TED (15) – 5043

(REVISION — 2015)

Reg. No.....

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DIPLOMA EXAMINATION IN ENGINEERING/TECHNOLOGY/ MANAGEMENT/COMMERCIAL PRACTICE — OCTOBER, 2018

CONTROL SYSTEMS

[*Time* : 3 hours

(Maximum marks : 100)

PART — A

(Maximum marks : 10)

Marks

I Answer *all* questions in one or two sentences. Each question carries 2 marks.

1. Write the mathematical expression for the Laplace transform of a function $f(t)$.
2. List the basic elements to model a mechanical translational system.
3. Define the order of a system ?
4. Define the transient and steady state response of a control system.
5. What is centroid of a root locus ? (5×2 = 10)

PART — B

(Maximum marks : 30)

II Answer any *five* of the following questions. Each question carries 6 marks.

1. Find the Laplace transform of the following function:
   (i) e^{-at}
   (ii) t
   (iii) sin at
2. Briefly explain about linear time variant and linear time invariant systems.
3. Derive the transfer function of RLC parallel circuit.
4. Write the procedure to draw signal flow graph from block diagram.
5. The open loop transfer function of a control system with unity feedback is $G(s) = \frac{10}{s(0.1s + 1)}$. Evaluate the static error constants of the system.
6. Construct Routh array and determine the stability of the system represented by the characteristic equation $s^5 + s^4 + 2s^3 + 2s^2 + 3s + 5 = 0$. Comment on the location of roots of the characteristic equation.
7. Explain the methods to find the crossing point of the root locus in the imaginary axis. (5×6 = 30)

Marks

PART — C

(Maximum marks : 60)

(Answer *one* full question from each unit. Each full question carries 15 marks.)

UNIT — I

III (a) Find the inverse Laplace Transform of the following functions :

(i) $F(S) = \frac{1}{(s+1)(s+4)}$ (ii) $F(S) = \frac{S}{s^2+6s+13}$ 8

(b) Compare open loop and closed loop control systems. 7

OR

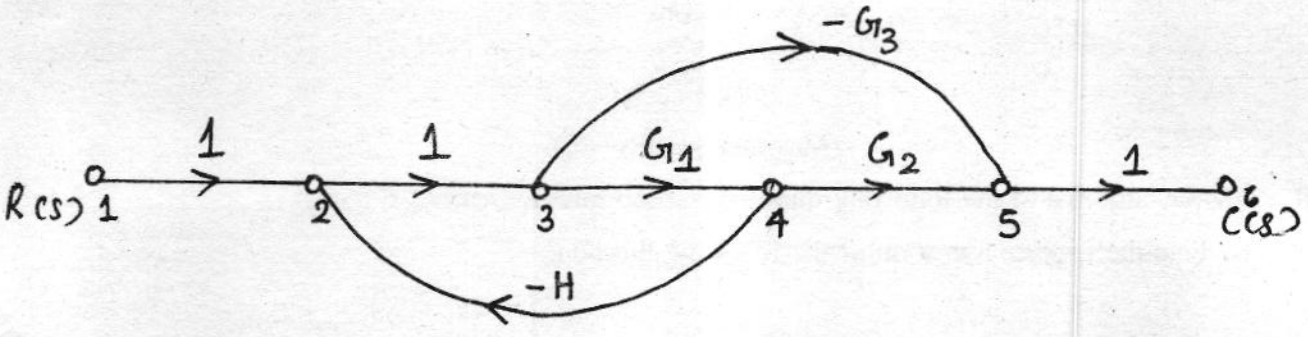
IV (a) State the differentiation and integration theorems of Laplace Transform. Express the following differential equation in Laplace transform form :

$\frac{d\theta}{dx} + 6\theta + 5\int \theta \, dt = 0$, given $\theta(0^+)$, $\theta'(0^+) = 0$ and $\theta^{-1}(0^+) = 0.1$ 8

