Course Name : Electronics Engineering Group

Course Code : ET/EN/EX/EJ/DE/ED/EI

Semester : Fifth

Subject Title : Control System & PLC

Subject Code : 17536

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	02	03	100	50#	--	25@	175

NOTE:

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).**

Rationale:

Control is the process of causing a system variable to take some desired value, known as reference value. A control system consists of several elements or components connected and operated in such a way as to achieve a desired control in a specific domain of operation of the system. This can be as simple as making the temperature in a room stay at 21°C or as complex as manufacturing an integrated circuit or guiding a spacecraft to Jupiter. In general, all the elements necessary to accomplish the control objective are described by the term control system.

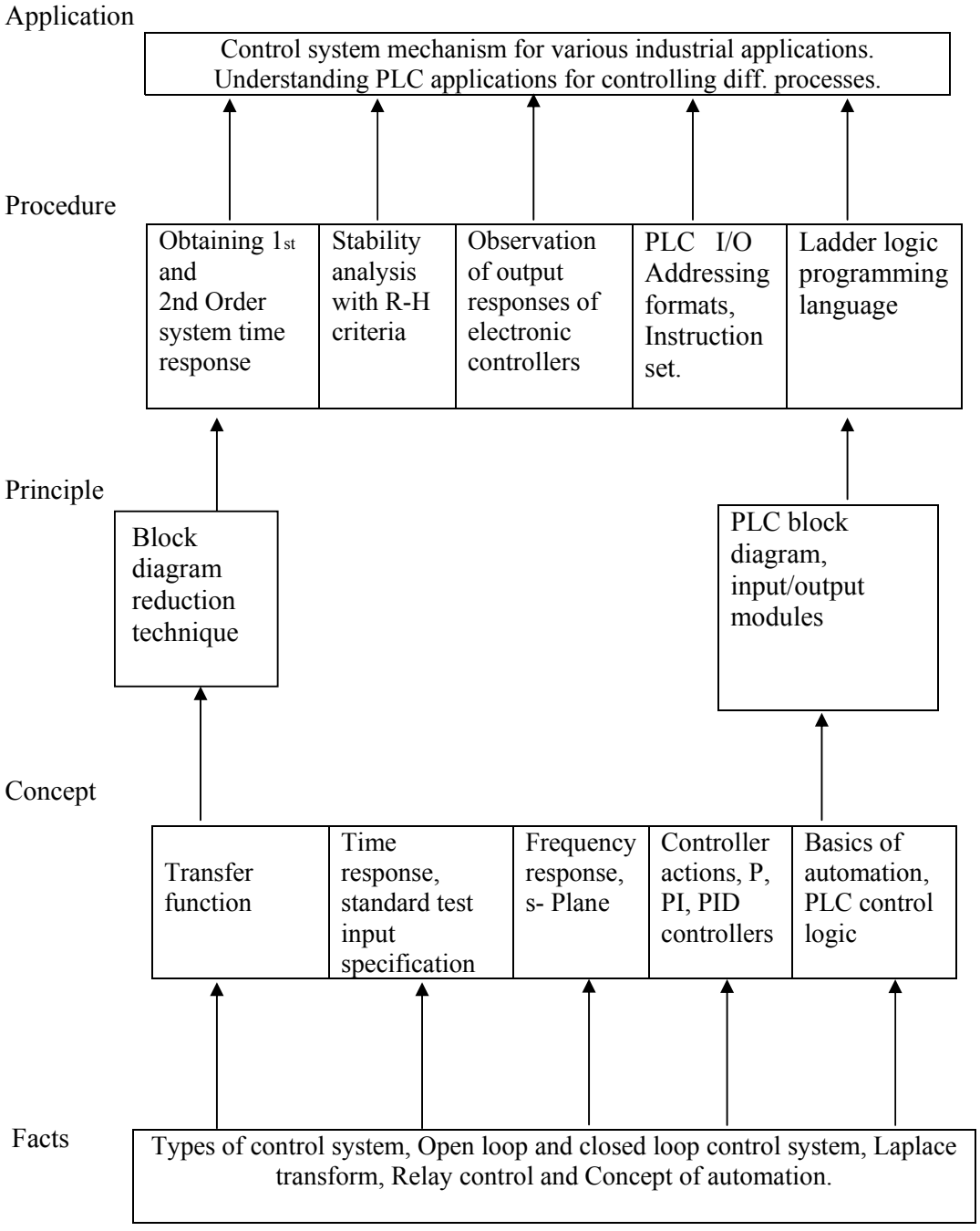
The subject intends to teach the student different control systems used in various field like automobile industry in application such as pick and place, welding, spray painting etc. The subject introduces the common industrial control system elements such as Programmable logic controller.

