NITTE MEENAKSHI INSTITUE OF TECHNOLOGY
(A Unit of Nitte Education Trust (R), Mangalore)
An Autonomous Institution

Department of Information Science and Engineering

Draft Syllabus for M.Tech – Computer Networks and Engineering (CNE)

Vision

To build a strong research and teaching environment in the field of Information Technology to meet the ever evolving global needs and to equip students with the latest knowledge, skills and practical orientation to face challenges in IT profession.

Mission

1. To offer comprehensive educational programs in the field of Information Technology producing highly accomplished graduates.

2. To inculcate among the students, the culture of research and innovation.

3. To encourage students to participate in co-curricular and extra-curricular activities leading to enhancement of their social and professional skills.

Programme Education Objectives (PEOs)

1. Graduate will have a sufficient depth of understanding in Computer Network & Engineering and the skills, confidence, professionalism, and experience necessary for successful careers in Computer Networks and related fields.

2 . Graduate will work with the latest technological topics, to find opportunities to engage in advanced studies, to conduct research, and develop skills for professionally communicating their work.

Programme Outcomes (POs)

PO-1	Students will have the ability to acquire and apply knowledge of computer network and engineering to evaluate, analyze and synthesize existing and new complex networking problems.
PO-2	Students will have the ability to apply independent judgment for critical appraisal skills – planning, organizing, problem solving and decision making which helps in conducting research in a wider theoretical, practical and policy context.
PO-3	Students will have the ability to Conceptualize and solve computer network based problems, evaluate a feasible and optimal solution for those problems by assessing the impact of global, social and cultural changes on IT industry.
PO-4	Students will have the ability to recognize the research problem; apply appropriate research methodologies, techniques and tools, design, conduct experiments, critical reviewing, documenting and reporting in the development of scientific or technological knowledge in one or more domains of Computer Network engineering.
PO-5	Students will have the ability to use current technology, skills and modern tools for networking and network management practices.
PO-6	Students will have the ability to possess knowledge and understanding of group dynamics, recognize opportunities for collaboration/ multidisciplinary work and relating computer networking issues with other disciplines to improve the outcomes.
PO-7	Students will have the ability to demonstrate knowledge and understanding of several computer networking ideas, algorithms and management principles for projects. To manage projects efficiently after considering the economical and financial issues.
PO-8	Students will have the ability to effectively communicate with the engineering community and with the society at large and capable of presenting reports and design documentation by adhering to appropriate standards.
PO-9	Students will have the ability to engage in lifelong learning independently, with the high level of enthusiasm and commitment to improve knowledge and competence continuously.
PO-10	Students will have the ability to acquire professional and intellectual integrity, code of conduct, ethics and professional practices and responsible to contribute to the community for sustainable development of the society.
PO-11	Students will have the ability to observe and examine the outcomes of one's actions periodically and make corrective measures subsequently, and learn from mistakes without depending on external feedback.

PSO-1	Student will be able to analyze, design and implement the solutions for the real world problems using latest computing and network paradigms like parallel, distributed and cloud computing
PSO-2	Student will be able to develop robust IOT based applications by designing network protocol stacks.

Scheme for M Tech (Tentative)

SEMESTER: I

Sl No	Subject Code	Subject Name	Course Type	Teaching Dept.	Teaching Hours/week			Examination			Credits
					L#	T#	P#	CIE*	SEE**	Total	
1	16CN101	Mathematical Foundation of Computer Network	PC		4	0	0	50	50	100	4
2	16CN102	Wireless Communications	PC		4	0	2	50	50	100	5
3	16CN103	Network Security	PC		4	0	0	50	50	100	4
4	16CN104	Advanced Computer Networks	PC		4	0	2	50	50	100	5
5	16CN105 EX	PROGRAM ELECTIVE – GROUP A	PE		4	0	2	50	50	100	5
6	16CN106	MINI PROJECT	PE		0	0	6	50	50	100	3
7	16CN107	Technical Seminar	PC		0	0	4	50	50	100	2
				TOTAL				350	350	700	28

