University of Mumbai			
Class: T.E.	**Branch:** Instrumentation Engineering	**Semester:** V	
Subject: Communications Systems (abbreviated as CS)			
Periods per Week (60 min. each)	Lecture	04	
	Practical	02	
	Tutorial	---	
		Hours	Marks
Evaluation System	Theory	03	100
	Practical & Oral	---	---
	Oral	---	---
	Term Work	---	25
	Total	03	125

Module	Contents	Hours
1	**Introduction to Communications Systems:** Elements of a communication system, noise in communication systems, introduction to radio wave propagation.	02
2	**Amplitude Modulation:** Introduction, time and frequency domain analysis, power relations, basic requirements and description of various modulators, comparison of DSB, SSB, VSB, spectrum	08

	modulator and detectors.	
3	**Angle Modulation:** Introduction, frequency modulation, phase modulation, spectrum of FM, effect of noise in FM, generation of FM, detection of FM.	08
4	**Transmitters and Receivers:** Introduction, transmitters - requirements, topologies, AM and FM transmitters, receiver - topologies, characteristics, variations, measurements, transceivers, characteristics and block diagram of broadcast radio transmitters.	10
5	**Pulse and Digital Modulation:** pulse modulation methods, pulse amplitude (PAM), pulse position (PPM), pulse duration/width (PDM/PWM)) Modulation methods for digital signals over analogue: amplitude shift keying(ASK), frequency shift keying (FSK), phase shift keying (PSK), Quaternary Phase ShiftKeying (QPSK), Quaternary Amplitude Modulation (QAM)) *Digital modulation methods*: Pulse Code Modulation (PCM); Delta modulation; Adaptive Delta modulation, *Multiplexing techniques*: space division; frequency division; time division; wavelength division.	12
6	**Telemetry:** Methods of data transmission, general telemetry system, types of telemetering systems - land line telemetering, RF telemetering, voltage telemetering system, current telemetering system, force balance telemetering, impulse and position telemetering system, land line telemetry feedback systems, FM telemetry systems, PAM telemetry, PCM telemetry.	08

Theory Examination:

21. Question paper will consist of total 7 questions carrying 20 marks each.
22. Only 5 questions need to be attempted.
23. Q.1 will be compulsory and based on the entire syllabus.
24. Remaining questions will be mixed in nature.
25. In question paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Term work:

Term work consists of minimum eight experiments, and a written test. The distribution of the term work shall be as follows,

Laboratory work (Experiments and Journal) :15 marks
Test (at least one) :10 marks
~~Attendance (Practical and Theory) :05 marks~~

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

List of Laboratory Experiments:

1. To analyze the signals in frequency domain.

2. To analyze the AM generation and detection and calculate the modulation index.
3. To analyze the SSB generation and detection.
4. To observe the FM generation and detection and measure frequency deviation and modulation index of FM.
5. To generate and detect phase modulation.
6. To analyze PAM generation and detection.
7. To analyze PWM generation and detection.
8. To analyze PPM generation and detection.
9. To analyze PCM generation and detection.
10. To analyze delta modulation and demodulation.
11. To observe time division multiplexing.
12. To observe frequency division multiplexing.
13. To analyze FSK modulation.
14. To analyze PSK modulation.

Text Books:

1. Blake, *Electronic Communication Systems*, 2nd Edition, Thomson Learning, 1989.
2. Haykin, Simon S., *Communication Systems*, John Wiley, New York, 1978.

Reference Books:

1. Taub & Schilling, *Principles of Communication Engineering*, 2nd Edition, McGraw Hill, 1993.
2. Bruce Carlson, *Communication Systems*, 2nd Edition, McGraw Hill, 1994.
3. Kennedy and Davis, *Electronic Communication Systems*, McGraw Hill, 1985.
4. Lathi Ghagwandas Pannalal, *Signals, Systems and Communications*, John Wiley, New York, 2000.
5. Dennis Roddy and John Coolen, *Electronic Communications*, 3rd Edition, Prentice Hall of India (P) Ltd., New Delhi, 1986.
6. A.K. Sawhney, *A Course in Electrical and Electronic Measurements and Instrumentation*, Dhanpat Rai and Co., 1997.
7. Perry A. Borden and W.J. Mayo, *Telemetering Systems*, Wells Reinhold publishing corporation, New York, 1959.
8. William Schweber, *Electronic Commu nication Systems*, PHI, 4th Edition, 2002.