General Objectives:

The student will be able to:

1. Understand classifications of control system.
2. Understand Steady state, time response, and frequency response analysis.
3. Analyze the Stability of control system using RH criteria.
4. Understand the fundamentals and diff. Hardware parts of PLC.
5. Draw ladder diagrams to program PLC

Learning Structure:



Theory:

Topic and Contents	Hours	Marks
Topic 1: Introduction to the Control System Specific Objectives: ➢ Explain different types of control system ➢ Develop transfer functions ➢ Differentiate between 1st& 2nd order of system ➢ Develop and solve block diagram of control system Contents: 1.1 [4 Marks] • **Control System:** Definition and practical examples. • **Classification of control system:** Open loop & closed loop systems - definition, block**,** diagram, practical example, and Comparison**,** Linear and non linear system**,** Time varying and time in varying systems • **Servo system:** Definition, Block diagram, classifications (AC & DC)**,** Block Diagram of DC servo system. 1.2 [4 Marks] • **Laplace transform:** Significance in control system. • **Transfer function:** Definition, Derivation of transfer functions for close loop& open loop control system, Differential equations & Transfer functions of RC and RLC electrical circuits. 1.3 [8 Marks] • **Order of a system**: Definition, 0, 1, 2 order system standard equation, practical examples. • **Block diagram reduction technique:** Need, reduction rules, problems.	08	16
Topic 2: Time Response Analysis Specific Objectives: ➢ Appreciate the importance of standard inputs and apply them in analysis of control system ➢ Differentiate between poles and zeros ➢ Analyze 1st& 2nd order control system for step input ➢ Calculate time response specifications for different systems Contents: 2.1 [4 Marks] • **Time domain analysis:** Transient and steady state response • **Standard test inputs:** Step, ramp, parabolic & impulse, Need, significance, and corresponding Laplace representation. • **Poles& zeros:** Definition, S-plane representation 2.2 [8 Marks] • **First order control system:** Analysis for unit step input, Concept of time constant • **Second order control system:** Analysis for unit step input, Concept, definition & effect of damping 2.3 [8 Marks] • **Time response specifications** (no derivations)	12	20

Tp,Ts,Tr,Td,Mp,ess. Problems on time response specifications • **Steady state analysis**: Type 0,1,2 systems, Steady state error & error constants, numerical Problems		
Topic 3: **Stability** Specific Objectives: ➢ Appreciate the importance of stability ➢ Analyze different types of stability ➢ Apply Routh's stability criterion for stability analysis and solve the numerical. Contents: 3.1 [4 Marks] • **Stability:** Definition of stability, Analysis of Stable, unstable, critically stable & conditionally stable system, Relative stability, Root locations in S-plane for stable and unstable systems. 3.2 [8 Marks] • **Routh's Stability Criterion:** Different cases & conditions (statement method),Numerical Problems	06	12
Topic 4: Control Actions Specific Objectives: ➢ Explain the need of Control actions ➢ Differentiate between different types of Control actions Such as P, I & D ➢ Explain composite controllers; PI, PD, PID controllers Contents: 4.1. [4 Marks] • **Process control system**: Block diagram & explanation of each block. 4.2. **Control actions** [8 Marks] • **Discontinuous modes:** ON OFF controllers: equation, neutral zone • **Continuous modes:** PROPORTIONAL controllers (offset, proportional band), INTEGRAL & DERIVATIVE controllers; o/p equations, corresponding Laplace Transforms, Response of P,I & D controllers • **Composite controllers**: PI, PD, PID controllers- O/P Equations, Response, Comparison	04	12
Topic 5: PLC Fundamentals Specific Objectives: ➢ Explain the basics of PLC. ➢ Draw functional block diagram of PLC. Contents: **5.1** [4 Marks] • Evolution of PLC in automation, need and benefits of PLC in Automation. **5.2** [12 Marks] • **Block diagram & description of different parts of PLC** : CPU – function, scanning cycle, speed of execution, Power supply-	06	16