Note : External examination should be combined for Seminar and Mini project (Viva Voce) but separate marks sheet should be submitted

SEMESTER: II

Sl No	Subject Code	Subject Name	Course Type	Teaching Dept.	Teaching Hours/week			Examination			Credits
					L#	T#	P#	CIE*	SEE**	Total	
1	16CN201	Wireless Sensor & Adhoc Networking	PC		4	0	2	50	50	100	5
2	16CN202	Network Programming	PC		4	0	2	50	50	100	5
3	16CN203	High Speed Networking	PC		4	0	0	50	50	100	4
4	16CN204	Analytical Approach in Data Network	PC		4	0	0	50	50	100	4
5	16CN205EX	PROGRAM ELECTIVE – GROUP B	PE		4	0	2	50	50	100	5
6	16CN206	MINI PROJECT	PE		0	0	6	50	50	100	3
7	16CN207	Technical Seminar	PC		0	0	4	50	50	100	2
		TOTAL						350	350	700	28

SEMESTER: III

Sl No	Subject Code	Subject Name	Course Type	Teaching Dept.	Teaching Hours/week			Examination			Credits
					L#	T#	P#	CIE*	SEE**	Total	
1	16CN301	SEMINAR/FIELD WORK/PROFESSIONAL TRAINING/ SELF STUDY/TERM PAPER	PC		-	-	8	50	50	100	4
2	16CN302	PROJECT PHASE -1	PC		-	-	32	50	50	100	16
							TOTAL	100	100	200	20

Note: 1.External examination should be combined for SEMINAR/FIELD WORK/PROFESSIONAL TRAINING/ SELF STUDY/TERM PAPER and PROJECT PHASE -1 (Viva Voce) but separate marks sheet should be submitted.
2. The Project willcommence immediately after the II semester.

SEMESTER: IV

Sl No	Subject Code	Subject Name	Course Type	Teaching Dept.	Teaching Hours/week			Examination			Credits
					L#	T#	P#	CIE*	SEE**	Total	
1	16CN401	PROJECT PHASE -2- THESIS ASSESMENT*	PC		-	-	15	100$	100#	200	08
2	16CN402	PROJECT PHASE -2- INTERNAL EVALUATION AND VIVO VOCE$	PC		-	-	24	100	100	200	16
							TOTAL	200	250	450	24

PROJECT PHASE -2- THESIS ASSESMENT* :-

The evaluation under this title involves two components 1. Thesis evaluation by the external examiner will be Considered as SEE

2. Thesis evaluation by the internal examiner will be Considered as CIE

PROJECT PHASE -2- INTERNAL EVALUATION AND VIVO VOCE$:-

The evaluation under this title involves two components 1. Final Viva Voce jointly conducted by the Internal and External examiner will be considered as SEE

2. Continuous evaluation of the project throughout the semester by a committee (at departmental level) will be Considered as CIE

Group – A

Sl No	Subject Code	Subject Name
1	16CN106E1	Internet of Things
2	16CN106E2	Cloud Computing
3	16CN106E3	Distributed Computing

Group – B

Sl No	Subject Code	Subject Name
1	16CN205E1	Big Data Analytics
2	16CN205E2	Industry Prescribed Elective
3	16CN205E3	
4	16CN205E4	

Department: *Information Science & Engineering*	***Course Type:*** *Core*
Course Title: **Mathematical Foundations of Computer Networking**	***CourseCode:16CN101***
L-T-P:4-0-0	***Credits:****04*
TotalContactHours:*48hrs*	***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 develop the models for different Network Scenario.
- Student will utilize the Network Resources optimally while designing the network.
- To provide guaranteed Quality of Service.

