COURSES OF STUDY (Syllabus)
T. Y. B. TECH.
(INSTRUMENTATION ENGINEERING)
w.e.f. July 2011
for the batch registering in 2011-12

Department of Instrumentation Engineering,
SGGS Institute of Engineering and Technology,
Vishnupuri, Nanded-431606 (MS), India
(An autonomous institute established by Govt. of Maharashtra)

COURSES OF STUDY (Syllabus)

T. Y. B. Tech. (Instrumentation Engineering) for the batch registering in 2011-12

STRUCTURE

Course Code	Name of the Course	Total No of credits	Lecture /week	Tutorial /week	Practical /week
I Semester					
IN 301	Feedback Control Systems	4	3	-	2
IN 302	Power Electronics	4	3	-	2
IN 303	Digital Signal Processing	4	3	-	2
IN 304	Chemical and Analytical Instrumentation	3	3	-	-
IN 305	Microprocessor Based Instrumentation	4	3	-	2
IN 306	Principles of Communication Engineering	2	2	-	-
	SubTotal	**21**	**17**	**00**	**08**
II Semester					
IN 307	Process Control	4	3	-	2
IN 308	Microcontrollers and Digital Signal Processors	4	3	-	2
IN 309	Biomedical Instrumentation	4	3	-	2
IN 310	Control System Components	4	3	-	2
IN 311	Power Plant Instrumentation and Unit Operation	3	3	-	-
IN 312	Data Communication for Automation	3	3	-	-
IN 313	Seminar	1	-	--	-
HU 301	Humanity Science	Audit	2	-	Audit
	SubTotal	**23**	**20**	**00**	**08**
	Total	**44**	**37**	**00**	**16**

Attendance Criteria:

Students have to maintain 75% attendance in all the registered courses in a semester to be eligible for appearing examinations.

SEMESTER-I
IN301 Feedback Control Systems
(4 Credits, L-3, T-0, P-2)

Introduction to control systems: Definition, History, elements of control systems, Examples of control systems, Open- loop (non feedback) and closed loop (Feedback) control systems, Effect of feedback on overall gain, Parameter variations, External disturbances or noise and control over system dynamics, Regenerative feedback, Linear versus nonlinear control systems, Time- invariant versus Time- varying systems, SISO and MIMO systems. (04)

Mathematical Modeling of dynamic systems: Introduction, Canonical form of feedback control systems, Transfer function and impulse response. Differential equations and transfer functions of physical systems such as Mechanical, Electrical, Electromechanical, Thermal, Pneumatic and liquid-level systems, Analogous systems, Force-Voltage, Force-current and Torque- current analogies, loading effects in interconnected systems, systems with transportation lags. Linearization of Nonlinear mathematical models, Block diagram representation of control system, Rules and reduction techniques, Signal Flow graph: Elements, definition, properties, Masons gain formula, Application of gain formula to block diagrams. (08)

Time- domain Analysis of control systems: Standard test signals, transient response, Steady state error and error constants, Dynamic error series, Time response of first and second order systems and transient response specifications, Effect of adding poles and zeros to transfer functions, dominant poles of transfer function, Basic control actions and response of control systems, Effects of Integral and derivative control action on system performance, Higher order systems. (06)

Stability of Linear Control systems: Concept of stability, BIBO stability: condition, zero-input and asymptotic stability, Hurwitz stability criterion, Routh-Hurwitz criterion in detail, Relative stability analysis. (06)

The Root–Locus technique: Introduction, Basic properties of the root loci, General rules for constructing root loci, Root- locus analysis of control systems, Root loci for systems with transport lag, Root-contour plots, Sensitivity of the roots of the characteristics equation. (06)

Frequency domain analysis: Frequency response of closed loop systems, Frequency domain specifications of the prototype second order system, Correlation between time and frequency response, Effect of adding a pole and a zero to the forward path transfer function, Polar plots, Bode plots, Phase and Gain margin, Stability analysis with Bode plot, Log magnitude versus Phase plots. Constant M and N circles, Nichols Chart, Gain adjustments, Sensitivity analysis in frequency domain, Nyquist stability criterion: Mathematical preliminaries, stability and relative stability analysis. (10)

Compensators: Introduction, Different types of Compensators (Electrical, Electronic and Mechanical type), their transfer functions, Bode plots, polar plots, Design of Lead, Lag, Lead-Lag Compensator using Root Locus and Bode Diagrams (08)

Note: The method and concepts given in each chapter should be addressed using the real world engineering applications.

Term work: It will consist of at least eight experiments/assignments/programs from the following list:

Experiments:

1. Determination of transfer function of an armature controlled d. c. motor.
2. Determination of transfer function of D. C. generator.
3. Effect of feedback on D. C. generator.
4. Transient response of second order system.
5. Study of D. C. positional servo system
6. Study of A. C. servo voltage stabilizer.
7. Study the performance of an open and closed loop control system using electronic amplifiers using OPAMPs.
8. Study the performance of a second order system (Use any OPAMP based electronic system such as an active second order Butterworth filter).
9. Study the performance of any first order and second order system.

