

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Electronics Engineering / Electronics & Communication Engineering / Electronics & Telecommunication Engineering

SUBJECT NAME: Embedded Systems

SUBJECT CODE: 2171005

B. E. 7th SEMESTER

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
PA	ALA	ESE	OEP							
3	0	2	5	70	20	10	20	10	20	150

Sr. No	Course Content	Total Hrs.
1	Introduction to Embedded Systems Embedded Systems, Processor Embedded into a System, Embedded Hardware Units and Devices In a System, Embedded Software in a system, Examples of Embedded Systems, Embedded System-on-chip (SOC) and Use of VLSI Circuit Design Technology, Complex Systems Design and Processors, Design Process in Embedded System, Formulization of System Design, Design Process and Design Examples, Classification of Embedded Systems, Skills Required for an Embedded System Designer	3
2	Device and Communication Bus for Devices Network IO Types and examples, Serial communication devices, Parallel Device ports, Sophisticated Interfacing Feature in Devices Ports, Wireless Devices, Timer and Counting Devices, Watch dog timer, Real time clock, Network Embedded Systems, Serial Bus Communication Protocols, parallel Bus Devices protocol-Parallel communication Network using ISA, PCI, PCI-X and advanced buses, Internet Enabled Systems- Network protocols, Wireless and mobile system protocol.	6
3	Device Drivers and Interrupt Services Mechanism Programmed-I/O Busy-wait Approach without Interrupt Services Mechanism, ISR Concept, Interrupt Sources, Interrupt Servicing(Handling) Mechanism, Multiple Interrupts, Context and the Periods for Context Switching, Interrupt Latency and Deadline, Classification of Processor Interrupt Service Mechanism from Context-Saving Angle, Direct Memory Access, Device Driver Programming	5

4	Interprocess Communication and Synchronization of processes, Threads and Tasks: Multiple process in an application, Multiple Threads in an application, Task and Task state, Task and Data, Clear-cut Distinction between Functions, ISRS and Tasks by their Characteristics, Concept of Semaphores, Shared Data, Inter process Communication, Signal Function, Semaphore Functions, Message Queue Functions, Mailbox Functions, Pipe Functions, Socket Functions, RPC Functions	8
5	Real Time Operating System: Operating system service, Process management, Timer function, Event function, Memory management, Device , File and I/O subsystem management, Interrupt routine in RTOS environment and handling of interrupt Sources calls, Real Time Operating Systems, Basic Design Using an RTOS, RTOS Task Scheduling Models, Interrupt Latency and Response of the Tasks as Performance Metrics, OS Security Issues	11
6	Case Study: Case Study : Motivation for MSP 430 Microcontrollers: MSP430 RISC CPU architecture, Compiler-friendly features, Instruction set, Clock system, Memory subsystem. Understanding of different MSP430 families. Introduction to Code Composer Studio (CCS) and use CCS for Embedded C. Digital I/O – I/O ports programming using C, Understanding the muxing scheme of the MSP430 pins, interrupt programming On-chip peripherals - Watchdog Timer, Basic Timer, Real Time Clock (RTC), ADC, Universal Serial Communication Interface (USCI). Interfacing LED, LCD, Seven segment LED modules interfacing. Example – Real-time clock, Low-power features of MSP430.	9

Books:

1. Embedded System: Architecture, Programming and Design by Rajkamal, 2nd edition, 2010, Tata McGraw Hill
2. MSP430 Microcontroller Basics by John H. Davies Elsevier; First edition (2010)
3. Computer as Components: Principles of Embedded Computing System Design, Wayne Wolf, 2nd edition, 2008, Morgan Kaufmann Publication

Manuals and other study materials:

- 1) <http://www.ti.com/ww/en/launchpad/launchpads-msp430-msp-exp430g2.html#project0>
- 2) <http://coder-tronics.com/msp430-programming-tutorial-pt1/>
- 3) <http://coder-tronics.com/msp430-programming-tutorial-pt2/>
- 4) <http://mspsci.blogspot.in/2010/08/tutorial-10-something-completely.html>
- 5) <http://mspsci.blogspot.in/2011/10/tutorial-16a-getting-serial.html>

- 6) <http://mbspici.blogspot.in/2010/08/tutorial-09-timers.html>
- 7) <http://mbspici.blogspot.in/2010/07/tutorial-08-beating-heart-bcs-part-i.html>

Course Outcomes:

After learning the course the students should be able to:

1. Understand the concepts of Embedded Systems
2. Understand interfacing of IO devices and other peripherals.
3. Device driver programming & interrupt service mechanisms
4. Understand Inter-process Communication and Synchronization of processes, Threads and Tasks
5. Learn OS functions and Real Time Operating System
6. Able to use MSP430 along with analog and digital peripherals.