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Teaching Methodology:

- Lectures
- Power Point Presentation
- Case Study

Assessment Methods:

- Three internals, 30Markseachwill be conducted and the Average of best of two will be taken.
- Final examination, of 100 Marks will 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**
CO1	*											
CO2	*	*	*		*							
CO3		*										
	S	M	W		M							

*S: Strong
M: Medium
W: Weak

Unit-1: Linear algebra

Vector and matrix algebra, Linear combinations, independence, basis, and dimension, Solving linear equations using matrix algebra, Linear transformations, eigenvalues and eigenvectors, Importance of eigenvalues, The role of the principal eigenvalue, finding eigenvalues and eigenvectors, Power method to compute the dominant Eigen value and Eigen vector, Similarity and diagonalization,Stochasticmatrices,Computing state transitions using a stochastic matrix, Eigenvalues of a stochastic matrix, GOOGLE Page Rank Algorithm**.**

10 hrs.

Unit-2: Optimization

System modelling and optimization, An introduction to optimization-Optimising a system with two control parameters, Optimising a system with three variables, Optimizing linear systems, Network flow, Integer linear programming- A Scheduling problem.Dynamic programming-Fibonacci Computation. **10 hrs**

Unit-3: Probability

Introduction, Axioms of probability, Joint and conditional probability,Bayes' rule.Randomvariables,Distribution,Cumulative density function, Expectation of a random variable,Variance of a random variable.Moments and moment generating functions, Standard discrete distributions-Bernoulli distribution,Binomialdistribution,Geometric distribution, Poisson distribution, Gaussian or Normal distribution.

10 hrs

Unit-4: Stochastic Processes

Useful theorems-Markov's inequality,Chebyshev'sinequality,Chernoffbound,Strong law of large numbers,Central limit theorem,Jointly distributed random variables,Bayesiannetworks.A general queuing system,Little's theorem**,** Stochastic processes,Discrete and continuous stochastic processes, Markov processes, Homogeneity, **10 hrs**

Unit-5: Queuing Theory

State transition diagrams, and the Chapman-Kolmogorov equations,A fundamental theorem,Equilibrium probability of a Markov chain,A second fundamental theorem,Mean residence time in a state,Birth-Death processes, The M/M/1 queue,Two variations on the M/M/1 queue,TheM/M/ queue: a responsive server,M/M/1/K: bounded buffers**.** **08 hrs.**

Text Books:

Mathematical Foundations of Computer Networking bySrinivasanKeshav, Addison-Wesley Professional Computing Series.

References:

1) Discrete –Event system simulation, by Jerry Banks, Fourth Edition, Pearson.
2) Applied statistics and Probability for Engineers, Douglas C. Montgomery, George C.Runger, Third Edition, John Wiely& Sons, Inc.

Department: *Information Science & Engineering*	***Course Type:*** *Core*
Course Title*: Wireless Communications*	***CourseCode:16CN105***
L-T-P:4-0-2	***Credits:****05*
TotalContactHours:*48hrs*	***DurationofSEE:****3hrs*
SEEMarks*:50*	***CIEMarks:****50*

Prerequisite:

- Fundamentals of Computer Network.

Course Outcomes:

- Student will be able to know working of modern wireless and cellular networks.
- Student will utilize the different models of wireless network to overcome path loss in large and small propagations.
- Student will be able to differentiate between the development of fixed and wireless networks.

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Teaching Methodology:

- Lectures
- Power Point Presentation
- Case Study

Assessment Methods:

- Three internals, 30Markseachwill be conducted and the Average of best of two will be taken.
- Final examination, of 100 Marks will 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**
CO1	*											
CO2	*	*	*		*							
CO3		*										
	S	M	W		M							

*S: Strong
M: Medium
W: Weak

Unit-I **10hrs**

Modern Wireless Communication Systems: Second Generation(2G) Cellular Networks, Third Generation (3G) Wireless Networks, Wireless Local Loop (WLL) and LMDS, Wireless Local Area Networks (WLANs), Bluetooth and Personal Area Networks (PANs), **The Cellular Concept- System Design Fundamentals:** Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Interference and System Capacity, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems.Short range wireless Technologies –Bluetooth ,LiFi… introduction to 4G and 5G.