Experiments based on Software (Programs)

1. Introduction to MATLAB, MATLAB's Simulink and control systems toolbox (with some examples) or any other control system related software package.
2. Compare and plot the unit-step responses of the unity-feedback closed loop systems with the given forward path transfer function. Assume zero initial conditions. Use any computer simulation program.
3. Study of effect of damping factor on system performance by obtaining unit step response and unit impulse response for a prototype standard second order system. Consider five different values for ξ = 0.1, 0.3, 0.5, 0.7 and 1.0. Also study the effect of varying undamped natural frequency by taking three different values. Comment on the simulations obtained.
4. Write a program that will compute the step response characteristics of a second order system i.e. percent overshoot, rise time, peak time and settling time. Generalize it for accepting different values of undamped natural frequency and damping factor.
5. Study and plot the unit step responses of addition of a pole and a zero to the forward path transfer function for a unity feedback system. Plot the responses for four different values of poles and zeros. Comment on the simulations obtained.
6. Study and plot the unit step responses of addition of a pole and a zero to the closed loop transfer function. Plot the responses for four different values of poles and zeros. Comment on the simulations obtained.
7. Program for compensator design using Bode plot.
8. Program for Compensator design using Root Locus Analysis.
9. Plot and comment on various properties of any three systems (Problems) using
    - Routh-Hurwitz criterion
    - Root locus technique
    - Bode plots
    - Nyquist plots.

Use any software package.

Home Assignments:
Verify the above mentioned four problems (in software) for their properties analytically and graphically.
Routh-Hurwitz criterion. (3 Problems)
Root locus (3 problems).
Bode plot (3 problems).
Nyquist criterion (3 problems).
At least three assignments based on above syllabus as prescribed by course instructor.

Practical Examination:

The examination will be of three hours duration and will consist of an experiment based on term-work and followed by an oral based on above syllabus.

Reference Books:

1. K. Ogata- Modern Control Engineering, Fourth edition, Pearson education India, 2002.
2. B.C. Kuo- Automatic control systems, Seventh Edition, Prentice –Hall of India, 2000.
3. Norman S. Nise- Control systems Engineering, Third Edition, John Wiley and Sons.Inc, Singapore, 2001.
4. R. C. Dorf and R.H. Bishop- Modern Control systems, Eighth edition, Addison-Wesley, 1999.
5. I.J. Nagrath and M. Gopal- Control systems Engineering, Third Edition, New age International Publishers, India, 2001.

IN302 Power Electronics
(4 Credits, L-3, T-0, P-2)

1. Introduction
   Modern power semiconductor devices and their characteristics, gate drive specifications, ratings, applications, Turn ON and Turn OFF methods, Design of gate triggering circuits using UJT, Diac, and Thyristor protection circuits
2. Phase Controlled Rectifiers
   Single phase rectifiers: Half wave, Center tapped, Bridge (half controlled and fully controlled) with R and RL load
   Three phase rectifiers: Half wave, Bridge with R and RL load
   Effect of source inductance, dual converters, Power factor improvement methods
3. DC Chopper
   Basic chopper, continuous and discontinuous current conduction, TRC, CLC methods, classification of choppers, step-up chopper, switching mode regulators
4. AC Voltage Controller
   AC Voltage Controller: Types of ac voltage controllers, single-phase and three phase ac voltage controllers with R and RL load, transformer tap changers

5. Cycloconverters: The basic principle of operations of single phase to single phase, three phase to single phase, three phase to three phase with circulating and non-circulating mode
6. Inverters
   Single phase inverters: series, parallel and bridge configurations with R load, PWM inverters. Three-phase inverters: 120° and 180° conduction with R and load RL, voltage control and harmonics reduction
7. Speed control of DC motors
   Basic characteristics of DC motors, operating modes, DC motor control using different rectifiers, choppers and microprocessor control of DC drives
8. Speed control of AC motors
   Induction motor drives, performance characteristics, stator voltage control, rotor voltage control, frequency control, voltage and frequency control, microprocessor control of AC drives.

Term Work

It will consist of record of at least six to eight experiments from the following list.

1. UJT Relaxation oscillator.
2. SCR characteristics.
3. Triac characteristics.
4. Power control using SCR.
5. Power control using Triac.
6. Single phase controlled Rectifiers.
7. Single phase half controlled Rectifiers.
8. Single phase fully controlled Rectifiers.
9. Single phase inverter using transistor/ MOSFET/IGBT.
10. Basic step-down chopper.
11. Basic step-up chopper.
12. Study of D.C. motor control using controlled rectifiers.
13. Study of D.C. motor control using choppers.
14. Study of A.C. motor control using inverter.

Practical Examination

The examination will be of three hours duration, and will consist of an experiment based on term-work and followed by an oral based on above syllabus.

Reference Books

1. V. R. Moorthi, Power Electronics: Devices, Circuits and Industrial Applications, Oxford University Press, 2006.
2. M. H. Rashid, Power Electronics: Circuits, Devices, and Applications, Pearson Education, Inc. Third Edition, 2004.

3. M. D. Singh and K. B. Khanchandani, Power Electronics, Tata McGraw-Hill Publishing Company Limited, New Delhi (India), 1998.
4. P. S. Bimbhra, Power Electronics, Khanna Publishers, New Delhi (India), 2nd Edition, 1998.
5. M. Ramamoorthy, An Introduction to Thyristors and Their Applications, Affiliated East-West Press Private Limited, New Delhi (India), 2nd Edition, 1991.
6. N. K. De and P. K. Sen, Electric Drives, Prentice Hall of India Private Limited, New Delhi (India), 1999.
7. G. De, Principles of Thyristorised Converters, Oxford and IBH Publications.

IN303 Digital Signal Processing
(4 Credits, L-3, T-0, P-2)

1. Signals and Signal Processing (4 Hours)
Motivation, Characterization and classification of signals, signal processing operations, examples of signals, signal-processing applications.

2. Discrete time signals and systems in the time domain (4 Hours)
Discrete time signals, typical sequences and sequence representation, the sampling process, Discrete time systems, Time domain characterization of LTI discrete time systems, Finite dimensional LTI Discrete time systems, correlation of signals, Random signals.

