V Term

S.No	Code No	Course Name	Hours/ Week	Credit	Scheme of Examination Allocation of Marks			Duration of Exam (Hrs)
					Internal	External	Total	
1	C301	Control Engineering	5	5	25	75	100	3
2	C302	Process Control Instrumentation	6	6	25	75	100	3
3	C401	Diversified Course - I	6	6	25	75	100	3
4	C303	Process Control Lab	6	3	25	75	100	3
5	C402	Diversified Course lab - I	6	3	25	75	100	3
6	C304	Simulation Lab	6	3	25	75	100	3
		Total	35	26	150	450	600	18

C401 - Diversified Course - I
A - Industrial Electronics

C402 - Diversified Course Lab - I
A - Industrial Electronics Lab

C301 CONTROL ENGINEERING

V Term (Applied)

5 Hours / Week Total Hours : 60

Unit I Basic principles of control engineering
Unit II System representation and control system components
Unit III Time response
Unit IV Frequency response
Unit V Stability

Unit I - BASIC PRINCIPLES OF CONTROL ENGINEERING (12 Hrs)

Basic definition of control system - Classification of control systems - SISO - MIMO - Static and dynamic control systems - Linear and non - Linear systems - Continuous and discrete systems- Open and closed loop systems.Laplace transform - Poles and zeros - Properties of laplace transform - Laplace transform of periodic functions – Inverse laplace transform - Partial fraction method , Heaviside's Partial fraction method - Method of residues - Laplace transform applications to solutions of differential equations.

Unit II - SYSTEM REPRESENTATION AND CONTROL SYSTEM COMPONENTS (12 Hrs)

Control system components - Electronic amplifiers Magnetic amplifiers - Phase-sensitive amplifiers -potentiometers - Synchros - Servo motor (ac & dc types) -Gyroscopes – Gear trains –Comparators- Stepper motors.

Transfer functions - Transfer function of linear systems -Simple RC , RLC network – Block diagram reduction techniques -Simple problems – signal flow graph – Mason's gain formula –Problems.

Unit III - TIME RESPONSE (12 Hrs)

Time domain specifications – Standard test signals (step , Ramp, sinusoidal) – I order, II order system response derivation - Problems – Transient performance of feed back control system - steady state error constants – Generalized error series problems.

Unit IV - FREQUENCY RESPONSE (12 Hrs)

Frequency response of linear system -Frequency response of I order, II order system – Bode plot – Bode stability criterion – Gain margin, phase margin – problems – Polar plot – correlation between time response and frequency response – problems.

Unit V - STABILITY (12 Hrs)

Definitions of stability - Absolute stability - Relative stability Methods of determining the stability of linear control systems - Charecterstic equation – Routh's stability criterion – Problems. Root locus – location of roots in the S-plane for stability – Locus techniques – properties of root locus – construction of root Locus – problems.

Reference

1. S.N.Verma, "Automatic Control Systems".
2. Benjamin S.RAO, "Automatic Control Systems", PHI 7th Edn.
3. Nagrath & Gopal, "Control System Engineering".
4. Palani, "Control systems".
5. Nagoor Kani, "Control systems".

C302 PROCESS CONTROL INSTRUMENTATION

V Term(Applied)

6 Hours / Week Total Hours : 72

Major Divisions:

Unit I Process control terminology and types of control system
Unit II Modes of control action, controllers
Unit III Tuning of controllers
Unit IV Final control element
Unit V Process control systems

Unit I - PROCESS CONTROL TERMINOLOGYAND TYPES OF CONTROL SYSTEM (14Hrs)

Review of transducer for measurement of process variables- Functional block diagram of a control system and their elements - Definition of actuating signal – Block diagram – Set point – Measured Variable – Manipulated variable – controlled variable – capacitance and capacity – Dead zone – Dead time – Disturbance – Deviation – Neutral zone – Offset – Rise time – Setteling time. Simple liquid level control system – flow control system - Temperature control system with transportation bag – Self regulation.

Unit II - MODES OF CONTROL ACTION, CONTROLLERS (15Hrs)

On-off action – Single two position, multi two position – On-off action with differential gap, without differential gap – application of two position control – proportional control action (P) its equation – proportional based and its graphical representation – Offset – Determination of magnitude and nature of offset – Control point, Artificial set point. Reset control action (I) repeat per minute Reset time – Response to reset action – Rate control action (D) – Rate amplitude - Rate time. Proportional + Integral action (PI), proportional+Derivative Action(PD), proportional+Integral+Derivative action (PID). Response of P,PI,PD,PID con- trol action for typical inputs (step, ramp, sinusoidal) pneumatic controller and its components
– On,off proportional (P), PI, PD, PID controllers, Electronic controllers and its componentd
– On,off P, PI, PD, PID controllers, comparison of Elctronic and pneumatic controllers.