List of Experiments:

1. Introduction to MSP430 Kit and Programming Environment with program to work with ports
2. Configure timer block with capture/compare channel 0 & 1 to generate 4.096 KHz & 1.024 KHz signal.
3. Configure watchdog timer in watchdog & interval mode.
4. Test various Power Down modes in MSP430.
5. Read Temperature of MSP430 with the help of ADC.
6. Use Timer to trigger ADC for reading analog signal in most efficient manner to reduce power consumption.
7. Configure DAC to generate positive ramp signal.
8. Use Comparator to compare the signal threshold level.
9. Implement Hardware Multiplier to multiply two arrays to perform MAC operation.
10. Implement DMA controller for basic convolution algorithm.
11. Use I2C protocol for communication between more than two MSP430 connected on I2C bus.
12. Use SPI protocol for communication between two MSP430.

Open Ended Problems:

1. Interface a pressure sensor giving full scale range output as 10 mV for 300 mmHg with MSP430. Design appropriate signal conditioning circuit and write a 'c' program to monitor the pressure in mmHg.
2. A load cell is required to be interface with MSP430 which gives 2mV as its full scale output. Design appropriate signal conditioning circuit and write a 'c' program to acquire the weight data and display this data on 3 and ½ multiplexed display field.
3. Use timer to generate a Pulse Width Modulated wave whose duty cycle is varied such that the average voltage is equal to the analog signal in the range of 0 to 2.5 Volts. Write a 'c' program for this task.

4. Use hardware multiplier to calculate RMS value of current and power associated with sinusoidal analog signal given as input to MSP430.
5. With the help of DMA controller implement digital FIR filter and use this filter for implementing Low Pass Filter action for the analog signal given as input to MSP430.
6. Implement suitable RTOS on suitable MCU platform to explore RTOS fundamentals.

Major Equipments:

- (1) MSP430 Launchpad and Development board (2) MSP430 FET Debugger (3) Function Generator (4) Oscilloscope (5) Digital Multi-meter (6) DC Power Supply (0-30 V) (7) Logic analyzer.

C. List of Software:

1. IAR Embedded Workbench
2. TI Code Composer Studio
3. Energia

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should be submitted to GTU.

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Electronics & Communication Engineering (11), Electronics & Telecommunication Engineering (12)

SUBJECT NAME: Satellite Communication

SUBJECT CODE: 2171007

B.E. 7th SEMESTER

Type of course: Undergraduate

Prerequisite: Electronics Communication, Digital Communication

Rationale: The course aims to:

- 1 To understand the basics of satellite communications
- 2 To understand different satellite communication orbits
- 3 To understand the satellite segment and earth segment
- 4 Provide an in-depth treatment of satellite communication systems operation and planning
- 5 To analyze the various methods of satellite access
- 6 Link budgets & planning
- 7 Review the state of the art in new research areas such as speech and video coding, satellite networking and satellite personal communications
- 8 To learn Digital audio/video broadcasting using satellites
- 9 To understand various applications of satellite communications

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction to Satellite Communication: Historical background, Basic concepts of Satellite Communications, Communication Networks and Services, Comparison of Network Transmission technologies, Orbital and Spacecraft problems, Growth of Satellite communications.	2	5

2	Orbits and Launching Methods: Introduction, Kepler's First Law, Kepler's Second Law, Kepler's Third Law, Definitions of Terms for Earth-Orbiting Satellites, Orbital Elements, Apogee and Perigee Heights, Orbit Perturbations, Effects of a non spherical earth, Atmospheric drag.	5	10
3	The Geostationary Orbit: Introduction, Antenna Look Angles, The Polar Mount Antenna, Limits of Visibility, Near Geostationary Orbits, Earth Eclipse of Satellite, Sun Transit Outage, Launching Orbits	4	10
4	Radio Wave Propagation: Introduction, Atmospheric Losses, Ionospheric Effects, Rain Attenuation, Other Propagation Impairments	2	5
5	Polarization: Introduction, Antenna Polarization, Polarization of Satellite Signals, Cross Polarization, Discrimination, Ionospheric Depolarization, Rain Depolarization, Ice Depolarization	2	5
6	The Space Segment : Introduction, The Power Supply, Attitude Control, Spinning satellite stabilization, Momentum wheel stabilization, Station Keeping, Thermal Control, TT&C Subsystem, Transponders, The wideband receiver, The input demultiplexer, The power amplifier, The Antenna Subsystem	4	15
7	The Earth Segment: Introduction, Receive-Only Home TV Systems, The outdoor unit, The indoor unit for analog (FM) TV, Master Antenna TV System, Community Antenna TV System, Transmit-Receive Earth Stations	4	10
8	The Space Link : Introduction, Equivalent Isotropic Radiated Power, Transmission Losses, Free-space transmission, Feeder losses, Antenna misalignment losses, Fixed atmospheric and ionospheric losses, The Link-Power Budget Equation, System Noise, Carrier-to-Noise Ratio, The Uplink, Saturation flux density, Input backoff, Downlink, Output back-off, Combined Uplink and Downlink C/N Ratio	5	15
9	Satellite Access: Introduction, Single Access, Preassigned FDMA, Demand-Assigned FDMA, Spade System, TDMA, Preassigned TDMA, Demand-assigned TDMA, Satellite-Switched TDMA, Code-Division Multiple Access	4	10

