GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3720519

Semester – II
Subject Name: Embedded Wireless Technologies.

Type of course: Embedded Wireless Communication

Prerequisite: Fundamental knowledge of Wireless and digital Communication.

Rationale: This Subject Provide the students an exposure to understand wireless communication technology and learn how to implement it on embedded platform. It also helps the students to develop their own project or carried our dissertation work on embedded wireless application. This subject provides the opportunity to the student to understand real environment problem in wireless communication and motivate them to bring out with the solution by practically implementing application.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
03	0	02	04	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Review of C Programming, Data Structures , Introduction to UML , Software Life Cycle Models , Embedded Systems Design, Implementation and Testing , Overview of Networking and Packet Switching Concepts, OSI Reference Model and TCP/IP Protocol Suite, LAN Protocol Suite .	10
2	Evolution of Wireless Communication - Radio architectures: TRF, single conversion, and dual conversion, Super-heterodyne receiver, IQ; Modulation - AM, FM, SSB, TDMA, CDMA, FDMA, OFDM, BPSK, QPSK, M-QAM; PLL – phase lock loops, Wireless Standards – IS136, IS95, 802.11(a-g), GSM, 3G, WiMax, Small Scale and large scale fading.	10
3	Embedded Systems – Hardware, Software, Internet Access; Development and Debugging Tools - Simulators, ICE, C Compiler; RTOS – System Services, Interrupt Handling, Real Time, Scheduling; Socket Programming – Internet Architecture, UDP, TCP, client/server; Internet Application Protocols – HTTP, FTP, SNMP, Audio/Video Applications	12
4.	Embedded systems hardware and software interfaces; Protocol Debugging & Testing Tools – PING, Sniffers, Load Generators; Development tools – SDK, simulators, debuggers; TCP/IP – architecture, socket programming and debugging	06
5.	Wireless Technologies and Mobile Programming - Wireless LAN : 802.11 & WiMAX, RFID & Bluetooth, GSM & GPRS, MIMOm Mobile Development Platforms (Android,	05

	Symbian, OpenMoko, J2ME), Bluetooth – architecture, protocols, implementation, and programming API; WiFi – architecture, protocols, implementation, and API; ZigBee – architecture, protocols, implementation, and API.	

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**20**	**30**	**20**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Embedded Systems and Wireless Technology: Theory and Practical Applications, Raul A. Santos, CRC Press
2. Embedded Systems and Wireless Technology: Theory and practical applications by Dr. Raúl Aquino santos, MSc. Arthur Edwards Block (University of Colima, Mexico)
3. Fundamentals of Mobile and Pervasive Computing by Frank Adelstein, Sandeep K.S. Gupta, Golden G. Richard III, and Loren Schwiebert, Publisher: McGraw-Hill Education, 2005, ISBN-10:0071412379, ISBN-13: 978-0071412377.
4. Context-Aware Pervasive Systems: Architectures for a New Breed of Applications by Seng Loke, Publisher: AUERBACH, 1st edition (December 7, 2006), ISBN-10: 0849372550, ISBN-13: 9780849372551
5. Cooperating Embedded Systems and Wireless Sensor Networks by Michel Banatre (Editor), Pedro Jose Marron (Editor), AnibalOllero (Editor), Adam Wolisz (Editor)

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Design a API using Embedded technology	20
CO-2	Analyse the performance of various embedded system	30
CO-3	Evaluate the performance of various protocols and wireless communication standards	20

CO-4	Understand the process of embedded software design and networking	30

List of Experiments:

Practical may be based on the syllabus using related simulation software and/or hardware platforms.

Major Equipment:

Latest android mobile

List of Open Source Software/learning website:

1. Sdk
2. Jdk
3. netBeans/eclipse

GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3720518
Semester –II
Subject Name: MIMO Systems

Type of course: To understand the performance of MIMO system in 4G/5G wireless communications. This course covers the fundamentals of Multiple input multiple output (MIMO) antenna based wireless communication systems. MIMO is now an essential part of modern wireless communication systems, such as 3G, 4G, WLAN / Wifi, LTE, WiMax, etc.

Prerequisite: Digital Communications, Signals and Systems, Wireless communications

Rationale: To learn about MIMO communication systems, capacity of MIMO, space time coding scheme and MIMO in 4G/5G wireless communications with available technology and schemes

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Contents:

Sr. No.	Content	Total Hrs
1	Unit 1: Introduction to Multi-antenna Systems, Motivation, Diversity, Types of Diversity, Types of multi-antenna systems, MIMO vs. multi-antenna systems	4
2	. Unit 2: Transmit diversity, Receive diversity, MIMO system, Space-time codes, the Alamouti scheme, Delay diversity, Cyclic delay diversity, The rake receiver, Combining techniques, Spatial Multiplexing, Layered Architecture, Spectral efficiency and capacity, Transmitting independent streams in parallel, Mathematical notation	
3	. **Unit 3:** The generic MIMO problem, Singular Value Decomposition, Eigen values and eigenvectors, Equalizing, MIMO systems, Disadvantages of equalizing MIMO systems, Predistortion in MIMO systems, Disadvantages of pre-distortion in MIMO systems, Pre-coding and combining in MIMO systems, Advantages of pre-coding and combining, Disadvantages of precoding and combining, Channel state information.	
4	**Unit 4:**Codebooks for MIMO, Beamforming, Beamforming principles, Increased spectrum efficiency, Interference cancellation, Switched beamformer, Adaptive beamformer, Narrowband beamformer, Wideband beamformer.	6
5	**Unit 5:** Case study: MIMO in LTE, Code words to layers mapping, Pre-coding for spatial multiplexing, Pre-coding for transmit diversity, Beamforming in LTE, Cyclic delay diversity based pre-coding, Pre-coding codebooks, Propagation Channels, Time & frequency channel dispersion, AWGN and multipath propagation channels, Delay spread values and time variations, Fast and slow fading environments, Complex baseband multipath channels, Narrowband and wideband channels, MIMO channel models	
6	**Unit 6:** Channel Estimation, Channel estimation techniques, Estimation and tracking, Training based channel estimation, Blind channel estimation, Channel estimation	

	architectures, Iterative channel estimation, MMSE channel estimation, Correlative channel sounding, Channel estimation in single carrier systems, Channel estimation for CDMA, Channel estimation for OFDM.	
7	**Unit 7:** Latest technologies with the application of MIMO, Concept of Massive MIMO, Application of Massive MIMO in 5th Generation Mobile telephony, IoT systems with MIMO, Massive MIMO with F-OFDM,MIMO based Cooperative Communication,MIMO Cognitive Radios	**8**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**30**	**20**	**10**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

References:

