Transducers, Sensors & Displays Systems (TIC-502)

Unit	Topic	Text Book/ Chapter	Lectures
1.	GENERALISED CONFIGURATIONS, FUNCTIONAL DISCRIPTION & PERFORMANCE CHARACTERISTICS OF MEASURING INSTRUMENTS: Functional elements of an instrument; active & passive transducers; analog & digital modes of operation ; null & deflection methods; I/O configuration of measuring instruments & instrument system – methods of correction for interfering & modifying inputs. Static characteristics; Meaning of static calibration, accuracy, precision & bias. Combination of component errors in overall system-accuracy calculation. Addition, subtraction, division & multiplication. Static sensitivity, linearity, threshold, resolution, hysteresis and dead space. Scale readability. Span. Generalized static stiffness & input impedance. Computer aided calibration & measurement, multiple regressions.	1/1	05
2.	MEASUREMENT OF DISPLACEMENT, FORCE, TORQUE & SHAFT POWER: Principle of measurement of displacement. Resistive potentiometers, variable inductance & variable reluctance pickups, LVDT, capacitance pickup. Principle of measurement of Force, Torque, Shaft power standards & calibration; basic methods of force measurement; characteristics of elastic force transducer-Bonded strain gauge, differential transformer, piezo electric transducer, variable reluctance/FM-oscillator, digital systems. Loading effects; Torque measurement on rotating shafts, shaft power measurement (dynamometers).	1/2	05
3.	TEMPERATURE MEASUREMENT: Standards & calibration; thermal expansion methods- bimetallic thermometers, liquid-in-glass thermometers, pressure thermometers; thermoelectric sensor (thermocouple) – common thermocouple, reference junction considerations, special materials, configuration & techniques; electrical resistance sensors – conductive sensor (resistance thermometers), bulk semiconductor sensors (thermistors), bulk semiconductor sensors (thermistors); junction semiconductor sensors; digital thermometers. Radiation Methods – radiation fundamentals, radiation detectors, unchopped (dc) broadband radiation thermometers. Chopped (AC) selective band (photon) radiation thermometers, automatic null balance radiation thermometers (optical pyrometers). Two color radiation thermometers., Black body-tipped fibre optic radiation thermometer, IR imaging systems. Fluoroptic temperature measurement.	1/3	08
4.	PRESSURE MEASUREMENT: Standards & calibration; basic methods of pressure measurement; dead weight gauges & manometer, manometer dynamics; elastic transducers; high pressure measurement; low pressure (vaccum) measurement – Mcleod gage, Knudsen gage, momentum-transfer (viscosity) gages, thermal conductivity gages, ionization gages, dual gage technique.	1/4	06
5.	FLOW MEASUREMENT;	1/5	08

	Local flow velocity, magnitude and direction. Flow visualization. Velocity magnitude from pilot static tube. Velocity direction from yaw tube, pivoted vane, servoed sphere, dynamic wind vector indicator. Hot wire and hot film anemometer. Hot-film shock-tube velocity sensor. Laser Doppler velocimeter; gross volume flow rate: calibration and standards. Constant-area, variable-pressure-drop meters (obstruction meters). Averaging pitot tubes. Constant pressure drop, variable area meters (rotameters), turbine meters, positive displacement meters. Metering pumps. Electromagnetic flow meters. Drag force flow meters. Ultrasonic flow meters, vortex shedding flow meters.		
5.	LEVEL MEASUREMENT: Capacitance probe; conductivity probes; diaphragm level detector, deferential pressure level detector, radiation level sensors, RADAR level gauges, level transmitter, ultrasonic level detector.	2/6	08
	DISPLAY DEVICES & SYSTEMS: Classification of displays- Storage CRTs, Flat CRTs, LEDs, LCD display, Gas discharge plasma displays, Incandescent display, Electrophoretic image displays(EPID), Liquid Vapor Display (LVD)	3/	05

Text Books:

1. Measurement systems application and design, ERNEST DOEBELIN, IV Edn. (Chapter 1, 2, 3, 4, 5).
2. Instrument Engineers Hand Book (process measurement), LIPTAK (Chapter 6).
3. Electronic Instrumentation – by H S Kalsi TMH 2nd Ed 2004

Analog Integrated Circuits (TEC-502)

