Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, July 2020

Course: Instrumentation & Control **Semester: IV**
Program: B.Tech Mechatronics **Time : 03 hrs.**
Course Code: ECEG3011 **Max. Marks: 100**

Instructions:

(i) There are total of six questions in this question paper. One in Section A and five in Section B
(ii) Section A will be conducted online on BB Collaborate platform
(iii) Section B consist of long answer based questions and has the total weightage of 75%. The questions for section B shall also appear in BB Collaborate
(iv) The maximum time allocated to Section A is one Hrs.
(v) Section B to be submitted within 24 hrs from the scheduled time.
(vi) The section B should be attempted in blank white sheets (hand written) with all the details like programme, semester, course name, course code, name of the student, Sapid at the top (as in the format) and signature at the bottom (right hand side bottom corner

Section A

1. MCQ **25 Marks**

Q1. The disadvantage of open loop systems, sensitivity to disturbances and inability to correct the

(a) Reference input
(b) Manipulated variable
(c) Disturbance input
(d) Feedback

Q2. The main source of steady state error is

(a) Nonlinear sources
(b) Linear sources
(c) Input
(d) Manipulated variable

Q3. The parameters are responsible for the forced response into the system is

(a) Input
(b) Output
(c) Controlled output
(d) Feedback

Q4. The natural response developed by the system due to its
(a) Internal parameter
(b) External parameter
(c) Input
(d) Output

Q5. Time constant of instrument is defined as the percentage of output

(a) 50
(b) 60
(c) 63.2
(d) 73.2

Q6. Find the steady state error for the system of transfer function, $T(s) = \frac{5}{s^2 + 7s + 10}$

and the input is a unit step.

(a)0.5

(b) 0.6

(c) 0.8

(d).18

Q7. For the marginal stability, the minimum number of roots must lie on the s-plane

(a) 2
(b) 3
(c) 4
(d) 1

Q8. For the stable system, the roots must lies of the s-plane.

(a) Right half

(b) Left half

(c) On the plane

(d) None

Q9. For the system of transfer function $\frac{k(s+3)}{s^4+7s^3+14s^2+(8+k)s+3K}$, find the frequency and gain ,K , for which the root locus crosses the imaginary axis.

(a)1.59 & 9.65

(b) 1.89 & 9.88

(c) 2.01 & 10.22

(d)2.05 & 10.52

Q10. Given a unity feedback system that has the forward transfer function

$G(s) = \frac{K(s+2)}{(s^2-4s+13)}$, find the break –in –point

(a)-7

(b)-8

(c)-6

(d)-9

Q11. A unity feedback system has the following forward transfer function

$$G(s) = \frac{10(s+20)(s+30)}{s(s+25)(s+35)}$$

Find the steady state error for the input $15u(t)$

(a)0

(b) 1

(c) 1.002

(d)1.004

Q12. Steady state error is the difference between the input and the output for a prescribed test input as time t tends to

(a) Infinity
(b) Zero
(c) Constant value
(d) Varies

Q13. Find the range of gain K, for the system of transfer function

$$T(s) = \frac{K}{s^3 + 18s^2 + 77s + K}$$

(a) 1386
(b) 1390
(c) 1395
(d) 1380

Q14. The product of branch gains found by traversing a path that start at a node and ends at the same node, following the directions of the signal flow, without passing through any other node more than once is called

(a) Loop gain
(b) Forward path gain
(c) Non touching loop gain
(d) None

Q15. Loops that do not have any node is common is called

(a) Non-touching loops
(b) Touching loops
(c) Self-loop
(d) None

Q16. The product of gains found by traversing a path from the input node to the output node of the signal flow graph in the direction of signal flow is called

(a) Forward path gain
(b) Self-loop gain
(c) Non-touching loop gain
(d) None

Q17. The output response of a system is the sum of two responses :

(a) Force response and natural response
(b) Initial response and force response
(c) Exponential response and natural response
(d) None

Q18. A pole of the input function generates the form of the

(a) Force response
(b) Natural response
(c) Exponential response
(d) None

Q19. A pole of the transfer function generates the form of the

(a)Force response
(b)Natural response
(c)Exponential response
(d) Amplitude

Q20. A pole on the real axis generates an
(a) Exponential response
(b) Force response
(c) Natural response
(d) None