10	Direct Broadcast Satellite Television and Radio: C-Band and Ku-Band Home Satellite TV, Digital DBS TV, DBS-TV System Design, DBS-TV Link Budget, Error Control in Digital DBS-TV, Master Control Station and Uplink, Installation of DBS-TV Antennas, Satellite Radio Broadcasting, Digital Video Broadcast(DVB) Standards, Digital Video Broadcast – Terrestrial (DVB-T)	4	10
11	Satellite Mobile and Specialized Services: Introduction, Satellite Mobile Services, VSATs, Radarsat, Global Positioning Satellite System (GPS), Orbcomm, Iridium	3	5
Total		39	

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	15	10	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. Satellite Communications, by Dennis Roddy(Fourth edition),McGraw Hill.
2. Satellite Communication Systems Engineering, by Wilbur L. Pritchard, Henri G. Suyderhoud, Robert A. Nelson (Second Edition), Pearson
3. Satellite Communication, by Timothy Pratt, Charles Bostian, Jeremy Allnutt(Second Edition),
John Wiley & Sons.
4. Satellite Technology, Principles and Applications, by Anil K. Maini, Varsha Agarwal (Second Edition), Wiley.

Course Outcome:

After successful completion of the course, the students will be able to:

1. Understand principle, working and operation of various sub systems of satellite as well as the earth station.
2. Apply various communication techniques for satellite applications
3. Analyze and design satellite communication link
4. Learn advanced techniques and regulatory aspects of satellite communication
5. Understand role of satellite in various applications

Suggested List of Experiments:

1. Understanding the basic concepts of satellite communication
2. To setup a communication link between uplink transmitter and downlink receiver using Satellite.
3. To setup an Active satellite communication link and demonstrate link fail operation
4. To communicate voice & Video signal through satellite link
5. Observe the effect of Different combinations of uplink and downlink frequencies on satellite link.
6. To transmit and receive three separate signals (Audio, Video , Tone) simultaneously through satellite link
7. To transmit and receive function generator signals through satellite link.
8. To measure the signal parameters in an analog FM/FDM TV satellite link.
9. To transmit digital waveforms through a satellite communication link.
10. To Calculate Bit Error Rate in a satellite communication link.

Design based Problems (DP)/Open Ended Problems:

1. To write a program to observe the variations in the antenna look angles for the earth station antennas.
2. To write a program to calculate to determine the limits of visibility for an earth station.
3. To obtain the plot of Orbital altitude versus satellite antenna diameter.
4. To write a Program for Estimated tropospheric attenuation due to Oxygen and water.
5. To write a Program for plot of Semimajor axis versus rate of change of argument of perigee.
6. To write program to calculate the rain attenuation (in dB) for horizontal polarization, vertical polarization and circular polarization for satellite wave propagation.
7. To write a program to determine the combined carrier to noise power spectral density ratio for satellite link budget.
8. To determine the degradation in the downlink C/I ratio when satellite orbital spacing is reduced.
9. To write a program to plot the degradation in downlink C/I.
10. To plot the variation in Carrier to Noise power spectral density ratio (uplink, downlink and combined) for changes in the input SFD for uplink and EIRP for downlink.
11. To write a program for plotting Half power beamwidth Vs. maximum number of days sun transit occurs at an earth station.
12. To write a program for plotting BER vs E_b/N_0 for BPSK signal for SatCom.

List of Open Source Software/learning website:

1. <http://nptel.iitm.ac.in/course.php>
2. <http://ocw.mit.edu>
3. www.radio-electronics.com
4. <http://en.wikipedia.org>
5. www.youtube.com

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GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Electronics Engineering / Electronics & Communication Engineering / Electronics & Telecommunication Engineering

SUBJECT NAME: Data Communication and Networking

SUBJECT CODE: 2171008

B.E. 7th SEMESTER

Type of course: Undergraduate

Prerequisite: Basics of Computer hardware and software

Rationale: This course imparts a unified systems view of the broad field of data and computer communications. The fundamental principles of data communications are thoroughly presented and then applied in data communication networking.