Unit	Topic	Text Book/ Chapter	Lecturers
1	IC OP-AMP applications: OP-AMP Fundamentals (brief review of differential amplifier, current mirror, active load, level shifter, output stage; ac and dc characteristics) Basic building blocks using OP-AMPS. Inverting/Non-inverting VCVS, Integrators, Differentiators, CCVS and VCCS, Instrumentation Amplifiers.	1/ 2, 1/6, 1/ 7	08
2	Waveform Generator: Square wave generators: 555Timer, Crystal controlled Oscillator Ramp Generator: Triangle generator, Sawtooth generator Sine wave generator: Requirement for sinusoidal oscillations, Wien-bridge and twin-T oscillators. Function Generators: Multi op-amp function generators, IC function generators Digitally controlled frequency synthesizer: PLL Fundamentals, PLL synthesizer, Totally digital synthesizer.	2/ 6	08

3	Active Filters: Introduction to filtering: Frequency response, Characteristics and terminology, Active versus passive filters Low pass filter: First order low pass active filter, second order active filter model, second order low pass filter characteristics, Sallen-Key unity gain filter, Sallen-Key equal component filter, Higher order filters. High pass active filter. Band pass filter: single op-amp band pass filter, multistage band pass filter 1. State variable filter	2/7	08
4	Non-linear Circuits: Logarithmic Amplifiers, Log/Antilog Modules, Precision Rectifier, Peak Detector, Sample and Hold Circuits. OP-AMP as Comparator, Schmitt Trigger, Square and Triangular Wave Generator, Monostable Multivibrator. IC Analog Multiplier applications OTA	2/8	08
5	Voltage Regulators: OP-AMP Regulators, IC Regulators, Fixed Voltage Regulators (78/79, XX), SMPS.	2/3	08

Text Book:

1. Sedra and Smith, Microelectronic Circuits", Oxford University press, 5th Edition, 2005.
2. J. Michael Jacob, Applications and design with Analog Integrated Circuits", PHI, 2nd Edition, 2004.

Reference Book :

1. B.P. singh and Rekha Singh, Electronic Devices an Integrated Circuits; Pearson Education, 1st Edition.

Microprocessors and Applications (TEC-503)

Unit	Topic	Text Book/ Chapter	Lectures
1	Introduction to Microprocessors: Evolution of Microprocessors, History of computers, Timing and control, memory devices: semiconductor memory organization, Category of memory, 8-bit Microprocessor (8085): Architecture, Instruction set, Addressing modes, Assembly Language Programming.	1/2 1/3 14 1/6	8
2	16-bit Microprocessors (8086/8088): Architecture, Physical address, segmentation, memory organization, Bus cycle, Addressing modes, difference between 8086 and 8088, Introduction to 80186 and 80286, Assembly Language Programming of 8086/8088.	2//2	10
3	Data Transfer Schemes: Introduction, Types of transmission, 8257 (DMA), 8255 (PPI), Serial Data transfer (USART 8251), Keyboard-display controller (8279), Programmable Priority Controller (8259)	1/8, 1/8 1/11, 1/10 1/12	8
4	Programmable Interval Timer/ Counter (8253/8254): Introduction, modes, Interfacing of 8253, applications. ADC and DAC: Introduction, DAC memthodes, ADC converters, Types of ADC, ADC IC (0808/0809, DAC and ADC Interfacing and Applications.	1/9 1/13	8
5	Advanced Microprocessors: Introduction to 32-bit and 64-bit microprocessors, PowerPC, Microcontroller (8051): Introduction, Architecture, Instruction set.	2/3, 2/4 2/5, 2/7	8

Text Books

1. R. Singh and B. P. Singh : Microprocessor Interfacing and Application, New Age International Publishers, 2nd Edition.
2. B.P. Singh and R. Singh : Advanced Microprocessor and Microcontrollers, New Age International Publishers, 2nd Edition.