University of Mumbai			
Class: T.E.	**Branch:** Instrumentation	**Semester:** V	
Subject: Control System Components (abbreviated as CSC)			
Periods per Week (60 min. each)	Lecture	04	
	Practical	02	
	Tutorial	---	
		Hours	Marks
Evaluation System	Theory	03	100
	Practical and Oral	---	---
	Oral	---	25
	Term Work	---	25
	Total	03	150

Module	Contents	Hours
1	**Pneumatics** Pneumatic System Components: Air compressors, Pressure regulation devices, Directional control valves and special types of pneumatic valves such as Pilot-operated valves, Non-return valves, Flow control valves, Sequence valves, and Time delay valve. Linear actuators- Single-acting, Double-acting, and special type of double-acting cylinders such as Cushion, Double rod, Tandem, Multi-position, Impact cylinders. Rotary actuators- Air motors. Symbols in pneumatics and Development of simple pneumatic control circuits for single-acting and double-acting cylinders. Process Control Pneumatics: Flapper Nozzle system, Volume boosters, Air relays, Pneumatic transmitters and controllers.	08
2	**Hydraulics** Hydraulic System Components: Hydraulic pumps, Pressure regulation method, Loading valves. Hydraulic valves and actuators. Speed control circuits for hydraulic actuators. Selection and comparison of pneumatic, hydraulic and electric systems.	04
3	**Transmitters** Electronic versus pneumatic transmitters, 2-wire; 3-wire and 4-wire current transmitters, Electronic type-temperature; pressure; differential pressure; level; flow transmitters and their applications, Smart (or Intelligent) transmitters, Buoyancy transmitters and their applications. Converters- Pneumatic to Electrical and Electrical to Pneumatic converters.	08
4	**Process Control Valves** Control valve terminology, Types- Globe, Ball, Needle, Butterfly, Diaphragm, Pinch, Gate, Solenoid, Smart control valves, and special designs of Globe valves. Flow characteristics, Control valve parameters	12

	-control valve capacity; valve rangeabilty; valve size; and valve gain, Selection criteria, and Control valve sizing procedure. Specifications and Installation of control valves. Valve positioners: necessity, types-motion balance and force-balance, and effect on performance of control valve. Control Valve Actuators- Electrical, Pneumatic, Hydraulic, Electro-mechanical, and Digital actuators. Selection criteria of valve actuators.	
5	**Auxiliary Process Control Components** Alarm annunciators, Square root extractor, Feeders, Dampers, Temperature regulator, Flow regulator, Temperature switch, Flow switch, Level switch, Pressure Switch, Relief valves, safety valves and rupture disk. Thermostats and Humidistats. Final control elements-Variable Speed Drives.	08
6	**Industrial Motor Control Components** Switches: Construction, symbolic representation, working, application of Toggle switches, Push buttons, Selector switches, DIP switches, Rotary switches, Thumbwheel switches , Drum switch, Limit switches-contact, non contact- type, Switch specifications. Control Relays: Construction, working, specifications, selection criteria and applications of Electro-mechanical relay, Reed relay, hermetically sealed relay, Solid state relays. Interposing relays and Overload relays. Contactors/starters: Construction, working, specifications and applications of starters and contactors. Comparison between relays and starters /contactors. Timers: On delay timers**;** Off delay; and retentive timers. Auxiliary output devices: Pilot Lights, Horns, Solenoids, and Heaters. Development of relay ladder and wiring diagrams for motor control applications using above components.	08

Theory Examination:

1. Question paper will consist of total 7 questions carrying 20 marks each.
2. Only 5 questions need to be attempted.
3. Q.1 will be compulsory and based on the entire syllabus.
4. Remaining questions will be mixed in nature.
5. In question paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Oral Examination:

The oral will be based on entire subject.
Oral examination : 25 marks

Term work:

Term work consists of minimum eight experiments and a written test. The distribution of the term work shall be as follows,
Laboratory work (Experiments and Journal) :10 marks

Test (at least one) :10 marks
Attendance (Practical and Theory) :05 marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