(b) Briefly explain about mathematical model of a control system. 7

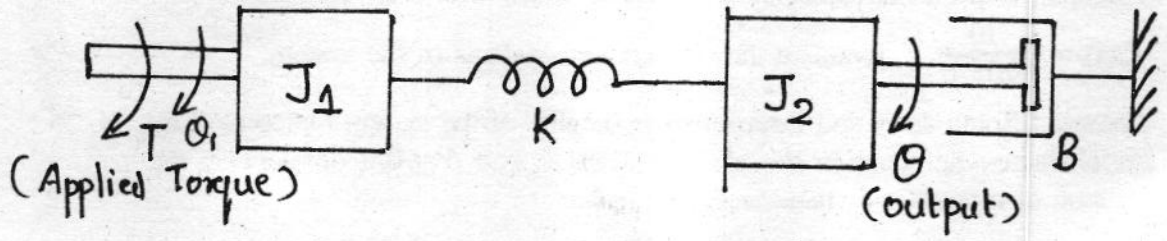
UNIT — II

V (a) State the Mason's gain formulae. Find the transfer function for the signal flow graph shown below :



8

(b) Write the differential equation of the mechanical rotational system shown below and obtain its transfer function.

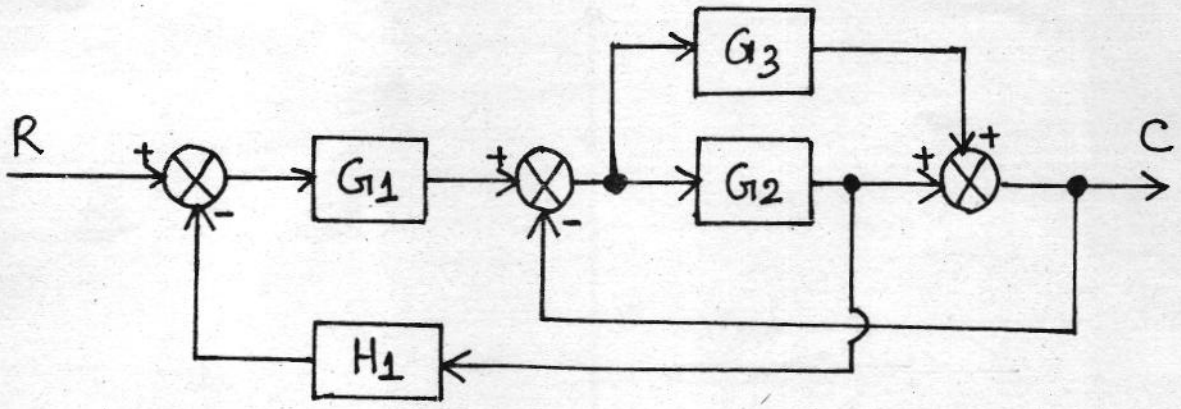


7

OR

Marks

VI (a) Using block diagram reduction method determine the overall transfer function C/R of the block diagram shown below :



8

(b) Describe Torque - Voltage and Torque - Current analogy. 7

UNIT — III

VII (a) Using Routh criterion determine the stability of the system having the following characteristic equation :

$s^6 + s^5 + 5s^4 + 3s^3 + 2s^2 - 4s - 8 = 0$. 8

(b) Find the response of a first order system for unit step input. 7

OR

VIII (a) Derive steady state error in terms of Kp, Kv and Ka for Type-0, Type-1 and Type-2 systems when the input is unit ramp. 8

(b) Briefly explain how stability of the control system is predicted by the location of roots of the characteristic equation in s - plane. 7

UNIT — IV

IX (a) With necessary steps draw the Bode plot for the function $1 + sT$. 8

(b) Explain the procedure to construct root locus. 7

OR

X (a) Sketch the root locus of the unity feedback system whose open loop transfer function is given as :

$G(s) = \frac{10}{s+2}$ 8

(b) Explain the step by step procedure to sketch the magnitude plot of the Bode plot. 7