Reference Books

1. D. V. Hall : Microprocessors Interfacing, TMH (2nd Edition).
2. R. S. Gaunkar: Microprocessor Architecture, Programming and Applications with 8085/8080, Penram Publication
3. Y.C. Liu and G.A. Gibson : Microcomputer Systems: The 8086/8088 Family Architecture Programming and Design, PHI 2nd Edition,

Automatic Control System (TEC-504)

Unit	Topic	Text Book/ Chapter	Lectures
1	Introduction to open loop and closed loop control systems, feedback characteristics of control systems, Mathematical Representation of physical systems Electrical, Mechanical, Hydraulic, Thermal systems, Block diagram algebra and signal flow graphs, Mason's gain formula.	1/2, 1/2	8
2	**Time Domain Analysis:** Standard Test Signals, Time response of First, Second and Higher order systems, Performance Indices. **Error Analysis:** Static and Dynamic Error Coefficients, Effect of adding poles and zeroes to the system, response of P, PI, and PID controllers.	1/5	10
3	**Concept of Stability:** Concept of stability, Asymptotic and conditional stability, Routh Hurcoitz Criterion, Root Locus technique (Concept and construction) **Frequency Response Analysis:** Correlation between time and frequency response, polar and inverse polar plots, Nyquist stability criterion, Bode plots, All pass and minimum phase systems, M and N circle.	1/6, 1/7, 1/8	9
4	**Design through compensation techniques:** Realization of lag, lead and lag-lead compensators, Design of closed loop control system using root locus and Bode plot Compensation	1/10	7
5	**Stable Variable Analysis:** Introduction, State space representation, State modes of linear systems, State equations, transfer matrices, diagonalization solution of state equations, controllability and observability, effect of pole zero cancellation in transfer function. **Advances in Control Systems:** Basic Introduction to Neural Networks and Fuzzy logic control.	1/12, 1/14	9

Text Books:

1. I J Nagrath & M Gopal, Control System Engineering; New Age International publishers.

Reference Books:

1. B C Kuo, Automatic Control Systems; PHI

2. Norman S Nise, Control System Engineering;John Wiley & Sons, Singapore
3. Dr D Ganesh Rao, Control System; Sanguine Technical Publisher, Bangalore
4. K Ogata, Modern Control Engineering; PHI.

Communication Lab-I (TEC-551)

1. To study Amplitude modulation using a transistor and determine depth of modulation.
2. To study envelope detector for demodulation of AM signal and observe diagonal peak clipping effect.
3. To study frequency modulation using reactance modulator.
4. Study of frequency modulation using varactor modulator.
5. Narrow band FM generator using Armstrong method.
6. Study of Foster- Seely discriminator.
7. Generation of DSB-SC signal using balanced modulator.
8. Generation of single side band signal.
9. Study of phase lock loop and detection of FM signal using PLL.
10. Measurement of noise figure using a noise generator.
11. Study of superheterodyne AM receiver and measurement of sensitivity, selectivity & fidelity.

Study and demonstration of active filter (low pass, high pass, and band pass type) .

Analog Integrated Circuits Lab (TEC-552)

1. Measurement of Op-amp Parameters. (Open Loop Gain, Input offset Voltage, CMRR, Slew rate)
2. Determination of Frequency response of Op-Amp.
3. Precision Rectifier
4. Instrumentation Amplifier.
5. Open Loop operation of Op-amp -Comparators - Schmitt Trigger.
6. Astable & Monostable Operation Using 555.
7. IC Voltage Regulator.
8. Voltage Controlled Oscillator.
9. Phase Locked Loop.
10. Frequency Multiplier
11. A/D Converters & D/A Converters.
12. Second Order Active Filter- High Pass & Low Pass Realization

Microprocessor Lab (TEC-553)

8085/8086 Based Experiments
1. Signed Multiplication using Booth's Algorithm.
2. Recursive routine for finding Factorial N.
3. Look up table method for finding the ASCII of an alpha-numeric code.
4. Interfacing with 8255 in I/O mode/BSR mode.
5. Interfacing with 8253.
Verification of Interrupts.
7. Interfacing with ADC/DAC.
8. Mini Project on some interfacing applications.
9. Serial communication between two kits through RS-232C using 8251.
Note :
In addition, Institutes may include two more experiments based on the expertise

Control System Lab (TEC-554)

1. To use D.C. potentiometers as an error detectors.
2. To verify characteristics of (a) self excited magnetic amplifiers, (b) Self excited magnetic amplifier with (i) Positive feedback (ii) Negative feedback.
3. To draw characteristics of (a) Series connected (b) Parallel connected magnetic amplifier.
4. To draw characteristics of synchro torque transmitters. Also draw the characteristics error detector using of two synchros.
5. To study speed control of universal motor using SCR and stroboscope
6. Speed control of AC motor using TRAIC.