List of Laboratory Experiments:

1. Study of various pneumatic and hydraulic system components.
2. Development, implementation and testing of pneumatic circuits.
3. Development, implementation and testing of hydraulic circuits.
4. Study of operation and calibration of 2-wire DP transmitter for flow and level control.
5. Design of 2-wire temperature transmitter.
6. Study of cut-view section of pneumatically operated control valve and flow characteristics.
7. Study of I to P and/or P to I converters.
8. Study of valve positioner.
9. Study of different types of control valve actuators (Any two).
10. Study of pressure/temperature/level/flow switches (Any two).
11. Study of square root extractor.
12. Study of different types of control relays.
13. Development, implementation and testing of motor control circuits using different types of switches and control relays.

Books Recommended:

1. Andrew Parr, "Hydraulics and Pneumatics- A technician's and engineer's guide", Jaico Publishing House, Mumbai.
2. Pneumatics, Festo Didactic.
3. Hydraulics, Festo Didactic.
4. C.D.Johnson, "Process Control and Instrument Technology", TMH.
5. Applied Instrumentation in the process Industries Vol I and II by WG Andrews and Williams.
6. P. Harriot, " Process Control", Tata McGraw Hill, 2001.
7. Bella G. Liptak, "Process Control and Optimization, Instrument Engineer's Handbook", 4th Edition, CRC Press.
8. Less Driskell, " Control Valve Selection and Sizing", ISA.
9. J. W. Hatchison, " ISA Handbook of Control Valves" 2nd Edition, ISA, 1990.
10. E. B. Jones, " Instrument Technology vol-III", Butterworth Publication.
11. D.P. Ekman, " Automatic Proces Control", Wiley Eastern, 1990.
12. Thomas E. Kisell, "Industrial Electronics", 3rd Edition, PHI.

University of Mumbai			
CLASS: T.E. Instrumentation Engineering		Semester - V	
SUBJECT: Environmental Studies			
Periods per week (each of 60 min.)	Lecture	2	
	Practical	-	
	Tutorial	1*	
		Hours	Marks
Evaluation System	Theory Examination	2	50
	Practical examination	-	-
	Oral Examination	-	-
	Term Work	-	25
	Total		75
* Class wise Tutorial			

Objective: This course is to create environmental awareness, of variety of environmental concerns.

Module	Contents	Hrs
1	The Multidisciplinary nature of environmental studies Definition, scope and importance Need for public awareness	1
2	Natural resources Renewable and non-renewable resources Natural resources & associated problem. a. Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people. b. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d. Food resources: World food problems overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e. Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies. f. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. • Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.	4
3	• Ecosystems • Concepts of an ecosystem. • Structure and function of an ecosystem. • Producers, consumers and decomposers. • Energy flow in the ecosystem.	3

	• Ecological succession. • Food chains, food webs and ecological pyramids. • Introduction, types, characteristic features, structure and function of the following ecosystem: a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries)	
4	Biodiversity and its conservation • Introduction-Definition: genetic species and ecosystem diversity • Bio-geographical classification of India • Value of biodiversity : Consumptive use, productive use, social, ethical, aesthetic and option values • Bio-diversity at global, national, local levels • India as a mega diversity nation • Hot spots of bio-diversity • Threats to biodiversity: Habitat loss, poaching of wild life, man-wildlife conflicts • Endangered and endemic species of India • Conservation of biodiversity: In- situ and Ex-situ conservation of biodiversity	4
5	Environmental Pollution Definition – • Causes, effects and control measures of: a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear Hazards • Solid waste management: Causes, effect and control measures of urban and industrial wastes • Role of an individual in prevention of pollution • Pollution case studies • Disaster management: floods, earthquake, cyclone and land slides	4
6	Social issues and environment • From unsustainable to sustainable development • Urban problems related to energy • Water conservation, rain water harvesting, watershed management • Re-settlement and rehabilitation of people: Its problems and concerns. Case studies. • Environmental ethics: issues and possible solution • Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. • Wasteland reclamation • Consumerism and waste products • Environment protection act • Air(Prevention and control of pollution) act • Water (Prevention and control of pollution) act • Wildlife protection act	4

