DEPARTMENT OF INSTRUMENT TECHNOLOGY
A.U. COLLEGE OF ENGINEERING (A)
VISAKHAPATNAM

M.TECH INDUSTRIAL PROCESS INSTRUMENTATION

COURSE STRUCTURE, SCHEME OF EVALUATION AND SYLLABUS

M.Tech Degree Examinationa

Industrial Process Instrumentation

Course Structure and Scheme of Evaluation (Semester-wise)

Sl. No.	Name of the Subject	Hrs./Week			Credits	Evaluation (Marks)			Total
		L	T	P		Int.	Written	Pract.	
SEMESTER-I									
1	Transducers and Measurements	3	1		4	30	70		100
2	Process Dynamics & Control	3	1		4	30	70		100
3	Computer Control of Process	3	1		4	30	70		100
4	Industrial Instrumentation	3	1		4	30	70		100
5	Analysis Instruments	3	1		4	30	70		100
6	Industrial Instrumentation lab	-	-	3	2	-	-	100	100
SEMESTER-II									
1	Microprocessor based Instrumentation	3	1		4	30	70		100
2	Electronic Instrumentation	3	1		4	30	70		100
3	Fibre Optics and Laser Instrumentation	3	1		4	30	70		100
4	Power Electronics	3	1		4	30	70		100
5	Signal Processing	3	1		4	30	70		100
6	Seminar / Comprehensive Viva				2			100	100
SEMESTER-III									
	Thesis / Dissertation / Project in the field of Instrumentation				26			100	100

M.TECH. I – 1.1 TRANSDUCERS AND MEASUREMENTS

1. Performance Characteristics – Accuracy, Sensitivity, Precision, Lizearity, resolution, hysterisis and dead zone, Inout and Output impedance. Static and Dynamic characteristics.

2. Resistance Transducers : Resistance Potentiometer, Stringauges – metallic and semi conducting, Thermistors, Photo transistors and Photo resistors.

3. Capacitance Transducers : Air gap and dielectric filled.

4. Piezoelectric Transducers : Piezoelectric crystals and its properties, configurations, sensitivity coefficients, ferro-electric materials, biomorphs – uses.

5. Magnetostrictive Transducers : Materials, Characteristics and applications.

6. Feedback Transducers : Application of negative feedback, advantages, typical schemes.

7. Elastic Transducers : Springs, billons, diaphragms, thin plates, mombranos, bourdon tubes – their special futures and applications.

8. Hall Transducers, Flapper hozzle, A.C. Tachogenerators, Infra and U-V Detectors, Ionizations gauges.

9. Smart Transducers – Optical & Hybrid Transducers.

Textbooks :

1. Hormon, K.P. Neubert, 'Instrument Transducers – An Introduction to their performance and design' 3rd Edn. Clarendon Press, Oxford.

2. Earnest O.Doeblin, 'Measurement Systems', 'Application and Design', McGraw-Hill, Kogakusha Ltd., New Delhi, 1983.

3. C.S.Rangan, G.R.Sharma and V.S.Mani, 'Instrumentation Devices and Systems', Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1983.

4. Barry E. Jone, 'Instrumentation, Measurement and Feedback', Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1983.

5. Kurt S. Lion, 'Elements of Electrical and Electronic Instrumentation' McGraw-Hill, Kogakusha Ltd.

6. D. Patranabis, Principles of Industrial Instrumentation', Tata McGraw-Hill Publishing, 1976.

M.TECH. I – 1.2 PROCESS DYNAMICS AND CONTROL

1. Dynamics of level, flow and thermal processes – Modelling of Processes – Degrees of freedom – Laws governing level, flow and thermal proceses – Formulation of mathematical models for simple processes in each category.

2. Basic control actions and controllers – Various types of control actions – On-Off, Speed Floating-P, I D P+D and P+I+D control actions – Pneumatics and electronic controllers to realize above control actions – Tuning of controllers – Performance indices – Continuous cycling method – Reaction Curve method – Evaluation of Process Control Loop.

3. Final Control Elements – Pneumatic, hydraulic and electrical actuators – Control valves – Characteristics – Control Valve – sizing – Cavitation and flashing in control valves – Solenoid valves – Motor operated valves – SCR as power control devices.

4. Complex Control Systems – Ratio control system – Food forward control – Cascade control – Adaptive control Selective Control – Averaging Control Systems with examples – their advantages and applications.

5. Case Studies – Various control loops in distillation column, steam boiler, paper manufacturing plant.

References :

1. P. Harriott, Process Control, Tata McGraw-Hill Publishing Co., Ltd., New Delhi, 1984.

2. A. Pollard, Process Control, Heinemann Educational Books, London, 1981.

3. T. Webber, An Introduction to Process Dynamics and Control, John Wiley & Sons, New York, 1973.

4. B.G. Liptak, Instrumentation in Processing Industries, Vol. II, Chilton Book Co., 1973.

M.TECH. I – 1.3 COMPUTER CONTROL OF PROCESSES

1. Multivariable Systems – State Variable representation of multi-input, multi-output systems – Solutions to state equations – STM – Food forward control, ratio control, cascade control – Interactive control systems – Controllability, observability – State variable feedback.

