GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS (10), ELECTRONICS & COMMUNICATION (11), ELECTRONICS & TELECOMMUNICATION ENGINEERING (12)

MICROPROCESSOR AND INTERFACING

SUBJECT CODE: 2141001

B.E. 4th SEMESTER

Type of Course: Micro Processor Architecture and Programming

Prerequisite: Students should have in depth knowledge of Digital Logic Design as well as logical ability and programming skills to develop the code

Rationale: Microprocessors are being excessively used in the field of automation in every field, so the knowledge of microprocessor is very essential for a student of BE in Electronics and Communication engineering. The students are studying the subject are supposed to learn the architecture and programming of a typical microprocessor. Students also understand the peripheral devices and interfacing it with microprocessor to design a digital system. The course will cover 8085, 8-bit Microprocessor in detail with sufficient exposure to design a digital system. The course will also deal with the architecture of 8086 and introduction to advance microprocessor.

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.	Topics	Teaching Hrs.	Module Weightage
1	**Introduction To 8-bit Microprocessor :** History of Microprocessor, 8085 Microprocessor architecture, buses, register, flags. 8085 pin configuration & function of each pin. Fetch, Decode and execute operations. Op-code Fetch, execute cycle, T state, Machine cycle. Memory and I/O read and write cycles WAIT state, interrupt timing diagram.	**7**	**20**
2	**Intel 8085 Microprocessor Instruction Set and Programming:** Addressing modes of 8085. Data transfer, Arithmetic, Logical, Rotate, Branch and machine control instructions. Development of 8085 assembly language programs, time delays. Concept of stack and Instruction related to stack. 8085 interrupts, RST, RIM, SIM instructions. Subroutines and conditional call instruction	**15**	**30**
3	**Interfacing of Memory Chips & Input / Output Chips :** Memory mapped I/o and I/O mapped I/O. Address decoding, interfacing of memory chips with 8085. Interfacing of input/output chips with 8085	**5**	**15**
4	**Peripherals IC and Applications :** Block diagram, Pin description and Interfacing of 8255(PPI) with 8085 Microprocessor. Interfacing of keyboard, display, ADC and DAC to 8255. Block diagram, Pin description and Interfacing of 8253(PIT) with 8085 Microprocessor. Brief description and application of 8259	**10**	**20**

	PIC, 8251 USART and 8237 DMA Controller		
5	**Introduction advance Microprocessor :** Intel 8086 Microprocessor architecture, Addressing Modes, 8086 pin configuration & function of each pin. Introduction and advance features of 8088, 80186, 80286, 80386 and 80486microprocessor	**8**	**15**

Suggested Specification table with Marks (Theory):

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

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate 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. Microprocessor 8085 and its Interfacing, By Sunil Mathur, Second Edition, PHI Learning Pvt. Ltd.
2. Microprocessor Architecture, Programming, and Applications with the 8085 –Ramesh S. Gaonkar Pub: Penram International.
3. 8085 Microprocessor And its Applications, By A. Nagoor Kani, Third Edition,TMH Education Pvt. Ltd.

Course Outcomes:
After successful completion of the course students should be able to:

1. Understand the architecture of 8085 8-bit Microprocessor.
2. Describe the importance and function of each pin 8085 Microprocessor.
3. Write, Debug and Simulate assembly language program.
4. Interface Memory, Input/output with 8085 Microprocessor.
5. Summarize the functionality of various peripheral chips.
6. Describe the architecture of 8086 16-bit Microprocessor.
7. List the difference between 8-bit, 16-bit and advance Microprocessor

List of Experiments:

- Familiarization with 8085 simulator and trainer kit.
- Verification of assembly language programs using the simulator and trainer kit.
- Development of interfacing circuits for various applications based on 8085.

Minimum of 25 programs to be written making effective use of all the instructions. Among these at least 6 programs must be subroutine programs, 4 to 5 programs based on peripheral ICs.

Design based Problems (DP)/Open Ended Problem:

1. Assembly programs include the concept of Arrays and the concept of Multiplication/Division.
2. Design an 8085 microprocessor based system with 4 KB RAM having a word length of 8-bits with the starting address of 0000H and two 1KB EPROMs having word lengths of 4-bits each with starting address of 8000H.
3. Interface one 4K x 8 RAM and two 8K x 8 ROM with 8085 such that the starting address assigned to each memory chip is 6000H, 8000H and C000H

respectively using a 3 x 8 decoder IC.