	• Forest conservation act • Issues involved in enforcement of environmental legislation • Public awareness	
7	Human population and the environment • Population growth, variation among nations • Population Explosion- family welfare program • Environment and human health • Human rights • Value education • HIV/AIDS • Women and child welfare • Role of information technology in environment and human health • Case studies	4
8	Understanding Existence and Co-existence Interrelation and Cyclicity between Material order, Bio-order, Animal order and Human order **Understanding the human conduct:** Relationship in Family, Justice in Relationship, Relationship of Human with Nature (Environment), Human Behavior, Human Values, Nature and Morality **Understanding the human society** Dimensions of Human Endeavor and Objectives, Interrelationship in Society, Mutual Fulfillment and Cyclicity in Nature.	6

Theory Examination:

1. Question paper will be comprising of total 7 questions, each of 10 marks.
2. Only 5 questions need to be solved.
3. Question number 1 will be compulsory and covering the all modules.
4. Remaining questions will be mixed in nature. (e.g.- suppose Q.2 has part (a) from, module 3 then part (b) will be from any module other than module 3.)
5. In question paper weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Term work:

Term work shall consist of minimum five projects (PROJECTS SHALL BE DESIGNED ON THE SAME GUIDE- LINE OF GIVEN TEXT BOOK) and a written test.
The distribution of marks for term work shall be as follows,
Laboratory work (Tutorial/Project and Journal) : 15 marks.
Test (at least one) : 10 marks.
The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

Recommended Books:

1. Erach Bharucha, text book of environmental studies, Universities Press/Orient Blackswan
2. Jagdish Krishnaswami, R J Ranjit Daniels, 'Environmental Studies", Wiley India Private Ltd. New delhi
3. Anindita Basak, 'Environmental Studies", Pearson
4. Deeksha Dave, "Text book of , 'Environmental Studies", Cengage learning, Thomason India edition
5. Benny Joseph , 'Environmental Studies", Tata McGRAW HILL
6. D L Manjunath, , 'Environmental Studies",Pearson
7. R Rajgopalan, , 'Environmental Studies", Oxford
8. Alok Debi, 'Environmental science and Engineering", University press
9. A. Nagraj, Jeevan Vidya- A Primer.

Periods per Week (60 min. each)	Lecture	04	
	Practical	02	
	Tutorial	---	
		Hours	Marks
Evaluation System	Theory	03	100
	Practical and Oral	02	25
	Oral	---	---
	Term Work	---	25
	Total	05	150

Module	Contents	Hours
1	**Introduction:** Microprocessor definition, operation of ALU, Van Numan, Haward architecture, evolution of microprocessors, block diagram of microprocessor based system and development cycle, Machine language, Assembly language, high level language, assembler, compilers.	05
2	**8085 Microprocessors & Memory Interfacing** 8085 architecture and its functional blocks, 8085 microprocessor IC pin outs and signals, de-multiplexing address and data bus, generation of control signals, machine cycles and timing diagram of instruction. Memory interfacing.	06
3	**Programming of 8085 Microprocessor** Programming model of 8085. Instruction set of 8085, addressing modes, writing assembly language programs, looping, counting, and indexing operations, BCD arithmetic, stack and subroutines, Conditional call and return instructions.	08
4	**Interfacing:** Basic interfacing concepts, interfacing input and output devices, memory mapped I/O and I/O mapped I/O. 8155 Interfacing and programming, 8255 Interfacing and programming, Keyboard and display Interfacing and programming ADC(0801/0808) and DAC (DAC 0808/DAC 0809) Interfacing and programming,	11
5	**Interrupt, DMA, and Serial Communication** Interrupt structure of 8085, RST instruction, vectored interrupts, interrupt process, 8259 interrupt controller Data transfer techniques, 8257 DMA controller Serial I/O lines of 8085 and implementation asynchronous serial data communication using SID, SOD lines	06
6	**Instrumentation Applications** Multi-channel Data Acquisition System (Minimum 4 channel with input modules of Pressure, voltage, current, temp, etc). Generation of different signals using DAC DC drives using h bridge Temperature Control application, Stepper motor control	06

7	**Advanced Processors** Architecture and organization of 8086, bus interface unit, operation of queue, 8086 hardware pin signals, timing diagram of 8086 family microprocessor, minimum and maximum mode, memory organization and addressing modes. Pipelining, super-scalar execution concept.	06

Theory Examination:

16. Question paper will consist of total 7 questions carrying 20 marks each.
17. Only 5 questions need to be attempted.
18. Q.1 will be compulsory and based on the entire syllabus.
19. Remaining questions will be mixed in nature.
20. In question paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Practical & Oral Examination:

Practical examination will be based on one experiment performed from the list of experiments given in the syllabus and the oral will be based on entire subject.