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)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction to Data Communication and Networking: Uses of Computer Networks, Network Hardware, Network Software Internet Reference Models (OSI and TCP/IP)	2	5
2	Physical Layer: Basis for Data Communication, Guided Transmission Media , Wireless Transmission Medium, Circuit Switching and Telephone Network, High Speed Digital Access	2	5
3	Data Link Layer: Data Link Layer Design Issues, Error Detection and Correction, Data Link Control and Protocols, Example Data Link Protocol	4	15
4	Medium Access Layer: Channel Allocation Problem, Multiple Access, CSMA, CSMA/CD, CSMA/CA	5	15
5	Local Area Network: Ethernet, Fast Ethernet, Gigabit Ethernet, Wireless LAN, Blue tooth, Connecting devices:-Repeaters, Hub, Bridges, Switch, Router, Gateways, Virtual LAN, Example Networks: X.25, Frame Relay, ATM, ISDN	4	10

6	Network Layer: Network Layer Design Issues, Routing Algorithms (Optimality principle, Static Routing Algorithms, Shortest Path, Flooding, Dynamic routing Algorithms, Distance Vector, Link State routing.), Congestion control Algorithms (Principles, Policies, Algorithms), Quality of Service (Requirements, Techniques, Integrated Services & Differentiated Services), Network Layer Protocols (IP Addressing , CIDR & NAT, IP layer protocols (ICMP, ARP, RARP, DHCP, BOOTP), IPv6)	10	15
7	Transport layer: Transport Layer Service, Elements of Transport protocols, Internet protocols (UDP and TCP)	4	10
8	Application Layer: DNS- Domain Name System, Electronic Mail, World Wide Web, Multimedia (Audio Compression, Streaming Audio, Voice over IP, Video Compression, Video on Demand)	4	15
9	Network Security: Cryptography, Symmetric key Algorithms (DES, AES), Public key Algorithms-RSA, Digital Signatures, IPSec ,Firewall	4	10
Total		39	

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.*

Text Books:-

1. Computer Networks by Andrew S. Tanenbaum (Fifth Edition), Pearson Education
2. Data Communication and Networking by Behrouz A. Forouzan (Fourth Edition), Tata McGraw Hill

Course Outcome:-

After successful completion of the course, the students will be able to:

1. Describe the components and infrastructure that form the basis for most computer networks
2. Describe the technical aspects of data communications on the Internet
3. Write networking programs in the C/C++ (or other programming language)

4. Propose network designs based on case studies in colleges or other institutions

Suggested List of Experiments:

1. Implementation of character stuffing and destuffing
2. Implementation of character stuffing and destuffing
3. Implementation of parity checker
4. Implementation of CRC
5. Implementation of checksum
6. Implementation of pure and slotted ALOHA
7. Implementation of bitmap protocol
8. Implementation of binary countdown protocol
9. Implementation of shortest path protocol
10. Implementation of string encryption and decryption
11. Introduction to RS 232C & UART
12. To perform byte transfer between 2 PCs using serial port using 'C' code
13. Study and execution of Network commands
14. To find out details of network from IP addressing scheme using 'C' code
15. Demonstration of Linux OS installation
16. Study and demonstration of internet packet capturing tool - Ethereal / Wireshark (Windows/Linux)
17. Study and demonstration of CISCO packet tracer (Windows/Linux)

Design based Problems (DP)/Open Ended Problems:

1. Identification of various networks components
 - a. Connections, BNC, RJ-45, I/O box
 - b. Cables, Co-axial, twisted pair, UTP
 - c. NIC (network interface card)
 - d. Switch, Hub
2. Sketch wiring diagrams of network cabling considering a computer lab of 10 systems

3. Interfacing with the network card (Ethernet)
4. Preparing of network cables
5. Establishment of a LAN if possible
6. Use of protocols in establishing LAN if possible
7. Trouble shooting of networks
8. Installation of network device drivers
9. Installation of networks (Peer to Peer networking client server interconnection)
10. Use/installation of proxy server
11. Configuration of network devices in CISCO packet tracer (Windows/Linux)
12. Implement communication between various network devices using CISCO packet tracer (Windows/Linux)
13. Network traffic monitoring using Wireshark/Ethereal (Windows/Linux)

List of Open Source Software/learning website:

1. <http://nptel.ac.in>
2. www.youtube.com

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GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Electronics Engineering / Electronics & Communication Engineering / Electronics & Telecommunication Engineering
SUBJECT NAME: Microwave Engineering
SUBJECT CODE: 2171001
B.E. 7th SEMESTER

Type of course: Core Course.

Prerequisite: Electromagnetic theory, Wave propagation, Antennas and Semiconductor physics

Rationale: This course provides basic knowledge of designing of transmission lines and wave guides. The various modes of propagations through transmission line and wave guides are included. Students will become familiar with the usage of active and passive components of microwave systems. Measurements of various parameters of microwave systems are also part of the subject.