Unit III - TUNING OF CONTROLLERS (14Hrs)

Concept of tuning – Criteria for controller tuning (Quarter decay ratio, IAE, ISE, ITAE) – Methods tuning - open loop response method – process reaction curve – closed loop response

method – ultimate cycle method, damped oscillation method , frequency response method – Bode stability criterion – Gain margin and phase margin – Margin of safety – Frequency response of P,PI,PD,PID.

Unit IV - FINAL CONTROL ELEMENT (15Hrs)

Introduction, Block diagram – Signal converters – P to I Converter – I to P converter – Actuators – Pneumatic, electric, Hydraulic and electro, pneumatic actuator. Control elements – Mechanical, electrical control valves - Control valve types – characteristics – Inherent and effective Characteristics – global valve – Single ported and double ported – Split range – Control valve – control valve sizing, Cv rating of a Control valve – Selection of control valves - Flashing cavitation of Control valve – Valve positioners

Unit V - PROCESS CONTROL SYSTEMS (14Hrs)

Feed forward control system – Feed back control System – cascade control system – Ratio control system – their Merits and demerits, programmable logic controller (PLC) –Block diagram – Ladder diagram –Programming in PLCs. Distributed control system (DCS) – Functional elements of DCS – Advantages Fuzzy logic control systems – Functional diagram – Basic features of fuzzy logic controller – Fuzzification of interface – Defuzzification –interface – applications. Introduction to neural network, Artificial Intelligence (concept only).

Reference:

1. Donald P.Eckman, “Process Control”.
2. Donald P.Eckmen, “Principles of Industrial Process Control”.
3. K.B.Jones, “Instrument Technology”, Vol 3.
4. Thomas J.Rhodes Revised by Carool, “Industrial Instrumentation for Measurements and Control”.
5. Peter Harnoll, “Process control”.
6. S.I.Abson, “Microprocessor with Applications in Process Control”.
7. Luptak, “Handbook of process control instrumentation”, V vol I & Vol II.
8. Considine, “Handbook of Process Control Instrumentation”.
9. Boltan, “Mechatronics”.

C401 A - INDUSTRIAL ELECTRONICS

V Term (Diversified)

6 Hours / Week Total Hours : 72

Major Divisions

Unit I Basics of thyristors and applications
Unit II Converters and inverters
Unit III Robotics and ultrasonics
Unit IV Programmable logic controller (PLC)
Unit V Numerical control of machines

Unit I - Basics of thyristors and applications: (15Hrs)

Characteristics of SCR:

Turn on (characteristics and measurements) - Turn off (characteristics and measurements) – Voltage and current ratings – Triggering circuits for SCRs – thyristor types – series and parallel operations of SCR.

Protection of SCRs:

di /dt protection – dv /dt protection – gate circuit protection – over voltage and over current protection – over current protections – contactors for protection – protection by limiting junction temperatures.

Application of SCRs:

Integral cycle triggering – over voltage protection – static circuit breaker - regulated supply DC and AC – emergency light using SCR – automatic battery charger circuit.

Unit II – CONVERTERS AND INVERTERS (Qualitative treatment only) (15Hrs)

Converters:

Single phase semi converters R,RL and fly wheel diode – single phase converters with R,RL, and fly wheel diode – output characteristics of bridge circuits – effect of source induc- tance – discontinuous current operation – effect of overlap angles – line commutation - Self commutations

Forced commutations (mention of types only) - Polyphase converters with resistive load only - phase semi converters - 3 phase full converter Dual converter.

Inverters:

Single phase inverters using thyristors with R, RL, loads – output voltage control in inverter – method of obtaining sine wave output from an inverter - typical inverter circuit – three phase inverter circuit – inverter characteristics – through pass inverter – applications of inverter – DC transmission – block schematic – advantages.

Unit III – ROBOTICS AND ULTRASONICS (14Hrs)

Robotics:

Classification – parts robots – uses of robots, mechanism of robots – position and orientation joints and links – degree of freedom – forward kinetics – Jacobean – dynamics – trajec- tory – position control – force control –servo mechanism – synchronous – control transformer – receiver servo motor – drive mechanisms – hydraulic and pneumatic drives – DC electric motor drives – stepper motor – unipolar operation – 2phase scheme – half stepping scheme – stepper motor drive circuit -open loop and closed loop control of stepper motors – comparison between Dc motors and stepper motors – electronic timers – Dc timer – AC timer, 555 IC timer – 555 IC sequence timer.

