

## UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program Name: B.Tech Electrical

Semester – VII

Course Name : Advanced control system

Max. Marks : 100

Course Code : ELEG 463

Duration : 3 Hrs

No. of page/s: 2

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### SECTION – A

ANSWER ALL THE QUESTIONS

5\*4 = 20

Q.1(CO5) How optimal control approach is differ from adaptive control.

Q.2(CO3) What do you understand by stability of nonlinear system?

Q.3(CO1,2) Define the thumb rules for selection of sampling.

Q.4(CO4,5) Which approach you will opt for trajectory control and why?

Q.5(CO1) Why we need A/D conversion to control analog system?

### SECTION – B

ANSWER ALL THE QUESTIONS

10\*4 = 40

Q.6(CO3) Explain Liapunov's stability criterion with necessary and sufficient conditions.

Q.7(CO3,4) Consider a nonlinear system described by the equations

$$\dot{x}_1 = x_2$$

$$\dot{x}_2 = \frac{-1 - |x_1|}{x_2} - x_1$$

Find the region in the state-plane for which the equilibrium state of the system is asymptotically stable  
(Hint : A Liapunov function is  $V = x_1^2 + x_2^2$ ).

Q.8(CO5) Devise a performance index for minimum deviation of state about origin with minimum control efforts and also explain the effect of different boundary conditions on devised performance index.

Q.9(CO4,5) Explain MRAC adaptive control schema and also discuss the advantage over self-tuning adaptive control.

### SECTION – C

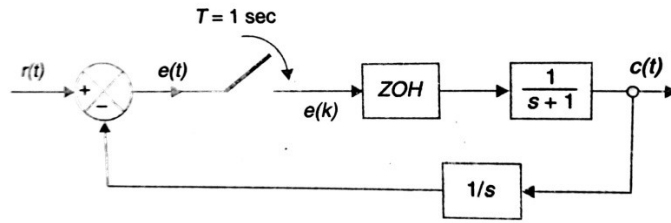
ANSWER BOTH THE QUESTIONS

20\*2= 40

Q.10(CO1,2,3) Check all the necessary and sufficient conditions of Jury's stability for the given polynomial and deduce the result.

$$F(z) = 2z^4 + 7z^3 + 10z^2 + 4z + 1$$

**Q.11(CO1,2,4)** For the sampled data control system shown in figure find the output  $c(k)$  for unit step input.



Roll No: -----



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### SECTION – A

ANSWER ALL THE QUESTIONS

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Q.1 (CO1) What are the main problems associated with implementation of digital control?

Q.2(CO5) Discuss the role of artificial intelligence for adaptive control.

Q.3(CO3) What do you understand by asymptotic stability for nonlinear systems.

Q.4(CO2) How you can perform discretization on analogous system and further convert it to digital signals?

Q.5(CO4) Differentiate hard constraint & soft constraint for optimal control approach with example.

### SECTION – B

ANSWER ALL THE QUESTIONS

10\*4 = 40

Q.6(CO3,4) Define Liapunov function V and also show that how function V can be used to check the stability of nonlinear system.

Q.7 (CO1,2,3) How we can ensure the stability on z plane by the mapping  $z=e^{st}$ .

Q.8 (CO2,3) Find the inverse z-transform for the given functions

(a)  $\frac{3z^2+2z+1}{z^2+3z+2}$

(b)  $\frac{z-0.4}{z^2+z+2}$

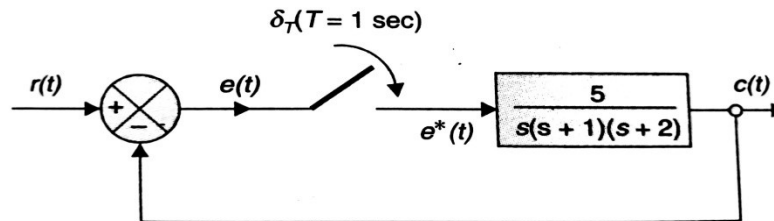
Q.9(CO5) Devise the performance index for minimum deviation of state about C with minimum control effort also consider the final state and time as flexible and initial state and time as fixed boundaries.

SECTION – C

ANSWER BOTH THE QUESTIONS

20\*2= 40

**Q.10(CO2,3,4)** Consider the sampled-data system given in figure. Determine its characteristic equation in the z-domain and ascertain via the bilinear transformation.



**Q.11 (CO1,2)** Sketch a schematic diagram of a speed control system using the following units: motor, tachogenerator, A/D converter, digital computer, D/A converter and power amplifier. Explain the function of each section of the diagram.