Term work:

Term work consists of minimum eight experiments and a written test. The distribution of the term work shall be as follows,

Laboratory work (Experiments and Journal) :10 marks
Test (at least one) :10 marks
~~Attendance (Practical and Theory)~~ ~~:05 marks~~

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

List of Laboratory Experiments:

1. 16 bit arithmetic (addition and subtraction)
2. 8 bit multiplication.
3. Hex to BCD conversion.
4. BCD arithmetic.
5. Finding largest & smallest no from given series.
6. Programs using stack and subroutines.
7. Generation of square wave on SOD pin of 8085
8. Generation of square wave using 8155 timer.
9. Program based Interfacing of 8255 (keyboard and 7 segment display).
10. Interfacing of ADC (DAQ).
11. Generation of different types of signals using DAC.
12. Temperature controller.
13. Stepper motor control.
14. Serial communication with PC.

Note: Experiments 1 to 5 may be performed on simulator

Text books

1. R. S. Gaonkar, *Microprocessor, Architecture, Programming and Application with 8085*, Penram International Publishing (India) Pvt. Ltd. Fifth Edition

2. Prof.U.V.Kulkarni, Dr. T.R.Sontakke, *The 8085 Basic, Programming and Interfacing*, SadhuSudha Prakashan

Reference books:

1. Douglas V. Hall, *Microprocessor and Interfacing*, Tata McGraw-Hill Publishing Co. Ltd. 2nd edition.
2. Udaykumar, *The 8085 Microprocessor : Architecture, Programming & Interfacing* , Pearson Education
3. Chowdhury et.al Microprocessors & Peripherals, SciTech Publications (India) Pvt. Ltd., Chennai.

University of Mumbai		
Class: T.E.	**Branch:** Instrumentation Engineering	**Semester:** V
Subject: Signal Conditioning Circuit Design (abbreviated as SCCD)		

Periods per Week (60 min. each)	Lecture	04	
	Practical	02	
	Tutorial	---	
		Hours	Marks
Evaluation System	Theory	03	100
	Practical & Oral	02	25
	Oral	---	*25
	Term Work	---	25
	Total	05	175

*-Oral examination will be based on a mini-project.

Module	Contents	Hours
1	**Components of Analog Signal Conditioning** Signal level and bias changes, linearization, conversion, filtering and impedance matching, concept of loading. Passive signal conditioners- voltage divider, Wheatstone bridge circuits (Current, Voltage, Balanced and Unbalanced), RC filters, and Active signal conditioners- op-amp based circuits. Standard Signals (Analog)	05
2	**Operational Amplifier** Ideal & practical op-amp. Differential Amplifier- a.c. & d.c. analysis, improving voltage gain using active load etc, current sources, unbalanced op-amp frequency response & stabilizing unbalanced operation, circuit diagram of IC741 & working in detail, a.c. & d.c. characteristics, specifications, measurement of op-amp parameters.	06
3	**Operational Amplifier Circuits in Instrumentation** Voltage follower, inverting & non-inverting Amplifier, Adder, Subtractor, Differential Amplifier, Instrumentation Amplifier, V to I & I to V converter with floating load & grounded load, Integrator, differentiator & compensated differentiator, Precision rectifier- half wave, full wave, absolute value circuits, clipping, clamping circuits, practical clamping circuits, sample & hold circuits, peak detectors, log amplifiers, temperature compensated log amplifier, antilog amp., multiplier, divider, comparator, threshold detector, zero crossing detector, window detector, Schmitt trigger, free running multivibrator, Wien-bridge oscillator, Phase shift	15