YEAR III, SEMESTER-VI
Industrial Management (TAS-601)

Unit	Topic	Text Book/ Chapter	Lectures
1	What is Operations Research? OR-research model, solving the OR model, Queuing and simulation models, Art of modeling, Phases of OR study.	1/1 Except 1.5, 1.7	2
2.	**Introduction to Linear Programming:** Two variable L-P model, Graphical LP solution, Analysis of selected LP models.	1/2.1, 2.2, 2.5	3
	The Simplex Method: LP solution space, Graphical to algebraic solution, The simplex method, Artificial starting solution, Special cases in simplex method applications.	1/3	4
	Transportation Model and its Variants: Definition of transportation model, Non-traditional transportation models, Transportation algorithms, Assignment model	1/5 Except 5.5	4
3.	**Network Models**: Network definitions, Minimal spanning tree algorithm, CPM and PERT.	1/6.1, 6.2, 6.6	4
	Game Theory: Optimal solution of two persons zero sum games, Solution of mixed strategy games.	1/ 14.4	2
4.	Introduction to Patents and Intellectual Propriety Right	Notes Supplied by UPTU	3
	Introduction to Engineering Management: Engineering and Management Historical Development of Engineering Management	 1/1 1/2	3
5.	**Functions of Technology Management** Planning and Forecasting Decision Making Organizing Motivating and Leading Technical People Controlling	 2/3 2/4 2/5 2/7 2/8	6
	Project Management Project Planning and Acquisition Project Organization, Leadership, and Control	 2/14 2/15	4

Text Books:

1. Hamdy H Taha, Operations Research – An Introduction; 7e, Pearson Education/ PHI – 2002.
2. Babcock & Morse, Managing Engineering and Technology; Pearson Education, 2004

Reference Books:

1. Hillier & Hillier, Introduction to Management Science; TMH Ed 05

Microcontroller & Embedded Systems (TIC-601)

Unit	Topic	Text Book/ Chapter	Lectures
1.	Introduction to Microcontroller: Microcontrollers and Microprocessors, Embedded versus external memory devices 8 and 16-bit micro controllers, CISE & RISC processors; Harivard & Von-Neumann architecture commercial Microcontroller devices.	1/1	6
2.	8051 Microcontrollers: Architecture, pins description I/O ports and memory organizations interrupts, timer & serial communication, addressing mode and instructions, simple programs, assembly language programming tools.	1/2 1/3, 1/4, 1/5, 1/6	12
3.	Architecture, pin description & features 8096/95, 98CXX,89C20XX, PIC micro-controllers, AVR micro-controllers.	1/7, 1/9 2/ 1/7	8
4.	Interfacing: LEDs, Push Buttons, Relay and Latch connections, keyboard, 7-segment display, and LCD interfacing ADC and DAC interfacing.	1/12	8
5.	Applications of Microcontroller different waves generation, frequency counter, Measurement applications, automation and controller application	1/13 1/8	6

Text Books:

1. Ajay V. Deshmukh, Microcontrollers; Theory and applications; TMH edition 2005.
2. John Catsoulis, Designing Embedded Hardware; O' Reilly edition 2002.

Reference Books:

1. B.P. Singh & Renu Singh, Advanced Microprocessors and Microcontrollers; New Age International Publishers Edition 2005.
2. Raj Kamal, Embedded Systems Architecture Prgoramming and Design, TMH Edition 2005.

Data Acquisition & Telementry (TIC-602)