3. Discrete Time signals in Transform domain (10 Hours)
Discrete time Fourier transform, Discrete Fourier Transform, Relationship between the DTFT and the DFT and their inverses, Discrete Fourier Transform properties, Computation of the DFT of real sequences, Linear convolution using the DFT, The Z-transform, ROC of the rational Z-transform, Inverse Z-transform, Z-transform properties, Transform domain representation of random signals.

4. LTI Discrete time systems in Transform Domain (6 Hours)
Finite dimensional Discrete time systems, the frequency response, the transfer function, types of transfer functions, Simple digital filters, All pass Transfer function, Minimum phase and maximum phase transfer functions, Complementary transfer functions, Inverse systems, Systems identification, Digital two pairs.

5. Digital filter structures (6 Hours)
Block diagram representation, equivalent structures, Basic FIR structures, Basic IIR structures, All pass filters, IIR tapped cascaded lattice structures, FIR cascaded lattice structures.

6. Digital Filter design (6 Hours)
IIR filter design – Bilinear transformation, Impulse invariant transformation, Low pass IIR digital filters, Spectral transformations, FIR filter design using windowing techniques, Frequency sampling technique, and Computer aided design.

7. DSP algorithm implementation (6 Hours)
Computation of DFT, FFT algorithms, Decimation in time, Decimation in Frequency, Different algorithms of FFT such as DIT and DIF where input and output is in order, radix-n algorithms.

8. Hilbert transforms, homomorphic systems and their use for deconvolution, cepstrum Analysis (6 Hours)
9. Applications of DSP: Speech, images, control systems, sampling rate alterations, introduction to sub-band coding. (4 Hours)

Term Work: Term work shall consist of at least six to eight assignment/tutorials/practical based on above syllabus. Some of the experiments may be from the following list.
Students are supposed to write the programs (at least eight) on general-purpose computer using any development environment (C/C++/Matlab) or on any DSP processor and development environment

1. Digital signal generation
2. Simple operations on signals
3. Linear Convolution
4. Discrete time Fourier transform
5. Discrete Fourier Transform - Direct computation, DIT algorithm, DIF algorithm
6. FIR filter design and software realization by windowing and Frequency sampling
7. IIR Filter Design and software realization of Butterworth and Chebyshev approx.
8. Any other experiment decided by the teacher

Reference Books:

1. E. C. Ifeachor, B. W. Jarvis, Digital Signal Processing- A Practical Approach, Second Edition, Pearson Education, New Delhi, 2002.
2. S. K. Mitra, Digital signal processing- A computer based approach, Tata McGraw Hill, 2002
3. A.V. Oppenheim, R, W, Schafer, Discrete time signal processing, Prentice-Hall of India, 2001.
4. J. G. Proakis, D. G. Manolakis, Digital signal processing –Principles, algorithms and applications, Prentice Hall of India, 2002.
5. R. G. Lyons, "Understanding Digital Signal Processing", Pearson Education New Delhi, 1999.

IN304 Chemical and Analytical Instrumentation
(3 Credits, L-3, T-0, P-0)

1. Introduction: selection of instruments for application in industries. Classification of Instrumental methods. Basic function of Instrumentation. On line instrumentation and laboratory techniques and brief review. Difference between analytical and other instruments.
2. PH measurement: Calorimetric method, potentiometeric methods, PH meters (Construction, advantages, disadvantages, factors affecting measurement) Applications.
3. Electrical conductivity measurement ; Electrical conductivity and molecular conductivity (definitions) Methods of measurement, conductometric Titrations, Application

4. Chromatography: introduction, definitions, classification, Gas chromatography apparatus, details of different parts, applications, factors affecting separation. HPLC-Instrumentation, Sample introduction, Separation Column, Detectors.
5. An introduction to absorption and emission spectroscopy: The nature of electromagnetic radiation, electromagnetic spectrum, atomic energy levels, vibrational energy level, Raman effect, nuclear spin behavior, electron spin behavior, X-ray energy levels.
6. Ultraviolet and Visible Spectrometry: Instrumentation radiation sources, detectors, Readout module filters, Monochromators, Monochromator performance, Grating Monochromator systems, Instruments for absorption Photometry.
7. Flame Emission and Atomic Absorption Spectroscopy; Instrumentation, application Fundamental laws of photometry, Turbidity and Nephelometry,
8. NMR and X-ray Spectroscopy: Nuclear Magnetic Resonance Spectroscopy-Basic principles, Continuous wave NMR spectrometers, pulse Fourier transform NMR spectrometer. Spectra and molecular structure. Elucidating of proton NMR spectra. Quantitative analysis. X-ray spectroscopy-production of X-rays spectra. Instrumental methods, detectors, direct absorption fluorescence methods. X-ray diffraction.
9. Mass Spectrometry : Components of mass spectrometers, Resolution, Mass spectrometers, Interfacing Chromatography and Mass spectrometry, Quantitative analysis of mixtures, use of stable isotopes, leak detection correlation of mass spectra with molecular structure
10. Radiochemical Methods: Nuclear Reactions, Neutron Sources, Activation Analysis, Isotope Dilution Analyses, Liquid Scintillation System Application

Reference Books:

1. Instrumental Methods of Analysis : Willard , Merritt Dean
2. Instrumental Methods of chemical analysis-Calen W. Ewing
3. Instrumental methods of chemical analysis – B.K. Sharma.
4. Basic Instrumentation in Industrial measurements O Higgins P.J Mc Gram – Hill
5. Principle of Industrial Instrumentation Patranabis-TMH Publication, New Delhi.
6. Instrumental Methods of Chemical analysis-Anand Chatwal

IN305 Microprocessor Based Instrumentation
(4 Credits, L-3, T-0, P-2)

1. Introduction to 8085: Architecture and operation, pin out diagram.
2. Assembly language programming for 8085 microprocessor instruction classification, instruction set study in details, addressing modes, writing assembly language programs, stacks subroutines, floating point routines.
3. Instruction set timing diagrams, a minimum configuration for 8085.