	oscillator, Active filters, Astable, Monostable, and Bistable multivibrators, Norton amplifier, Pulse, Triangle and Sine wave generator, PLL. Guidelines for analog signal conditioning design, design problems based on these guidelines.	
4	**Components of Digital Signal conditioning** Converters - ADC, DAC, V to F (LM331 and 555 Timer) and F to V- Types and Structure, conversion, resolution and other characteristics. Characteristics of digital data- digitized value, sampled data system and linearization. Standard signals (Digital). Data acquisition system hardware. Data Logger.	08
5	**Transducer signal conditioning design** Thermal sensor conditioning – design considerations and applications for RTD, Thermistor, thermocouple and solid state temperature sensors. Optical sensor conditioning-photoconductor, photovoltaic, photodiode, phototransistor, and photomultiplier tube, Optical encoder conditioning for linear displacement, linear velocity and angular displacement application. Other Sensors conditioning - Potentiometer , LVDT , strain gages, piezoelectric transducers and capacitive transducers	10
6	**Power Supply Design: -** Power Supply design using 78xx series, 79xx series and adjustable IC regulator 723/317. Switch mode Power Supply (SMPS) Block Diagram with advantages and disadvantages over conventional power supply.	04

Theory Examination:

1. Question paper will consist of total 7 questions carrying 20 marks each.
2. Only 5 questions need to be attempted.
3. Q.1 will be compulsory and based on the entire syllabus.
4. Remaining questions will be mixed in nature.
5. In question paper, weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Practical & Oral Examination:

Practical examination will be based on one experiment performed from the list of experiments given in the syllabus and the oral will be based on entire subject.

Term work:

Term work consists of minimum eight (four experiments From 1 to 6 and four from 7 to 14 of list given below) experiments and a written test. The distribution of the term work shall be as follows.

Laboratory work (Experiments and Journal) :10 marks
Test (at least one) :10 marks
Attendance (Practical and Theory) :05 marks

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

*Oral Examination Based on Mini project

Mini-project should be a hardware based on subject of SCCD. The student should submit a detail report containing the design and implementation of the mini project. (Group of maximum 3 students)

The subject teacher will coordinate the activity. Oral examination will be based on project report and demonstration.

List of Laboratory Experiments:

All Experiments should be performed using Bread Board and discrete components:

1. Measurement of Operational amplifier Parameters.
2. Linear Applications of Op Amps.(any Four)
3. To design an Instrumentation Amplifier using Op Amps.
4. Non-Linear Applications of Op Amps(Any Three)
5. To design and implement a-stable and mono-stable multi-vibrator using IC555 timer.
6. Low Pass and High Pass Filter design.
7. To design general signal conditioning to convert sensor O/p to 0-5V.
8. To design general signal conditioning to convert sensor O/p to 4-20 mA.
9. To design signal conditioning for an RTD.
10. To design thermocouple signal conditioning with reference junction compensation.
11. To design general signal conditioning of weight measurement system using strain gauges.
12. To design signal conditioning for capacitive transducer using oscillator and F to V converter with offset and gain control.
13. Power Supply Design for +/- 5 V ,+/-12V.
14. To design adjustable low and high voltage regulator using IC723/LM317 (High Power Design).

Text Books:

1. Ramakant Gaikwad. *Op-Amp & Linear ICs*. PHI Perason Education.
2. C. D. Johnson. *Process Control Instrumentation Technology (VIII th Ed.)*

Reference Books:

1. Coughlin & Driscoll. *Op-amp and linear ICs*, 6th edition. PHI. 2002.
2. Robert G. Seippel. *Transducer Interfacing- signal conditioning for process control*, Prentice Hall.
3. C. D. Johnson. Microprocessor Based *Process Control. PH*
4. Sergio Franco. Design with op-amp analog ICs. Mcgraw Hill. 1988.
5. Roy Choudhary. Linear Integrated Circuits. Wiley Eastern. 1991.
6. Burr-Brown *General Catalog*. Tucson. Ariz: Burr- Brown. 1979.
7. Datel - Intersil *Data Acquisition Component Handbook*. Mansfield. Mass: Datel - Intersil. Inc.. 1980.
8. D.E. Pippenger and F. J. Tobanen. *Linear and Interface Circuits Applications*. 2nd Edition. Mcgraw Hill Book Company. 1988.