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)
						PA	ALA	ESE	OEP		
04	00	02	06	70	20	10	20	10	20	150	

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction to Microwaves. History of Microwaves, Microwave Frequency bands, General Applications of Microwaves, Advantages of Microwaves	2	5
2	Mathematical model of Microwave Transmission Concept of Mode, Characteristics of TEM, TE and TM Modes, Losses associated with microwave transmission, Concept of Impedance in Microwave transmission	4	5
3	Analysis of Microwave Transmission Lines and Waveguides Transmission line equations & solutions, reflection and transmission coefficient, standing wave and standing wave ratio, line impedance and admittance, impedance matching, using stub line, application of smith chart in solving transmission line problems Introduction to strip lines, Micro strip lines, parallel strip lines, coplanar strip lines, shielded strip lines, Rectangular and circular waveguides-theory and analysis.	13	20
4	Microwave Network Analysis Equivalent Voltages and currents for non-TEM lines, Network	5	10

	parameters for microwave Circuits, Scattering Parameters.		
5	Passive and Active microwave Devices Microwave Passive components: Directional Coupler, Power Divider, Magic Tee, Wave-guide Corners, Bends, Twists, Attenuator, Circulator, Isolator and Resonator. Microwave Active components: Tunnel diode, Varactor diodes, Step recovery diodes, Schottky Barrier diodes, PIN diodes, Gunn Diodes, IMPATT and TRAPATT diodes, Parametric Amplifiers, Microwave Transistors, Microwave oscillators and Mixers. Microwave tubes: Klystron, TWT, Magnetron.	12	20
6	Microwave Measurements Power, Frequency and impedance measurement at microwave frequency, Network Analyzer and measurement of scattering parameters, Spectrum Analyzer and measurement of spectrum of a microwave signal, Noise at microwave frequency and measurement of noise figure, Measurement of Microwave antenna parameters.	6	15
7	Modern Trends in Microwaves Engineering Effect of Microwaves on human body, Medical and Civil applications of microwaves, Electromagnetic interference / Electromagnetic Compatibility (EMI / EMC), Monolithic Microwave IC fabrication , RF MEMS for microwave components, Microwave Imaging	5	15
8	Microwave Systems Wireless Communications system, Radar Systems, Radiometer Systems, Satellite Communication, Remote sensing, Microwave Propagation, Microwave Antennas.	5	10
Total		52	

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
05	20	10	20	10	05

**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. Samuel Liao - Microwave devices and circuits, PHI
2. Dennis Roddy - Microwave Technology, PHI
3. G. Kennedy - Electronic Communication systems, McGraw-Hill Book Company
4. Annapurna Das, Sisir K.Das- Microwave engineering, (TMG)

5. Siteshkumar Roy & Manojit Mitra - Microwave semiconductor devices, PHI
6. A. K. Gautam - Microwave engineering, (S. K. Kataria pub)
7. Sanjeev Gupta, Microwave Engineering, Khanna Pub.

Course Outcome:

After learning the course the students should be able to:

- 1 Understand basic concepts and applications of microwave systems.
- 2 Design, analyze and solve problems related to microwave transmission lines.
- 3 Design, analyze and solve problems related to microwave waveguide.
- 4 Analyze, test and use various passive microwave components for different applications.
- 5 Design and implement the microwave layouts.
- 6 Design and implement the microwave amplifier, oscillator, and mixer circuits

Suggested List of Experiments:

- 1 Introduction and identification of microwave component.
- 2 Study of the characteristics of Klystron tube and to determine its electronic tuning range.
- 3 Study of following characteristics of Gunn Diode
 - 3.1 Output power and frequency as a function of voltage.
 - 3.2 Square wave modulation through PIN diode.
- 4 To measure the polar pattern and the gain of a waveguide horn antenna.
- 5 To determine the frequency & wavelength in a rectangular waveguide working in TE₁₀ mode.
- 6 Study of function of multi hole directional coupler by measuring the following parameters:
 - 6.1 Main line and auxiliary line SWR
 - 6.2 Coupling factor and directivity.
- 7 To determine the standing wave ratio and reflection coefficient.
- 8 To perform PC to PC Communication using Microwave test bench
- 9 To study and perform the voice communication by using Microwave Test Bench
- 10 To study the Fixed and variable attenuator.
- 11 To measure an unknown impedance with smith chart.
- 12 To measure SWR of ports, isolation and coupling coefficients of Magic Tee.
- 13 To measure Input VSWR, Insertion loss and isolation of isolator/ circulator
- 14 To measure resonant frequency of Cavity resonator.
- 15 To study and perform the square law behavior of a microwave crystal detector.
- 16 Introduction to spectrum analyzer and measurement of spectrum of microwave signal using the same.

Design based Problems (DP)/Open Ended Problem:

Designing and simulation of various waveguides, micro-strip line, coupler in HFSS.