4. Interfacing memories EPROM and RAM with 8085 with exhaustive and partial decoding techniques.
5. Interrupt structure of 8085, internal interrupt circuit, hardware and software interrupts, serial data transfer.
6. Following structure programmable peripheral devices are to be studied in details as regards block diagram, software for their interfacing with 8085: 8255, 8253, 8279, 8251.
7. Bus interfacing standards- RS 232, IEEE 488.
8. Interfacing application: Interfacing seven segment displays keyboard, A to D and D to A converter.
9. Microprocessor based data acquisition and control system: Temperature control system, Flow control system etc.
10. Introduction to 8086, 80486, and Pentium processors.

Term Work:

It will consist of records of at least six to eight experiments from the following lists:
At least 3 software program from the following list

- Block transfer
- Searching and Sorting
- BCD binary Arithmetic
- Number system conversion
- Interfacing 7-segment displays with 8255.
- Interfacing Keyboard matrix with 8255.
- Interfacing DAC
- Interfacing ADC
- Programming for 8253.
- Software implementation of ADC
- Observing timing diagram on CRO.
- Study of interrupts.

Practical Examination:

The examination will be of three hours duration and will consist of an experiment based on term-work and followed by an oral based on above syllabus.

Reference Books:

1. K. L. Short "Microprocessor and programming logic", Second Edition, Prentice-Hall India Pvt. Ltd.
2. R. S. Gaonkar "Microprocessor Architecture, Programming and application with 8085/8085A", Fourth Edition, Willey Eastern Ltd.
3. U. V. Kulkarni and T. R. Sontakke "The 8085A Basics: Programming and Interfacing", Sadusudha Prakashan, Nanded.
4. Intel Mcs, "8085 users manual" Intel Corporation.
5. B. Ram "Fundamentals of microprocessor and Microcomputer", Dhanpat Rai and Sons, New Delhi.

6. Ajit Pal "Microprocessor Principles and Applications", Tata Mc-Graw Hill, New Delhi.
7. B. Ram "Advanced Microprocessor and Interfacing" Tata McGraw-Hill Publishing Company Ltd., New Delhi.

IN 306 Principles of Communication Engineering
(2 Credits; L-2, T-0, P-0)

1. Amplitude Modulation (05)
AM wave equation, spectrum, power relation, generation methods, high-level modulation, and low-level modulation, DSBSC and SSB modulation, SSB generation methods, ISB, VSB.

2. **Frequency Modulation** (05)

Mathematical representation of FM, Frequency spectrum of FM, Generation methods of FM (Direct, Indirect methods), effect of noise on FM, Noise triangle, Pre-emphasis and De-emphasis, Phase Modulation, Compare AM, FM, PM, Frequency Division Multiplexing.

3. Noise in Communication Systems (04)
Noise types, Noise calculations, Noise Figure, Noise température.

4. Radio Receivers (05)
Receiver types, Performance parameters such as sensitivity, selectivity, fidelity, image frequency rejection, AM receivers: Block Diagram, RF Section, Frequency changing and Tracking, IF Amplifiers, Detection and AGC, Delayed AGC, FM receivers: Block Diagram, comparison with AM Receiver, Amplitude limiting, Slope detector, Balanced slope detector, Phase discriminator, Ratio Detector.

5. Pulse Communications (05)
Advantages of pulse modulation, PAM, Time Division Multiplexing, PWM, PPM generation and demodulation, PCM, PCM advantages and applications, DPCM, Delta modulation, Introduction to FSK, PSK, ASK.

6. Radiation and Propagation of Waves (03)

Electromagnetic radiation, propagation of waves

7. Antennas (04)

Basic considerations, wire radiators in space, terms and definitions, effects of ground on antennas, antenna coupling at medium frequencies, directional high frequency antennas.

8. Basic Telephony (02)

9. Telemetry and Telecontrol (04)

Smart transmitters, typical telemetry and telecontrol schemes for industrial applications telemetry errors caused by noise, telemetry and carrier communication systems, Introduction to MODEM.

Reference Books:

1. G. Kennedy, Electronic Communication Systems, McGraw Hill, New Delhi.
2. D. Roddy and J. Coolen, Electronic Communications, Prentice-Hall of India Private Limited, Third Edition, 1984.
3. Blake, Electronic Communication Systems, 2nd Edition

SEMESTER-II

IN307 Process Control
(4 Credits, L-3, T-0, P-2)

1. Introduction to Chemical Process Control: Incentives for Chemical Process Control, Design aspects and Hardware for a Process Control System, Introduction to ISA symbology: P & ID for Process Control (2)
2. Modeling of Chemical Processes: Development of a mathematical model, necessity, State Variables and State Equations, Additional Equations, Additional Elements of the Mathematical Models; Dead Time; Modeling Difficulties; The input-output Model; Degrees of freedom and process controllers; Transfer function of a process with single/multiple outputs.(5)
3. Dynamic Behavior of systems: Dynamic Behavior of First Order, second order and higher order systems; Dynamic systems with Dead Time/Inverse Response, Computer simulation of process dynamics, linearization of Nonlinear systems (6)
4. Controller Principles, Process characteristics, Control System Parameters, Discontinues controller Modes, Two-Position, Multi position, Floating Control Mode, Continues controller Mode, P, I and D, Composite control Mode, P+I, P+D, P+I+D Controller modes. (6)
5. Dynamic behavior of Feed Back Controlled Processes: Input output models of feedback controllers, common measuring devices, Transmission lines, final control element Effect of on-off, Proportional, Integral, Derivative and composite control actions on the Response of a controlled Process. Generation of control action: Control action generation in electronic and pneumatic controllers.
6. Design of Feed Back controllers: Outline of Design problems; simple performance criteria, time integral performance content; selection of a feedback controller; controller tuning using Cohen-Coon method; Bode Stability criterion, gain and phase margins, Ziegler-Nichols Turning Technique.(6)
7. Analysis and Design of Advanced Control systems: Feedback control systems with large dead time or inverse response; cascade, selective and split range control; feed forward and ratio control; adaptive and inferential control systems. (8)
8. Design of Control Systems for Multi variable processes: Synthesis of alternative control, configurations for multiple input-multiple output