University of Mumbai			
Class: T.E.	**Branch:** Instrumentation	**Semester:** V	
Subject: Signals and Systems (abbreviated as S&S)			
Periods per Week (60 min. each)	Lecture	04	
	Practical	--	
	Tutorial	02($)	
		Hours	Marks
Evaluation System	Theory	3	100
	Practical & Oral	---	---
	Oral	---	---
	Term Work	--	25
	Total	3	125

$- Tutorial to be conducted batch wise.

Module	Contents	Hours
1	**Introduction:** 1. Definition of signal, Basic signals in continuous time and discrete time domain. Basic operation on continuous and Discrete signal. 2. Singular Functions: Ramp, step and Impulse functions, Axiomatic, Definition of impulse function, approx. to impulse function and the generalized impulse function. 3. Classification of signals: Periodic/ non-periodic, Even/Odd, Deterministic/ Stochastic and Energy/ Power signals. 4. Representation of a system as a mapping between input and output signals, System as a means of transformation of signals. 5. System representation in continuous and discrete time domain in terms of differential and difference equation respectively. Normal form representation of signals. 6. Block diagram of continuous and Discrete time system, Classification of systems: Causal / Non-causal, time-varying, time-invariant, stable/ unstable, invertible / non- invertible and lumped/distributed parameter systems.	11
2	**Linear Time Invariant System:** Continuous Time LTI system: Linear differential equations, Representation of signals by a continuum of impulses, System impulse response and the convolution integral. Evaluation and	04

	Interpretation of Convolution Integral Discrete Time LTI system: Convolution sum (linear and Circular convolution). Properties of LTI system.	
3	**Laplace Transform:** Definition and its Properties, Inverse Laplace. Transient and steady state response of LTI system. Stability of system.	03
4	**Z-Transform:** Definition, Convergence, properties and inversion of Z-Transform. Concept of single and double sided Laplace Transform. Analysis of discrete time system using Z-Transform. Relationship between Laplace and Z-Transform, Fourier transforms.	10
5	**Continuous and Discrete Time Fourier Series:** Orthogonal functions: Definitions, approximations, coefficient calculation on the basis of minimum mean square error. Fourier series: Representation of Fourier series in terms of trigonometric, exponential functions. The complex Fourier spectrum. Properties of Fourier series. Convergence of Fourier series. Gibbs's phenomenon.	05
6	**Continuous and Discrete Time Fourier Transform:** Continuous and Discrete time Fourier transform and its properties.	03

Theory Examination:

11. Question paper will consist of total 7 questions carrying 20 marks each.
12. Only 5 questions need to be attempted.
13. Q.1 will be compulsory and based on the entire syllabus.
14. Remaining questions will be mixed in nature.
15. In question paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

Term work:

Term work consists of minimum eight tutorials properly recorded and graded as well as assessed test paper. The distribution of the term work shall be as follows,

Laboratory work (Journal) :15 marks
Test (at least one) :10 marks
~~Attendance (Practical and Theory)~~ ~~:05 marks~~

The final certification and acceptance of term-work ensures the satisfactory performance of laboratory work and minimum passing in the term-work.

List of Tutorials:

1. Difference between continuous time and discrete time signals, classification, problems on Signals classification.

2. Difference between continuous time and discrete time signals, classification, problems on Systems classification.
3. Problems on Basic Operations on signals.
4. Singular functions, Impulse function and its approximation, I/O systems. Difference equation formulation.
5. Problems on convolution Integral, convolution sum and correlation.
6. Problems on laplace and its properties.
7. Concept of Z-Transform (Single and Double Sided), analysis, relation between Laplace Transform and Z-Transform.
8. Fourier series representation, properties, problems on Fourier series and Fourier Transform.
9. Fourier Transform, properties, problems on Fourier Transform.
10. Relation between Fourier and Laplace, Solutions to differential equations

Text Books:

1. Oppenhelm, Wilsky and Nawab, *Signals and Systems*, PHI / Pearson Education, 2nd edition, 2002.
2. S. P. Xavier, *Signals and Systems*, 2nd Edition, S. Chand and Co., 1998.
3. J.B. Gurung, *Signals and Systems*, 1st Edition, PHI, 2009.

Reference Books:

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