Unit	Topic	Text Book/ Chapter	Lectures
1.	**Introduction to Telemetry Principles:** Basic System, Classification, Non electrical telemetry systems, Voltage and	1/1	2

	current Telemetry systems, Frequency Telemetering, Power line carrier Communication		
2.	**Multiplexed System:** Frequency Division Multiplex System- FDM, IRIG Standards, FM circuits, Phase Modulation Circuits, Receiving end, Phase Locked Local Loop, Mixers. Time Division Multiplexed System – TDM/PAM system, PAM/PM systems, TDM- PCM System, Digital Multiplexer, PCM Reception, Coding for varying level, DPCM, Standards	1/4,1/5	10
3.	**Modems:** Modems Introduction, QAM, Modem protocol	1/6	4
4.	**Transmitter and Receiver:** Transmitters, Transmission Techniques, Inter stage Coupling, Receiver **Antennas:** The Ideal structure, dipoles, arrays, current distribution and design consideration, Microwave Antennas	1/7, 1/9	10
5.	**Filters:** Polynomial, Filters, Active RC Filters, Universal Filter Circuits, Switched Capacitor Filters, Digital Filters	1/11	4
	Basics of Satellite and Fiber Optic Telemetry	1/12, 1/13	8
	Data Acquisition Systems (DAS), µP based DAS, Remote Control	1/14	4

Text Book:
1. D Patranabis, Telemetry Principle; TMH Ed 1 1999

Process Control Engineering (TIC-603)

Unit	Topic	Text Book/ Chapter	Lectures
1	Signal Conditioning ❖ Analog ❖ Digital	 1/2 1/3	10
2.	Signal conversions, Actuators & Control Elements : ❖ Final control operation ❖ Signal conversations ❖ Actuators ❖ Control elements	1/7	6
3	CONTROLLER PRICIPLES: Introduction, Process characteristics, control system parameters, discontinuous controller modes, continuous controller modes, composite control modes.	1/9	6
4	CONTROLERS (a) Analog (b) Digital: Introduction, general features, electronic controllers, Pneumatic controllers, and Design considerations.	1/10, 1/11	10
5	CONTROL LOOP CHARACTERISTICS: Introduction, control system configuration, multi variable control systems, control system quality, stability, process loop tuning.	1/12	6

TEXT BOOKS:

1. Process Control Instrumentation Technology, JOHNSON CURTIS, Prentice Hall of India, 7th edition.

REFERENCE BOOKS:

1. Chemical process Control: An introduction to theory and practice, STEPHANOPOULS G, Prentice Hall of India, ISBN-81-203-0665-1.
2. Computer Aided Process Control, S K SINGH, Prentice Hall of India,

ISBN-81-203-2282-7.
3. Automated Process Control Electronics, HARRINGTON J & ALBANY, Prentice Hall of India, 1989.
4. Instrument Engineers Hand Book, Process Measurement Volume-I, Process Control Volume – II, BELA.G. LIPTAK, Chilton Book Company / Radnor, 3rd edition, Pennsylynia, 1969).

Digital Signal Processing (TEC-602)

Unit	Topic	Text Book/ Chapter	Lectures
1.	**Discrete Fourier Transform:** Frequency Domain Sampling: The Discrete Fourier Transform Frequency-Domain Sampling and Reconstruction of Discrete-Time Signals. The Discrete Fourier Transform (DFT). The DFT as a linear Transformation. Relationship of the DFT to Other Transforms. Properties of the DFT. Periodicity, Linearity, and Symmetry Properties. Multiplication of two DFTs and Circular Convolution. Additional DFT Properties. Frequency analysis of signals using the DFT.	1/5	10
2.	**Efficient Computation of DFT** Efficient Computation of the DFT: FFT Algorithms, Direct Computation of the DFT. Radix-2 FFT algorithms. Efficient computation of the DFT of two real sequences, computations, Efficient computation of the DFT of a 2N-Point real sequences, Gortezel Algorithm, Chirp Z-transform algorithm.	1/6	10
3.	Basic IIR Filter Structures: Direct forms (I & II), cascade and parallel realizations. Signal flow graph, Transposed structure, Basic FIR filter structures-. Direct form structure, frequency sampling structure, Lattice structure, Linear phase FIR structure . FIR structures.	1/7	08
4.	Symmetric and Anti-symmetric FIR Filters, Design of Linear-Phase FIR Filters Using Windows, Design of Linear-Phase FIR Filters by the Frequency Sampling Method, Design of FIR, Equiripple filter design Differentiators. Design of Hilbert Transformers.	1/8	08
5.	**Design of IIR Filters From Analog Filters:** IIR Filter Design by Approximation of Derivatives, IIR Filter Design by Impulse Invariance. IIR Filter Design by the Bilinear Transformation. The Matched-z Transformation, Characteristics of Commonly Used Analog Filters. Application of above technique to the design of Butterworth & Chebyshev filters.	1/8	08

Text Books:

1. Proakis, J.G. & Manolakis, D.G., "Digital Signal Processing: Principles Algorithms and Applications", Prentice Hall (India).