Unit –II **9hrs**

Mobile Radio Propagation: Large-Scale Path Loss: Introduction to Radio Wave Propagation, Free Space Propagation Model, Relating Power to Electric Field, The Three Basic Propagation Mechanism , Reflection, Ground Reflection(Two Ray) Model, Diffraction, Scattering, Practical Link Budget Design Using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings, Ray Tracing and Site Specific Modeling

Unit-III **10hrs**

Mobile Radio Propagation: Small –Scale Fading and Multipath: Small Scale Multipath Propagation, Impulse Response Model of a Multipath Channel, Small-scale Multipath Measurements, Parameter of Mobile Multipath Channels, Types of Small-Scale Fading, Rayleigh and Ricean Distributions, Statistical Models or Multipath Fading Channels, Simulation of Clarke and Gans Fading Model, Level Crossing and Fading Statistics, Two-ray Rayleigh Fading Model, Saleh and Valenzuela Indoor Statistical Model, SIRCIM and SMRCIM indoor and outdoor Statistical models , Theory of Multipath Shape Factors for Small-Scale fading wireless channels

Unit-IV **9hrs**

Modulation Techniques for Mobile Radio: Frequency Modulation vs Amplitude Modulation, Amplitude Modulation, Angle Modulation, Digital Modulation- and Overview, Line Coding, Pulse Shaping Techniques, Geometric Representation of Modulation Signals, Linear Modulation Techniques.

Unit-V **10hrs**

Wireless Networking: Introduction to Wireless Networks, Difference Between Wireless and Fixed Telephone Networks, Development of Wireless Networks, Fixed Network Transmission Hierarchy, Traffic Routing in Wireless Networks, Wireless Data Services, Common Channel Signaling (CCS), Integrated Services Digital Network(ISDN) Signaling System No.7 (SS7), An Example o f SS7-Global Cellular Network Interpretability, Protocols for Network Access, Network Databases, Universal Mobile Telecommunication System (UMTs), Multiple Input Multiple output(MIMO) IMS,VOLET Technologies.

Text book: Wireless Communications Principles and Practice 2nd Edition by Theodore S Rappaport.

Semester I **Year: 2016-17**

Department: *Information Science & Engineering*	***Course Type:*** *Core*
Course Title **Network Security**	***CourseCode:*** **16CN103**
L-T-P:4-0-0	***Credits:****04*
TotalContactHours:*50hrs*	***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 rigorous approaches.
- Understand the security technology like firewall and Intrusion Detection and Prevention System

CO-PO&PSO Mapping:

PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO 1**	**PSO 2**
CO1	*				*									
CO2	*										*			*
CO3	*						*	*					*	
CO4		*	*	*	*				*	*	*	*		
CO Relation Level	3	2	2	1	1		2	3	2	2	2	2	2	2

Course Contents

MODULE I **10 Hours**

Classical Encryption Techniques: Symmetric Cipher Model, Cryptography, Cryptanalysis and Brute-Force Attack, Substitution Techniques, Caesar Cipher, Mono alphabetic Cipher, Play fair 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, theUse 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.

MODULE II **10 Hours**

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 system, Elliptic curve arithmetic, Abelian groups, Elliptic curves over real numbers, Elliptic curves over Zp, Elliptic curves over GF(2^m), 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, PRNG based on Elliptic curve cryptography.

MODULE III **10 Hours**

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, PKIX Management Functions, PKIX Management Protocols. **UserAuthentication:** Remote user Authentication principles, Mutual Authentication, One wayAuthentication. 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, Mutual Authentication, One way Authentication. Federated identity management, Identity management, Identity federation. Personal identity verification, PIV System Model, PIV Documentation, PIV Credentials and Keys, Authentication.