4. Design an 8085 microprocessor based system with input device connected at I/O mapped address A0h. Three LEDs (common cathode): LED-1(Green) at D0 bit, LED-2 (Yellow) at D3 bit and LED-3 (Red) at D6 bit of the output device connected at I/O mapped address C0h. Write an assembly program to take data from input device,

   Glow LED-1 ; if data <=50H
   LED-2 ; if 50H >data<=A0H
   LED-3 ; if data>A0H.

   Take data from input device at every 10 mS time.
5. Design a digital system to display token number on a seven-segment displays (common anode) of Port-A and switch connected to Port-C of 8255 PPI. Display 1,2,3……9,0 and repeat as switch is pressed.
6. Interface stepper motor with 8085 microprocessor using 8255, rotate it counterclockwise.
7. Design a digital system to monitor room temperature using ADC connected with 8255.
8. Design a digital clock using 6 seven-segment displays (common cathode) using 8255 PPI and 8253 PIT (to generate time delay).

Major Equipments:

1. 8085 microprocessor trainer kit with peripheral devices.
2. Computer system.
3. CRO, Power supply

List of Open Source Software/learning website:

1. 8085 simulator.
2. nptel.ac.in
3. wikipedia.org/wiki.intel_8085

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

ELECTRONICS (10), ELECTRONICS & COMMUNICATION (11), ELECTRONICS & TELECOMMUNICATION ENGINEERING (12)

ANALOG CIRCUIT DESIGN

SUBJECT CODE: 2141002

B.E. 4th SEMESTER

Type of Course: Circuit Design and Analysis

Prerequisite: Basic knowledge of electronic active and passive components and low frequency circuit analysis techniques etc

Rationale: This course aims to familiarize students with high frequency analysis of BJT circuits, various oscillators, differential amplifier, op-amp and its applications, and op-amp based filter circuits.

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	20	10	20	10	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	**The Transistor at High Frequencies:** Hybrid–pi CE transistor model, Hybrid–pi conductance, Hybrid–pi capacitances, Validity of hybrid–pi model, Variation of hybrid–pi parameters, CE short-circuit current gain, Current gain with resistive load, Single-stage CE transistor amplifier response, Gain-bandwidth product, Emitter follower at high frequencies	**07**	14
2	**Oscillators:** Sinusoidal oscillators, Phase-shift oscillator, Resonant circuit oscillators, A general form of oscillator circuit, Wien bridge oscillator, Crystal oscillators, Frequency stability	**05**	10
3	**Operational Amplifiers:** The basic operational amplifier, The differential amplifier, The emitter-coupled differential amplifier, Transfer characteristics of a differential amplifier	**03**	6
4	**Introduction to Operational Amplifiers, Interpretation of Data Sheets and Characteristics of an Op-amp:** Introduction, Block Diagram representation of a typical op-amp, its equivalent circuits, types of ICs, Manufacturers' designations and package types for ICs, Power supplies for ICs, Interpreting datasheet, Ideal op-amp, Equivalent circuit of an op-amp, Ideal voltage transfer curve, Open-loop op-amp configurations	**03**	6
5	**An Op-amp with Negative Feedback:** Voltage series feedback amplifier, Voltage shunt feedback amplifier, Differential Amplifier	**04**	8
6	**Op-amp Offset Voltage:** Introduction, Input offset voltage, Input bias current, Input offset	**04**	8

	current, Total output offset voltage, Thermal Drift, Effect of variation in power supply voltages on offset voltage, Change in input offset voltage and input offset current with time, Other temperature and supply voltage sensitive parameters, Noise		
7	**General Linear Applications:** DC and AC Amplifiers, AC amplifiers with single supply voltage, Peaking amplifier, Summing, Scaling and Averaging Amplifier, Instrumentation Amplifier – its block diagram along with applications, Differential input and differential output amplifier, Voltage-to-current converter with floating load (low voltage DC voltmeter, low voltage AC voltmeter, Diode match finder, Zener diode tester, Light emitting diode tester), Current-to-voltage converter, Integrator, Differentiator	**08**	15
8	**Comparators and Converters:** Comparator, Zero crossing detector, Schmitt Trigger, Voltage limiters, Clipper and clampers, Absolute value output circuit, Peak detector, Sample and hold circuit, Precision rectifier – Half/Full Wave, Square, Triangular and Saw tooth wave generator, Common mode configuration and common mode rejection ratio, Slew rate and its equations, Effect of slew rate in applications	**06**	11
9	**Specialized ICs and its Applications:** **a. 555 Timer and its applications:** Block diagram, Monostable and Astable multivibrator, Applications as Frequency divider, Square wave generator **b. Phase Locked Loops and its Applications:** Block diagram and operation, Applications as Frequency Multiplier, Frequency Shift Keying **c. Design of Power Supply:** Simple op-amp voltage regulator, Three terminal voltage regulators, Fixed and adjustable voltage regulators (78XX, LM317), Heat sink, Dual power supply (LM320, LM317), Basic switching regulator and its characteristics	**04**	7
10	**Op-amp based Filter Circuits:** Classification of filters, Magnitude and frequency scaling, Magnitude and attenuation characteristics of ideal and practical filters, Design parameter Q and $\omega 0$, Biquad (Universal) filter design, Butterworth low-pass and high-pass filters – 1st and 2nd order circuits design, Butterworth pole location, Sallen and key circuit, Butterworth bandpass filters – frequency transformation, Deliyannis – friend Circuit, Chebyshev filter characteristics, Band reject filters	**08**	15