2. Introduction to Computer Control Systems – Need for computer in a control system – Functional Block diagrams of Data Acquisition Systems, Supervisory Control, Direct Digital Control, Programmable Logic Control, Hierarchy Concept, Distributed Digital Control.

3. Digital Controller and Algorithms – Functional block of a Computer Control System – Digital Controller Algorithms – Dead-beat, Dahlin's Kalman's, PID.

4. Self-tuning Controllers – Tuning of Controllers – Performance indices – Adaptive Systems –Self Tuners

5. Distributed Digital Control System – Significance of Distributed Control System (DCS) – Advantages – Configuration – Commercial Systems.

6. Process Control Computers – Requirement of a computer for process applications – Peripheral devices analog & digital subsystems – Microprocessor based process systems – Personal computers for Processes.

References :

1. C.M. Houpis, G.B. Lamont, Digital Control Systems, Theory, Hardware, Software, International Student Edition, McGraw-Hill Book Company, 1985.

2. S.I Ashon, Microprocessors with Application in Process Control, Tata McGraw-Hill Publishing Company Ltd., 1984.

3. C.D. Johnson, Microprocessor based Process Control, Prentice Hall Inc., 1984.

4. C.L. Smith, Digital Computer Process Control, Intext Educational Publishers, 1972.

5. E.F. Johnson, Automatic Process Control, McGraw-Hill, 1967.

M.TECH. I – 1.4 INDUSTRIAL INSTRUMENTATION – I

1. Design and fabrication of pressure measurement devices :
   Piezo electric, Piezo resistive, capacitive and inductive pressure pickups. Ionization, Alphatron gauge. High Pressure measurement – Piezo resistive and electro optic type. Force balance, Motion balance type transmitters – P/I and I/P convertors. IC pressure sensors and current trends. Standards and calibration procedures.

2. Flow Measuring Devices :
   Installation and maintenance of different types of Head flow meters. Variable area flowmeter – Principle – Rotameter glass and armour type piston type – bypass rotameter – installation and maintenance Inferential flow meters – Propeller type – turbine meter. Electromagnetic flowmeter – Principle – DC AC and pulsed type – Ultrasonic flowmeter – Principles – transit time – Doppler shift – beam deflection – Tracer type flowmeter – cross correlation – NMR Mass flowmeter transverse momentum – Coriolis – Pressure differential type – Thermal type – Vortex shedding – Principle – fluid oscillating type – Swirl meter Sold flow measurement – Capacitance type – Force sensing type standards and Calibration procedures.

3. Design and fabrication of Level Measuring Devices :
   Piezometric method using diaphragms and bellows – Conductive and Capacitive method – electro mechanical method – ultrasonic radiation and microwave sensors – use of light and thermistor as point sensors. Solid level measurement – Paddler method – capacitance method for powder level measurement.

4. Design and fabrication of Density and Weight :
   Load cell method – Strain gage, LVDT, Piezoelectric – Pneumatic and hydraulic load coil – null balance method – conveyor belt weighing for on line measurement.

References :

1. N.P.Choromisionoff, Process Level Instrumentation and Control Marcel Dekkar Inc., New York, 1981.

2. Y.L.Arora, Flow measurement Techniques, Universal Book Corporation, Bombay, 1978.

3. R.K.Jain, Mechanical and Industrial Measurements, Khanna Publishers, Delhi, 1984.

4. E.O. Doebelin, Measurement Systems, Application and Design, McGraw Hill, Tokyo, 1983.

5. R.S.Sirohi and H.C. Radhakrishna, Mechanical Measurements, Wiley Eastern, 1980.

M.TECH. I – 1.5 ANALYSIS INSTRUMENTS

1. Fourier Transform Spectroscopy – Emission spectroscopic Instruments – grating type instruments – principle of operation and constructional details – Applications X-ray diffraction – energy dispersion analysis – detectors – X-ray absorption fluoroscene spectrometry – Radiation sources - α, β, γ, sources – detectors – Geiger Mueller counter – proportionalunters – Ionization chamber scintillation counter – Solid State Detector – rate meter – Industrial application of radiation measurement.

2. Nuclear Magnetic Resonance (NMR) spectroscopy – Principles of operation and constructional details of NMR spectrophotometer – Broad band spectrometer – Application principles and application of Electron Spin Resonance (ESR) spectrometer. Mass spectrometry – principle of operation – Co-analyser – Commercial mass spectrometer.