MODULE IV **10 Hours**

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. IEEE 802.11i Wireless LAN 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.**Transport-level Security**, **Web Security Considerations:** Web Security Threats, Web Traffic Security Approaches. **Secure Sockets Layer :**SSL Architecture, SSL Record Protocol, Change Cipher Spec Protocol,Alert Protocol, Hand shake Protocol, Cryptographic Computations. **Transport Layer Security:** Version

Number, Message Authentication Code, Pseudorandom Function, 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.

MODULE V **10 Hours**

Security Technology Firewalls and VPNs: Introduction, Access control- Identification, Authentication, Authorization, Accountability. Firewalls- Firewall processing modes, Firewalls categorized by generation, Firewalls categorized by structure, Firewalls architectures, Selecting of right firewalls, Content Filters. Protecting remote connections- Remote Access, Virtual Private Networks.

Intrusion Detection and Prevention Systems - IDPS terminology, Why use an IDPS ? Types of IDPS, IDPS detection methods, IDPS response behavior, Selecting IDPS approaches and products, Strength and limitations of IDPS, Measuring the effectiveness of IDPS. Honeypots, Honeynets and Padded cell systems. Scanning and analysis tools. Biometric access controls- effectiveness of biometrics, Acceptability of Biometrics.

Text Books:

1. William Stallings: Cryptography and Network Security, Pearson 6th edition.
2. M. E. Whitman and Herbert J. Mattored , Principles of Information Security, Information Security Professional 4th edition.

References

1. V k Pachghare: Cryptography and Information Security.

Semester: I Year: 2016-17

Department: *Information Science & Engineering*	***Course Type:*** *Core*
Course Title*: Advanced Computer Networks*	***CourseCode:16CN105***
L-T-P:4-0-2	***Credits:****05*
TotalContactHours:*36hrs*	***DurationofSEE:****3hrs*
SEEMarks*:50*	***CIEMarks:****50*

Prerequisite:

- Have taken at least an undergraduate-level Computer networks course.
- 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 design a network with appropriate protocols selected according to requirement.
- Students will be able to analyze different routing protocols and traffic engineering methods deployed in networking.
- Understand the concept of SDN (i.e. abstracting and centralizing the control plane).
- Analyze the implications of shifting from traditional network architectures to software defined networks.
- Apply and analyze network functions virtualization.
- Implement a network service using the knowledge acquired throughout the lectures.

Teaching Methodology:

- Lectures
- Programming Assignments
- Case Study

Assessment Methods:

- Three internals, 30Markseach 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 Outcome to Programme Outcome Mapping

PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	*											
CO2	*	*	*		*							
CO3		*										
CO4					*							
	S	M	W		M							

*S: StrongM: Medium

W: Weak

CourseContent

UNIT I: 09Hours

Routing in Packet Networks; Shortest Path Routing;Traffic Management at packet level; Traffic management at flow level;

UNIT II: 09Hours

Advanced Network Architecture: Integrated Services in Internet, RSVP, Differentiated Services, MPLS, Real-time Transport Protocol

UNIT III:

Evolution of Switches and Control Planes, Cost, SDN Implications for Research and Innovation, Data Center Innovation, Data Center Needs, **The Genesis of SDN**: Abstract, The Evolution of Networking Technology, Forerunners of SDN, Software Defined Networking is Born, Sustaining SDN Interoperability, Open Source Contributions, Legacy Mechanisms Evolve Toward SDN, Network Virtualization, May I Please Call My Network SDN? **How SDN Works**: Abstract, Fundamental Characteristics of SDN, SDN Operation, SDN Devices, SDN Controller, SDN Applications, Alternate SDN Methods.

