



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 7 Examination in Engineering: August 2015

Module Number: ME 7331

Module Name: Industrial Automation and Control

[Three Hours]

[Answer all questions, each question carries ten marks]

- Q1. a) Production systems are generally divided into two categories or levels. What are the factors in above two categories, which have to be considered before automating the production system? [2 Marks]
- b) The degree of automation is a function of the quantity of units produced and of product variety. Describe the relationship between the product variety and production quantity. How do you relate the above relationship with the different types of plant layouts? [3 Marks]
- c) What are the types of automation and how would you relate those automation types to production quantity and product variety? [2 Marks]
- d) Distinguish the relative strengths between Humans and Machines in automation. [3 Marks]
- Q2. a) Briefly explain the difference between Analog and Discrete sensing. [2 Marks]
- What do you mean by "hysteresis" in real time sensing? Briefly explain how you would overcome the hysteresis. [2 Marks]
- b) Name six major non-contact sensing technologies and briefly explain three of them with real time applications. [6 Marks]
- Q3. a) Define the terms; *Nominal sensing distance*, *Usable sensing distance*, *Effective (or Real) sensing distance*, *Standard target*. [2 Marks]
- b) Briefly explain the "inductive principle" using suitable diagrams. [2 Marks]
- c) What are the factors to be considered when selecting the appropriate sensing technology for a particular application? [2 Marks]
- d) Select the most appropriate sensing technology for each of the following applications. [4 Marks]
- Security door interlock
 - Proximity of a metal object
 - Oil level of a buried petroleum tank
 - Cartons moving on a conveyor
 - Shiny surface of a milk powder container
 - Collision detection for AGVs
 - An index mark on a glass bottle
 - Nib of a ballpoint pen moving on a fast conveyor

- Q4. a) What is a PLC? [1 mark]
- b) What are the advantages of using PLC over Relays? [2 marks]
- c) List out the programming languages in PLC. [1 mark]
- d) Explain On-delay and Off-delay timer instruction in PLC. [2 marks]
- e) A material handling system consists of an AGV (Automated Guided Vehicle). The AGV has to move from one place to another for loading and unloading the items it carries. ~~The Figure Q5 depicts the movements.~~ When the start push button is pushed, the AGV has to move from left to right. When the LS2 (Limit Switch 2) is triggered, the AGV stops and remains there for 5 seconds to load the items and then moves back to HOME position. When LS1 (Limit Switch 1) is triggered the AGV stops and remains there for unloading and it waits for the start signal. Draw a simple PLC Ladder diagram to execute this process. [4 marks]
- Q5. a) A conveyor is run by switching a motor on and off. We are positioning parts on the conveyor with an optical detector. When the optical sensor goes on, we want to wait 1.5 seconds, and then stop the conveyor. After a delay of 2 seconds the conveyor will start again. We need to use a start and stop button - an indicator light should light up when the system is active. Develop a PLC ladder logic programme to control the conveyer. [5 marks]
- b) It is required to add a sorting system to the conveyor discussed above.. Gages have to be attached that can decide whether parts are good or bad. If the part is good, the conveyor should bring the next part, but if the part is bad, a pneumatic cylinder should be actuated without delaying for 2 seconds. How would you modify your control program to be compatible with the above changes? [5 marks]
- Q6. a) State five possible ways of energy losses associated with industrial pneumatics. [2 Marks]
- b) State five technical solutions for safety improvement in pneumatics circuits. [2 marks]
- c) For each of the following cases, state three key technical concerns to be adhered to.
 - Selecting a new solenoid for replacing a burnt solenoid of a directional control solenoid valve.
 - Deciding the suitable energy source (pneumatics or hydraulics) to be selected for a punching machine.
 - When a 2-way directional control solenoid coil is energized or de-energized, where pneumatic supply direction does not change.
 [3 marks]
- d) "The main pneumatic cylinder of a machine actuates slower in both directions than its original speed in normal operating conditions". Give a reasonable procedure for fault tracking and indicate possible rectifying tips. [3 marks]