GUJARAT TECHNOLOGICAL UNIVERSITY

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

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
				Theory Marks			Practical Marks			
L	T	P	C	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

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 submit to GTU.

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;

Learning Objectives:

1. To learn digital signal processing fundamentals.
2. To understand the representation of discrete time signals in frequency domain, using z-transform and discrete Fourier transform.
3. To Understand the implementation of the DFT in terms of FFT, as well as some of its applications.
4. To learn the basic forms of FIR & IIR filters, and to design filters.
5. To know the typical applications of digital signal processing.

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	3	05

	domain representation of sampling, Reconstructions of band limited signals from its samples		
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. 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.	8	15
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 (TMSC6000) 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":Oppeheim, Schafer, 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 same filter design tool. (B) Design an FIR filter with side lobe attenuation of 40 dB using Kaiser Window of 200 points.
4	(A) Design low pass butter worth digital filter with given specification using impulse invariance method. (B) Design a high pass elliptical filter with given specification using impulse invariance method. (C) Design a band pass chebychev-2 filter with given specification using impulse invariance method.
5	Design a second-order digital bandpass Butterworth filter with the following specifications: fu= 2.6 kHz,fL = 2.4 kHz , fs = 8000 Hz. Plot the magnitude and phase response.
6	Write a program to demonstrate the time shifting and frequency shifting property of DTFT.
7	Write a program to perform circular convolution of two sequences using DFT.
8	Write a program to up sample the sinusoidal sequence by an integer factor.
9	Write a program to down sample the sinusoidal sequence by an integer factor.
10	Write a program to convert the sampling by non integer factor of a sinusoidal sequence.

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 of equivalent software.

C. List of Software: MATLAB/Code Composer Studio

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

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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)		ESE (V)	PA (I)	
					PA	ALA	ESE	OEP	
4	0	2	6	70	30		30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightag
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).

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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 & TelecommunicationEngineering

SUBJECT NAME: Embedded Systems
SUBJECT CODE: 2171005
B. E. 7th SEMESTER

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)	
					PA	ALA	ESE	OEP	
3	0	2	5	70	30		30	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://mspsci.blogspot.in/2010/08/tutorial-09-timers.html
7) http://mspsci.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

GUJARAT TECHNOLOGICAL UNIVERSITY

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

SUBJECT NAME: BIOMEDICAL INSTRUMENTATION
SUBJECT CODE:2171102
B.E. 7th SEMESTER

Type of course: Core Engineering

Prerequisite: Knowledge of basic electronics principles, sensor/ transducers, op-amp based circuit, simulation, Matlab or other software

Rationale: The techniques like ECG, EEG, EMG, etc. are vital signs considered for preliminary diagnostic tools for patient health condition. This course describes the principles, applications, and design process of the medical instruments used for Bioptential measurement. The course covers the topic from the origin of biopotnetials, through electrodes, to the special amplifier design requirement and electric safety in hospitals.

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	% Weightag
1	**The Human Body**: Overview Cell structure, Body fluids, Major systems of the body.	2	8
2	**Basic concepts of Medical Instrumentation** Generalized medical instrumentation system, operational modes, medical measurement constraints, classification of biomedical instruments, interfering and modifying inputs, compensation techniques, Design criteria, commercial medical instrumentation development process	3	8
3	**Fundamentals for bio-signal processing Measurement errors** - Types & analysis Noise - Types, SNR, Noise factor, figure and temperature, Noise in cascade amplifiers, Noise reduction strategies Sensor - Types, error sources, Tactics and signals processing for improved sensing, Matching sensors to circuit	4	12

