STUDY & EVALUATION SCHEME

THREE YEAR DIPLOMA COURSE IN
INSTRUMENTATION AND CONTROL ENGINEERING

(2014 Scheme)

SEMESTER - V

Code No.	Subject	Study Scheme Period/Week			Evaluation Scheme						Total Marks
		L	T	P	Internal Assessment		External Assessment Exam				
					Theory	Practical	Written Paper		Practical		
					Max Marks	Max. Marks	Max. Marks	Hrs.	Max. Marks	Hrs.	
1	Industrial Automation	4	-	3	50	50	100	3	100	3	300
2	Industrial Electronics	4	-	3	50	50	100	3	100	3	300
3	Process Control and Instrumentation	4	-	3	50	50	100	3	100	3	300
4	*Electronics Devices and Circuits-3	4	-	3	50	50	100	3	100	3	300
5	Principle of Automatic Control	4	-	3	50	50	100	3	100	3	300
6	# Environmental Studies	4	-	-	50	-	100	3	-	-	150
**	Student Centered activities	-	-	1							
	TOTAL	24	-	16							1650

** Student centered activities will include: extension lectures, field visits, Soft Skills, seminars, debates, hobby clubs, library studies, awareness regarding ecology and environment, conservation of energy (Petroleum products, electricity etc), social service camps and other co-curricular activities including games. Advanced planning for each semester has got to be made

*Common with Digital/Medical Electronics
Common with Mechanical Engg. & Civil Engg.

INDUSTRIAL AUTOMATION

L	T	P
4	-	3

Rationale:

The students are required to know about the automation in the industry which is an important factor of a plant. This subject enables students to understand the automation process control concepts.

DETAILED CONTENTS

1. Introduction to Automation :- (8 Hrs.)
   Need for automation, various automation strategies, concept of flexible manufacturing systems (FMS), Components of FMS and its various layouts. Brief idea of Numerical Control (NC & CNC).Introduction of CAD and interfacing technique (Synchronous, Asynchronous, RS 232, RS 485 and line driver).

2. Programmable Logic Controllers (PLC) **:-** (8 Hrs.)
   Development of ladder diagram and flow chart for simple processes, examples of simple programming in PLC's using ladder logic, interfacing PLCs to PC, operation of PLCs, Comparison of PLCs and PCs (Personal Computer).

3. Introduction to Robotics Technology**:-** (8 Hrs.)
   Robot anatomy, classification of robots, various control loops, sensors used in robotics, Introduction to intelligent robots and vision system, robot programming methods. Simple exercise of OFF line programming in any high level language.

4. Introduction to Electrical Drives **:-** (10 Hrs.)
   Concept of electrical drives, general classification of electrical drives, brief review of characteristic of dc shunt, series, and 3-phase induction motors. Starting of electrical motors; effect of starting on power supply, motor itself and load, methods of starting electrical moors, methods to reduce energy loss during starting. Breaking of Electrical Motors; types of braking, braking of d.c. shunt, series motors, regenerative braking of 3-phase induction motors. Speed Control; closed loop speed control of d.c. motor drives.

5. Industrial Applications of electrical Drives in steel mills and cement kiln**.** (5Hrs.)
   One typical application of electrical drives in each of the following industries is to be studied.
   (i) Steel Mills, (ii) Paper Mills, (iii) Cement, (iv) Petro-Chemical, (v) Machine tool.

LIST OF PRACTICALS

1. Speed Control of DC Motor
   a) Armature Voltage control
   b) Field Weakening
2. Speed Control of 3-phase induction motor
   a) Frequency Control
   b) Rotor resistance Control

3. Speed Control of D.C. motor using Chopper Circuit.
4. Speed Control of D.C. motor using Single phase controlled interface.
5. Braking of D.C. motors.
6. D.C. dynamic braking of 3-phase induction motor.
7. Plug braking of 3-phase IM (Induction motor)
8. Exercise on CAD (Auto CAD)
9. Experiment on PLC.
10. Study of Robots.

