LESSON PLAN

Class: B.E. Engineering
Academic Term: July –OCT 2018
Course: Automation and Control Engineering

Faculty Member: Saurabh Korgaonkar

Prerequisites: None

Course Objectives:

1. Students will be able to understand Pneumatic and Hydraulic circuits of medium complexity.

2. Students will understand basic working of PLC and Electropnumatics circuits.

3. Students will be able to model simple system and find Transfer function.

4. Students will be able to check stability of a mechanical system

Periods (Hours) per week:

Lecture: 4   Practical: 2

University Evaluation Method:

Theory examination: 80 Marks (3 Hrs)
Internal Assessment: 20
Practical Examination: 25
Term work: 25
Total: 150

Syllabus

Modules	Details	Hrs.
01	**Automation** Definition; Automation in production systems; Automation principles and strategies; Basic elements of an automated system; Advanced automation functions; Levels of automation; Types of automation; Benefits and Impact of Automation in Manufacturing and Process Industries. Architecture of Industrial Automation Systems.	06
02	**Pneumatic control systems** Overview of different types of valves and Actuators in Pneumatics, their applications and their ISO symbols. Design of Pneumatic circuits using Cascade method and Shift register method (up to 3 cylinders). Design of Electro-Pneumatic Circuits using single solenoid and double solenoid valves with and without grouping. Design of Pneumatic circuits using PLC Control (ladder programming only and up to 3 cylinders) with applications of Timers and Counters and concept of Flag and latching.	11
03	**Hydraulic control systems** Overview of different types of valves, Actuators and Accumulators used in Oil hydraulic circuits, their applications and their ISO symbols. Basic hydraulic circuits involving linear and rotary actuators (No sequential circuits). Fundamental concepts of digital and servo hydraulic controls. Comparison between proportional, digital and servo hydraulic control systems.	07
04	**Digital logic:** Number systems; Logic Gates; Boolean Algebra; Simplification of Boolean equations using Karnaugh Maps. **Microprocessors and Microcontrollers (Only basic understanding and applications)** Concept of Microprocessor based control and its application; Parts of a Microprocessor system with block diagram of the general form of a microprocessor system; Data bus, Address bus and Control Bus; General internal Architecture of a Microprocessor; Functions of constituent parts such as ALU, Various Registers and the Control unit. Difference between a Microprocessor and a Microcontroller. General Block diagram of Microcontroller.	11
05	**Sensors and Transducers** Fundamentals of displacement, position and Proximity Sensors; Velocity and Motion Sensors; Force and Fluid Pressure Sensors; Liquid level and Flow sensors; Temperature and light Sensors; Control of stepper motors.	02

06	**Fundamentals of Control System** Control system concepts, classification of control systems, mathematical representation of system equations, response characteristics of components and systems through classical solution. Analog computer and Laplace transformation, Frequency response analysis, polar plots, Testing of System's stability using Routh's criteria, Bode plots, Nyquist plot and Root locus method of analysis.	11

Mapping of CO's to PO's:

CO# / PO#	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEC801.1	2	2	2	0	0	0	0	0	0	0	0	2
PEC801.2	2	2	2	0	3	0	0	0	0	0	0	2
PEC801.3	2	2	2	2	0	0	0	0	0	0	0	2
PEC801.4	2	2	2	2	0	0	0	0	0	0	0	2

Lesson Plan

Week	Date	Duration	Topic	Methodology
1	2/7/2018	1	*Definition, types of automation*	Blackboard , interactive problem discussion
	3/7/2018	1	*Applications of automation*	Ppt, interactive problem discussion
2	4/7/2018	1	*Introduction pneumatics, Symbols and standards in Pneumatics*	Blackboard
	9/7/2018	1	*Design of circuit diagram*	Blackboard, simulation
	10/7/2018	1	*Direct and indirect control*	Blackboard
3	11/7/2018	1	*Logic functions AND and OR*	Blackboard
	16/7/2018	1	*Pressure relief valve, delay valve and air throttling*	Blackboard
	17/7/2018	1	*Multiple cylinder circuits*	Blackboard Simulation
	18/7/2018	1	*Cascade introduction*	Blackboard
4	20/7/2018	1	*Cascading practice*	Blackboard
	23/7/2018	1	*Shift register introduction*	Blackboard Simulation
	24/7/2018	1	*Shift register practice*	Blackboard
	25/7/2018	1	*Introduction to electro pneumatics*	Blackboard
5	27/7/2018	1	*Design of electro pneumatics*	Blackboard Simulation
	30/7/2018	1	*Logic functions AND and OR*	Blackboard