processes, Interaction and decoupling of control loops; Design of control systems for complete plants, some case studies. (8)

Reference Books:

1. T. E. Marlin, "Process Control: Designing Processes and Control Systems for Dynamic Performance", McGraw Hill International Edition, 2000.
2. G. Stephanopoulos, "Chemical Process Control: An Introduction to Theory and Practice", Prentice Hall of India, New Delhi, 2001.
3. Simulation and Control for Chemical Engineering- Luyben W.L. 2nd Edition Mc Graw Hill 1989.
4. Curtis Johnson, "Process Instrumentation Technology", 4th Edition, Prentice Hall of India, New Delhi, 1996
5. E. Umez- Eronini, "System Dynamics and Control", Thomason Learning, 2002.

Term Work: The term work shall consist of a record of at least eight experiments based on the syllabus given above. Some of the experiments may be from the following list.

1. Design of an electronic ON-OFF controller and plot the characteristics of natural zone of controller
2. Design an electronic PID controller and study its response for step input.
3. Design electronic temperature transmitter for transmitting temperature from 50^{O}C to 90^{O}C to 4 to 20mA
4. **Cascade control trainer (P, PI, PID, On / off)**
   Study of Cascade Control trainer (Flow & Level control)
5. **Level control trainer**
   a) Study of open loop response (Manual control)
   b) Study of on/off controller
   c) Study of proportional controller
   d) Study of proportional integral controller
   e) Study of proportional derivative controller
   f) Study of proportional integral derivative controller
   g) Tuning of controller (Open loop method)
   h) Tuning of controller (Closed loop method)
6. **Flow control trainer**
   a) Study of open loop response (Manual control)
   b) Study of on/off controller
   c) Study of proportional controller
   d) Study of proportional integral controller
   e) Study of proportional derivative controller
   f) Study of proportional integral derivative controller
   g) Tuning of controller (Open loop method)
   h) Tuning of controller (Closed loop method)
7. **Flow measurement**
   a) To Calculate coefficient of discharge of Venturi meter.
   b) To Calculate coefficient of discharge of Orifice meter.

c) To Calculate coefficient of discharge of Pitot tube.
d) To calibrate and find accuracy of Rotameter.
e) To find accuracy of Water meter.

8. Determine the time-constant of RTD for given step-input.
9. To determine the mathematical model of the given process
10. To determine the constants of PID controllers by given method.
11. Use of dead beat algorithm and other algorithms in the controller design
12. Use of optimum controller methods for tuning of PID controller.

Practical Examination: It shall consist of any one experiment based upon the term work and syllabus. The examination shall not be less than three hours duration.

IN308 Microcontrollers and Digital Signal Processors
(4 Credits, L-3, T-0, P-2)

1. Introduction to microcontrollers: Comparison of microprocessor and microcontrollers 4-bit, 8-bit, and 16-bit microcontrollers 89C5I and other 8-bit microcontroller chips.
2. 8051 Architecture: Pin out diagram, 8051 oscillator and clock, Program counter and Data Pointer, A and B CPU registers, Flags and PSW, internal memory, stack and stack pointer, SFRS, internal ROM, I/P and O/P ports.
3. Assembly language programming for 8051 microcontroller instruction classification, instruction set Arithmetic and logical operations, jump and call instructions etc., Writing assembly language programming based on instruction set, stacks and subroutines.
4. Interrupts of 8051 Serial data i/p and o/p, serial data transmission and communication counters and timers, timer modes timer/counter programming.
5. 8051 microcontroller interfacing with: 8255, Keyboard and Display, A/D and D/A chips external memories (RAM and EPROM).
6. Design of dedicated systems using 8051 for temperature indication OR/AND control, Flow indication OR/AND control stepper motor control Embedded control systems, Smart transmitters.
7. Introduction to ARM processor
8. Digital signal processing systems and Application;
   TMS320 family, Digital Signal Processing Application, Digital Signal Processor, Architecture, CPU, Memory Configuration, Peripherals and Input/output, Software Development, Instruction Set, Assembly Programs, Hardware Selection, Hardware Configuration, Development using Code Composer Studio.
9. Fixed point digital signal processor;
   TMS320C55x: Architectural Overview, Central Processing Unit, Addressing Modes, Instruction Set, Optimization of C program.
   TMS320C64x: Architectural Overview, Central Processing Unit, Addressing Modes, Instruction Set, Optimization of C Program, Programming Consideration.

10. Floating point processor
    TMS320C67x: Architectural overview, Central processing unit, Addressing modes, Instruction set, Optimization of C program, introduction to DSP/BIOS, Programming consideration, pipeline operation.