Suggested Specification table with Marks (Theory):

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

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate 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. Electronics Device and Circuits by Jacob Milman, Christos C. Halkias, Chetan D. Parikh, Tata Macgraw Hill Publication [Second Edition].
2. Op-amps and Linear Integrated Circuits, Ramakant A. Gaikwad, Fourth Edition, PHI.
3. Electronics Principles by Albert Malvino [seventh Edition]

Course Outcomes:

After successful completion of the course students should be able to:

1. To analyze BJT circuits at high-frequency.
2. To analyze various oscillator circuits.
3. To analyze differential amplifier circuit.
4. To interpret and measure op-amp parameters.
5. To analyze various application circuits designed using op-amp.
6. To design Biquad filer circuits.
7. To design Sallen and Key filter circuits.
8. To design Delyiannis-Friend circuits

List of Experiments:

1. To build transistor based RC phase shift oscillator circuit, and measure and verify its frequency of operation.
2. Measurement of input and output offset voltage of 741 ICs.
3. To configure op-amp in voltage follower mode and to measure its slew rate.
4. To configure op-amp in inverting and non-inverting amplifier mode and measure their gain and bandwidth.
5. To prepare precision rectifier using op-amp and verify its operation using measurements.
6. To prepare full-wave rectifier using op-amp and verify its operation using measurements.
7. To measure PSRR and CMRR of given op-amp.
8. To design Schmitt trigger circuit using op-amp and take measurements.
9. To design, build astable and monostable multivibrators using 741 IC and verify their operation using measurements by observing waveforms.
10. To design, build and obtain the frequency responses of first order low pass and band pass active filters.
11. To build op-amp based Weign bridge oscillator circuit, and measure and verify its frequency of operation.
12. Design the following amplifiers:
    a. A unity gain amplifier
    b. A non-inverting amplifier with a gain of ’A’
    c. An inverting amplifier with a gain of ‘A’

    Apply a square wave of fixed amplitude and study the effect of slew rate on the three type of amplifiers.
13. Design and test the integrator for a given time constant.
14. Design a second order butter-worth band-pass filter for the given higher and lower cut-off frequencies.
15. Design and test a notch filter to eliminate the 50Hz power line frequency.
16. Design and test a function generator that can generate square wave and triangular wave output for a given frequency.

17. Design and test voltage controlled oscillator for a given specification (voltage range and frequency range).
18. Design and test a Low Dropout regulator using op-amps for a given voltage regulation characteristic and compare the characteristics with standard IC available in market.
19. Design and test an AGC system for a given peak amplitude of sine-wave output.
20. Design and test a PLL to get locked to a given frequency 'f'. Measure the locking range of the system and also measure the change in phase of the output signal as input frequency is varied within the lock range.

Design based Problems (DP)/Open Ended Problem:

1. Design single stage CE amplifier for high frequency.
2. Design Wien bridge oscillator for a particular frequency.
3. Design voltage series feedback amplifier with op-amp.
4. Design averaging amplifier with op-amp.
5. Design an instrumentation amplifier for particular application.
6. Design zener diode tester with op-amp.
7. Design zero crossing detector circuit using op-amp.
8. Design antilog amplifier.
9. Design touch switch using 555 IC.
10. Design two different color driver using 555 IC.
11. Design a buzzer to indicate end of the class using 555 IC.
12. Design adjustable voltage regulator using LM317 IC.
13. Design 2nd order High Pass Butterworth filter using op-amp.