1. Claude Oestges, Bruno Clerckx, "MIMO Wireless Communications : From Real-world Propagation to Space-time Code Design",Academic Press, 1st edition, 2010.
2. MohinderJanakiraman, "Space - Time Codes and MIMO Systems", Artech House Publishers, 2004.
3. EzioBiglieri, Robert Calderbank, Anthony Constantinides, Andrea Goldsmith, ArogyaswamiPaulraj, H. Vincent Poor, "MIMO Wireless Communications, Cambridge.
4. Rakhesh Singh Kshetrimayum, "Fundamentals of MIMO Wireless Communications",Cambridge University Press 2017
5. ArogyaswamiPaulraj, RohitNabar, and DhananjayGore."Introduction to Space-Time Wireless Communications" (Cambridge University Press, New York, NY, USA)
6. Yong Soo Cho, Jaekwon Kim, Won Young Yang, Chung G. Kang, "MIMO-OFDM WIRELESS COMMUNICATIONS WITH MATLAB" Wiley
7. Aditya K. Jagannatham, "Principles of Modern Wireless Communication Systems" McGraw-HillEducation
8. Tolga M. Duman and Ali Ghrayeb, "Coding for MIMO Communication systems", John Wiley & Sons, West Sussex, England, 2007.
9. A.B. Gershman and N.D. Sidiropoulus, "Space-time processing for MIMO communications", Wiley, Hoboken, NJ, USA, 2005.
10. H. Jafarkhani, "Space-time coding: Theory & Practice", Cambridge University Press, 2005
11. Larsson, Erik G. and PetreStoica, "Space-Time Block Coding for Wireless Communications", Cambridge University Press (2008).

GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3720518

Course outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Understand the basic concept of antenna diversity schemes.	20 %
CO-2	Analyse the signal processing of MIMO in 4G LTE Communication.	20 %
CO-3	Compare the channel capacity of MIMO system under different channel conditions.	20 %
CO-4	Understand the problems related to Alamouti coding and BLAST structure of MIMO system.	10 %
CO-5	Analyze the Massive MIMO environment in 5G systems.	20 %
CO-6	Understand the cooperative communication along with cognitive radio.	10 %

List of Experiments:

MATLAB exercise problems may be given based on

1. Understand the different wireless channel Models.
2. Performance comparison of SISO, SIMO, MISO and MIMO.
3. Channel capacity of MIMO system.
4. The Alamouti scheme
5. Space time coding in MIMO Communications.

Major Equipments:

USRP

List of Open Source Software/learning website:

Scilab, NPTEL

GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3720517
Semester – II
Subject Name: Markov Chain and Queuing System

Type of course: Program Elective IV

Prerequisite: Higher Engineering Mathematics, Probability theory, Random variables and Random Processes

Rationale:

PG Students of EC Engineering need to possess good understanding of the fundamentals Algebra and random variable. They are expected to be able to understand random processes and perform matlab implementation of stochastic processes like point processes, Poisson process. Students will learn discrete time Markov chains, Continuous time Markov chains, Markovian queueing systems, Markov chain applications to M/G/1, G/M/1, and Queues with vacations, priority queues.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Unit 1:** Introduction: Review of basic probability, properties of nonnegative random variables, laws of large numbers and the Central Limit Theorem.	6
2	**Unit 2:** Renewal Processes: Basic definitions, recurrence times, rewards and renewal reward theorem, point processes, Poisson process, Walds equation, Blackwell's theorem.	6
3	**Unit 3:** Discrete time Markov chains: definitions and properties, matrix representation, Perron- Frobenius theory.	8
4	**Unit 4:** Continuous time Markov chains: basic definitions, Q-matrix, birth-death processes, quasi birth death Processes, Embedded Markov processes, semi Markov processes, reversible Markov chains, Random walks.	6
5	**Unit 5:** Fundamental queuing results: Little's theorem, invariance of the mean delay, Conservation law. Markovian queues: Jackson and BCMP networks, numerical Algorithms. M/G/1 & G/M/1 queues and G/G/1 queues.	8
6	**Unit 6**: Advanced queuing models: priority, vacation and retrials in queues.	8

GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3720517

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**30**	**20**	**20**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

References:

- Cliffs, "Stochastic Modelling and the Theory Queues", Prentice Hall, 1989.
- P.Bremaud, "Markov Chains", Springer-Verlag, 1999.
- E.Seneta, "Non Negative Matrices and Markov Chains", Springer Series in Statistics, Springer,1981.
- R.Gallager, "Discrete Stochastic Processes", Kluwer Academic Press, 1996.
- L.Kleinrock, "Queuing Systems", vols I and II, John Wiley and Sons 1976.

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Recall knowledge of probability theory, Random variables and Random processes.	15
CO-2	Understand Markov Chains and regenerative processes used in modeling a wide variety of systems and phenomena.	25
CO-3	Model a system as queuing system with some aspect of the queue governed by a random process.	30
CO-4	Understand telecommunication systems modeling using Markov chains with special emphasis on developing queuing models.	30

List of Experiments:

1. Write a MATLAB program for derivatives of random process.
2. Write a MATLAB program for integration of random process.
3. Write a program to create discrete time Markov chain.
4. Write a program to create Markov Chain using Transition Probabilities matrix.
5. Explore M/G/1 queuing theory with Simulink.
6. Explore G/M/1 queuing theory with Simulink.
7. Explore G/G/1 queuing theory with Simulink.

More Simulation exercises can be designed based on the syllabus.

List of Open Source Software/learning website:

- Scilab
- http://www.vlab.co.in/
- NTPEL

GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3720516
SPEECH SIGNAL PROCESSING
SEMESTER: II

Type of course: PE-III

Prerequisite: Digital signal processing

Rationale: For humans, speech is a natural way of communicating the ideas. This course is a fundamental course on how to process digital speech signal to extract useful information. The course builds upon the theory of digital signal processing and extends the concepts applied to speech signal in particular. The course also discusses the applications of speech signal processing.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Sr. No.	Content	Total Hrs
1	Speech Communication: Introduction, discrete-time speech signal processing, speech communication, review of signals and linear Systems	4
2	Speech Production and acoustic phonetics: Anatomy and physiology of speech organs, speech sounds and classification, International Phonetic Alphabet (IPA), Articulatory Phonetics: Manner of articulation and place of articulation, vowel triangle, Acoustic Phonetics: spectrograms, wide-band and narrow-band spectrograms, acoustic characteristics of speech sounds, coarticulation and prosody	6
3	Time-domain models for speech processing: Introduction to short-time speech analysis, windowing, short-time energy and average magnitude, short-time Zero-Crossing Rate (ZCR), speech vs. silence discrimination using energy and zero crossings, short-time autocorrelation function, short-time Average Magnitude Difference Function (AMDF)	8
4	Short-time Fourier analysis: Short-time Fourier transform (STFT), spectral displays, time-frequency resolution tradeoffs, Linear filtering interpretation, short-time synthesis, filter bank summation method	8
5	Linear Predictive Analysis: Basic principles of Linear predictive analysis, autocorrelation method and covariance method, computation of gain for the model, prediction error signal, frequency domain interpretation of LP analysis, frequency domain interpretation of mean squared prediction error, applications of LPC parameters	8
6	Homomorphic Signal Processing: Concept of Homomorphic processing, Homomorphic systems for convolution, properties of complex cepstrum, Homomorphic filtering, complex cepstrum of voiced speech, complex cepstrum of unvoiced speech, Mel-scale cepstrum	8
7	Speech Coding: Fundamentals of coding, liner prediction and harmonic noise models in speech coding, modeling excitation for voiced and unvoiced speech, Code-Excited linear prediction coding	6