REFERENCE BOOKS:

1. Automation Production System and Computer - Integrated Manufacturing by M.P Groover (PHI)
2. Robotics Technology and Flexible Automation By : S.R. Deb (PHI)
3. Process Control Instrumentation in Technology By: Curtis Johnson (PHI)
4. A First Course on Electrical Drives SK Pillai
5. Electrical Drives by U.K. Dubey (PHI)
6. Electric Drives by M. Chilkin (Mir Publisher)

INDUSTRIAL ELECTRONICS

L	T	P
4	-	3

Rationale

Electronics adapted to industrial plant, in terms of timing action switching action or parameter control, is called Industrial Electronics. Other common areas of application where electronics is increasing its interface with other branches of engineering include temperature control, welding control, speed regulation of motor and soldering. The student should study this subject with a view to understand the use of electronics to bring about faster and more accurate response in industrial plants.

Detailed Contents

1. Name symbol, characteristic and working principles of SCR Triac, Diac, SCS, SBS and LASCAR. Mention of their applications.
2. Thyristor rating and gate ratings. Turn on methods - DC gate, AC Gate and Pulse Gate Triggering and R-C trigger circuits. Turn off methods - Natural and Forced turn off methods.
3. Internal power dissipation and need for heat Sinks in thyristors. Definition of following terms and their relationship with the power dissipation of the device (no derivation)
   a) Heat Sink efficiency
   b) Heat sink transfer co -efficient
   c) Heat dissipating area of a Heat Sink. Connect of Thermal resistance of Heat sinks. Various types of Heat sinks and techniques of mounting devices on heat sinks.
4. Basic structure, principle of operating and V-I characteristic of UJT. Explanation of working of UJT as relaxation oscillator and its use in thyristor triggering.
5. Principle of operation and working of the following switching circuits, using SCRs and Triacs
   a) Automation Battery Charger
   b) Voltage regulator
   c) Emergency light
   d) Alarm circuit
   e) Time delay relay circuit
   f) Circuit for over voltage and over current
6. a) Explanation of the working of a 3 phase half wave and full wave bridge rectifier with the help ofwave forms and appropriate mathematical derivations
   b) Explanation of working of following controlled rectifier using SCRS and resistive and inductive loads with the help of wave forms and appropriate mathematical expression (no derivation)
      - Single phase; half wave full wave and bridge rectifier
      - Three phase; Half wave, full wave and bridge rectifier

7. Principle of working of AC phase control circuit using triac

8. Application of phase controlled rectifications and AC phase control circuits in:
   a) Illuminating Control
   b) Fan speed control
   c) Temperature Control
   d) Speed control of DC and small AC motors

9. Principles of operation of basic inverter circuits. Basic series and parallel commutated inverters.

10. Principles of induction and dielectric heating and their typical applications.

11. Introduction Basic Measurement System function of its elements namely the transducer, signal conditioner, display or readout and power supply.

12. Digital system architecture
    - Factory communication - LAN/WAN/INTERNET
    - Network to Network Interconnection.

13. Signal Conditions

    Characteristic of instrumentation amplifiers in respect of input impedance, output impedance, drift, DC offset. noise gain, common mode rejection ratio, frequency response etc. Relating the suitability of these characteristic amplifying signals from various transducers. Difference between instrumentation Amplifier and OP-AMPS.Need and working of a typical isolation amplifier.

14. Operational Amplifier

15. Linear Integrated Circuit

LIST OF PRACTICALS

1. To identify various Thyristors family such as SCR, DIAC, TRIAC.
2. To study V-I characteristics of SCR.
3. To study V-I characteristics of TRIAC.
4. To study V-I characteristics of UJT.
5. To study UJT as a relaxation oscillator circuit.
6. To study light dimmer circuit with SCR and TRIAC.
7. To study SCR based single phase half wave controller rectifier circuit using UJT relaxation oscillator.
8. To study SCR based single phase half wave full wave controller rectifier circuit using resistive circuit.
9. To study single phase half wave full wave controlled rectifier circuit using gate triggering circuit.
10. To study SCR based single phase controlled bridge rectifier.
11. To study SCR based fan control.
12. To study SCR based single phase full wave controlled rectifier circuit.
13. To study 6V emergency light using SCR.