3. Flue Gas and Water Analysers :
   Flue gas analysis using thermal conductivity principle – Katharometer – Oxygen analyzer using paramagnetic, depolarization principles – Zirconium oxide cells – Co Monitor combustibles analyzer – Different types of Dust and Smoke meter – Visible Emissions Monitor – Remote sensing laser instruments – Water purity meter – Conductivity meters – Steam purity measurement – Dissolved oxygen meter using polarographic principle – sodium analyzer – Silica analyzer.

4a. CHROMOTOGRAPHY : Basic Principle – Gas Chromotography – Liquid Chromotograph – Different types of columns – Detectors – Recorders and associated equipment.

4b. Salient features of liquid chromatography – detectors used – application of high precision liquid chromatography – p based spectroscopic analysis – current trends in analysis instrumentation.

References :

1. D.A. Skoog and D.M. West, Principles of Instrumental Analysis, Holt Saunder's publication, Philodelphia, 1980.

2. C.K. Mann, T.J. Vichers and W.H. Gulick, Instrumental Analysis, Harper and Row Publishers, New York, 1974.

3. H.A. Willard, L L Merrit and J.A. Dean, Instrumental Method of Analysis D. Van Nostrand Co., New York, 1958.

4. E.B.Jones, Instrument Technology, Vol.II, Instruments, Butterwork Scientific Pub., London, 1956.

5. E.G. Liptak, Instrumentation in Process Industries Suppl. To Vol.I and II Chilton Book Co., 1974.

M.TECH. I – 2.1 MICROPROCESSOR BASED INSTRUMENTATION

1. Review of Microprocessors, Microprocessor architecture Intel 8085 Instruction set – Assembly language programming – IO Interrupts – 16 Bit Processors.

2. Input / Output Interface devices – Review of A/D and D/A converters – Isolated I/O and memory mapped I/O + I/O Device selection. Universal programmable peripheral interface 8255 and different modes of operation. Serial and Parallel I/O ports – RS 232 & IEEE 488 buses – Asynchronous and Synchronous communication (8251). LED and seven segment display interface Keyboard and display controllers.

3. Microprocessor measurement systems: Measurement and monitoring of electrical and non-electrical quantities – Analog and digital multiplexers – Sample and hold – multi channel scanning, Annunciation and data storage.

4. Microprocessor control systems : Data acquisition systems – Supervisory Control – Direct digital control – Control algorithms – programmable logic control.

5. Microprocessor applications in process control : Multipoint temperature sensors – Microprocessor based flow control loop, temperature control loop- air fuel ratio control schemes for a boilers – UP based four (4) loop control system.

References :

1. A.P. Mathur, Introduction to Microprocessors, Tata McGraw-Hill 1985.

2. L.A. Leventhal, Introduction to Microprocessors – Software hardware, Programming, Prentice Hall of India (P) Ltd.

3. S.I. Abson, Microprocessors with applications in Process Control, Tata McGraw-Hill, 1984.

4. C.D.Johnson and D. Curtis, Microprocessor based Process Control, Prentice Hall Inc., 1984.

M.TECH. I – 2.2 ELECTRONIC INSTRUMENTATION

1. Review of analog and digital building blocks – Different types of linear and digital IC's – Classification and specifications for UA 741, LM 108 series, 7400 TTL Series, 725 series.

2. Power supplies : Types of IC power supplies functional blocks – Fixed and variable supply voltages – Precision power supply IC's – External current boosting circuits – Overload and short circuit protection circuits – Switch mode power supplies.

3. Analog Instruments : Cathode ray oscilloscopes – General purpose and advanced types – Sampling CRD's – Basics of storage CRT's wide band AC milli voltmeters – Average reaching peak reading and true RMS types – Wave analyzers and FFT analyzers.

4. Digital Instruments : Digital multimeters – Dual slope and successive approximation types of A/D conversion – Digital counters – Digital storage CROs.

5. Display and recording devices : Seven segment and dot matrix displays – X-Y recorders – Magnetic type recorders.

References :

1. E.O. Doebelin, Measurement Systems, Application and Design, McGraw-Hill International Book Co., 3rd Edition, 1983.

2. C.S. Rangan, G.R. Sarma, V.S.V. Mani, Instrumentation – Devices and Systems, Tata McGraw-Hill Pub. Co., New Delhi, 1985.

3. C.B.Clayton, Linear Integrated Circuits and Application, Ruston Publishing Co., 1975.

4. W.D. Cooper, Electronic Instrumentation and Measurement Techniques, Prentice Hall, India, 1981.

5. H.V. Malmstadt, C.M. Enke & S.R. Crouch, Instrumentation for Scientist Series, Benjamin / Commings Pub., Co., 1974.

M.TECH. I – 2.3 FIBRE OPTICS AND LASER INSTRUMENTATION

1. Theory of classification of fibre optics – Different types of fibres – properties and considerations – Fabrication of fibre components

2. Fibre optic sensors – Fibre optic communication and instrument system – Advantages of optical communications – Different types of Modulators – Detectors – Fibre optic communication setup – Applications in instrumentation.