	Total	48

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**30**	**20**	**20**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Speech Communication: Human and machine, D. O'Shaughnessy , Uniiversity Press
2. Digital Processing of Speech Signals, L. Rabiner and R. Schafer, Pearson Education
3. Discrete-time Speech Signal Processing, T. Quatieri, Pearson Education

Course Outcomes☹COs)

A student who successfully completes this course should be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	To apply basic principles of problem solving in speech signal processing for the society and environment	20
CO-2	To analyze and design speech signal processing systems using acoustic phonetics,time domain methods, short time fourier analysis, linear predictive analysis, homomorphic signal processing for the society and environment in ethical way	30
CO-3	To prepare post graduates with the knowledge, ethics and skills so that they can be applied to various speech processing applications in environment friendly manner for the society	20
CO-4	To build projects individually or in a group consisting of speech processing system as per the need of the society in a professional ethical and environment friendly manner	20
CO-5	To apply the knowledge of speech processing to troubleshoot the speech related products in ethical way and constructively useful for the society and environment	10

List of Experiments:

1. To study the effects of windowing.
2. To understand the difference between stationary and non-stationary signals.
3. To extract a slice of speech signal and compute its spectrum for different window length.
4. To simulate periodic glottal pulse train.
5. To synthesize vowel using source filter model.
6. To compute wideband and narrowband spectrogram of a given speech signal.
7. To compute short-time energy and ZCR of a given speech signal.
8 To compute short-time autocorrelation function and plot pitch contour for given utterance.

9. To compute short-time AMDF and plot pitch contour for given utterance.
10. To detect pitch using harmonic product spectrum.
11. To study LPC and cepstral analysis method.

1. An important pre-processing step in many speech processing tasks is to discriminate between a speech and a silence. In this problem you should come up with an algorithm to segment a given speech signal into speech and silence parts.
2. For a given speech signal, classify speech segments into two parts: voiced and unvoiced speech segments
3. Given a speech signal, determine whether it contains an adult voice or a child voice.
4. Determine pitch of a given speech signal.
5. Determine the locations of vowels in the given speech signal.

List of Open Source Software/learning website:

- Scilab
- http://www.vlab.co.in/ (Virtual labs at IIT Guwahati)
- NTPEL
- Signal Processing Toolbox
- Praat: doing phonetics by computer (version 5.4.01)

GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3720514
Software Defined Networks
SEMESTER: II

Type of course: Program Elective III

Prerequisite: Data Communication and Networking, Advanced Computer Network

Rationale: Software Defined Networks (SDN) is an emerging technology that has been rapidly changing the networking industry and networking research. By separating the network control from the underlying packet forwarding hardware, SDN lowers the entry-point for innovation in network control and enables a global approach to specify complex networking tasks in one single control framework, which promises significant simplification of network management, control, and monitoring. SDN has gained significant traction among major industrial players including Cisco, Broadcom, Google, IBM, and Intel, and has been deployed in wide area networks, campus networks, and data centers. In this course, students will learn the fundamentals of Software Defined Networks.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Introduction to SDN:** Overview; History and evolution of SDN; Architecture of SDN; SDN Flavours; Scalability (Data Centres, Service provider networks, ISP Automation); Reliability (QoS, and Service Availability); Consistency (Configuration management, and Access Control Violations); Opportunities and Challenges	6	15
2	**Control and Data Plane Separation:** Introduction to OpenFlow; History and evolution; Control and data plane separation; virtual networking; Use-cases (Network Access Control, Virtual Customer Edge, Datacenter Optimization)	6	15
3	**Network Virtualisation:** Abstraction of Physical Network (constrained forwarding model, distributed state, detailed configuration); components of a virtual network (Virtual Switch, Bridge, Host-virtual adapter, NAT device, DHCP server, Network adapter); Network as a Service (NaaS)	8	15

4	**Applications of SDN:** Network management; Resource utilization; Network service chaining; Bandwidth calendaring and Network programmability.	**6**	**15**
5	**SDN Design and Development:** Mininet; Applications; Network Virtual Machines; SDN Controller (POX, Floodlight, OpenDayLight; Applicability of OpenFlow protocols in SDN Controllers	**8**	**20**
6	**SDN PROGRAMMING** Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs – Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications	**8**	**20**
	Total	**42**	**100**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**20**	**30**	**20**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Ying-Dar Lin, Ren-Hung Hwang, and Fred Baker, "Computer Networks: An Open Source Approach", McGraw-Hill Science/Engineering/Math, 2011.
2. Paul Goransson and Chuck Black, "Software Defined Networks: A Comprehensive Approach", Morgan Kaufmann, 2014.
3. Thomas D. Nadeau, Ken Gray, SDN: Software Defined Networks, O'Reilly Media, 2013.

Course Outcomes:

Sr. No.	**CO statement**	**Marks % weightage**

CO-1	Analyze the evolution of software defined networks	15
CO-2	Express the various components of SDN and their uses	30
CO-3	Explain the use of SDN in the current networking scenario	30
CO-4	Design and develop various applications and programming of SDN	25

List of Experiments:

1. Setup Virtual Box/Mininet or equivalent simulator Environment for SDN
2. Verify SDN Environment in Mininet or equivalent simulator
3. Determine Flow Inactivity Timeout in Mininet or equivalent simulator
4. Determine the Flow‘s Hard Timeout in Mininet or equivalent simulator

List of Open Source Software/learning website:

- Mininet
- Virtual Box
- NTPEL

GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3720514
Semester – II
Subject Name: IoT and Applications

Type of course: PE-III

Prerequisite: Fundamentals of computer networking

Rationale: IoT market is growing rapidly from installed base of about 10 billion devices in the year 2018 and expected to 20 billion devices by 2020 for Consumer and business/industry. Industry 4.0 is based on IoT. This subject will provide opportunity to the students for contribution in IoT applications.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Internet of Things and Web Technology, The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.	8
2	M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.	8
3	IoT Architecture -State of the Art – Introduction, State of the art, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.	9
4	IoT Applications for Value Creations, IoT applications for industry (Industry 4.0: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.	5

5	Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues,	**4**
6	IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, SMARTIE Approach. Data Aggregation for the IoT in Smart Cities	**5**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**20**	**30**	**20**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

[1] Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", , Paperback, 2015.