PROCESS CONTROL & INSTRUMENTATION

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Rationale:

Process control and instrumentation deals with temperature, pressure flow and level system. It also covers on-ff, proportional modes. It helps students to develop skills in the multi-loop control, alignment and timing which is commonly used in the Boil Plant control in an Industry.

DETAILED CONTENTS

1. Basic Control loops of

(a) Single capacity flow loop system.

(b) Single capacity temp loop system.

(c) Single capacity level loop system.

(d) Single capacity pressure loop system.

Dead - Time process lag-First order approx. of process system and transfer function of simple process. Control valve definition, valve terminology, types (solenoid, diaphragm, butterfly, ball, needle, sliding gate, etc.) Characteristic, Selection of valves based on process dynamic, actuator and positioners, booster, plug types, other types, other final control elements, specification of a control valve. Calibration procedure of control valve, current to pneumatic converter, Delta Cell

Transmitter and Converters : Pneumatic to electrical, electrical to pneumatic, Buoyancy Transmitters, Signal conditioning (V to I, I to V), 2-Wire and 4-Wire Transmitter SMART Transmitters (introduction and their application), Standard Signals used in instrumentation (such as 4 to 20mA, 3 to 15 psi etc.) Interlocking (Boiler, Compressor, etc.), Intrinsic Safety, Symbols in process control, Piping and instrument diagram, Annunciators (Types, sequence of operation) **(12 Hrs.)**

2. Controllers - Types of control actions (On-Off, single speed floating, Proportional, Integral, derivatives, PI, PD, P I D) their selection and application. Electronic and pneumatic controllers (Principle of working, Equations circuitry used) specifications of a controller. Programmable logic controller, Tuning of controller, Process reaction curve, Zieler - Nichol's Method with simple calculation problem. **(10 Hrs.)**

3. Multi - Loop System : Definition and application of feedback, Feedforward, cascade, ratio control

4. Computer Control System (Process line diagram, function of different elements.)

5. Case study of Process Instrumentation for Distillation Column. **(5 Hrs.)**

LIST OF PRACTICALS

Students are expected to perform minimum eight experiment based on the above topics on a Process Trainer

1. Study of flow, temperature, pressure and level feedback control system with standard signals in the loop.

2. Study of ON/OFF controller for level control/flow control.
3. Study of proportional or throttling controller for very low proportional band values and the response of the system at load change.
4. Study of PI controller for temperature/level/flow control and observe the effect of reducing integral time on the response of the process.
5. Study of PD controller for temperature/level/flow control by increasing the derivative time gradually.
6. Study of PID controller for temperature/level/flow control.
7. Study of tuning of controller (open loop method) for level/flow control system. Plot the graph of process value vs time from process reaction curve.
8. Study of flow characteristics of control valve and its calibration.
9. Study of cascade control system.

Reference Books:

1. Process Control Instrumentation Technology**.** By Curtis Johnson (PHI)
2. Process / Industrial Instrumentation Control Hand Book, By CONSIDINE
3. Instrument Engineering Handbook, By :Bela. G. Liptak
4. Applied Instrumentation in Process Industrial. By Andrews.
5. Process Control System By F.G. Shinskey
6. Chemical process control by Geogre Stephanopoulos (PHI)

ELECTRONIC DEVICES & CIRCUITS – III

L	T	P
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Electronic devices and circuits –III deals with the concept of wave shaping circuits, timer, multi-vibrator, thyristor and VCO, students can also learn the same using simulation software such as orcad, electronic work bench. These will enhance the knowledge and the skill to implement the applications in the industry.

DETAILED CONTENTS

1. **Wave shaping Circuits (15%)**
   General idea about different wave shapes. Review of transient phenomena in R-C and R-L Circuits. R-C and R-L differentiating and integrating Circuits.The applications (physical explanation for square/ rectangular input wave shapes only). Diode clippers, series and shunt biased type. Double clipper circuits.Zener diode clipper circuits.Use of transistors for clipping. Diode clamping circuit for clamping to negative peak, positive or any other level for different input waveforms (e.g. sine, square, triangular), ideal transistor switch, explanation using C.E. output characteristics.

2. **Timer I.C. (10%)**
   Block diagram of I.C. timer (such as 555) and its working. Use of 555 timer as mono-stable and astablemultivibrators.

