ECH-602

B. TECH.
(SEM VI) BACKPAPER THEORY EXAMINATION, 2017-2018
PROCESS DYNAMICS & CONTROL

Time: 3 Hours *Total Marks: 100*

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION-A

1. Attempt *all* questions in brief. 2 x10 = 20

(a) Explain stability of a control system.
(b) Define amplitude ratio.
(c) Define ‘‘Rise time’.
(d) Differentiate between PI and PD controllers.
(e) Define ‘characteristic equation’.
(f) Define non-interacting system.
(g) What do you mean by ‘over damped’?
(h) Define interacting system.
(i) Discuss the transportation lag.
(j) Discuss the limitations of PI controller.

SECTION-B

2. Attempt any *three* of the following: 10x3 = 30

(a) Discuss the term ‘feed-forward control’. With the help of a general block diagram, describe the feedback control of a process.

(b) What are Initial Value and Final Value theorem and how are they useful in control system analysis? Find the inverse Laplace transform of following

$$f(s) = 7/(s^3 + 3s^2 + 7s + 5)$$

(c) Validate that by the addition of integral mode in a proportional controller, the offset is completely removed.

(d) Determine the decay ratio of the response, if a step change of magnitude *2* is introduced in to a system having transfer function:

$$Y(s)/X(s) = 5 / (s^2 + 0.4s + 0.5)$$

(e) Differentiate between a negative feedback and positive feedback control system with suitable example.

SECTION-C

3. Attempt any *one* part of the following: **10x1 =10**

(a) Examine the response of 'interacting and non-interacting systems in series' with the help of suitable examples.

(b) Explain the substitution rule for finding amplitude ratio and Phase difference for a system. Find these for a second order system and for PI and PID controller.

4. Attempt any *one* part of the following: **10x1 =10**

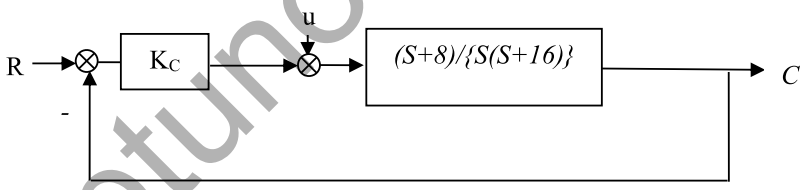
(a) Discuss the various modes of control action and their response with their limitations and advantage.

(b) Discuss the Routh's test for testing the stability of a control system. What other information are obtained by Routh's theorem about the control system?

5. Attempt any *one* part of the following: **10x1 =10**

(a) A thermometer having first order dynamics with a time constant of 3 minutes is at 780C. It is placed in a water bath at 980C for 4 minutes and then again placed in a water bath at 800C. Obtain an expression for thermometer reading with respect to time and find temperature shown by the thermometer at (a) 3 minutes and (b) 5 minutes.

(b) Find the closed loop transfer function *c(s)/u(s)* for the following control system. Also find offset for a unit step change in u if $K_C = 8$.



6. Attempt any *one* part of the following: **10x1 =10**

(a) Justify this statement that "Thick walled thermometer behaves as a second order over damped system".

(b) Draw the root locus for a control system having following characteristic equation.

$$1+ [\{k (16s+1)\}/\{s(s+4) (s+8)\}] =0$$

7. Attempt any *one* part of the following: **10x1 =10**

(a) Explain the significances of 'open-loop and closed-loop' in control system with the help of a simple block diagram.

(b) Discuss the terms 'overshoot' and 'decay ratio' as applied to response of a second order system? Obtain the expressions for them in term of τ and ξ.