[2] Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1stEdition, Apress Publications, 2013.
[3] A. McEwen, H. Cassimally, "Designing the Internet of Things", Wiley, 2013.
[4] CunoPfister, "Getting Started with the Internet of Things", O_Reilly Media, 2011.
[5] Yashwant Kanetkar, "21 Internet of Things Experiments", Kindle edition

Course Outcomes:

On successful completion of the course, the students should be able to:

- Understand the concept of IOT and M2M
- Design applications based on IOT Architecture
- Evaluate security and privacy issues in IoT
- To apply data aggregation for IoT in smart cities

Sr. No.	**CO statement**	**Marks % weightage**
CO-1	Understand the concept of IOT and M2M	20

CO-2	Design applications based on IOT Architecture	30
CO-3	Evaluate security and privacy issues in IoT	25
CO-4	To apply data aggregation for IoT in smart cities	25

Laboratory Experiments

1. Experiments based on IoT protocols such as MQTT
2. Experiments based on Security algorithms
3. Uploading sensor data on cloud
4. Web based device control
5. Agriculture IoT applications (Soil moisture, PH monitor)
6. IoT based home automation
7. Smart energy experiments
8. Smart city IoT applications

List of Open Source Software/learning website:

1. NPTEL online course on IoT: https://onlinecourses.nptel.ac.in/noc18_cs08
2. IoT Tutorial point www.tutorialspoint.com
3. https://www.microsoft.com/en-us/internet-of-things/

GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering

Subject Code: 3720513

ADVANCED COMMUNICATION NETWORKS

SEM-II

Type of course: Programme Core –I

Prerequisite: Basics of Computer hardware, Computer software, data Communication and computer networks

Rationale:

Students of EC Engineering need to possess good understanding of the advancements in networking and various networking standards and protocols. This course imparts a unified systems view of the broad field of advanced computer communications. The fundamental principles of advanced communications networks and protocols are thoroughly presented and applied in data communication networking.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Syllabus:

Sr. No.	Content	Total Hrs	% Weightage
1	**Unit 1:** Overview of Internet-Concepts, challenges and history Overview of-ATM. TCP/IP Congestion and Flow Control in Internet-Throughput analysis of TCP congestion control. TCP for high bandwidth delay networks. Fairness issues in TCP.	**07**	15
2	**Unit 2:** Real Time Communications over Internet. Adaptive applications. Latency and throughput issues. Integrated Services Model (intServ). Resource reservation in Internet. RSVP.Characterization of Traffic by Linearly Bounded Arrival Processes (LBAP). Leaky bucket algorithm and its properties.	**08**	20
3	**Unit 3:** Packet Scheduling Algorithms-requirements and choices. Scheduling guaranteed service connections. GPS, WFQ and Rate proportional algorithms. High speed scheduler design. Theory of Latency Rate servers and delay bounds in packet switched networks for LBAP traffic.Active Queue Management - RED, WRED and Virtual clock. Control theoretic analysis of active queue management.	**07**	20
4	**Unit 4:** IP address lookup-challenges. Packet classification algorithms and Flow Identification- Grid of Tries, Cross producting and controlled prefix expansion algorithms	**08**	15
5	**Unit 5:**Admission control in Internet. Concept of Effective bandwidth. Measurement based admission control. Differentiated Services in Internet (DiffServ). DiffServ architecture and framework	**07**	15
6	**Unit 6:**IPV4, IPV6, IP tunnelling, IPswitching and MPLS, Overview of IP over ATM and its evolution to IP switching. MPLS architecture and framework. MPLS Protocols. Traffic engineering issues in MPLS.	**07**	15

GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering

Subject Code: 3720513

References:

- Jean Wairand and PravinVaraiya, "High Performance Communications Networks", 2nd edition,2000.
- Jean Le Boudec and Patrick Thiran, "Network Calculus A Theory of Deterministic Queueing Systems for the Internet", Springer Veriag,2001.
- Zhang Wang, "Internet QoS", Morgan Kaufman,2001.
- Anurag Kumar, D. Manjunath and Joy Kuri, "Communication Networking: An Analytical Approach" , Morgan Kaufman Publishers,2004.
- George Kesidis, "ATM Network Performance", Kluwer Academic, Research Papers,2005.
- Computer Networks, Andrew Tanenbaum, 5th Edition, PearsonEducation
- Data Communication And Networking, Behrouz Forouzan, 4th Edition,TMH
- Michael A.Gallo, William A. Hancock : Computer Communication andNetworking Technologies, Thomson Asia

Course Outcomes:

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

- Identify the different types of network devices and their functions within anetwork.
- Understand and build the skills of sub-netting and routingmechanisms.
- Familiarise and Understand basic protocols of computer networks, and how they can be used to assist in network design andimplementation
- Get an insight into packet scheduling algorithm

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Awareness advancement and bottlenecks in the conventional technologies	15 %
CO-2	Awareness and possibilities in Real Time Communication techniques.	20 %
CO-3	Identify the possibilities with scheduling techniques in networking.	20 %
CO-4	Learn Packet classification and control techniques for networking.	15 %
CO-5	Analyzethe techniques used for authentication in networking.	15%
CO-6	Identify the advance topics related with networks and application.	15%

List of suggested experiments

1. **Basics of Network Simulation**
   Introduction | Platform required to run network simulator | Backend Environment of Network Simulator | Basics of Tcl Programming for NS-2 | Agents and applications | Tracing
2. **Simulating a Local Area Network**
   Local Area Network | LAN Topologies | MAC Protocols | Taking turns | Ethernet | Ethernet Frame Structure | Ethernet Versions | Simulating a LAN using Network Simulator 2
3. **Measuring Network Performance**
   Network Performance Evaluation | Performance Evaluation Metrics | Parameters Affecting the Performance of Networks | Performance Evaluation Techniques | Network Performance Evaluation using NS-2
4. **Simulation of a Satellite Network**
   Satellite | Simulating a Satellite network in ns2 | Geostationary satellite nodes | Terminal nodes | Polar orbiting satellite nodes(Non-geostationary satellite) | Satellite links | Handoffs | Routing | Structure of trace files in Satellite network
5. **Simulating a Wi-Fi Network**
   Wi-Fi Networks | IEEE 802.11 Standards | Hardware Requirements for Wi-Fi | How to connect to the Wi-Fi Networks? | Advantages of Wi-Fi | Limitations | MAC Protocols | Use of RTS/CTS to Exchange Data | Issues in Wi-Fi Networks | The Hidden Terminal Problem | Solution of Hidden Terminal Problem | Exposed Terminal Problem | Solution to the Exposed Terminal Problem | Simulating a Wi-Fi using Network Simulator 3

