BE IVYear (EI): End Semester Examination

Time: 3 hrs EI 005: Process Dynamics & Control MM 36

Scheduled at: 2 PM, Dec 7th 06 **Instructor:** Mandeep Singh, AP, EIED

Note : Attempt all the questions

Q1 (a) A valve positioner attached to a pneumatic valve has three distinct roles to play. What are these? (3)

Q1 (b) Dampers are being fast replaced by modern power saving device. What is the principle of working of this device and how will you calculate its payback period? Give an illustrative example. (3)

Q2 (a) Discuss a control strategy which has one measured variable, two manipulated variables and one controlled output. By what name is this strategy known as? (3)

Q2 (b) A very popular boiler control uses part ratio and part cascade control. Identify the measured, manipulated and controlled output variables in this scheme. What is this scheme commonly known as? Draw its schematics and explain its working. (3)

Q3 (a) Derivative control makes second order system less oscillatory. Do you agree with this statement? Support with necessary mathematical deductions. (3)

Q3 (b) What is micro-stepping in stepper motors? How is it achieved? Explain with neat diagrams. (3)

Q4 (a) A 5 m diameter cylindrical tank is emptied by a constant outflow of 1.0 m^3/min. A two position controller is used to open and close a fill valve with an open flow of 2.0 m^3/min. For level control, the neutral zone is 1 m and the set point is 12 m. Calculate the cycling period and plot the level versus time. (3)

Q4 (b) For a proportional controller the controlled variable is a process temperature with a range of 50 to 130 °C and a setpoint of 73.5 °C. Under nominal conditions the setpoint is maintained with the output of 50%. Find the proportional offset resulting from a load change that requires 55% output if the proportional gain is (i) 0.1 (ii) 2 (iii) 5. (3)

Q5 (a) A PI controller is reverse acting, PB = 20, 12 repeats per minute. Find (i) the proportional gain (ii) the integral gain, and (iii) the time that the controller output will reach 0% after a constant error of -1.5% starts. The controller output when the error occurred was 72%. (3)

Q5 (b) A PI controller has $K_P = 4.5$ and $K_I = 7\ s^{-1}$. Find the controller output for an error given by $e_P = 3 \sin(\pi t)$. What is the phase shift between error and controller output? (3)

Q6 (a) Design a two-position controller that turns a 5-V light relay ON when a silicon photocell output drops to 0.22V and OFF when the cell voltage reaches 0.78V. (3)

Q6 (b) Rate (derivative) action is needed for steering a boat. The rate gain should be K_D = 0.02%/(%/min). The error voltage range is -4.0 to +4.0V, and the output signal varies from 0 to 2.5 V. The fastest physical turning period is 0.4 min. Find the component values of a derivative mode Op-Amp circuit. (3)