3. Characteristics and fundamentals of lasers – Laser emission and light amplification – Properties of laser beams – Laser modes – Resonator configuration – Q-switching mode locking – Single frequency operation.

4. Types of lasers – Gas lasers – Solid lasers – liquid lasers – semiconductors lasers.

5. Lasers for Analysis – Laser application in holographic microscopy – holographic interferometry – saturation spectroscopy.

6. Industrial application of Lasers – Measurement of distance and length, velocity, acceleration, atmospheric effects, sonic boom, pollutants, Material processing, laser heating, melting, scribing, splicing, material removal, calculation of power requirement of laser for material processing.

References :

1. H.C. Allen, An Introduction to Optical Fibres, McGraw-Hill International Book Co., 1983.

2. D. Reddy and J. Coolon, Electronic Communication, Prentice Hall, 1985.

3. L.Allen, Esssentials of Lasers, Oxford University Press, 1969.

4. D.C. Oshea and W.Russel Callen, Introduction to lasers and their Applications, Addison Wesley, 1978.

5. BS.. Wherrelt, Laser Advances and Applications, John Wiley, 1979.

6. W.O.N. Guimarass and A.Mooradian, Lasers and Application Springer Verlag, 1981.

M.TECH. I – 2.4 POWER ELECTRONICS

1. Single Phase and three phase converters – Sigle phase and three phase – Bridge type controlled rectifiers – Single phase and three phase - Expressions for DC output and ripple content – Dual converters.

2. Inverters – Line commutated and forced commutated inverters – Series converter – Impulse commutated converter – three phase inverters.

3. Cycle converters and Choppers – Cycle converters and Cycle inverters – Frequency doublers and frequency triplers – AC chopper – DC Chopper – different types.

4. DC and AC Motor Speed Control – D.C. motor speed control using SCRs – Two quadrant and four quadrant speed control – A.C. motor speed control – Slip-power recovery scheme.

5. Thyristor Applications in Instrumentation – Use of SCR as a final control element in process loop – Ramp and Pedestal control using SCRs – On-Off and Proportional control of level and thermal process using thyristors – Light control – Switching mode voltage regulators.

References :

1. F.F.Mazda, Thyristor Control, Newnes Butterworths, London, 1973.

2. B.D.Bedford and R.G.Hoft, Principles of Inverter Circuits, John Wiley, New York, 1964.

3. M.Ramamoorthy, An Introduction to Thyristors and their Applicatiions, East West Press, New Delhi, 1977.

4. SCR Manual, General Electric Company, U.S.A., 1984.

M.TECH. I – 2.5 SIGNAL PROCESSING

1. Signal Representation – Classification of Signals and their mathematical representation – step, impulse, ramp, periodic, non-periodic and random signals – Fourier series and Fourier transforms – Modifying signals, interfering signals, White-noise signal to noise ratio.

2. Signal Modulators – Different types of modulators – Amplitude and frequency modulators – Modulation and Demodulation techniques and circuits – Pulse modulation – PPM, PWM, PCM – Demodulators.

3. Signal Converters – Analog and Digital multiplexers, sample hold devices, D/A and A/D converters, sampling, quantizing and encoding, control logic and interfacing, output signal reconstruction.

4. Active Filters – Active filter circuits and design – LP, BP, HP Special filter mechanization – Band rejection and notch filters.

5. Digital filters – Definition, Block diagram model – Difference equations– z – transforms – Pulse transfer function – Classification of digital filters – recursive and non-recursive – Infinite Impulse Response (IIR) and Finite Impulse Response Filters (FIR).

References :

1. J.Millman and C.C.Halkias, Integrated Electronics Analog and Digital Circuits and Systems, McGraw-Hill, Kogakusha Ltd., Tokyo, 1982.

2. L.R. Rabniner and B.Gold, Theory and Application of Digital Signal Processing, Prentice Hall, New Delhi, 1985.

3. P.Gamett, Analog Systems for Microprocessors and Minicomputers, Prentice Hall Pub. Co., 1985.

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DEPARTMENT OF INSTRUMENT TECHNOLOGY

VISAKHAPATNAM,

Date : 06-11-2008.

From

HEAD OF THE DEPARTMENT

To

The Principal,
A.U. College of Engineering (A),
Visakhapatnam.

Sir,

Sub: Submission of IPI & B.Tech Syllabai – Reg.

* * *

I am herewith sending CD containing the syllabai of Industrial processing Instrument and B.Tech. Engineeringfor your kind perusal.

Thanking you,

Yours faithfully,

(M.MARIYA DAS)

HEAD OF THE DEPARTMENT