- Design and implement different Symmetric and Asymmetric cryptographic algorithms.
- Design a solution to MD5 and SHA-1 Algorithms.
- Design and implement various network attacks by using suitable tool.

CO-PO&PSO Mapping:

PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**PSO1**	**PSO2**
CO1	1			1	2			1	1	2			3
CO2	1			1	2			1	1	2			3
CO3	1			1	2			1	1	2			3
CO Relation Level	1			1	2			1	1	2			3

Note: Use C/C++/Java or equivalent tool to implement the following experiment

1.	Consider a file with composite data, create an encryption of the data-using substitute the content and transpose the ciphers (Caesar Cipher, Monoalphabetic Cipher, Playfair Cipher, Hill Cipher, and Polyalphabetic Cipher).	**CO1**
2.	Develop a mechanism to setup a security channel using Diffie-Hellman Key Exchange between client and server	**CO1**
3.	Implementation of Message Authentication Code using cryptography VMAC function.	**CO1**
4.	Implement secure hash algorithm for Data Integrity. Implement MD5 and SHA-1 algorithm, which accepts a stringinput, 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.	**CO2**
5.	Implement a Brute-force password attack by using software/ simulation tool.(Hydra)	**CO3**
6.	Create an attack (DoS, DDoS) launch to other system and capture all the intrusion packets (Wireshark).	**CO3**
7.	Develop a mechanism to setup (configure) a port scanner and identify the intrusion.(TCP Dump)	**CO3**