Term Work:

It will consist of records of at least six experiments from the following lists:

1. At least 4 software programs from the following list
   a] Block transfer
   b] Searching Sorting
   c] BCD binary Arithmetic
   d] Number system conversion etc.
2. Interfacing Keys and LED's with microcontroller.
3. Developing two programs using SPJ system simulator.
4. Interfacing ADC with microcontroller.
5. Interfacing DAC with microcontroller.
6. Interfacing 7 segment display with microcontroller
7. Study of interrupts.
8. Interfacing of stepper motor with microcontroller.
9. Write a program for sine wave generation.
10. Write a program for Impulse Response.
11. Write a program for linear convolution.
12. Write a program for circular convolution.
13. Write a program for DFT/FFT.
14. Real time implementation for FIR filters.
15. Real time implementation for IIR filters.
16. Write a program for noise cancellation from input signal.

Practical Examination:

The examination will be of three hours duration and will consist of an experiment based on term-work and followed by an oral based on above syllabus.

Reference Books:

1. 8051 Microcontroller: Architecture by Ayala K.J., Programming and applications 2nd Edition, Penram international.
2. Programming and customizing the 8051 Microcontroller – Myke Predko, Tata McGraw-Hill Edition., New Delhi.
3. 8031 Microcontroller – Architecture, Programming and Hardware Design. – N.G. Palan, Technova publishing House.
4. Intels Manual.
5. Sen M. Kuo, Woon-Seng Gan, Digital Signal Processors, Architecture, Implementation and application. Pearson education. Indian Edition 2005.
6. B Venkataramani, M Bhaskar, Digital Signal Processors, Architecture, Implementation and application., Tata McGraw Hill

7. Texas Instrument Manuals for processor.
8. C:\CCStudio_v3.1\docs\hlp (c6713dsk.hlp)Help regarding 6713 processor
9. User manual for 6713 by Cranes Software International Limited.

IN309 Biomedical Instrumentation
(4 Credits, L-3, T-0, P-2)

1. **Introduction:** Biomedical instrumentation, Introduction to human body systems, Cell, Electrophysiology, Biomedical signals and their ratings and features, The body as a control system.
2. **Electrodes and Transducers for Biomedical measurements:** Electrodes for Biophysical sensing, Electrode model circuit, Medical surface electrodes, Microelectrodes, Cup electrodes, Disposable electrodes, Transducers used in Biomedical Instrumentation.
3. **Bioelectric Amplifiers:** Operational amplifiers, High-impedance PH probe amplifier, Circuit for driving large capacitive loads, Low-droop positive peak detector, Multiple input amplifier, Differential amplifier, Instrumentation amplifier with NPN and FET inputs, PH probe electrometer instrumentation amplifier, Bridge amplifier with 1 Hz low pass filter, Hot wire anemometer-thermistor circuit, 4 ma to 20 ma current loop bridge transmitter, load cell weighing scale instrumentation amplifier, Input protection circuit, signal processing circuits, Offset null methods, Auto-zero amplifier, Isolation amplifier
4. **Electrographs:** The heart as a potential source, the ECG waveform, standard lead system, ECG preamplifier, Defibrillator protection circuit, Electrosurgery unit interference filter, multichannel physiological monitoring system, five patient electrode (6-lead) ECG system, QRS and pacer pulse detector system, ECG machine mechanism, patient cables,ECG machine maintenance, ECG faults and trouble shooting.
5. **Physiological pressure measurements:** pressure measurements, blood pressure measurements, Oscillometric and ultrasonic Noninvasive pressure measurements, Direct methods (H_2o manometers), pressure transducers, pressure amplifiers, Calibration methods, systolic, diastolic and mean detector circuits, pressure differentiation (dp/dt) circuits. Automatic zero circuits, practical problems in pressure monitoring.
6. **Other Cardiovascular Measurements:** Cardiac output measurement, Dilution methods, Input circuit for a thermo dilution cardiac output computer, Right side heart pressures, Plethysmography, Blood flow measurements, phonocardiography, Vectorcardiogaphy (VCG).
7. **Cardiac stimulation and life support equipments:** Defibrillator, Defibrillator circuits, Cardioversion, Testing Defibrillators, Pacemakers. Heart lung machines, Audiometers, Hearing aids, EMG, Artificial kidney, endoscope, Different therapetic instruments (electronic pain killer, ultrasound therapy).
8. **Respiratory system:** Human respiratory system, Gas laws, internal (cellular) respiration, External (Lung) respiration, Organs of respiration, Mechanics of breathing, parameters of respiration, regulation of respiration, Unbalanced and

diseased stages, Major measurements of pulmonary functions, Respiratory Instrumentation: Respiratory transducers and instruments, spirometers, Respiratory therapy equipment, oxygen therapy, artificial mechanical ventilator.

9. **Instrumentation for measuring Brain parameters:** Organization of the nervous system, the neuron, cerebral angiography, computerized axial tomography (CAT), EEG, EEG electrodes and the 10-20 system, EEG amplitude and frequency bands, EEG diagnostic uses, EEG amplifiers, EEG telemetry systems.
10. **Radiology and nuclear Medicine equipments:** Physics of sound waves, Ultrasound energy, ultrasound transducer, Types and uses of X-Ray and Nuclear Medicine equipments. Generation of X-Ray in an X-Ray tube, Block diagram and operation of X-Ray machine.
11. **Electrical safety in the Medical environment:** Definition of electrical safety, Macro shock and micro shock, Design considerations for reducing electric hazards, Line isolation system, Equipotential grounding systems, Ground fault interrupters, Proper power wiring, Distribution and ground systems, specialized electric safety test equipment's.