Major Equipment:

Microwave test bench, klystron and gunn power supply, SWR meter, Frequency meter, Microwave spectrum analyzer

List of Open Source Software/learning website:

HFSS, NPTEL video

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GUJARAT TECHNOLOGICAL UNIVERSITY

SUBJECT NAME: Digital Signal Processing

SUBJECT CODE: 2171003

B.E. 7th SEMESTER

Type of course:

Compulsory

Prerequisite:

- Higher Engineering Mathematics, Different Transforms (Fourier, Laplace, Z-transforms)
- Signals and systems

Rationale:

The purpose of this course is to provide an understanding of Digital Signal Processing. Topics include: Introduction to digital signal processing and application, discrete time signals and systems; Analysis of LTI systems; Structures of discrete time systems; Filter designing techniques; DFT and FFT; Architecture of DSP Processors, and Multi-rate Signal Processing and applications.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
PA	ALA	ESE	OEP							
4	0	2	6	70	20	10	20	10	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment; OEP-Open Ended problem; AL-Active learning;

Contents:

Sr. No.	Contents	Total Hrs	% Weight age
1	Introduction to DSP: Overview: Signals, systems and signal processing, classification of signals, elements of digital signal processing system, concept of frequency in continuous and discrete time signals, Periodic Sampling, Frequency domain representation of sampling, Reconstructions of band limited signals from its samples	3	05
2	Discrete-Time Signals and Systems (Frequency Domain analysis): Z-transform & Inverse z-transform, Linear convolution and its properties, Linear Constant Coefficient Difference equations, Frequency domain representation of Discrete-Time Signals & Systems, Representation of sequences by discrete time Fourier Transform, (DTFT), Properties of discrete time Fourier Transform, and correlation of signals, Fourier Transform Theorems.	5	10
3	Analysis of Linear Time Invariant System: Analysis of LTI systems in time domain and stability considerations.	8	15

	Frequency response of LTI system, System functions for systems with linear constant-coefficient Difference equations, Freq. response of rational system functions relationship between magnitude & phase, All pass systems, inverse systems, Minimum/Maximum phase systems, systems with linear phase.		
4	Structures for Discrete Time Systems: Block Diagram and signal flow diagram representations of Linear Constant-Coefficient Difference equations, Basic Structures of IIR Systems, lattice and lattice-ladder structures, Transposed forms, Direct and cascade form Structures for FIR Systems, Linear Phase FIR structure, Effects of Co-efficient quantization.	7	15
5	Filter Design Techniques: Design of Discrete-Time IIR filters from Continuous-Time filters Approximation by derivatives, Impulse invariance and Bilinear Transformation methods; Design of FIR filters by windowing techniques.	9	15
6	Discrete-Fourier Transform & Fast Fourier Transform: Representation of Periodic sequences: The discrete Fourier Series and its Properties Fourier Transform of Periodic Signals, Sampling the Fourier Transform, The Discrete-Fourier Transform, Properties of DFT, Linear Convolution using DFT. FFT-Efficient Computation of DFT, Goertzel Algorithm, radix2 Decimation-in-Time and Decimation-in-Frequency FFT Algorithms.	9	15
7	Advance DSP Techniques: Multirate Signal Processing: Decimation, Interpolation, Sampling rate conversion by rational factor Adaptive filters: Introduction, Basic principles of Forward Linear Predictive filter and applications such as system identification, echo cancellation, equalization of channels, and beam forming using block diagram representation study only.	7	15
8	Architecture of DSP Processors & applications: Harward architecture, pipelining, Multiplier-accumulator (MAC) hardware, architectures of fixed and floating point (TMS320C6000) DSP processors. Applications	4	10
	Total	52	100

Books:

1. "Digital Signal Processing: Principles, Algorithm & Application", 4th edition, Proakis, Manolakis, Pearson
2. "Discrete Time Signal Processing":Oppenheim, Schaffer, Buck Pearson education publication, 2nd Edition, 2003.
3. Digital Signal Processing fundamentals and Applications, Li Tan, Jean Jiang, Academic Press, 2nd edition, 2013
4. Digital Signal Processing – A computer based Approach, S.K.Mitra, Tata McGraw Hill, 3rd edition, 2006

5. Fundamentals of digital Signal Processing –Lonnie c.Ludeman, Wiley
6. Digital Signal processing-A Practical Approach,second edition, Emmanuel I. feacher, and BarrieW..Jervis, Pearson Education
7. Digital Signal Processing, S.Salivahanan, A.Vallavaraj, C.Gnapriya TMH
8. Digital Signal Processors, Architecture, programming and applications by B. Venkatramani, M Bhaskar, Mc-Graw Hill

Suggested specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
5	15	15	15	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.