	31/7/2018	1	*Signal storage and delay*	Blackboard
	1/8/2018	1	*Cascading*	Blackboard
6	1/8/2018	1	*Introduction to hydraulics*	Blackboard
	3/8/2018	1	*Fluid power pumps and motors*	Blackboard
	6/8/2018	1	*Pressure control valves*	Blackboard
	7/8/2018	1	*Flow control valves*	Blackboard
7	8/8/2018	1	*Design of hydraulic circuits*	Blackboard, Simulation
	10/8/2018	1	*Hydraulic circuits*	Blackboard
	13/8/2018	1	*Hydraulic circuits*	Blackboard
	14/8/2018	1	*Electrical components in hydraulic circuits*	Blackboard
8	15/8/2018	1	*Electro hydraulics*	Blackboard
	20/8/2018	1	*Industrial examples*	Blackboard
	21/8/2018	1	*Introduction to logic control, karnaugh map*	Blackboard
	24/8/2018	1	*Basic control circuits*	Blackboard
9	27/8/2018	1	*Introduction to plc*	Blackboard
	28/8/2018	1	*Ladder diagrams*	Blackboard
	29/8/2018	1	*Introduction to microprocessor based systems*	Blackboard
	31/8/2018	1	*Features and design principles of electrical circuit drives*	Blackboard
10	4/9/2018	1	Control system concepts ,	Blackboard
	5/9/2018	1	Classification of control systems	Blackboard
	7/9/2018	1	Mathematical representation of C.S.	Blackboard
	10/9/2018	1	Transfer function	Blackboard
11	11/9/2018	1	Block diagram Reduction	Blackboard
	12/9/2018	1	Block diagram Reduction with examples	Blackboard
	14/9/2018	1	MIMO with examples	Blackboard
	17/9/2018	1	Classical solution method	Blackboard
12	18/9/2018	1	Analog Computer method	Blackboard
	19/9/2018	1	Laplace Transformations	Blackboard
	24/9/2018	1	Root Locus Introduction	Blackboard , Simulation
	25/9/2018	1	Root Locus Examples	Blackboard
	26/9/2018	1	Bode plot Introduction	Blackboard
	28/9/2018	1	Bode plot Examples	Blackboard
	1/10/2018	1	Polar plot Introduction with examples	Blackboard
	3/10/2018		Nyquist plot Introduction with examples	Blackboard
	5/10/2018		Discussion of Exam papers	Blackboard

* Methods of Teaching include but are not limited to following list:
- ✔ Lecture
- ✔ Demonstration
- ✔ PPTs
- ✔ Simulations and Animations
- ✔ Role Plays
- ✔ Case Studies
- ✔ Industrial Visits

Reference Books

1. *Automation, Production Systems, and Computer-integrated Manufacturing (3rd Edition),* by Mikell P. Groover, PHI Learning Private Limited, New Delhi.
2. *Pneumatic Controls,* by Joji P., Wiley India Pvt. Ltd.
3. *Principles Of Control Systems,* by U.A.Bakshi, V.U.Bakshi, Technical Publications Pune .
4. *Pneumatics Basic Level*, by Peter Croser, Frank Ebel, Festo Didactic GmbH & Co. Germany
5. *Electropneumatics Basic Level,* by G. Prede, D. Scholz, Festo Didactic GmbH & Co. Germany.
6. *Programmable logic controllers Basic Level,* by R. Bliesener, F. Ebel, C. Löffler, B. Plagemann, H. Regber, E. V. Terzi, A. Winter, Festo Didactic GmbH & Co. Germany.
7. *Vickers Industrial Hydraulics Manual (3rd Edition),* Vickers Inc.; Maumee, OH. *Hydraulic and Pneumatic Controls (2nd Edition),* by R. Srinivasan, Vijay Nicole Imprints Pvt. Ltd. Chennai.
8. *Introduction to Hydraulics and Pneumatics,* by S.Ilango and V. Soundararajan, PHI Learning Pvt. Ltd. New Delhi.

Tutorial / Practical's Plan:

Week	Duration (Hrs.)	Topic	Method of Conducting Practical
1	2	**Pneumatics Introduction**	**Conducted On Festo Pneumatics Trainer**
2	2	**Pneumatics with Limit Switches**	**Conducted On Festo Pneumatics Trainer**
3	2	**Pneumatics with Time delay**	**Conducted On Festo Pneumatics Trainer**

4	2	**Simulation On Fluid Sim**	**Simulation conducted on Fluid Sim Software**
5	2	**Electro-Pneumatics Introduction**	**Conducted On Festo ElectroPneumatics Trainer**
6	2	**Electro-Pneumatics with Limit Switches**	**Conducted On Festo Elctro-Pneumatics Trainer**
7	2	**Electro-Pneumatics with Time delay**	**Conducted On Festo Electro-Pneumatics Trainer**

* Method of Conducting Practicals / Tutorials include but not limited to:
  - ✔ Experiments
  - ✔ Assignments
  - ✔ Presentations
  - ✔ Mini Project