UNIVERSITY OF MUMBAI
SCHEME OF INSTRUCTIONS AND EXAMINATION
at
B.E. (Instrumentation Engineering)
Revised Scheme Considering 60 Minute Periods Instead of 45 Minute Periods as per AICTE Guidelines

SEMESTER - VI

Sr. No.	Subjects	No. of Periods per Week			Duration of Theory Paper (Hrs)	Marks				
		Lectures	Practicals	Tutorials		Theory Paper	Term Work	Practical	Oral	Total
1	Process Instrumentation Systems	3	2	-	3	100	25	-	25	150
2	Linear Integrated Circuits and Applications	3	3	-	3	100	25	25	25	175
3	Advanced Microprocessors	4	3	-	3	100	25	-	*25	150
4	Control Systems Engineering	4	2	-	3	100	25	-	25	150
5	Computer Communication Networks	3	2	-	3	100	25	-	25	150
6	#Industrial Economics and Management	3	-	-	3	100	-	-	-	100
Total		**20**	**12**	**-**	**-**	**600**	**125**	**25**	**125**	**875**

∗ Oral examination of Advanced Microprocessors will be based on Elements of Microprocessors (Semester V) as well as Advanced Microprocessors (Semester VI).

Subject common with Electronics, Electrical, and Electronics & Telecommunication Engineering branches.

Process Instrumentation Systems

Lectures per week: 3
Practicals per week: 2
Paper: 100 marks, Duration: 3 hours
Term Work: 25 marks
Oral: 25 marks

1. **Development of Mathematical Model of a Process:** Need of mathematical modeling. Energy and mass balance equations for some of the processes viz. CSTR, STH, mixing process, fluid flow system, liquid level system, modeling difficulties, modeling considerations for control purposes.

2. **Process Dynamics:** Dynamic Elements in Control Loops. Dead time processes. Dynamic behaviours of first order, second order, and higher order systems. Interacting and non-interacting systems.

3. **Controller Principles:** Process characteristics. Control system parameters. Discontinuous, continuous, and composite modes of control action (P, PI, PD & PID).

4. **Analog and Digital Controllers:** General features. Electronic controllers, pneumatic controllers and hydraulic controllers. Design considerations.

5. **Process Loop Tuning:** Open loop transient response method. Ziegler-Nichols method. Frequency response method.

6. **Different Control Paradigms:** Introduction to feedback, feedforward and inferential controls. Multivariable control, cascade control, split range control, ratio control, selective control and their applications.

7. **Discrete-State Process Control:** Discrete state process control, characteristics of the system, discrete state variables, process specifications and event sequence description, ladder diagram – ladder diagram elements and examples, programmable controller – relay sequencers, programmable logic controller, architecture, operation and programming, types of PLC.

8. **Batch and Continuous Process Control:** Batch mode, batching nomenclature, batch formulation, system selection factors, batch versus continuous process control, computers in process control.

References:

1. George Stephenopoulos, *Chemical Process Control*, PHI, 1999.

2. Curtis Johnson, *Process Control Instrumentation Technology*, PHI/Pearson Education, 2002.

3. Kirk and Rimbol, *Instrumentation*, D.B. Taraporewala Sons and Co. Pvt. Ltd., 1996.

4. Peter Harriott, *Process Control*, Tata McGraw Hill, 1995.

5. Norman A. Anderson, *Instrumentation for Process Measurement and Control*, 3rd Edition, ISA, 1997.

6. M. Gopal, Control Systems – *Principles & Design*, 2nd Edition, TMH, 2002.

7. Douglas M. Considine, *Process/Industrial Instruments and Control Handbook*, 4th Edition, McGraw Hill International Edition, 1974.

8. Bela G. Liptak, *Process Control, Instrument Engineer's Handbook*, 3rd Edition, Chilton Book Company, 1970.

9. Gary Dunning, *Introduction to Programmable Logic Controllers*, Thomson Learning, 2nd Edition, 2001.

10. M. Chidambaram, *Computer Control of Processes*, Narosa, 2002.

11. B. Wayne Bequette, *Process Control*, PHI, 2003.

Experiments:

1. Mathematical modeling of CSTR and STH systems and their simulation using simulation software.
2. Application of P, PI, and PID for a typical process.
3. Application of ON-OFF control action.
4. Application of cascade control for a process.
5. Ratio control system.
6. To design and check the performance of an electronic PID controller.
7. To study pneumatic controllers.
8. To study a hydraulic controller.
9. Supervisory and direct digital control system.
10. Tuning of a PID controller.
11. Ladder programming for a simple process.