6. **Simulating a WiMAX Network**
   WiMAX Network | Standards | Comparison of Wi-Fi and WiMAX | How WiMAX works ? | Limitations of WiMAX | Modulation Shemes | Here some terminology,expression and table are given below | Difference between low symbol rate and high symbol rate | WIMAX module for NS-2 | How to download and install patch for WIMAX? | Addressing Format in ns2 | The Default address format | The Hierarchical address format | Wireless (New) Trace File Format | Description of New Trace File Format | Wireless Trace File Format
7. **Simulating a Mobile Adhoc Network**
   Ad Hoc Network | Mobile Ad-hoc NETwork (MANET) | Routing | Routing in MANET | Routing protocols for MANET | Destination-Sequenced Distance-Vector (DSDV) algorithm: | Dynamic source routing (DSR) | Application of MANET | Advantages | Disadvantages | Simulating a MANET using Network Simulator 2
8. **Simulating a Wireless Sensor Network**
   Wireless Sensor Networks | Basic Characteristics of WSNs | Operating Systems for WSNs | Differences with Mobile Ad hoc Networks | Types of Wireless Sensor Networks | Routing protocols for WSNs | Clusters and Cluster heads in WSNs | The LEACH Protocol | Operation of LEACH | Discussions on LEACH | Applications of WSNs | Simulating a WSN using Network Simulator 2
9. **Setting up a Bluetooth Network**
   Bluetooth Network | Who started Bluetooth ? | Bluetooth vs Wi-Fi | Bluetooth – Power Classes | Bluetooth - Versions | How does Bluetooth work ? | Networking of Bluetooth | How to connect Bluetooth ? | Simulating Bluetooth Network with NS-2
10. **Setting up a ZigBee Network**
    ZigBee Network | IEEE 802.15.4 and ZigBee | ZigBee vs. Bluetooth | Features & Characteristic of ZigBee Technology | Application of ZigBee Technology | Component of IEEE 802.15.4 LR-WPAN | Network Topologies | ZigBee Architecture | The Superframe structure | Nodes Configuration | Energy Model

List of Assignments:

1. Study of Networking Commands (Ping, Tracert, TELNET, nslookup, netstat, ARP, RARP) and Network ConfigurationFiles.
2. Linux NetworkConfiguration

   b. Determining IP Address and MAC Address using if-configcommand. c .Changing IP Address usingif-config.
   d. Static IP Address and Configuration byEditing. e .Determining IP Address usingDHCP.
   f. Configuring Hostname in /etc/hostsfile.

3. Design TCP iterative Client and Server application to reverse the given inputsentence.
4. Design a TCP concurrent Server to convert a given text into upper case using multiplexing system call“select”.
5. Design UDP Client Server to transfer afile.
6. Configure a DHCP Server to serve contiguous IP addresses to a pool of four IP devices with a default gateway and a default DNS address. Integrate the DHCP server with a BOOTP demon to automatically serve Windows and Linux OS Binaries based on client MACaddress.
   a. Configure DNS: Make a caching DNS client, and a DNS Proxy; implement reverse DNS andforward DNS, using TCP dump/Wireshark characterise traffic when the DNS server is up and when it isdown.
7. Configure a mail server for IMAP/POP protocols and write a simple SMTP client in C/C++/Java client to send and receivemails.
8. Configure FTP Server on a Linux/Windows machine using a FTP client/SFTP client characterise file transfer rate for a cluster of small files 100k each and a video file of 700mb.Use a TFTP client and repeat theexperiment.
9. Signaling and QoS of labeled paths using RSVP inMPLS.
10. Find shortest paths through provider network for RSVP andBGP.

11.Understand configuration, forwarding tables, and debugging ofMPLS

List of Journals:

1) The *Journal of Communications and Networks* , **ISSN:** 1976-5541, **Published**by IEEECommunicationsSociety
2) **The IEEE Transactions on Network Science and Engineering, ISSN:** 2327-4697, **Published by:** IEEE ComputerSociety

Learning website:

www.nptel.ac.in

GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering

Subject Code: 3720513

GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3720512
Semester – II
Subject Name: Antennas and Radiating Systems

Type of course: Elective I

Prerequisite: This course assumes that students have had an introduction to Higher Engineering Mathematics, Fundamental knowledge of Engineering Electromagnetics (Maxwell's equations, three basic coordinate systems and polarization).

Rationale: This course provides a comprehensive understandinging of the fundamentals and applications of Antenna and wave propagation, including radiation from point sources as applied to antenna, antenna types and their radiation patterns. They are expected to be able to design different antennas for specific given frequency and application. They should be acquainted with concept of arrays and antenna measurement methods. They will be practiced in study of antenna radiation patterns and in measurement of different antenna parameters. They will be able to design and analyze some basic antennas in hardware and application specific antenna in software tolls like HFSS,CST etc.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	PA(V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Review of Antenna Theory:** Fundamental theory of antennas: Reciprocity theorem, Antenna equivalent Circuit, Classification of antennas, Special types of Antennas for different frequency bands.	6	12
2	**Antenna Parameters:** Radiation Impedance, Radiation Pattern, Antenna Impedance, Bandwidth, Directivity, Gain, Antenna efficiency, Radiation Efficiency, Antenna Polarization, Antenna Vector effective length, Antenna Apertures, Antenna temperature, near-field and far-field concepts, and radiation and far-field concepts, and radiation mechanism. Input Impedance, Friis Transmission equation.	7	18
3	**Arrays: Linear, Planar, and Circular:** Two-Element Array N-Element Linear Array: Uniform Amplitude and Spacing N Element Linear Array: Directivity Design Procedure ,N Element Linear	8	12

	Array :Three-Dimensional Characteristics Rectangular-to-Polar Graphical Solution , Broadside and End fire array, N-Element Linear Array: Uniform Spacing, Nonuniform, Super directivity, Binomial Array Amplitude , Planar and Circular Arrays.		
4	**Antenna synthesis:** Introduction to various methods of antenna synthesis such as Schelkunoff Polynomial, Fourier transform, Woodward Lawson.Dolph-Chebyshev,Triangular, Cosine, and Cosine-Squared Amplitude Distributions	5	10
5	**Micro strip Antennas :** Rectangular and Circular Patch, Quality Factor, Bandwidth, and Efficiency, Input Impedance, Coupling, Circular Polarization, Arrays and Feed Networks, Multi Band, Recent advances in fractal antenna and patch array. Applications in Wireless and Satellite communication, electromagnetic effects in high speed digital circuits, bio electromagnetics, Electromagnetic hazards and the environment.	6	12
6	**Horn and Reflector antenna:** Horn Antennas - Rectangular Horn (Pyramidal), Circular Aperture Horn, Circular (Conical) Corrugated Horn Reflector Antennas - Paraboloidal Reflector Geometry, Dual Reflector Antennas and feeds, Spherical Reflector, Shaped Reflectors,	4	10
7	**Phased arrays:** Fixed Phase Shifters or Phasers, Non-uniform and Random Element Existence Arrays, Feed Networks, Adaptive Antenna & Digital beam forming, smart antenna for wireless communication	4	10
8	**Antenna Analysis:** Introduction to antenna analysis methods: Integral equation method, Moment method, Finite Difference Time Domain methods; Applications of these methods to the practical antennas such as dipole, loop, helical, microstrip patch, and PIFA.	6	10
9	**Antenna Optimization Techniques:** Various optimization techniques (OT) such as Genetic algorithm, Artificial Intelligence, Fuzzy logic. Comparative analysis of the OT's for particular application and antenna type.	2	6
	Total	**48**	100