Course Outcome:

By the end of this course, the student will be able to:

1. Formulate engineering problems in terms of DSP tasks
2. Analyse digital and analog signals and systems
3. Analyze discrete time signals in frequency domain
4. Design digital filters
5. Change sampling rate of the signal
6. Conceptualize the need of adaptive filters in communication applications.
7. Understand the key Architectural features of Digital Signal Processor
8. Apply digital signal processing algorithms to various areas

Suggested List of Suggested Experiments:

Sr. No.	Experiment Name
1	Write a program for Direct form – I, II form realization of the given IIR system function.
2	Write a program to plot pole-zero of a given FIR filter.
3	(A) Create Blackman Harris, Hamming and Gaussian window and plot them in the

	<p>same filter design tool.</p> <p>(B) Design an FIR filter with side lobe attenuation of 40 dB using Kaiser Window of 200 points.</p>
4	<p>(A) Design low pass butter worth digital filter with given specification using impulse invariance method.</p> <p>(B) Design a high pass elliptical filter with given specification using impulse invariance method.</p> <p>(C) Design a band pass chebychev-2 filter with given specification using impulse invariance method.</p>
5	<p>Design a second-order digital bandpass Butterworth filter with the following specifications: $f_u = 2.6$ kHz, $f_L = 2.4$ kHz , $f_s = 8000$ Hz. Plot the magnitude and phase response.</p>
6	<p>Write a program to demonstrate the time shifting and frequency shifting property of DTFT.</p>
7	<p>Write a program to perform circular convolution of two sequences using DFT.</p>
8	<p>Write a program to up sample the sinusoidal sequence by an integer factor.</p>
9	<p>Write a program to down sample the sinusoidal sequence by an integer factor.</p>
10	<p>Write a program to convert the sampling by non integer factor of a sinusoidal sequence.</p>

Design based Problems (DP)/Open Ended Problem:

Apply Digital Signal Processing technique to any one specific area like Speech processing, Image processing, Audio processing, Bio-Medical Instrumentation, Encoding of signals, Signal Compression etc. Develop a program for the same using MATLAB/SciLab or equivalent software.

C. List of Software: MATLAB/Code Composer Studio

Learning website: www.nptel.edu, <http://ocw.mit.edu>, <https://cnx.org/content>

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus is covered. The power-point slides should be put up on the web-site of the College/ Institute,

along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Electronics Engineering / Electronics & Communication Engineering / Electronics & Telecommunication Engineering
SUBJECT NAME: Wireless Communication
SUBJECT CODE: 2171004
B.E. 7th SEMESTER

Type of course:-

The course addresses the fundamentals of wireless communications and provides an overview of existing and emerging wireless communication Technology and networks. It covers radio propagation and fading models, fundamentals of cellular communications, multiple access technologies, and various wireless systems like GSM, CDMA etc., including past and future generation wireless networks.

Prerequisite: - It is desirable that student is familiar with following domains: Digital and analog Communication, Signals & Systems, Electromagnetic Theory, Probability & Random Processes.

Rationale: - The course will provide fundamental about many theoretical & practical concepts that form the basis for wireless communication systems and Networks. Also the emphasis is given for creating foundation of cellular concepts which will be useful for understanding the fundamentals of cellular mobile communication systems design. The students will learn Mobile Radio Propagation models and various wireless channel effects. Student will understand Multiple Access techniques. Students will also be exposed to recent emerging trends in wireless communication like Software Defined Radio as well. The course also covers overview of recent trends like wireless communication like Wi-Fi, Wi-MAX, bee, UWB Radio and Wireless Adhoc Networks.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	2	6	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Introduction to Wireless Communication System: Evolution of mobile communications, Mobile Radio System around the world, Types of Wireless communication System, Comparison of Common wireless system, Trend in Cellular radio and personal communication. Second generation Cellular Networks, Third Generation (3G) Wireless Networks , Wireless Local Loop(WLL),Wireless Local Area network(WLAN), Bluetooth and Personal Area Networks.	3	10

2	The Cellular Concept- System Design Fundamentals: Cellular system, Hexagonal geometry cell and concept of frequency reuse, Channel Assignment Strategies Distance to frequency reuse ratio, Channel & co-channel interference reduction factor, S/I ratio consideration and calculation for Minimum Co-channel and adjacent interference, Handoff Strategies, Umbrella Cell Concept, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular System-cell splitting, Cell sectorization, Repeaters, Micro cell zone concept, Channel antenna system design considerations.	12	20
3	Mobile Radio Propagation Model, Small Scale Fading and diversity: Large scale path loss:-Free Space Propagation loss equation, Path-loss of NLOS and LOS systems, Reflection, Ray ground reflection model, Diffraction, Scattering, Link budget design, Max. Distance Coverage formula, Empirical formula for path loss, Indoor and outdoor propagation models, Small scale multipath propagation, Impulse model for multipath channel, Delay spread, Feher's delay spread, upper bound Small scale, Multipath Measurement parameters of multipath channels, Types of small scale Fading, Rayleigh and rician distribution, Statistical for models multipath fading channels and diversity techniques in brief.	09	20
4	Multiple Access Techniques: Introduction, Comparisons of multiple Access Strategies TDMA, CDMA, FDMA, OFDM, CSMA Protocols.	07	15
5	Wireless Systems: GSM system architecture, Radio interface, Protocols, Localization and calling, Handover, Authentication and security in GSM, GSM speech coding, Concept of spread spectrum, Architecture of IS-95 CDMA system, Air interface, CDMA forward channels, CDMA reverse channels, Soft handoff, CDMA features, Power control in CDMA, Performance of CDMA System, RAKE Receiver, CDMA2000 cellular technology, GPRS system architecture.	12	20
6	Recent Trends: Introduction to Wi-Fi, WiMAX, ZigBee Networks, Software Defined Radio, UWB Radio, Wireless Adhoc Network and Mobile Portability, Security issues and challenges in a Wireless network.	09	15
Total		52	

