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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination – December, 2017

Program/course: **B.Tech/Mechatronics** | **Semester –7th**
Subject: Process Control Description | **Max. Marks : 100**
Code : MEEL431 | **Duration : 3Hrs**
No. of page/s:2

Section A

Attempt all the questions. Each question carries 5 Marks.

1. Consider a household heating system with on-off control. Normally there is a dead band of 2°F;that is, the temperature must drop to 1°F below the set point before the heater kicks on, and it must go 1°F above the set point before the heater kicks off. Clearly the thermostat/heater has periodic behavior with periods where the heater is on, followed by periods where it is off. Discuss the effect of the dead band on this periodic behavior . Sketch the expected heater (on-off) and temperature profiles as the dead band is changed.

2. Consider a first order open loop unstable process that has the following transfer function

$$g_p(s)= k_p/(-\Gamma_u s+1)$$

Find the range of values of parameters for a PI controller that stabilize this process.

3. Calculate the offset to a step set point change due to P-only control, for the following process;

$$g_p(s)= 1/s(2s+1)$$

4. A process has the following transfer function ;

$$g_p(s)= 2(-3s+1)/(5s+1)$$

Using a P-only controller , find the range of the controller gain that will yield a stable closed -loop system.

Section B

Attempt all the questions. Each question carries 10 Marks.

5. What are the possible problem with offset using proportional controllers.

6. Derive the expression for the direct synthesis for a first -order process.
7. Derive the expression of the controller for a first order process with a PI controller.
8. Develop the control block diagram including a load disturbance.

OR

Explain open loop unstable systems.

Section C

Attempt all the questions. Each question carries 20 Marks.

9. Consider the following first-order process;

$$g_p(s)= 1/s(2s+1)$$

If the desired closed-loop response to a set point change in second order with the following form,

$g_{CL}(s)= \alpha s+1/(\gamma s+1)^2$

Find the feedback controller required , where α and γ are adjustable tuning parameters. What type of controller is this. If the controller is PID form, find each of the tuning parameter.

10. Consider a first -order process with a desired closed loop response that is second order. Use the direct synthesis procedure with the following specified closed loop transfer function (which is critically damped)

$$g_{CL}(s)= 1/(\gamma s+1)^2$$

to derive the controller.

OR

Derive the expression for the PID controller. Explain any one method of PID tuning.