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**20**	**20**	**30**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Balanis C A, Antenna Theory:Analysis and design, Wiley
2. J.D.Krass, Antennas McGraw Hill.
3. Hohnson R C and H Jasik, Antenna Engineering Handbooks, McGraw Hill
4. Ramo, Whinnery, Fields and waves in communication electronics John Wiley
5. Robert Stratman Elliott, 'Antenna Theory and Design', Prentice-Hall, 1981 David Olver, 'Microwave Horns and Feeds', IEEE Press
6. Allan Walter Love, 'Reflector antennas', IEEE Antennas and Propagation Society
7. A.W. Love, 'Electromagnetic Horn Antennas', IEEE press
8. Robert J. Mailloux, 'Phased Array Antenna Handbook' ARTECH HOUSE
9. J.D. Kraus and Daniel A Fleisch ,Electromagnetics with Applications,TMH,5Th edition

Course Outcomes:

A student who successfully completes this course should be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	To apply basic principles of problem solving in antenna and radiating systems for the society and environment	**20**
CO-2	To analyze and design antenna and radiating systems like dipole antennas and its variants, antenna arrays,microstrip antennas, horn antennas,reflector antennas for the society and environment in ethical way	30
CO-3	To prepare post graduates with the knowledge, ethics and skills so that they can be applied to various applications of antennas in environment friendly manner for the society	20
CO-4	To build projects individually or in a group consisting of antenna and radiating systems system as per the need of the society in a professional ethical and environment friendly manner	20
CO-5	To apply the knowledge of antenna and radiating systems to troubleshoot the antenna and radiating systems products in ethical way and constructively useful for the society and environment	10

Suggested Experiment List

1. To study the variation of field strength of radiated with distance from transmitting antenna.

2. To demonstrate that the transmitting and receiving radiation patterns of an antenna are equal and hence confirm the reciprocity theorem of antennas.
3. To plot the radiation pattern of an Omni directional antenna.
4. To plot radiation pattern of directional antenna.
5. To study Phenomena of Circular, Linear and Elliptical Polarization of antennas.
6. To study and plot the radiation pattern of the dipole/Folded dipole antennas in Azimuth & Elevation planes on log & linear scales on polar and Cartesian plots.
7. To study and plot the radiation pattern of the helical antennas and Measure its Bandwidth and Beam width.
8. To study and plot the radiation pattern of the parabolic reflector and Measure its Gain, Bandwidth and Beam width.
9. To study and plot the radiation pattern of the Broadside antennas and Measure its Gain, Bandwidth and Beam width.
10. Design and simulate micro strip patch antenna in HFSS simulator.
11. To plot the radiation pattern of a Slot antenna.
12. To plot radiation pattern of $3\lambda/2$ dipole antenna.

List of Open Source Software/learning website:

- Scilab
- http://www.vlab.co.in/ (Virtual labs at IIT Guwahati)
- NTPEL
- HFSS
- CST

GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3720511
ANALOG CMOS CIRCUIT DESIGN – I
SEMESTER: II

Type of course: MOSFET based analog circuit design

Prerequisite: Basic knowledge of MOSFET and device modeling.

Rationale: This course provides a platform for students to understand the working of active device such as MOSFET; designing aspects of analog circuit building blocks like Op-amps, sources, sinks, mirrors, Op-amps, and references. Students are also taught to design, simulate, and analyze these analog circuits. This is one of the foundation courses which are required for students to develop their skills of complex analog circuits and systems.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Introduction to CMOS Analog Circuit Design:** Introduction to Analog Design, Basic MOS Device Physics-General Consideration, MOS I/V Characteristics, Second-Order Effects, MOS Device Models	4	5
2	**Single-Stage Amplifiers:** Basic Concepts, Common-Source Stage, Source Follower, Common-Gate Stage, Cascode Stage – Folded Cascode	5	15
3	**Differential Amplifiers:** Single-Ended and Differential Operation, Basic Differential Pair, Common-Mode Response, Differential Pair with MOS Loads, Gilbert Cell.	5	15
4	**Passive and Active Current Mirrors:** Basic Current Mirrors, Cascode Current Mirrors, Active Current Mirrors	5	15
5	**Frequency Response of Amplifiers:** General Considerations, Common-Source Stage, Source Followers, Common-Gate Stage, Cascode Stage, Differential Pair	6	10
6	**Operational Amplifiers:** General Considerations, One-stage Op Amps, Two-Stage Op Amps, Gain Boosting, Comparison, Common-Mode Feedback, Input Range Limitations, Slew Rate, Power Supply Rejection, Noise in Op Amps.	8	20
7	**Stability and Frequency Compensation:** Introduction, Multipole Systems, Phase Margin, Frequency Compensation, Compensation of Two-Stage Op amp, Other Compensation Techniques.	5	10

8	**Band Gap Reference**: Supply independent biasing, temperature-independent references, negative and positive TC voltage, Bandgap reference, PTAT generation, constant gm biasing, speed and noise issues.	5	5
9	**Applications of Analog Building Blocks:** Comparators, Oscillators, Multipliers, PLL, Frequency Synthesizers, Sample-And-Hold Circuits, DC-DC converters	5	5
Total		52	100

Suggested Specification table* with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**20**	**10**	**10**	**5**	**5**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

**This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary from above table.*

Reference Books:

1. Design of Analog CMOS Integrated Circuits, Behzad Razavi, TMH.
2. Analysis and Design of Analog Integrated Circuits, P R Gray and R G Meyer, 5th Edition, Wiley, 2009.
3. RF Microelectronics, Behzad Razavi, Prentice Hall.
4. CMOS Analog Circuit Design, P. Allen and D. Holberg, Oxford Uni. Press.
5. Geiger, Allen and Stradder, VLSI Design Techniques for Analog and Digital Circuits, Tata McGraw-Hill Education, 2010.