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	15	10	15	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:

Text Book:

- 1 Wireless Communication, Theodore S. Rappaport, Prentice hall
- 2 Wireless Communications and Networking, Vijay Garg, Elsevier
- 3 Wireless digital communication, Kamilo Feher, PHI
- 4 Mobile Communications Engineering, William C. Y. Lee, Mc Graw Hill Publications
- 5 Mobile and personal Communication system and services by Rajpandya, IEEE press (PHI).
- 6 Wireless Communications-T.L.Singh-TMH
- 7 Adhoc Mobile Wireless network, C.K.Toh Pearson.

Course Outcome:

After learning the course the students should be able to:

- 1 Understand the basics of propagation of radio signals
- 2 Understand the basic concepts of basic Cellular System and the design requirements
- 3 Have an understanding of the basic principles behind radio resource management techniques such as power control, channel allocation and handoffs.
- 4 Gain insights into various mobile radio propagation models and how the diversity can be exploited to improve performance
- 5 Gain knowledge and awareness of the technologies for how to effectively share spectrum through multiple access techniques i.e. TDMA, CDMA, FDMA etc.
- 6 Have in-depth understanding of the design consideration and architecture for different Wireless Systems like GSM, CDMA, GPRS etc
- 7 Understanding of the emerging trends in Wireless communication like WiFi, WiMAX, Software Defined Radio (SDR) and related issues and challenges.

List of Experiments:

Experiments and Problems will be based on Concept of GSM, Cellular System Design Concepts, Wi-Fi, -MAX, Zig bee standard , Multipath propagation Environment and its parameter and loss measurement, Adhoc N/Ws & Protocols , Software Defined Radio, UWB Radio, GPRS etc.

Following are the examples of Experiments from the various part of syllabus topic. Same or similar Experiments may be given to the students based on availability of resources in wireless laboratory of the institute.

➤ **Experiments based on MATLAB OR SCILAB**

Write a MATLAB/ SCILAB Program/s based on

- 1** Free space Propagation Model & Frequency Selective Fading Model
- 2** Ground Reflection (Two-ray) Model
- 3** Diffraction (Knife-Edge) Model
- 4** Large-scale Empirical models
- 5** Small-scale Empirical models
- 6** Cellular Systems
- 7** Wireless LANs

➤ **Experiments based on GSM (Using Wireless Communication Trainer)**

- Study the implementation of –GMSK modulation, OQPSK detection.
 - Observe phase response of Tx and Rx and Spectrum of Tx and Rx.
 - Measure the BER value
 - GSM AT Commands

➤ **Experiments based on CDMA (Using Wireless Communication Trainer)**

- Study the performance of DS-CDMA system under multi-path condition for single user case
 - Using RAKE receiver with MRC method and EGC method
 - Observation of SNR vs BER curve for two different combining techniques.

➤ **Experiments based on OFDM (Using Wireless Communication Trainer)**

- Study OFDM system synchronization requirement
 - Observe the performance of Schmidl-Cox algorithm used for timing acquisition and fractional freq offset estimation
 - Integer Frequency offset estimation

Design based Problems (DP)/Open Ended Problem:-

- 1.** Design of Any Arbitrary Modulation Scheme
 - 8PSK, QAM (16, 64 etc), EDGE, WCDMA*, WiFi*, WiMAX*
 - Compare at base-band, IF and RF
- 2.** Design of Discrete Multi-tone modem, FM Radio Reception.
- 3.** Design/implement the different Channel Coder/Decoder
 - Turbo decoder
 - LDPC coder / decoder
- 4.** Project based on Reception of local GSM broadcast channel
- 5.** Project based on Frequency Hopping Spread Spectrum (FHSS)

Major Equipment: -

DSO, CRO, Signal Generators, Spectrum Analyzers, GSM, GPRS, GPS, CDMA Trainer Kits, Mobile Communication & Wireless Communication Trainer Kits etc.

List of Open Source Software/learning website:-

Students may use SCILAB, MATLAB, NETSIM, NS2 and NPTL Videos, MIT open course website, Virtual Labs (Source:[http://vlab .co.in](http://vlab.co.in)).

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should be submitted to GTU.