Term Work: Each candidate shall submit a journal in which he/she has recorded laboratory work of at least eight experiments performed in the laboratory, given to him/her by the concerned teacher (duly graded). Graded answer books for the test along with the graded journal shall be considered as term work and is allotted a maximum of 25 marks by the examiners.

Linear Integrated Circuits and Applications

Lectures per week: 3
Practicals per week: 3
Paper: 100 marks, Duration: 3 hours
Term Work: 25 marks
Oral: 25 marks
Practical: 25 marks

1. **Introduction:** Fabrication process for monolithic ICs, process of fabrication for BJTs, diodes, capacitors, resistors, and MOSFETs in brief.
2. **Analog ICs:** Ideal and practical op-amp, differential amplifier – ac and dc analysis, improving voltage gain using active load etc., current sources, unbalanced op-amp frequency response and stabilizing unbalanced operation, circuit diagram of IC741 and working in detail, ac and dc characteristics, specifications measurement of op-amp parameters.
3. **Linear Applications of Op-Amp:** Effect of source impedance, bias current, offset voltage, frequency response of all the applications as – voltage follower, inverting and non-inverting, adder, subtractor, instrumentation amplifier, V to I and I to V converter with floating load and grounded load, Howland current source, 3 mode integrator, differentiator and compensated differentiator, gyrator (simulation of inductance).
4. **Non-Linear Applications of Op-Amp:** Precision rectifier half wave, full wave, absolute value

circuits, clipping, clamping circuits, practical clamping circuits, sample and hold circuits (performance parameters), peak detectors, log amplifiers, temperature compensated log amplifier, antilog amplifier, multiplier, divider, comparator, threshold detector, zero crossing detector, window detector, Schmitt trigger, free running multivibrator, Wien-bridge oscillator, phase shift oscillator.

5. **Voltage and Power Regulator:** Functional block diagram of series and shunt regulator, break down protection, thermal shutdown, 78xx series, negative 79xx series, adjustable IC regulator 723 and its applications, pulse width modulator voltage regulator, TL494/SG1524.

6. **555 Timer:** Astable multivibrator, monostable multivibrator (one application of each).

7. **PLL IC and Applications:** Functional block diagram and applications of Phase Locked Loop ICs LM4046 and LM565.

8. **Active Filters:** Low pass, high pass, band pass, band reject, 1st and 2nd order filters (Butterworth and Chebyschev), state variable filters.

9. **Miscellaneous ICs:** Temperature Sensing ICs – LM34, LM35, LM335, AD590, Instrumentation Amplifer ICs – AD521 and AD522, Function Generator IC8038 and IC566.

References:

1. Coughlin and Driscoll, *Op-Amp and Linear ICs*, 6th Edition, PHI, 2002.
2. Sergio Franco, *Design with Op-Amp Analog ICs*, McGraw Hill, 1988.
3. Ramakant Gayakwad, *Op-Amp and Linear ICs*, PHI/Pearson Education, 4th Edition, 2002.
4. Roy Choudhary, *Linear Integrated Circuits*, Wiley Eastern, 1991.
5. Linear IC Data Book: National Semiconductor, 1989.
6. SCR Manual: General Electric.
7. Greame, Tobey and Huelsman, *Operational Amplifier*, 1981.
8. Burr-Brown General Catalog, Tucson, Ariz: Burr-Brown, 1979.
9. Datel-Intesil Data Acquisition Component Handbook, Mansfield, Mass: Datel-Intersil Inc., 1980.
10. D.E. Pippenger and E.J. Tobaben, *Linear and Interface Circuit Applications*, 2nd Edition, McGraw Hill Book Company, 1988.
11. Linear Application Data Book: National Semiconductor, 1986.
12. Voltage Regulator Handbook: National Semiconductor, 1980.
13. Op-Amp Data Book: National Semiconductor.

Experiments:

1. Measurement of op-amp parameters.

2. Linear applications of op-amps (any 4): V to I with floating load and with grounded load, I to V converter, frequency response of differentiator and integrator, comparator, adder and subtractor, instrumentation amplifer, gyrator.

3. Non-linear applications of op-amps (any 3): Precision rectifier, clipping, clamping, logarithmic amplifier, antilog amplifier, Schmitt trigger, free running multivibrator, Wien bridge oscillator.

4. Any two of the following...

    - 555 astable multivibrator
    - Low pass Butterworth filter
    - High pass Butterworth filter

5. Low and high voltage regulator using IC723.

6. Voltage regulator using PWM IC1524 or 494.

Term Work: Each student shall appear for at least one written test during the term. The journal should consist of at least 8 experiments properly recorded and graded. Term work will carry 25 marks. Distribution of marks: 15 marks for the journal and 10 marks for the test.