Unit IV 10hrs

SDN in the Data Center, Abstract, Data Center Definition, Data Center Demands, Tunneling Technologies for the Data Center, Path Technologies in the Data Center, Ethernet Fabrics in the Data Center, SDN Use Cases in the Data Center, Open SDN versus Overlays in the Data Center, Real-World Data Center Implementations **SDN in Other Environments** : Abstract, Consistent Policy Configuration, Global Network View,8.1 Wide Area Networks, Service Provider and Carrier Networks, Campus Networks, Hospitality Networks, Mobile Networks, In-Line Network Functions, Optical Networks, SDN vs. P2P/Overlay Networks,

Unit V 10hrs

Network Function Virtualization: Introduction, Existing Network Virtualization Framework (VMWare and others), Mininet based examples, Virtualization and Data Plane I/O, Services Engineered Path, Service Locations and Chaining, NFV at ETSI, Non-ETSI NFV Work, **Network Topology and Topological Information Abstraction**: Introduction, Network, Topology, Traditional Methods, LLDP, BGP-TE/LS, ALTO, I2RS Topology **Building an SDN Framework**: Introduction, Build Code First; Ask Questions Later...,The Juniper SDN Framework, IETF SDN Framework(s),Open Daylight Controller/Framework, Policy, Conclusions

TextBooks:

1. Communication Network by Alberto Leon Garcia and IndraWidjaja.
2. 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.

3. Software Defined Networks: A Comprehensive Approach, by Paul Goransson and Chuck Black, Morgan Kaufmann, June 2014, Print Book ISBN: 9780124166752, eBook ISBN : 9780124166844(unit 1)

References:

1. SDN and OpenFlow for Beginners by Vivek Tiwari, Sold by: Amazon Digital Services, Inc., ASIN: , 2013.

2. Network Innovation through OpenFlow and SDN: Principles and Design, Edited by Fei Hu, CRC Press, ISBN-10: 1466572094, 2014.

Electives Group A

Semester :I Year: 2016-17

Department: *Information Science & Engineering*	***Course Type:*** *Elective*
CourseTitle*: Internet of* Things (IOT)	***CourseCode:16CN106E1***
L-T-P:4-0-2	***Credits:****05*
TotalContactHours:*48hrs*	***DurationofSEE:****3hrs*
SEEMarks*:50*	***CIEMarks:****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:

- Lectures
- Course Project/Programming Assignments
- Summarization by the student at the end of the session
- 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 Outcome to Programme Outcome Mapping

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO1	*				*									
CO2	*										*		*	
CO3	*						*	*						*
CO4		*	*	*	*				*	*	*	*		
CO Relation Level	3	2	2	1	1		2	3	2	2	2	2	2	2

CourseContent

UNITI **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

UNITII **12 Hours**

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

UNITIII **13 Hours**

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

UNITIV: **09Hours**

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

UNITV **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.
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,PeterFriess**Internet of Things:ConvergingTechnologiesfor Smart Environmentsand Integrated Ecosystems. River Publishers Series in Communication.

Semester: I Year: 2016-17

Department: *Information Science & Engineering*	***Course Type:*** *Elective*
Course Title*: Cloud Computing*	***Course Code:16CN105E2***
L-T-P: *4-0-2*	***Credits:*** *05*
Total Contact Hours: *48hrs*	***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 Ubiquitous computing and Internet of Things
- 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

PO	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
CO1	**S**											
CO2	**S**		**M**		**S**				**M**	**M**	**W**	
CO3	**S**						**S**					
CO4	**S**		**S**		**S**				**M**	**M**	**M**	

*S: Strong

M: Medium

W: Week

Course contents

UNIT I **10hrs**

Virtual Machines and Virtualization of clusters and Data centers: Implementation Levels of Virtualization, Virtualization Structures/Tools and mechanisms, virtualization of cpu, Memory and I/O devices, Virtual clusters and resource Management, Virtualization for data center automation

UNIT II **10hrs**

Cloud Platform architecture over virtual data centers: Cloud Computing and service models, Data center design and interconnection networks, Architectural design of compute and storage clouds, Public cloud platforms: GAE, AWS and Azure, Inter cloud Resource Management, Cloud security and Trust Management.