Q21. The zeros and poles generates the amplitude for the

(a) Forced and the natural response
(b) Forced and exponential response
(c) Natural and exponential
(d) Forced response

Q22. The nature of the response of the first order system is

(a) Exponential
(b) Linear
(c) Parabolic
(d) Ramp

Q23. The concept of control system started from the

(a) Watt governor
(b) Flywheel
(c) Pressure
(d) Turbine

Q24. The natural frequency of the rotating system with damping is

(a) $\sqrt{\frac{K_t}{I}}$
(b) $\sqrt{\frac{K_t}{2I}}$
(c) $\sqrt{\frac{2K_t}{I}}$
(d) $\sqrt{\frac{K_t}{3I}}$

Q25. The natural frequency of the mass spring damper system is

(a) $\sqrt{\frac{K}{m}}$

(b) $\sqrt{\frac{2K}{m}}$

(c) $\sqrt{\frac{K}{2m}}$

(d) $\sqrt{\frac{3K}{m}}$

Section B

Attempt all the questions

2. Sketch the rough nature root locus for the system shown in Figure 1 and determine the range of gain for marginal stability. 15 Marks

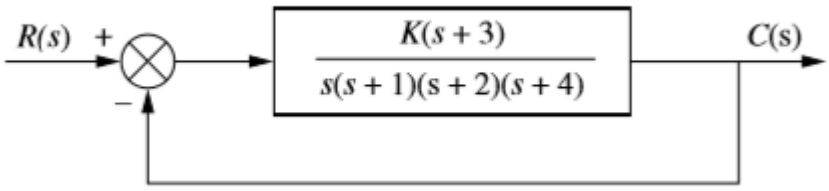

Fig.1

3. Find the steady-state error, for a unit step input given the non-unity feedback system of Figure2. Repeat for a unit ramp input. Assume input and output units are the same. 15 Marks

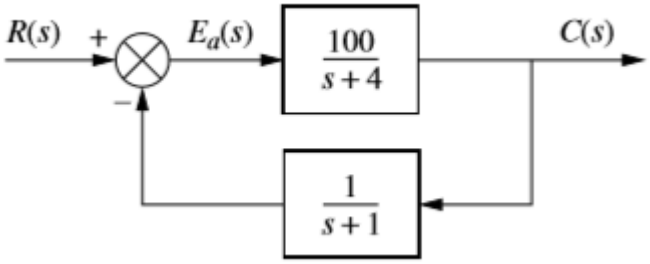

Fig.2

4. For the system shown in figure 3.Find
   (a)The transfer function
   (b) The percent overshoot, settling time, damping factor and peak time 15 Marks

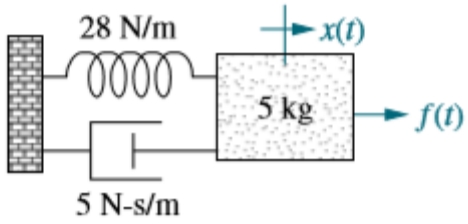

Fig.3

5. In a nuclear power generating plant, heat from a reactor is used to generate steam for turbines. The rate of the fission reaction determines the amount of heat generated, and rods inserted into the radioactive core control this rate. The rods regulate the flow of neutrons. If the rods are lowered into the core, the rate of fission will diminish; if the rods are raised, the fission rate will increase. By automatically controlling the position of the rods, the amount of heat generated by the reactor can be regulated. Draw a functional block diagram for the nuclear reactor control system shown in Figure4.Show all blocks and signals. 15 Marks

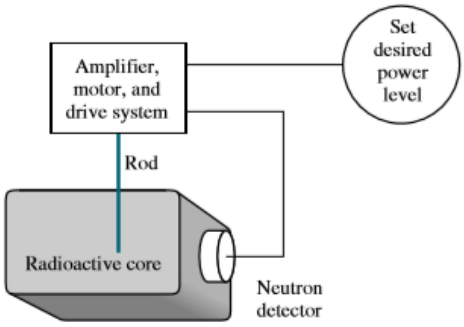

Fig.4

6. The transducer of an arterial blood pressure instruments consists of a four element piezo resistive Wheatstone bridge and its sensitivity is 10μV per volt of excitation per torr of pressure. Its output is fed to an amplifier with voltage gain of 100.Determine the output voltage if the bridge is excited by the 6 V dc and 120 torr of pressure is applied. 1 torr=1mm Hg. 15 Marks