	Bioelectric Amplifiers		
4	**The Origin of Bio-potential Electrical activity of excitable cells-** Resting states, Active states, Network equivalent circuit of nerve/ skeletal fiber, propagation of action potential Volume conductor fields	**4**	12
5	**Bio-potential Electrodes:** The electrode-electrolyte interface, Polarization, Polarizable and nonpolarizable electrodes, Electrode behaviour and circuit models, The electrode skin interface and Motion artifact, Body-surface recording electrodes, Internal electrodes, Electrode arrays, Microelectrodes.	**6**	15
6	**Electrocardiography Anatomy & physiology of heart**: electro-conduction system of the heart, The ECG waveform. The standard lead system, other ECG signals, ECG Noises, ECG amplification and signal conditioning circuits, ECG readout devices, ECG machines and maintenance of it, ECG faults & troubleshooting	**7**	15
7	**The Human nervous system & Brain function measurement**: Organization of the nervous system, the neuron. Instrumentation for brain function measurement Cerebral angiography, cranial x-rays, brain scans, ultrasonic equipment Electroencephalography: Neuron membrane potentials, EEG electrodes and the 1- 20 system, EEG amplitude and frequency bands, EEG diagnostic uses and sleep patterns, EEG system block diagram, Preamplifiers and EEG system specifications, Visual and auditory evoked potential recordings, EEG telemetry, Typical EEG system artifacts, faults, troubleshooting, and maintenance	**8**	15
8	**Electrical Safety:** Physiological effects of electricity, Important susceptibility parameters, distribution of electric power, Macro shock hazards, Electrical- Safety codes and standards, basic approaches to protection against shock, power distribution protection, equipment protection	**5**	15
Total		**39**	

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**15**	**15**	**15**	**10**	**5**

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. **1** Introduction to Biomedical Equipment Technology by Josheph J. Carr and John M. Brown, Pearson Education.
2. Medical Instrumentation- Application and Design by John. G. Webster, John Wiley & Sons.
3. Handbook of Biomedical Instrumentation by R.S. Khandpur.
4. Biomedical Digital Signal Processing by Willis J. Tompkins, Prentice-Hall of India.
5. Signals and Systems in Biomedical Engineering by Suresh R. Devashahayan, Kluwer academics/ Plenum publication.

Course Outcome:

After learning the course the students should be able to:
CO1. characterize anatomy and physiology of important physiological system of human body.
CO2. Analyze and design of medical instruments (particularly electronics part) by evaluating medical parameter measurement constraint.
CO3. Analyze important vital sign parameters to evaluate certain disease conditions
CO4. Implementation of the electric safety of the medical instruments.

List of Experiments:

1. Study of typical medical and physiological parameters along with their measurement range, frequency and standard sensor or method.
2. Study of Physiological system of human body.
3. Implementation of Filter for noise removal in medical parameter measurements using software or hardware.
4. Implementation of Multiplexer, ADC & DAC.
5. Implementation of semiconductor based sensor ICs
   a. Temperature sensor IC- TMP 102, LM 35
   b. Pressure Sensor IC- Smartec SPD015G
6. Study of ECG measurement system : -
   (i) study of electrodes, patient cable and monitors
   (ii) Study of ECG simulation software
   (iii) demonstration of wireless ECG system (lead-I measurement only).
7. Measurement of Blood pressure using i).sphygmomanometer ii) Pressure gauge
8. Visit report of I.C.U of hospital / micro biology laboratories
9. Course Project - A product report of any bio-medical instrument/ device/ system.

Design based Problems (DP)/Open Ended Problem:

1. Design ECG front end (monitoring grade only) using instrumentation amplifier/ operational amplifiers.
2. Propose a remote patient monitoring system.
3. Simulate generation of action potential phenomena using MatLab or Scilab.
4. Simulate various filters/ algorithm to remove noise from ECG/EEG, etc using MatLab or SciLab.

Major Equipment:

Computers, simulation software, ECG measurement system, Blood pressure measurement system, etc.

List of Open Source Software/learning website:

http://nptel.ac.in/video.php?subjectId=108105064

http://coep.vlab.co.in/?sub=25&brch=78 – online biomedical and signal processing laboratory

http://www.physionet.org/physiobank/database/mitdb/ - for patient ECG data

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 submit to GTU.