3. **Multivibrator Circuits (15%)**
   Concept of multivibrator :astable, monostable, bistable. 555 timer as mono and astablemultivibrator. Op-amp as monostable, astablemultivibrator and schmitt trigger circuit.

4. **Time Base Circuits (15%)**
   Need of time base (sweep) wave forms, special features of time base signals. Simple method of generation of saw tooth wave using charging and discharging of a capacitor. Constant current generation of linear sweep voltage circuit using op-amp.

5. **Integrated Electronics (5%)**
   Fabrication of transistor by planner process, a typical fabrication process for ICS (brief explanation).

6. **Regulated Power Supply (15%)**
   Concept of regulation.Principles of series and shunt regulators.Three terminal voltage regulator ICs (positive, negative and variable applications). Block diagram of a regulated power supply. Concepts of cv,cc and foldback limiting, short circuit and overload protection. Major specifications of a regulated power supply and their significance (line and load regulation, output ripple and transients). Basic working principles of a switched mode power supply (SMPS). Concept of floating and

grounded power supplies and their interconnections to obtain multiple output supplies. Brief idea of CVT,UPS and dual tracking power supply.

7. **VCO (IC565) and PLL(IC566) and their applications (10%)**

8. **Thysistors and UJT (15%)**
Name,symbol,characteristics and working principles of SCR, Triac, diac, SCS, SUS,SBS and LASCR. Mention of their applications. Basic structure, principle of operation and VI characteristics of UJT.Explanation of working of UJT as relaxation oscillator and its use in thyristor.

LIST OF PRACTICALS

1. Observe and Plot the output Waveshapes of R-C differentiating circuits
2. Observe and Plot the output Waveshapes R-C integrating circuits for squarewave input (observe the effect of the R-C time constant of the circuit on the output waveshape for both the circuits)
3. Construct biased and unbiased series and shunt clipping circuits for positive and negative peak clipping of a sine wave using switching diodes and d.c. sources.
4. Construct a double clipper circuit using diodes and sources and observe wave shapes.
5. Construct zener diode and transistor clipper circuits for positive peak, negative peak and double clipping of sine (other wave shapes).
6. To clamp sine and square wave to their positive and negative peaks and to a specified level.
7. To plot input vs. output characteristics of schmitt trigger circuit and plot the input output waveshapes with aine wave input.
8. To test mono and astablemultivibrator and to plot waveform.
9. To make and test the operations of monostable and astablemultivibrator circuits using 555 timer.
10. To determine and plot firing characteristics of SCR by varying anode to cathode voltage and varying gate current.
11. To note the waveshapes and voltages at various points of a UJT relaxation oscillator circuit.
12. To plot the firing characteristics of a triac in different modes, namely, mode I+, mode I-, mode III+ and mode III

Note : Use of simulation software such as OrCADPSpice MULTISIM, ELECTRONIC WORK BENCH etc. for performing some of the above on the computer also, which will enhance the understanding of the students beyond traditional laboratory experiments.

PRINCIPLE OF AUTOMATIC CONTROL

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RATIONALE

The students are required to know about the process system which is an important factor of a plant.It is a prerequisite for understanding the total plant controls, In this subject introduction to theory in control system has been given which will enable the student to understand the process control concepts to be covered in the subsequent semesters. Faculty is advice to teach the subject by citing the practical examples.

Detailed contents

1. **Introduction to automatic control :**
   Basic elements of control system. Definition of terminology used in control system. Definition terminology used in control system. Open loop and closed. loop system concept of feedback. Functional block diagram of a control system. Time lag, dead time, Hysterisis, linearity. Self regulating and non self regulating system. Practical examples of the above

2. **Block diagram and transfer Function**
   Review of Laplace transform. Transfer function of simple control components like mass-spring damper, thermometer, single and multi-capacity processes Single feedback configuration.

3. **Time Response of System :**
   Order of systems Test inputs, step response of Ist and IInd Order system - overshoot and under shoot, rise time damping ratio. Simple example of 1 order and II order system. Steady state response and error.

4. **Introduction to stability Analysis**
   characteristic equation, "Rouths" table, Nyquist criteria**,** relative stability, phase margin and gain margin.