Ultrasonics:

Piezo electric ultrasonic oscillator – applications –SONAR – flaw detectors – drilling – soldering – cleaning – medical applications – saw filter – applications.

Unit IV – Programmable logic controller (PLC): (14Hrs)

Evolutions of PLCs – hardwired control system definition – programmable logic control system: advantages of PLCs. Block diagram of PLC system – symbols used – relays and logic functions – OR, AND, Comparator, Counters review. Introduction to local area – principles – transmission media - topologies – network transactions – protocols – principles only.]

Programming of PLCs – different methods – ladder STL and CSF, ladder programming of simple system like traffic light controller – conveyers – list of various PLCs available.

Unit V – Numerical control of machines:

Basic concept of numerical control - driving devices – hydraulic systems – data processing unit – data reading – tape recorder – photo electric type – typical reading unit – tape formats – programming – part programming – general information – post processor elements – APT –

syntax –(no programming exercises) – other programming systems –ADAPT / EXAPT, AUTOSPOT – characteristics of N /C system – CNC / DNC – CNC typical system block diagram – adaptive control systems – ACC – ACO.

Reference:

1. P.C.Sen, “Power Electronics”, TMH 2nd Edn.
2. G.K.Mithal, “Industrial Electronics”, Khanna Publishers, 17th Edn.
3. P.A.Janakiraman, “Robotics and Iimage Processing”, TMH.
4. M.Ramamoorthy, “Thyristors and their applications”, 2nd Edn.
5. Rashid, “Power Electronics – CIRCUITS, DEVICES AND APPLICATIONS”.
6. S.K.Bhattacharya and S.Chatterjee, “Industrial Electronics and Control”, SCR Manual, 6TH Edn GE.
7. George L.Battin, “Programmable controllers hardware software applications”.
8. Grower & Others MGH, “Industrial Robotics”.

C303 PROCESS CONTROL LAB

V Term (Applied)

6 Hours / Week Total Hours : 72

List of Experiments:

1. Transients and steady state response of a thermocouple.
2. Response of thermocouple with and without wheel.
3. Damping time of electrical instrument.
4. Immersion effect of thermometer.
5. Effect of Dead time.
6. Effect of capacity.
7. Dynamic response of first order instrument to a
    a. Step input
    b. Ramp input
8. On– off control of temperature process
9. On – off control of pressure process.
10. On – off control of level process.
11 Response of thermometer with different medium.
12. Calibration of differential pressure transmitter.
13. Calibration of temperature transmitter.
14. Calibration of electro pneumatic transmitter.
15 Control valve characteristics.
16 Differential output of a thermocouple.
17 Study of proportional band (Determine magnitude, offset, Nature of offset, control point, artificial Set point).
18. Controller tuning experiments.
19. PID controller response (step / ramp)
20. Experiments using PLCs.

C402 A - IDUSTRIAL ELECTRONICS LAB

V Term (Diversified)

6 Hours / Week Total Hours : 72

List of Experiments:

11. Construct A.C timer circuit using transistor to operate a switching circuit after a time delay (time can be specified depending on the components available). Test its perfor- mance with a standard stopwatch.
12. Construct a D.C timer circuit using transistor to operate a switching circuit after a time delay. Test its performance with a standard stopwatch.
13. Construct sequence timer using 555 – timer chip.
14. Construct and test the performance of the photo relay using LDR.
15. Construct a bias controlled half wave rectifier using SCR. Plot the firing angle output current graph for resistive load.
16. Construct and test the performance of a bias controlled full wave rectifier using SCR for resistive load. Plot the output waveform for different firing angles.
17. Construct and test the performance of SCR triggering circuit using UJT.
18. Construct and test the performance of a battery charger circuit using SCR.
19. Construct and test the performance of SCR speed control circuit for universal motor.
20. Speed control of stepper motor using micro controller.
21. Construct and test SCR regulated DC power supply.
22. PSPICE simulation of SCR circuit.
23. Construct and test TL emergency light.
24. Construct and test lamp dimmer using TRIAC.
25. Simulation of traffic light controller using OLC.
26. Construct and test temperature controller using UJT and TRIAC (using a thermistor).
27. Study of servo stabilizer.
28. Study of UPS.

C304 SIMULATION LAB

V Term (Applied)

6 Hours / Week Total Hours : 72

List of Experiments :

1. Generation of signals
2. Function generator.
3. Pulse and transition measurement.
4. Add waveform.
5. Heat equation.
6. Impulse generator.
7. Linear algebra calculator.
8. Signal generation and processing.
9. Temperature system.
10. Vibration analysis.
11. Tank simulation.
12. Movement of robot arm.