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Analyze the basic principle, operation and applications of single stage amplifiers like common-source , source Follower, common-gate stage, cascode Stage – folded cascode.	20 %
CO-2	Analyze the basic principle, operation and applications of Basic Differential Pair, common-mode response, differential pair with MOS loads, Gilbert cell.	20 %
CO-3	Analyze the basic principle, operation and applications of basic current mirrors, cascode current mirrors, active current mirrors.	20 %
CO-4	Analyze the basic principle, operation and applications of one-stage Op Amps, Two-Stage Op Amps	20 %
CO-5	Understand the input range limitations, slew rate, power supply rejection, noise in Op amps; and understand multipole systems, phase margin, frequency	10 %

	compensation techniques	
CO-6	Understand the designing aspects of supply/temperature independent, and Bandgap references.	10 %

List of Experiments:

1. To implement common source with diode connected load.
2. To implement cascode circuit
3. To implement and analyze Cascade OP-AMP with input and output shorted.
4. To implement and analyze the basic differential pair circuit

* Each student has to complete other 10 practicals based on syllabus in a group of two or three over and above the listed 10 practicals

Open Ended Problems:

1. Find static power dissipation and dynamic power dissipation for any CMOS logic gate.
2. Design a common source amplifier with typical value of gain.
3. Design a CS stage with source degeneration with typical value of g_m.
4. Design a common gate amplifier with typical value of gain.
5. Implement a folded Cascode circuits using Ngspice.
6. Find voltage gain of differential circuits.
7. Implement Gilbert cell with Ngspice.
8. Design Cascode current mirror for a typical values of current.
9. Derive large signal and small signal analysis for Active current Mirrors.
10. Find input impedance for Source follower at high frequency.
11. Design high CMRR 2- or 3-stage op-amp.
12. Design high slew-rate op-amp for given gain.
13. Seminar/Mini Project

Major Equipments : C.R.O., Function Generator, Power Supply, Multimeter, Digital Storage Oscilloscope

List of Open Source Software/ Learning website:

Ng-spice
www.nptel.com
www.nptel.ac.in

GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3720506
SATELLITE COMMUNICATION
Semester -II

Type of course: Major Elective

Prerequisite: This course assumes that students have had an introduction to communication systems and the description of signals and circuits in terms of their frequency spectra and frequency response. A basic knowledge of analog and digital modulation is required, as is a working level familiarity with the basics of random variables and probability distributions.

Rationale: This course provides a comprehensive understanding of satellite communication principles and related technologies. Starting from orbital mechanics related to spacecraft deployment, the course evolves through satellite link design, signal processing, and access techniques.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	PA(V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**SATELLITE ORBITS** Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, Station keeping, GEO stationary and non GEO-stationary orbits, Look Angle Determination, Limits of visibility, Eclipse-Sub satellite point, Sun transit outage, Launching Procedures launch vehicles and propulsion.	8	12
2	**RADIO WAVE PROPAGATION** Signal impairment: Rain attenuation, Atmospheric losses, Ionospheric effects, Polarization, Antenna radiation patterns, Antenna arrays	5	7
3	**SPACE SEGMENT AND SATELLITE LINK DESIGN** Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command. Satellite uplink and downlink Analysis and Design, link budget, E/N calculation- performance impairments-system noise, inter modulation and interference, Propagation Characteristics and Frequency considerations- System reliability and design lifetime.	8	22
4	**SATELLITE ACCESS** Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video broadcast, multiple access: FDMA, TDMA, CDMA, Assignment Methods, Spread Spectrum communication, compression – encryption	7	15
5	**EARTH SEGMENT**	6	12

	Earth Station Technology-- Terrestrial Interface, Transmitter and Receiver, Antenna Systems TVRO, MATV, CATV, Test Equipment Measurements on G/T, C/No, EIRP, Antenna Gain.		
6	**SATELLITE APPLICATIONS** INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS INMARSAT, LEO, MEO, Direct Broadcast satellites (DBS)- Direct to home Broadcast (DTH), Digital audio broadcast(DAB)- World space services, Business TV(BTV), GRAMSAT, Specialized services – E –mail, Video Conferencing, Internet. Global Satellite Navigation system, Maritime Satellite ,Satellite Constellations ,Navigation Satellites of different countries such as Glonas and Compass, GAGAN,IRNSS, NAVIC Receiver and applications	10	25
7	**CASE STUDIES** DBS-TV, GPS, LEO and VSAT network	3	7
Total		**47**	100

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**30**	**20**	**10**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Dennis Roddy, 'Satellite Communication', McGraw Hill International, 4th Edition, 2006.
2. Satellite Communication, by Timothy Pratt, Charles Bostian, Jeremy Allnutt, Willey Student Edition, second edition
3. Wilbur L. Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, 'Satellite Communication Systems Engineering', Prentice Hall/Pearson, 2007.
4. A.K. Maini and V. Agrawal, Satellite Technology, John Wiley and Sons, 2007.
5. B. Elbert, Introduction to Satellite Communication, 3rd ed., Artech House, 2008.
6. Global Navigation Satellite Systems Insights into GPS, GLONASS, Galileo, Compass, and others B. Bhatta BSP Books
7. Global Navigation Satellite Systems ,Rao,TMH
8. Global Navigation Satellite Systems , R, Acharya ,Academic Press
9. Others: IEEE Transactions and other journals.

GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3720506

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Understand the satellite communication systems in creative and systematic approach.	15
CO-2	To analyse modulation and coding schemes in satellite communication systems.	20
CO-3	To design satellite communication systems using GEO or LEO satellites to carry voice, video or data signals using analog and digital modulation.	35
CO-4	Analysis and link budget calculation.	30

List of Experiments:

1. To write a program to observe thevariations in the antenna lookangles for the earth stationantennas.
2. To write a program to calculate todetermine the limits of visibility foran earth station.
3. To obtain the plot of Orbital altitudeversus satellite antenna diameter.
4. To write a Program for Estimated topospheric attenuation due to Oxygen and water.
5. To write a Program for plot ofSemimajor axis versus rate ofchange of argument of perigee.
6. To write program to calculate therain attenuation(in dB) forhorizontal polarization, verticalpolarization and circularpolarization for satellite wavepropagation.
7. To write a program to determinethe combined carrier to noisepower spectral density ratio forsatellite link budget.
8. To determine the degradation inthe downlink C/I ratio whensatellite orbital spacing is reduced.
9. To write a program to plot thedegradation in downlink C/I.
10. To plot the variation in Carrier toNoise power spectral densityratio(uplink,downlink andcombined)for changes in the inputSFD for uplink and EIRP fordownlink.
11. To write a program for plotting Halfpower beamwidth Vs. maximumnumber of days sun transit occursat an earth station.
12. To write a program for plotting BER vsEb/No for BPSK ,QPSK signals forSatCom.