5. **Routh - Hurwitz criterque**
   Root locus technique
   Bode Plot Polar Plot. Gain margin and Phase margin

LIST OF PRACTICAL (PRINCIPLE OF AUTOMATIC CONTROL)

1. Study of closed loop control system for pressure control.
2. Study of closed loop control system for flow control in a pipe line.
3. Study of open loop control system for level control.
4. Study of closed loop control system for temperature control of water.
5. Study of pressure gauge used in closed loop control system with its calibration procedure.
6. Study of current to pressure converter used in the control loop system with its calibration procedure.

7. Study of Pneumatic control valve and positioner used in the closed loop control system with its calibration procedure.
8. Study of differential pressure transmitter used in control loop system with its calibration procedure.
9. Study of response of flapper nozzle system and its application in Pneumatic controller.

REFERENCE BOOKS:

1. Auto. Control system by KuO.
2. Modern control engineering by Ogata.

3.6 ENVIRONMENTAL STUDIES

L	T	P
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Unit 1: The Multidisciplinary nature of environmental studies (5%)

Definition, scope and importance, Need for public awareness.

Unit 2: Natural Resources (15%)

Renewable and non renewable resources:

a) Natural resources and associated problems
   - Forest resources: Use and over-exploitation, deforestation, case studies, Timber extraction, mining, dams and their effects on forests and tribal people.
   - Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dam's benefits and problems.
   - Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
   - Food Resources: World food problems, changes caused by agriculture and over grazing, effects of modern agriculture, fertilizers- pesticides problems, water logging, salinity, case studies.
   - Energy Resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources, casestudies
   - Land Resources: Land as a resource, land degradation, man induces land slides, soil erosion, and desertification.

b) Role of individual in conservation of natural resources.

c) Equitable use of resources for sustainable life styles.

Unit 3: Eco Systems (15%)

- Concept of an eco system
- Structure and function of an eco system.
- Producers, consumers, decomposers.
- Energy flow in the eco systems.
- Ecological succession.
- Food chains, food webs and ecological pyramids.
- Introduction, types, characteristic features, structure and function of the following eco systems:
- Forest ecosystem
- Grass land ecosystem
- Desert ecosystem.
- Aquatic eco systems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit 4: Biodiversity and it's Conservation (15%)

- Introduction-Definition: genetics, species and ecosystem diversity.
- Biogeographically classification of India.

- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values
- Biodiversity at global, national and local level.
- India as a mega diversity nation.
- Hot-spots of biodiversity.
- Threats to biodiversity: habitats loss, poaching of wild life, man wildlife conflicts.
- Endangered and endemic spaces of India.
- Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

Unit 5: Environmental Pollution (15%)

Definition Causes, effects and control measures of:

a) Air pollution
b) Water pollution
c) Soil pollution
d) Marine pollution
e) Noise pollution
f) Thermal pollution
g) Nuclear hazards

Solid waste Management: Causes, effects and control measures of urban and industrial wastes

Role of an individual in prevention of pollution Pollution case studies Disaster management: Floods, earth quake, cyclone and land slides

Unit 6: Social issues and the Environment (15%)

- Form unsustainable to sustainable development
- Urban problems related to energy
- Water conservation, rain water harvesting, water shed management
- Resettlement and rehabilitation of people; its problems and concerns, case studies
- Environmental ethics: issues and possible solutions
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies.
- Wasteland reclamation
- Consumerism and waste products
- Environment protection Act
- Air (prevention and control of pollution) Act
- Water (prevention and control of pollution) Act
- Wildlife protection act
- Forest conservation act
- Issues involved in enforcement of environmental legislations
- Public awareness

Unit 7: Human population and the environment (10%)

- Population growth and variation among nations
- Population explosion- family welfare program
- Environment and human health
- Human rights
- Value education
- HIV / AIDS
- Women and child welfare
- Role of information technology in environment and human health
- Case studies

Unit 8: Field work (10%)

Visit to a local area to document environment assets river / forest / grassland / hill/ mountain. Visit to a local polluted site-urban/rural/industrial/agricultural. Study of common plants, insects, birds. Study of simple ecosystems-pond, river, hill slopes, etc (field work equal to 5 lecture works)