UNIT III **10hrs**

Service Oriented Architecture for Distributed Computing: Services and Service Oriented Architecture, Message Oriented middleware, Discovery, Registries, Metadata and Databases

UNIT IV **10hrs**

Cloud Programming and Software Environments: Features of cloud and grid platforms, Parallel and distributed programming paradigms, programming Support for Google App Engine, Programming on Amazon AWS and Microsoft Azure, Emerging Cloud software Environments.

UNIT V **08hrs**

Ubiquitous Clouds and the Internet of Things: Cloud Trends in supporting Ubiquitous Computing, Enabling Technologies for the Internet of Things, Innovative Applications of the Internet of Things

Text book: 1. “Distributed and cloud computing” by Kai Hwang, Geoffrey C Fox and Jack J Dongarra.

Semester: I Year: 2016-17

Department: *Information Science & Engineering*	**Course Type:** Elective
Course Title: Distributed Computing	**Course Code:16CN106E3**
L-T-P:4-0-2	**Credits:**05
TotalContactHours:48hrs	**Duration of SEE:**3hrs
SEEMarks:50	**CIEMarks:**50

Pre-requisites:

Student needs basic knowledge of operating system

Course Outcomes:

1. Students will be able to recognize various architectural models, resource sharing and inter process communication techniques
2. Students will be able to demonstrate client server communication and describe remote procedure call events
3. Students will be able to identify synchronization of deadlocks, distributed mutual exclusion and deadlocks
4. Students will be able to describe design and implementation issues of distributed transactions and shared memory.

Teaching Methodology:

- Black board teaching
- PowerPoint presentations (if needed)
- Course Project / Case Study / Programming Assignments

Assessment Methods

- Three internals, 30 Marks each will be conducted and the Average of best of two will be taken.
- Final examination, of 100 Marks will be conducted and will be evaluated for 50Marks.
- Rubrics for Case Studies / Case Study / Programming Assignments

Course Outcome to Programme Outcome Mapping

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

Course Content

UNIT I **9 HOURS**

CHARACTERIZATION OF DISTRIBUTED SYSTEMS: Introduction, Examples of distributed systems, Trends in distributed systems, Focus on resource sharing, Challenges, Case study: The World Wide Web. **SYSTEM MODELS**: Introduction, Physical models, Architectural models, Fundamental models.

UNIT II **10 HOURS**

REMOTE INVOCATION: Introduction, Request-reply protocols, Remote procedure call, Remote method invocation, Case study: Java RMI. **DISTRIBUTED OBJECTS AND COMPONENTS**: Introduction, Distributed objects, Case study: CORBA, from objects to components, Case studies: Enterprise JavaBeans and Fractal.

UNITIII **9 HOURS**

DISTRIBUTED FILE SYSTEMS: Introduction, File service architecture, Case study: Sun Network File System, Case study: The Andrew File System. **NAME SERVICES**: Introduction, Name services and the Domain Name System, Directory services. **TIME AND GLOBAL STATES**: Introduction, Clocks, events and process states, Synchronizing physical clocks, Logical time and logical clocks, Global states, distributed debugging.

UNITIV **10 HOURS**

COORDINATION AND AGREEMENT: Introduction, Distributed mutual exclusion, Elections, Coordination and agreement in group communication, Consensus and related problems.
TRANSACTIONS AND CONCURRENCY CONTROL: Introduction, Transactions, Nested transactions, Locks, Optimistic concurrency control, Timestamp ordering, Comparison of methods for concurrency control.

UNITV **10 HOURS**

DISTRIBUTED TRANSACTIONS: Introduction, Flat and nested distributed transactions, Atomic commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery.
REPLICATION: Introduction, System model and the role of group communication, Fault-tolerant services, Case studies of highly available services: The gossip architecture, Bayou and Coda, Transactions with replicated data.

Text Book:

1. Distributed Systems Concepts and Design: George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair, Fifth Edition, Pearson, M.Addison Wesley Co1987.