Term work:

Shall consists of at least eight experiments from the list given below

1. Use of ECG machine to read 12 lead waveform on CRO or PC screen
2. Use of EEG machine to record 10-20 lead output and study of eyelid movements and illumination effects on EEG waveform.
3. Use of audiometer to select a particular hearing aid.
4. Lung capacity measurements using bell jar and electronic spirometer.
5. Measurement of BP and study of constructional details of BP apparatus.
6. Use of ultrasonic. Electronic and thermal therapy equipment.
7. Use of defibrillator and study of its operation.
8. Study of International Safety Analyzer
9. Study of ICU/CCU design and safety aspects
10. Study of biomedical signal standard databases and normal values of man data.

Practical Examination:

The examination will be of three hours duration, and will consist of an experiment based on term-work and followed by an oral based on above syllabus.

Text Books:

1. Biomedical Instrumentation by Joseph J. Carr and John M. Brown

Reference Books:

1. Handbook of Biomedical Instrumentation by R.S. Khandpur
2. Biomedical Instrumentation and Measurements by Leslie Cromwell, Weibell and Pfoeiffer

3. Medical physics and physiological measurements by B. H. Brown and R.A. Smallwood.
4. Introduction to biomedical instrumentation by S.G. Kahalekar.

IN310 Control System Components
(4 Credits, L-3, T-0, P-2)

1. Mechanical networks and Gears: introduction, springs, mass dash-pot and absorbers, mechanical equalizes and their transfer function, comparison of electrical and mechanical systems, introductions to gears, types of gears and use of gears in control system, flyweight tachometer.
2. Hydraulic components: introduction basic types of hydraulic transmission lines, servo motors, power supply, Hydraulic circuits and transmission, applications like motor speed control, reciprocating, loading, unloading, sequencing of cylinders and direction control.
3. Pneumatic components: pneumatic power supplies, introduction to pneumatic systems and their analysis, filters and pressure regulators, flapper nozzle system, pneumatic motors.
4. Control valves: classification of valves. Valve actuators and accessories, detail study of valve characteristics. Study of valve construction by considering examples from hydraulic, pneumatic and electrical types. Introduction to valve selection and specifications. Valve sizing with mathematical treatment. Introduction to analog and digital fluidic devices.
5. Synchros: transmitter and receiver construction, principal, analysis and applications of synchros as an error detector.
6. AC and DC servomotors: Constructional features, theory of operations, analysis, approximate transfer function and block diagram, load-torque, speed-torque characteristics, electronic drive circuits, comparative studies and applications in control system.
7. Stepper motor: construction, types such as variable reluctance stepper motor, single stack and multi stack, permanent magnet stepper motor, hybrid steeper motors and their principle of operations, drive circuits and high speed operations, applications in control systems.
8. Relays: introduction to types of relays, cam timer relays and bulk timer relays, electromagnetic relays and contactors, constructional features and applications in control system.

Term work:

It will consist of a record of at least six of the following experiments based on the prescribed syllabus.

1. Study of cut section views of different control system components
2. Study of synchro transmitter and receiver pair
3. Study of stepper motor
4. Study of AC/ DC servo motors

5. Study of Motor Speed torque characteristics
6. Study of hydraulic control valves and accessories
7. Study of pneumatic control valves and accessories
8. Study of ON/Off, Linear and Equal percentage Valve Characteristics
9. Study of logic fluidic devices
10. Study of flapper nozzle system
11. Study of different types of relays

Practical Examination:

The examination will be of three hours duration and will consist of an experiment based on term-work and followed by an oral based on above syllabus.

Reference Books:

1. Process Instruments and Control Handbook by Douglas M. Considine, McGraw Hill
2. Industrial control Handbook volume 2 by E.A . Parr, BSP Professional Books
3. Measurement Systems – Application and Design by Ernest O. Doebelin, 4th Edition, McGraw Hill
4. Control system components by M. D. Desai , PHI
5. Control system Engineering – Nagrath/ Gopal (W.E)
6. Measurement and control handbook –Liptak
7. Control system components- Gibson & Tueter (Mc Graw Hill)
8. Control valve primer by – Bauman
9. Control – Valves Selection and Sizing by Les Driskell, ISA
10. Applied instrumentation by –Andrew
11. Process Control Instrumentation Technology by Curtis Johnson. 4th Edition, Prentice – Hall

IN311 Power Plant Instrumentation and Unit Operation
(3 Credits, L-3, T-0, P-0)

1. Introduction: Concepts of Unit Operation and Unit Processes, Material Balance and Energy Balance. Introduction to Thermal Power Plant, Significance of Instrumentation in Power Plant, Principle and Working of Hydroelectric, Nuclear, Gas Turbine Plant, only their layout and Salient Feature.
2. Evaporation: liquid Characteristics, Types of Evaporators, Principle and Operation of Single and multiple effect Evaporators.
3. Distillation: Equipment Setup, Flash Distillation, Batch Distillation, Continuous Distillation, Operational Features, Construction and Working Only.
4. Leaching and Extraction: Principle, Working of Equipments.
5. Gas Absorption: Principle and Working Operation of Packed Tower.
6. Humidification and Dehumidification: Equipment Setup, Principle of working.
7. Adsorption: Principle and Operation of equipment.
8. Drying: Classification of Dryers, Principle and Operation.
9. Size Reduction: Different Crushers and Grinders, Working Principle.
10. Crystallization: Principle and Operation and Equipment.