List of Open Source Software/learning website:

1. International Journal of Satellite Communications and Networking Wiley Publications Online ISSN: 1542-0981.
2. http://spacejournal.ohio.edu/
3. www.nptel.ac.in

GUJARAT TECHNOLOGICAL UNIVERSITY
Master of Engineering
Subject Code - 3720001
Semester II
Subject Name: Mini Project with Seminar

Type of course: Core

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
0	0	4	2	0	0	0	100	100

Content:

A mini project requires comparatively less time than major projects. They are comparatively simpler and have shorter duration. Mini Project helps students to explore and strengthen the understanding of fundamentals through practical application of theoretical concepts. Mini Project can help them to boost their skills and widen their horizon of thinking. It will act like a beginners guide to undertake the major project/dissertation during the final year and will ensure preparedness of students to undertake major projects/dissertation. Students will be required to select the topic relevant to their specialization and that has value addition. Students will get an opportunity to work in actual industrial environment if they opt for internship. Based on the selected topic student will also prepare seminar report based on the literature survey

Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available. End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution. Continuous assessment of Mini Project at Mid Sem and End Sem will be monitored by the departmental committee.

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

1. Identify engineering problems reviewing available literature.
2. Study different techniques used to analyze complex systems.
3. Solve a live problem using software/analytical/computational tools and present solution by using his/her technique applying engineering principles.
4. Learn to write technical reports and develop skills to present and defend their work in front of technically qualified audience.

GUJARAT TECHNOLOGICAL UNIVERSITY

Constitution of India
SUBJECT CODE: 3700005
SEMESTER: I/II

Type of course: Audit course

Prerequisite: -

Rationale: -

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE(E)	PA (M)	PA (V)	PA (I)	
2	0	0	0	50	0	0	0	50

Content

Sl. No.	Topic	Teaching Hours	Module Weightage (%)
1.	**History of Making of the Indian Constitution** History Drafting Committee, (Composition & Working)	4	17
2.	**Philosophy of the Indian Constitution:** Preamble Salient Features	4	17
3.	**Contours of Constitutional Rights & Duties:** Fundamental Rights Right to Equality Right to Freedom Right against Exploitation Right to Freedom of Religion Cultural and Educational Rights Right to Constitutional Remedies Directive Principles of State Policy Fundamental Duties.	4	17
4.	**Organs of Governance:** Parliament Composition Qualifications and Disqualifications Powers and Functions Executive President Governor Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions	4	17

5.	**Local Administration:** District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy	4	16
6	**Election Commission:** Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.	4	16

Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.

Course Outcome:

At the end of the course, the student will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective
2. To address the growth of Indian opinion regarding modern Indian intellectuals constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

GUJARAT TECHNOLOGICAL UNIVERSITY

English for Research Paper Writing
SUBJECT CODE: 3700001
SEMESTER: I/II

Type of course: Audit course

Prerequisite: -

Rationale: -

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE(E)	PA (M)	PA (V)	PA (I)	
2	0	0	0	50	0	0	0	50

Content

Sl. No.	Topic	Teaching Hours	Module Weightage (%)
1.	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4	17
2.	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	4	17
3.	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check	4	17
4.	key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature	4	17
5.	skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	4	16
6	useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	4	16

Reference Books:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Course Outcome:

At the end of the course, the student will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title
4. Ensure the good quality of paper at very first-time submission

GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering

Subject Code: 3720520

ADVANCED COMMUNICATION NETWORKS

SEM-II

Type of course: Programme Core –IV

Prerequisite: Basics of Computer hardware, Computer software, data Communication and computer networks

Rationale:

Students of EC Engineering need to possess good understanding of the advancements in networking and various networking standards and protocols. This course imparts a unified systems view of the broad field of advanced computer communications. The fundamental principles of advanced communications networks and protocols are thoroughly presented and applied in data communication networking.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.	%Wtg
1.	**Advance Topics in Networking** Packet Switching, Circuit Switching, A Network of Networks, Delay Loss and Throughput in Packet-Switched Networks, Principles of Congestion Control, Approaches to Congestion Control, TCP Congestion Control, Fairness, Explicit Congestion Notification (ECN), Fairness, IPv4 and IPv6, Generalized forwarding and SDN, OSPF, BGP, SDN, ICMP, SNMP, VLANs, MPLS, Process of a Web Page Request.	12	30%
2	**Network at Application** Web and HTTP, Cookies & Web Caching, Electronic Mail, DNS, P2P, Video Streaming and Distribution, UDP and TCP Socket Programming,	6	15%
3	**Mobile and Multimedia Networking** WiFi, 802.11 Wireless LANs, Cellular Internet Access, 4G LTE, Mobility Management, Mobile IP, Cellular Mobility Management, Multimedia Networking, Streaming Video, Voice Over IP, RTP, SIP, Multimedia QoS.	6	15%
4	**BroadBand Distribution & Access Network** A History of Broadband Networks, Legacy Access Networks, Copper DSL Evolves, Challenges to DSL Access Networks, DSLAM Evolution, ATM DSLAMs, Ethernet DSLAMs, Triple-Play Services, MPLS Backbone Networks, Ethernet DSLAMs, High-Availability Broadband Access, PPP, PPPoA, PPPoE, ADSL Access, G.DMT, G.Lite, ADSL2, ADSL2+, VDSL and VDSL2, SHDSL	8	20%
5	**Security in Networking** Network Security and Cryptography, Message Integrity and Digital Signatures, End-Point Authentication, E-mail Security, TCP and SSL, IPSec and VPN, Wireless Security, Firewall and IDS.	8	20%

References:

- Kuros and Ross, Computer Networking A Top Down Approach 7th Ed, Pearson Publication

- Chris Hellberg, Dylan Greene, Truman Boyes - Broadband Network Architectures_ Designing and Deploying Triple Play Services-Prentice Hall (2007)
- Andrew Tanenbaum, Computer Networks, 5th Edition, PearsonEducation
- Behrouz Forouzan, Data Communication And Networking, 5th Edition,TMH
- Patrick J. Conlan - Cisco network professional's advanced internetworking guide-Wiley Technical Pub (2009)
- James Roberts, Ugo Mocci, Jorma Virtamo (eds.) - Broadband Network Traffic_ Performance Evaluation and Design of Broadband Multiservice Networks-Springer

Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Describe the basic building blocks of a computer network and understand the architecture of the global Internet	
CO-2	Describe, analyze and compare a number of datalink, network, and transport layer protocols	
CO-3	Develop a strong theoretical foundation on performance analysis of various queueing models with applications to Internet	
CO-4	Develop the ability to explore the design and development of more resource efficient and state of the art networking technologies	
CO-5	Gain experience with using software tools for network simulation, testing, troubleshooting	

List of Experiments

Experiments can be based on following listed any or multiple techniques but not limited to that tutor can have his own selection suitable with the subject matter.

1. Wireshark Lab
2. Socket Programming Assignments
3. Network Simulator 2
4. Network Simulator 3
5. GNS3
6. Cisco Packet Tracer
7. OPNet
8. Python Programs
9. Matlab or Scilab based Simulations
10. Various Server Implementation
11. Configuration of Physical Devices
12. Creating Enterprise Network Designs