Major Equipments and Components:

C.R.O., Function Generator, Power Supply, Multi-meter, Digital Storage Oscilloscope, Experimental Trainer Kits (e.g. Analog System Lab Kits, Operational Amplifier Trainer Kits, Linear IC Trainer, etc.), Bread Board, General Purpose PCB, 741/082 op-amp, 555 Timer, Resistors, Capacitors, Diodes, etc.

List of Open Source Software/learning website:

Ng-spice/Multisim
www.nptel.com

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.

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ELECTRONICS (10), ELECTRONICS & COMMUNICATION (11), ELECTRONICS & TELECOMMUNICATION ENGINEERING (12)

ELECTRONICS MEASUREMENT AND INSTRUMENTATION

SUBJECT CODE: 2141003

B.E. 4thSEMESTER

Type of Course: NA

Prerequisite: Students are expected to have basic knowledge of analog and digital electronics .

Rationale: In the field of Electronics, it is essential to know the functional aspects of several instruments useful in the process of signal measurement. Prior to the measurement, the process of signal conversion to equivalent electrical quantity and conversion of electrical quantify in one or the other forms are important steps. The fundamentals of signal measurement in analog as well as digital domains both need to be emphasized for modern instruments.

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.	Topics	Teaching Hrs.	Module Weightage
1	**Measurement Errors and Standards:**Definitions, Accuracy and Precision, Significant Figures, Types of Error, Statistical Analysis, Probability of Errors, Limiting Errors, Time and Frequency Standards, Electrical Standards	2	10
2	**Bridge Measurements**: Wheatstone Bridge, Kelvin Bridge, AC Bridge and their Applications, Maxwell Bridge, Hay's Bridge, Unbalance Conditions, Wein Bridge. Anderson's Bridge, De Sauty's Bridge, Schering Bridge.	5	10
3	**Electronics Instrument For Measuring Basic Parameters**: True RMS Responding Voltmeter, Digital Frequency Meter, Circuit for Measurement of Frequency, High Frequency Measurements, Period Measurement, Ratio and Multiple Ratio Measurements, Time Interval Measurements, Vector Impedance Meter.	6	15
4	**Cathode Ray Oscilloscope**: Introduction, Oscilloscope Block Diagram, Cathode Ray Tube, Delay Line, Multiple Trace, Oscilloscope Scope and Transducers, Oscilloscope Techniques, Digital Storage Oscilloscope.	4	8
5	**Instrument for Generation and Analysis of Waveforms**: Introduction, The Sine Wave Generator, Frequency Synthesized Signal Generator, Frequency Divider Generator, Signal Generator Modulation, Sweep Frequency Generator, Pulse and Square Wave Generator,	6	15

	Function Generator, Wave Analyzers, Harmonic Distortion Analyzer, Spectrum Analyzer.		
6	**Transducers:** Electrical Transducers Selection and Considerations, Resistive, Strain Gauges, Temperature Transducers: Platinum Resistance Type, Thermistor, Thermocouples, Inductive, LVDT, Capacitive, Load Cell, Piezoelectric, Photoelectric Transducers.	4	7
7	**Signal Converters:** I To P / P To I Converter, Temperature to Voltage Converter, Conversion To Frequency, Period, or Time Duration, Measurement of Phase Difference Using X-OR and SR Flip-Flop Method, Measurement of Active And Reactive Power of Supply Line, Locking Amplifiers, Variable Oscillators, Direct Sensor-Microcontroller Interfacing.	5	10
8	**Isolation Techniques:** Transformer Isolation, Optical Isolation, Digital Techniques For Optical Isolation, Hall-Effect Principle And Measurement Of Displacement, Current And Power Using Hall Sensors, Amplifications Of Low Level Signals, Guarding, Shielding.	5	10
9	**Data Acquisition And Conversion:** Analog Signal Processing, Sample And Hold Operation, S/H Circuits Using Op-Amps, Introduction To Data Acquisition System, Various DAS Configurations, Single Channel DAS, Multi-Channel DAS, IC Based DAS, Data Acquisition, Data Acquisition in PLC.	5	15

Suggested Specification table with Marks (Theory):

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

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate 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. Helfrick Albert D. and Cooper W. D., "Modern Electronic Instrumentation and MeasurementTechniques", Prentice Hall India, 1st Ed., 1990
2. Shawhney A. K. "A Course In Electrical And Electronics Measurements And Instrumentation",Dhanpat Rai & Sons, 11th Ed., 1999
3. Kalsi H. S. "Electronic Instrumentation", Tata McGraw-Hill Education, 2nd Ed., 2004 .
4. Bell David A. "Electronic Instrumentation and Measurements", PHI / Pearson Education, 2006.
5. Rangan C. S., Sarma G. R. and Mani V. S. V., "Instrumentation Devices And Systems", Tata McGraw-Hill, 2nd Ed., 2004.
6. A. J. Bouvens, "Digital Instrumentation", McGraw-Hill, 1st Ed., 1997.