11. Mixing: Types of Mixers, Construction and Working.
12. Power Plant Instrumentation: Combined Operation of Different Power Plants, Load Division between plants.
13. Boiler Instrumentation and Control: measurements and Control Loops, Feedback Regulation Drum Level Control (Single Element Two Element, Three Element), Fuel Flow control, Furnace Draft and Excess Air Control, Combustion Control, Steam pressure Control, Boiler Safely Interlocks.
14. Turbine Monitoring and Control: Turbine-Supervisory System for monitoring of Mechanical Parameters-Speed, Vibration, eccentricity Axial shift, Shell Temperature Monitoring, Lube Oil Temperature Control, Turbine Trip Condition.
15. Alternator Instrumentation and Control: Generator Cooling System, Hydrogen charging and Discharging System.
16. Auxiliaries in Power Plants: Soot Blowers, Electrostatic Precipitator, Oil Automation System, Water Treatment Plant, Cooling Towers.
17. Instrumentation and Control of Condenser, Steam Heaters, Pumps and Compressors.

Reference Books:

1. McCabe W. L. Smith J. C., Peter Harriot "Unit Operation of Chemical Engineering", McGraw Hill Inc., 1993.
2. Leverspel O. "Chemical Reaction Engineering", Second Edition Willey Eastern Pvt Ltd.
3. Robert H. Perry and Don Green "Perry's Chemical Engineer's Handbook", Sixth Edition, International Student Edition.
4. B. G. Liptak "Instrumentation Engineers Handbook: Process Measurement", Chilton Book Company
5. B. G. Liptak "Instrumentation Engineers Handbook: Process Control" Chilton Book Company
6. National Power Training Institute Manuals.
7. M. W. Jervis, Power station Instrumentation, Buuterworth-Heinemann publication, 2000
8. British Electricity London, Modern Power Station Practice, Third Edition, Volume F, Control and Instrumentation, Pergamon Press, 1991.
9. Arora and Domkundwar "A Course in Power Plant Engineering", Dhanpat Rai and Sons, New Delhi.
10. Keswani H. B. "Power Plant Engineering", Standard Book House Delhi

IN312 Data Communication for Automation

(3 Credits, L-3, T-0, P-0)

1. Introduction to computer networks: uses of computer network, networking concepts, concepts of protocol, some simple examples. Layering concept in computer networks, need for standardization, OSI and TCP/IP reference models, terminologies and definitions, services and primitives. (6)

2. The physical layer: Theoretical basis for data communication, Guided Transmission media, Wireless transmission, Communication satellites, The public switched telephone networks, Mobile Telephone system. (4)
3. Data link layer, definition and scope, Design issues; services provided, framing techniques. Error control, flow control, link management examples of data link protocols, sliding window protocols, one bit sliding window protocol, A protocol using Go back selective repeat, protocol performance impact of sliding window, examples of data link layer. (6)
4. Medium access control sub layer: The channel allocation problem, multiple access protocols, Ethernet, Wireless LANS, Broadband Wireless. (4)
5. Network layer concepts, networks layer design issues- LAN and WAN services, frame formats and options, network design issues, routing algorithms, flow control, congestion control algorithms (6)
6. Transport layer concepts: The transport service, Elements of transport protocols, A simple Transport protocol, the Internet transport protocol: UDP and TCP, Performance issues. (6)
7. Application layer concepts: DNS- the domain name system, electronic mail, the World Wide Web, multimedia. (4)

Reference Books:

1. A. S. Tanennbaum, "Computer Networks", Fourth Edition, Prentice Hall of India, New Delhi, 2002.
2. W. Stallings, "Data and Computer communication, 6th Edition, Pearson Education, New Delhi, 2001.
3. Comer, "Computer Networks and Internets", Second Edition, Pearson Education, 2001.
4. Behrouz A. Forouzen, "Data Communication and Networking" Fourth Edition, McGraw Hill Publications, 2007.

IN313 Seminar

(1 Credit, L-0, T-0, P-2)

The seminar will consist of a report of about 25 typewritten pages based on

Survey of latest developments in a specific field of instrumentation and control systems.

OR

Investigation of practical problems in the manufacturing and or testing of an instrument.

OR

Design modification of an existing equipment/instrument.

AND

Seminar on one of the following topics should be delivered (without report)

- Entrepreneurship
- Personality development
- Value education

- Life profiles of eminent personalities like Lokmanya Tilak, Swami Vivekanand, Arvind Ghosh, A.P .J. Abdul Kalam
- Stories of successful Entrepreneurs,
- Stories of scientists/renowned persons

HU301 Humanities
(Audit Course L-2, T-0, P-0)

1. Importance of attitude: Building positive attitude, self esteem
2. Cultural heritage of India : Cultural tenets, values, peculiarities, family unit, old scriptures
3. Ancient science and technology: Astronomy, Physics, chemistry, Mathematics, Ayurveda, Kanad's atom theory, Aryabhatt, Viman Shastra Surgery etc.
4. Vedic mathematics
5. Life management techniques as preached by Saints, western philosophers etc.
6. Motivation: How does it work, stages from motivation to demotivation, motivational stories
7. Goal setting of life: Why goals are important?, Why don't more people set goals, Goals must be balanced,
8. Problems before the nation and role of an individual
9. Culture and different isms: Indian culture, communism, Socialism, capitalism
10. Role of media and expectations
11. Theory "i'' Management
12. Science and spirituality: stress management

Reference Books:

1. India vision 2020 by Dr APJ Abdul Kalam
2. Ancient science and technology By Dr. Gopalkrishnan
3. Theory of I management by Arindam Choudhary
4. India: what it can teach us by Maxmuller
5. Third way by Datopant Tengati
6. Swami Vivekananda(2004), Collected Works (Commentary on Yogasutras, vol.), Ramakrishna Mission, Kolkata
7. Gita-pravacane,
8. Upanishadaancaa Abhyaasa
9. Gitaaii Cintanikaa
10. A Constructive Survey of Upanishadic Philosophy
11. Bhagvadgita: Saakshaatkaaradarshana

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