SEVENTH SEMESTER B.TECH DEGREE EXAM (MODEL) NOVEMBER 2016

BIOTECHNOLOGY & BIOCHEMICAL ENGINEERING

13.701 PROCESS DYNAMICS & CONTROL

Model Question Paper

Time: 3 hours   **Max. Marks: 100**

PART A

Answer **all** questions. Each question carries **2** marks

1) Using the definition obtain the Laplace transform of A cos(ωt).

2) What do you mean by a transfer function? Write an example of a typical transfer function.

3) Derive the amplitude ratio and phase angle for a simple first order system.

4) Compare between Feedback control and Feed forward control.

5) Elucidate Critically damped and undamped system.

6) Define offset with respect to a controller.

7) Explain Ziegler Nicholas tuning and controller settings.

8) Compare P, PI and PID controllers.

9) Explain adaptive control scheme.

10) Differentiate between discrete and continuous systems.

PART B

Answer **one full** question from **each** Module. Each carries **20** marks

MODULE I

11. a) Invert the following transform

$$x(s) = \frac{1}{s(s^2 - 2s + 5)}$$ **(10 Marks)**

   b) Briefly discuss about the hardware elements in a typical process control system.

                                                                                         (10 Marks)

or

12. a) Derive the transfer function for a single tank liquid level system.   **(10 Marks)**

b) A thermocouple of time constant 1 minute is placed in a bath at 250 ^{0}C.The bath temperature increases linearly at the rate of 1 ^{0}C/min .Sketch the response of the system. **(10 Marks)**

MODULE II

13. a) Derive the dynamic response of first order system to a sinusoidal input. **(12 marks)**

b) Explain the terms Decay ratio, Rise time, Overshoot and period of oscillation.

(8 marks)

or

14. a) Derive the transfer function for a pure capacitive process. **(10 marks)**

b) Derive the transfer function for interacting liquid level system. **(10 marks)**

MODULE III

15. a) Sketch neatly the bode diagram for the process shown in figure below.
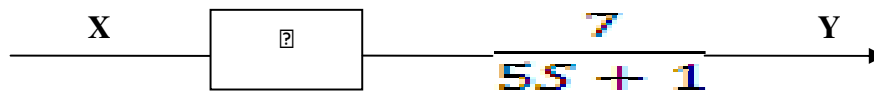
(10 marks)

b) Define stability. Explain it based on the roots of the characteristic equation.

(10 Marks)

or

16. a) Differentiate between proportional, proportional integral and proportional integral derivative controllers. Also plot the expense of these controllers to a unit step change in error. **(10 Marks)**

b) The closed loop transfer function of a system is given below

$$\frac{Y(s)}{X(s)} = \frac{k}{s(s^2 + s + 1)(s + 2) + k}$$

Analyze the stability of the system and specify the range of k for which the system is stable. **(10 Marks)**

MODULE IV

17. a) Explain split range & cascade control scheme. **(10 Marks)**

    b) Discuss on dead time compensation. **(10 Marks)**

or

18. Obtain Ziegler Nichols settings for P,PI and PID controllers for a multi capacity process with the following details.

$$G_{p(S)} = \frac{1}{(5S+1)(2S+1)}$$

$$G_{m(S)} = \frac{1}{(10S+1)} \quad G_{f(S)} = 1$$

(20 marks)