Course Outcomes:

After successful completion of the course students should be able to:

1. Define measurement parameters and methods, standards, characteristics, errors.

2. Graduates will be able to study the working of different ac and dc bridges, Transformers.
3. Gain knowledge on different voltmeters, multimeter, wave analyzers
4. Gain knowledge on different digital meters.
5. Gain knowledge on general purpose oscilloscopes and recorders.
6. Gain knowledge on data acquisition and conversion.
7. Gain Knowledge on Utilization & interpretation of various Transducers along with practical implementation.
8. Utilization,operation and maintanance of various instruments for generation and analysis of waveforms as well as for electronic testing and measurement.
9. To understand basics of data acquisition process and utilize for measurement.
10. To understand signal convertors for the signal measurement.
11. Use various measuring electronics instruments and measurement methods in electronic systems.

List of Experiments:

1. To find the value of unknown resistor using Wheatstone bridge.
2. To find the value of unknown capacitance and inductance using Maxwell's bridge.
3. To find the value of unknown capacitance using Wein's series and parallel bridge.
4. To extend the range of given voltmeter and ammeter.
5. Measurement of frequency using Lissajous method.
6. To study and verify characteristic of variable resistor transducer (strain gauge).
7. To study and verify characteristic of LVDT
8. To study and verify characteristic of Thermocouple/RTD.
9. To study the front panel controls of storage CRO.
10. To analyze analog and digital multi meter for various measurements.
11. To verify the performance characteristics of compensated attenuator.
12. To demonstrate the functionality of function generator and its use as a test and
1. measurement equipment.
13. Measurement of LCRQ meter.
14. To demonstrate the functionality of IC tester and test various ICs.
15. Fourier series analysis of a square wave using spectrum analyzer.
16. To study and simulate any two measurement system using LAB VIEW.
17. To generate various signals using arbitrary waveform generator.
18. To demonstrate the functionality of distortion meter.
19. Disection of Horinzontal deflection system of CRO and to measure /observe voltage/Current waveforms at each important test points.
20. Disection of Vertical deflection system of CRO and to measure /observe voltage/Current waveforms at each important test points.

Design based Problems (DP)/Open Ended Problem:

1. To design various bridges for finding the unknown quantities.(May use tools also like Labview/Pspice/MultiSim etc. for practical design and testing)
2. To design various transducer circuits systems for measuring different non-electrical quantities.
3. To test the probe using CRO.
4. To test various active and passive components using CRO.
5. To obtain Lissajous pattern and eye diagram using CRO.
6. To measure high voltage using CRO.
7. To design a sine wave, square wave and pulse generator as per given specification. .(May use tools also like Labview/Pspice/MultiSim etc. for practical design and testing)
8. To design a required waveform using arbitrary waveform generator and measure various parameters using DSO.

9. To design function generator and frequency counter as per given specification..(May use tools also like Labview/Pspice/MultiSim etc. for practical design and testing)
10. Design of sample and hold circuit for required measurement as per given specification and requirement.

Major Equipments:

1. Function generator
2. Digital multimeter
3. D.C. power supply
4. Cathode Ray Oscilloscope
5. Digital Storage Oscilloscope
6. LCR-Q meter
7. Field strength meter(dB meter)
8. Experimental trainer kits, Bread board, Computers

List of Open Source Software/learning website:

i. Electronic Workbench/MultiSIM/Circuit Maker /Pspice
ii. www.ocw.mit.edu
iii. www.home.agilent.com
iv. Labview

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.

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ELECTRONICS (10), ELECTRONICS & COMMUNICATION (11), ELECTRONICS & TELECOMMUNICATION ENGINEERING (12)

CONTROL SYSTEM ENGINEERING

SUBJECT CODE: 2141004

B.E. 4th SEMESTER

Type of course: Modeling, performance analysis and control with potential application to engineering systems.

Prerequisite: Knowledge of Linear differential equations, Differential equations and its solution, and Laplace transform.

Rationale: This course explores the fundamentals of systems and control. The course has two primary focuses:

(1) Understanding and predicting system behavior, and
(2) Design and analysis of closed loop control systems.