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Electronics & Communication Engineering (11), Electronics & Telecommunication Engineering (12)
SUBJECT NAME: Satellite Communication
SUBJECT CODE: 2171007
B.E. 7thSEMESTER

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	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 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 Per turbations, 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 Depolarizaon, 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 satellitecommunication
2. To setup a communication link betweenuplink transmitter and downlink receiverusing Satellite.
3. To setup an Active satellite communicationlink and demonstrate link fail operation
4. To communicate voice & Video signal throughsatellite link
5. Observe the effect of Different combinationsof uplink and downlink frequencies on satellitelink.
6. To transmit and receive three separatesignals (Audio, Video , Tone) simultaneouslythrough satellite link
7. To transmit and receive function generatorsignals through satellite link.
8. To measure the signal parameters in ananalog FM/FDM TV satellite link.
9. To transmit digital waveforms through asatellite communication link.
10. To Calculate Bit Error Rate in a satellitecommunication link.

Design based Problems (DP)/Open Ended Problems:

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 Estimatedtopospheric attenuation due toOxygen 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 signal forSatCom.

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.coms

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GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Electronics & Communication (11), Electronics & Telecommunication (12)
SUBJECT NAME: INDUSTRIAL AUTOMATION (Department Elective-II)
SUBJECT CODE: 2171103
B.E. 7th SEMESTER

Type of course: Department Elective course

Prerequisite: Knowledge of Basic Electrical Engineering, Basic Electronics, Digital Electronics, Electronics Measurement and Instruments

Rationale: Automation is playing a key role in Industries. Industries rely heavily on automation for economic viability and mass production. It is important for the students to learn basic of automation, how system works and importance of PLC, SCADA and robots in automation. This course will provide opportunity to learn industrial automation techniques.

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	30		30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Introduction:** Automation overview, Requirement of automation systems, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA). Industrial bus systems: modbus & profibus	**5**	15%
2	**Automation components**: Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.	**6**	15%
3	**Computer aided measurement and control systems:** Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation	**8**	20%

4	**Programmable logic controllers:** Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.	**8**	20%
5	**Distributed Control System:** Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.	**8**	20%
6	**Overview of Industrial automation using robots:** Basic construction and configuration of robot**,** Pick and place robot, Welding robot.	**3**	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
5	**15**	**25**	**10**	**10**	**5**

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] Industrial Instrumentation and Control By. S.K. Singh The McGraw Hill Companies

[2] Process Control Instrumentation Technology By. C.D. Johnson, PHI

[3] Industrial control handbook, Parr, Newnem

[4] Programmable logic controller, Dunning, Delmar

Course Outcome:

After learning the course the students should be able to:

1. Understand various automation components and systems
2. Draw block diagram of industrial automation and control system
3. Explain architecture of industrial automation system
4. Measure industrial parameters like temperature, pressure, force, displacement, speed, flow, level, humidity and pH.

5. Explain fundamentals of process control
6. List basic devices used in automated systems
7. Use programmable logic controllers for industrial automation
8. Draw block diagram of supervisory control and data acquisition (SCADA).
9. Integrate SCADA with PLC systems
10. Use Internet of Things for industrial automation
11. Know use of robot for industrial applications

Suggested List of Experiments:

(General guidelines.. Institute may change list of experiments based on laboratory set up available)

1. Use industrial grade sensors and transducer introduction and characteristics like proximity detector, linear encoder, rotary encoder, touch sensor, force sensor, accelerometer, RTDs, loadcells and LVDT for measurement
2. Use Various actuators such as relay, solenoid valve, process control valve and motors for control applications
3. Simulate analog and digital function blocks
4. Relay logic diagram and ladder logic diagram
5. Understand and perform experiments on timers and counters
6. Logic implementation for traffic Control Application
7. Logic implementation for Bottle Filling Application
8. Tune PID controller for heat exchanger using DCS
9. FBD for autoclavable laboratory fermentor
10. Develop graphical user interface for the plant visited by you
11. Industrial visit report

There may be separate list of experiment where laboratory setup is developed by Siemens under Centre of Excellence.

Design based Problems (DP)/Open Ended Problem:

1. Design of low cost PLC Systems
2. Design of humanoid robots

Major Equipment:

1. ADC, DAC and Controller, Switches, LEDs, Solenoid valves
2. Relay, motor
3. PLC with software
4. MATLAB or LABView or other similar software
5. AC Servo drives and DC Servo drives
6. Zeegbee and Bluetooth based short range automation system.
7. IoT boards.
8. Robot for demonstration

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 submit to GTU.