Reference Books:

1. Sanjit K. Mitra, "Digital Signal Processing", Third Edition, TMH, 2005
2. Oppenheim A.V. & Schafer, Ronald W., "Digital Signal Processing", Pearson Education.
3. Rabiner, L.R. and Gold B., "Theory and applications of DSP", PHI.
4. DeFatta, D.J., Lucas, J.G. & Hodgkiss, W.S., "Digital Signal Processing", John Wiley & Sons

Microcontroller Lab (TIC-651)

8051 Based Experiments

1. Hexadecimal Addition of two numbers.

2. Splitting a Byte in to nibbles.
3. Check the number for being ODD or EVEN.
4. Hex multiplication of two numbers.
5. Display a character on CRT.
6. Display the number in accumulator on CRT screen.
7. Stepper motor control using Microcontroller.
8. Downloading and Uploading FROM/ON PC memory using XTALK software.

TRANSDUCER LAB (TIC- 652)

1. Characteristics of resistance transducer
   (i.) Potentiometer
   (ii.) Strain Gauge/ Measurement of Strain using quarter, half and full bridge.
2. Characteristics of LVDT.
3. Characteristics of capacitance transducer:
   (i) Variable area
   (ii) Variable distance.
4. Characteristics of Thermisters
5. Characteristics of RTD.
6. Thermocouples and AD590.
7. Characteristics of LDR, Photo Diode, and Phototransistor:
   (i) Variable Illumination.
   (ii) Linear Displacement.
8. Measurement of resistance by Wheatstone bridge and measurement of bridge sensitivity.
9. Measurement of self-inductance by – Maxwell and Anderson Bridge.
10. Measurement of Capacitance by desautys and Schering Bridge.
11. Measure of low resistance by Kelvin's double bridge.
12. Calibration of ammeter, voltmeter using DC potentiometer.
13. Characteristics of diaphragm type pressure transducer.
14. Study of Storage Oscilloscope & Transient response of RLC.
15. Instrumentation Amplifier: Design for specific gain and verification of CMRR.
16. Characteristics of Opto coupler.
17. Characteristics of one Solid State sensor/ Fiber optic sensor,
18. Design and test a signal conditioning circuit for the transducers.
19. Convert a given AC Analog signal into digital using S/H & ADC and recover the analog signal using DAC IC.
20. Characteristics of a Strain Gauge.

TELEMETRY LAB (TIC-653)

1. Measurement of Temperature Using RTD/ Thermister and amplification to an appropriate level suitable for Tele transmission.
2. Sampling through a S/H Circuit and reconstruction of the sampled signal. Observe the effect of sampling rate & the width of the sampling pulses.
3. Realization of PCM signal using ADC and reconstruction using DAC using 4-bit/8 bit systems. Observe the Quantization noise in each case.
4. Fabricate and test a PRBS Generator.

5. Realization of data in different formats such as NRZ-L, NRZ-M and NRZ-S.
6. Clock recovery circuit from NRZ-L data using PLL.
7. Manchester coding & decoding (Biphase L) of NRZ-L Data.
8. Coding and decoding NRZ-L into URL-L (Unipolar return to Zero coding).
9. ASK – Modulation and Detection
10. FSK – Modulation and Detection
11. PSK - Modulation and Detection.
12. Error introduction, Error Detection & Correction using Hamming Code.
13. Amplitude modulation and Detection of signal obtained from experiment no.1.

Digital Signal Processing Lab (TEC-652)

1. Sampling & Waveform Generation.
2. Quantization
3. PCM Encoding
4. Delta Modulation
5. Digital Modulation Schemes (ASK, PSK, FSK)
6. Error Correcting Codes
7. DFT Computation.
8. Fast Fourier Transform.
9. FIR Filter implementation.
10. IIR Filter implementation.
11. DSP Processor Implementation
12. Computational Experiments with Digital Filters

U.P. TECHNICAL UNIVERSITY
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Syllabus
of
3rd Year (Sem. V & Sem. VI)

B. TECH.
Instrumentation and Control Engineering