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	20	10	20	10	20	100

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Introduction to Control Systems: Introduction, Brief History of Automatic Control, Examples of Control Systems, Engineering Design, Mechatronic Systems, The Future Evolution of Control Systems.	**3**	**5-6**
2	Mathematical Models of Systems: Differential Equations of Physical Systems, Linear Approximations of Physical Systems, The Laplace Transform, The Transfer Function of Linear Systems, Block Diagram Models, Signal-Flow Graph Models.	**6**	**12-14**
3	State Variable Models: The State Variables of a Dynamic System, The State Differential Equation, Signal-Flow Graph and Block Diagram Models, Alternative Signal-Flow Graph and Block Diagram Models, The Transfer Function from the State Equation , The Time Response and the State Transition Matrix.	**8**	**14-18**
4	Feedback Control System Characteristics: Error Signal Analysis, Sensitivity of Control Systems to Parameter Variations ,Disturbance Signals in a Feedback Control System, Control of the Transient Response, Steady-State Error, The Cost of Feedback.	**3**	**6-8**
5	The Performance of Feedback Control Systems: Test Input Signals, Performance of Second-Order Systems, Effects of a Third Pole and a Zero on the Second-Order System Response, The s-Plane Root Location and the Transient Response, The Steady-State Error of Feedback Control Systems, Performance Indices, The Simplification of Linear Systems.	**4**	**8-10**
6	The Stability of Linear Feedback Systems: The Concept of Stability,	**3**	**5-8**

	The Routh-Hurwitz Stability Criterion, The Relative Stability of Feedback Control Systems, The Stability of State Variable Systems.		
7	The Root Locus Method: The Root Locus Concept. The Root Locus Procedure, Parameter Design by the Root Locus Method, Sensitivity and the Root Locus, Three-Term (PID) Controllers.	**4**	**6-9**
8	Frequency Response Methods: Frequency Response Plots, Frequency Response Measurements, Performance Specifications in the Frequency Domain, Log Magnitude and Phase Diagrams.	**5**	**7-8**
9	Stability in the Frequency Domain: Mapping Contours in the s-Plane, The Nyquist Criterion, Relative Stability and the Nyquist Criterion, Time-Domain Performance Criteria in the Frequency Domain, System Bandwidth, The Stability of Control Systems with Time Delays.	**6**	**10-12**
10	The Design of Feedback Control Systems: Approaches to System Design**,** Cascade Compensation Networks, Phase-Lead Design Using the Bode Diagram, Phase-Lead Design Using the Root Locus, System Design Using Integration Networks, Phase-Lag Design Using the Root Locus, Phase-Lag Design Using the Bode Diagram, Design on the Bode Diagram Using Analytical Methods.	**8**	**15-18**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
R Level	U Level	A Level	N Level	E Level
12-15	15-20	20-25	30-35	20-30

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate 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. Modern Control System by Richarc C. Drof and Robert H. Bishop,11th Edition Person Int.
2. Modern Control Engineering by Katsuhiko Ogata, 4th Edition, Prentice Hall of India.
3. Automatic Control Systems by Benjamin C.Kuo, 8th Edition, Farid Golnaraghi, John Wiley & Sons.
4. Control Systems Engineering by Nagrath and Gopal New Age Publication
5. Feedback and Control Systems by Joseph J Distefano 2nd Edition TMH

Course Outcome:

At the successful completion of this course, a student will be able to:

1. Apply systems theory to complex real world problems in order to obtain models that are expressed using differential equations, transfer functions, and state space equations
2. Predict system behavior based on the mathematical model of that system where the model may be expressed in time or frequency domain
3. Analyze the behavior of closed loop systems using tools such as root locus, Routh Hurwitz, Bode, Nyquist, and Matlab
4. Design controllers using classical PID methods, root locus methods, and frequency domain methods.
5. Devise a safe and effective method of investigating a system identification problem in the lab
6. Write a report that effectively communicates the results of an analysis or design.

List of suggested Experiments:

1. Simulation of DC motor working
2. Simulation of synchros
3. Generating standard test signals i.e. step, ramp, unit impulse on a simulator
4. Analysis of time response of second order system
5. Effect of P, PD, PI, PID Controller on a second order systems.
6. Plotting root locus of a given transfer function using a simulator
7. Temperature control using PID
8. Plotting phase magnitude plot of a given transfer function with a simulator.
9. Obtaining frequency response of a common emitter amplifier and plotting on a Bode plot.
10. Simulation of a given transfer function using OPAMPs
11. Stability Analysis (Root locus, Bode, Nyquist) of Linear Time Invariant System.
12. Study of a PLL as a closed loop control system on a simulator.

Use SCILAB/MATLAB or other equivalent software as a simulator.