function, Block diagram, Memory – function & organization of ROM & RAM, Input modules- function, diff. input devices used with PLC(only name & their uses) 0utput modules- function, diff. output devices used with PLC(only name & their uses) ,Fixed and Modular PLCs.		
Topics 6: PLC Hardware &Programming Specific Objectives: ➢ Explain the details of diff. I/O modules of PLC. ➢ Get familiar with the instruction set of PLC system. ➢ Develop PLC programming skills**.** Contents: 6.1. [8 Marks] • **Discrete input modules:** Block diagram, typical wiring details and specifications of AC input modules & DC input module. Sinking and sourcing concept in DC input modules. • **Discrete output modules:** Block diagram description, typical wiring details and specifications of AC output module & DC output modules. • **Analog input and output modules:** Block diagram, typical wiring details and specifications. 6.2. [16 Marks] • **I/O addressing of PLC** • **PLC Instruction set**: relay instructions, timer instructions, counter instructions, data handling instructions, logical and comparison Instructions. • PLC programming examples based on above instruction using Ladder programming language.	12	24
Total	**48**	**100**

Practical:
Skills to be developed:

Intellectual Skills:

- Reading and interpretation of the graph.
- Interpretation of the results from observations and calculations.
- Software development
- Programming using ladder language

Motor Skills:

- Proper handling of instruments.
- Measuring physical quantities accurately.
- Observational Skills

List of Practical:

1. Measurement and Control error of angular position with DC position control system
2. Analyze the step response RC (First Order) circuit
3. Understand the concept of temperature control with ON-OFF controller
4. Understand temperature control with PI controller
5. Understand temperature control with PID controller

6. Verify the function of Logic Gates for the given Ladder Diagram by using PLC
7. Draw and Verify the Ladder Diagram for ON-OFF control of lamp by using PLC.
8. Develop Ladder Diagram for lamp ON and OFF by using timer and counter and verify it by using PLC
9. Draw and Verify the Ladder Diagram for stepper motor by using PLC
10. Draw and Verify the Ladder Diagram for temperature controller by using PLC

List of Laboratory equipment:

1. DC Position trainer kit
2. PID controller trainer kit
3. PLC Trainer kit(with minimum 20 digital I/O points and 2 Analog I/O channels)

List of Assignments:

Numerical problems from Chapter 1, 2 & 3.

Learning Resources:

1. Books:

Sr. No.	Author	Title	Publisher
1	J. J. Nagrath & M. Gopal	Control System Engg.	McGraw-Hill
2	K. Ogata	Modern control Engg.	PHI
3	C. D. Johnson	Process control instrumentation Technology	Prentice Hall
4	Gary Dunning	Intro. To Programmable logic control	Cenage Learning
5	F. D. Petruzella	Programmable logic controllers (Third edition)	Tata McGraw-Hill
6	Jhon Hackworth and Federic Hackworth	Programmable logic controllers	Pearson education

2. Websites:

www.learningpit.com - for PLC simulation software downloading.
www.plctutor.com - for PLC tutorials
en.wikipedia.org/wiki/PID_controller