Design based Problems (DP)/Open Ended Problem:

- Op Amp Differentiating Circuit, Pulse Generating Op Amp, OP Amp Control System, PLL
- Television Beam Circuit,
- Space Shuttle Rocket, Satellite Orientation Control, Roll Angle Control,
- Mars Rover Vehicle, Mars Guided Vehicle Control, Mars Rover,
- Disk Drive Read Write System, Rotating Disk Speed Control, Disk Drive Read .
- Wind Power,
- Embedded Computers,

Lab Work: MATLAB/SCILAB based assignments and simulations covering design, analysis and modelling of control systems relevant to curriculum.

List of Open Source Software/learning website:

Ng-spice/MATLAB, www.nptel.com

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

ELECTRONICS (10), ELECTRONICS & COMMUNICATION (11), ELECTRONICS & TELECOMMUNICATION ENGINEERING (12)

SIGNALS AND SYSTEMS

SUBJECT CODE: 2141005

B.E. 4th SEMESTER

Type of Course: Foundation of signals and systems for electrical, electronics and electronics and communication engineering

Prerequisite: Inclination to learn mathematics, basic knowledge of differential equations and difference equations, electrical circuits and networks.

Rationale: The course will provide strong foundation on signals and systems which will be useful for creating foundation of communication and signal processing. The students will learn basic continuous time and discrete time signals and systems. Student will understand application of various transforms for analysis of signals and systems both continuous time and discrete time. Students will also explores to power and energy signals and spectrum.

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	20	10	20	10	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Basic definitions, Classification of signals and systems. Signal operations and properties. Basic continuous time signals, signal sampling and quantization, discretization of continuous time signals, discrete time signals. Basic system properties, Representation of digital signals. Case study of different signals form communication and biomedical field	**7**	**15**
2	Impulse response characterization and convolution integral for CT- LTI system, signal responses to CT-LTI system, properties of convolution, LTI system response properties from impulse response. (***Review of Laplace transform with reference to CT signals and systems.)**	**7**	**15**
3	Impulse response characterization and convolution sum, Causal signal response to DT-LTI systems. Properties of convolution summation, Impulse response of DT-LTI system. DT-LTI system properties from Impulse response. System analysis from difference equation model	**9**	**30**
4	Representation of periodic functions, Fourier series, Frequency spectrum of aperiodic signals, Fourier Transform, Relation between Laplace Transform and Fourier Transform and its properties. **Introduction to DTFT and DFT**	**8**	**25**
5	The z-Transform, Convergence of z-Transform, Basic z-Transform, Properties of z-Transform, Inverse z-Transform and Solving difference equation using z-Transform	**7**	**15**

***This has been covered in circuits and networks in third semester as well as required in control system engineering course. Thus, quick review is recommended.**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
R Level	U Level	A Level	N Level	E Level
7	21	14	21	7

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate 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. Signals and Systems by Alan V. Oppenheim, Alan S. Wilsky and Nawab, Prentice Hall
2. Signals and Systems by K. Gopalan, Cengage Learning (India Edition)
3. Signals and Systems by Michal J. Roberts and Govind Sharma, Tata Mc-Graw Hill Publications
4. Signals and Systems by Simon Haykin and Bary Van Veen, Wiley- India Publications
5. Linear Systems and Signals by B.P.Lathi, Oxford University Press
6. Signal, Systems and Transforms by Charles L. Philips, J. M. Parr and E. A. Riskin, Pearson Education
7. Digital Signal Processing Fundamentals and Applications by Li Tan, Elsevier, Academic Press
8. Signal and Systems By Anand Kumar, 3rd Edition, PHI

Course Outcomes:

After learning the course the students should be able to:

- Understand about various types of signals, classify them, analyze them, and perform various operations on them.
- Understand about various types of systems, classify them, analyze them and understand their response behavior.
- Appreciate use of transforms in analysis of signals and system.
- Carry simulation on signals and systems for observing effects of applying various properties and operations.
- Create strong foundation of communication and signal processing to be studied in the subsequent semester

List of Experiments:

1. Generations and capturing various continuous time signals from sensors.
2. Generation and capturing of discrete time signals and plot them.
3. Discretization using different sampling rate and observing aliasing effect.
4. Observing the effects of lower sampling rate and higher sampling rate on CT signal.
5. Performing various operations on the signal using circuits and computational software.
6. Using digital circuit building block to perform operations on signals.
7. Simulation of continuous time LTI system.
8. Simulation of discrete time LTI systems.
9. Obtaining impulse response of the systems.
10. Computing FT and DTFT of the CT signals and DT sequences.

Design based Problems (DP)/Open Ended Problem:

1. Design of active noise removal / cancellation circuit.
2. Design of digital building blocks to perform various operations on discrete time sequences and singals.
3. Design of efficient and accurate signal converter.
4. Design of sample and hold circuits
5. Design of anti aliasing filter,

Major Equipments:

Computers, analog circuit blocks, digital circuit blocks, signal generators, digital storage oscilloscope and spectrum analyser

List of Open Source Software/learning website:

SEQUEL
SCILAB
NPTEL Videos
MIT open course ware website

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

ELECTRONICS (10), ELECTRONICS & COMMUNICATION (11), ELECTRONICS & TELECOMMUNICATION ENGINEERING (12)

SIMULATION AND DESIGN TOOLS

SUBJECT CODE: 2141006

B.E. 4th SEMESTER

Type of Course: Introduction of various Simulation and Design tools for Electronics

Prerequisite: Basic knowledge of computer programming and Analog and Digital Electronics.

Rationale: The course provides introduction to Simulation and Designing softwares for electronics. Using simulation software the students can design and analyze various analog and digital circuits. The students can design PCB layout for the desired circuits using PCB design tools. Using MATLAB/SCILAB various waveforms can be generated and various electronics systems can be implemented.

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		
0	0	2	2	0	0	0	50	30	20	100

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Introduction to PSpice software General purpose circuit simulation using Schematic Editor, Introduction to netlist command based SPICE simulation, basic netlist commands. Basic circuit analyses: DC, AC Transient.	**20**	**56%**
2	Introduction to PCB Design software Schematic Entry, Netlist Creation, Working with component libraries, Design of Boards, Layout of Parts, Optimizing Parts Placements, Pads and Via, Manual and Auto Routing, Handling Multiple Layers	**08**	**22%**
3	Introduction to SCILAB Introduction to SCILAB, use SCILAB functions. Writing simple programs using SCILAB, handling arrays, files, plotting of functions etc. Writing SCI files for Creation of analog & discrete signals, plotting of signals etc. Simulation of electronic circuits using SCILAB	**08**	**22%**

Reference Books:

Modelling and Simulation in Scilab/Scicos By. Stephen L. Campbell et. Al. Springer

(This subject aims "Learning by doing" so best practice is use software and its help document and guidance from faculty, however above book is suggested for SCILAB)

Course Outcomes:
After successful completion of the course students should be able to:

1. Design the electronics circuits using software tools like NGspice/LTSpice/Multisim.
2. Simulate various analog and digital circuits using NGspice/LTSpice/Multisim
3. Able to design PCB for given circuit using PCB Software like EAGLE, ExpressPCB,OrCAD.
4. Use open source SCILAB tool and write simple programs
5. Plot various waveforms using SCILAB.
6. Simulate basic electronic system blocks using SCILAB

List of suggested Experiments:

1. Simulation of one rectifier circuit and one clipper/clamper circuit.
2. Simulation of any one transistor biasing circuit.
3. Simulation of CE single/double stage amplifier circuit.
4. Simulation of any one power amplifier circuit.
5. Simulation of any one JFET/MOSFET amplifier circuit.
6. Simulation of any one negative feedback circuit.
7. Simulation of encoder/multiplexer circuit.
8. Simulation of decoder/de multiplexer circuit.
9. Simulation of any one flip-flop circuit using gates.
10. Simulation of any one register/counter circuit.
11. Design of PCB for any one circuit from experiment 1 to 6.
12. Design of PCB for any one circuit from experiment 7 to 10.
13. Plot the sine, cosine, triangle and exponential waveform using SCILAB.
14. Plot sampled sine, cosine, triangle and exponential waveform using SCILAB.
15. Study of Simulink. (only source and sink available in Simulink library).

Design based Problems (DP)/Open Ended Problem:

The student has to carry out any one project based on the following topics :

- Design of any complex analog or digital or hybrid circuit, implement it using simulation software and design the PCB for the same circuit.
- Generate and observe basic signals using XCOS.
- Design of GUI for any analog or digital circuit using SCILAB

Major Equipments:

Personal Computers with necessary simulation and design tools

List of Software/learning website:

NGspice, LTSpice,MULTISIM, Orcad, Proteus or other open source PCB design tools, SCILAB

Website: http://www.scilab.org/ **(To download SCILAB open source software)**
http://www.linear.com/**,**
http://www.expresspcb.com/
http://ngspice.sourceforge.net/