Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

SECOND SEMESTER M.TECH. (CONTROL SYSTEMS)
END SEMESTER EXAMINATIONS, APRIL - 2018

SUBJECT: ROBUST AND H-INFINITY CONTROL [ICE 5249]

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A. Find the ∞ norm of the function (i) $G(s)=\dfrac{1}{s+1}$ (ii) $G(s)=\dfrac{1}{s-1}$ **2**

1B. For the plant $P(s)=\dfrac{1}{(s+3)(s+4)}$; it is desired to find an internally stabilizing controller so that output (y) asymptotically tracks a ramp input (r) **3**

1C. Find an internally stabilizing controller C for plant model P(s) = $\dfrac{3}{s-4}$ of unity feedback system shown in Fig. Q1C so that the tracking error e goes to zero, where r is a ramp and n=d=0. **5**

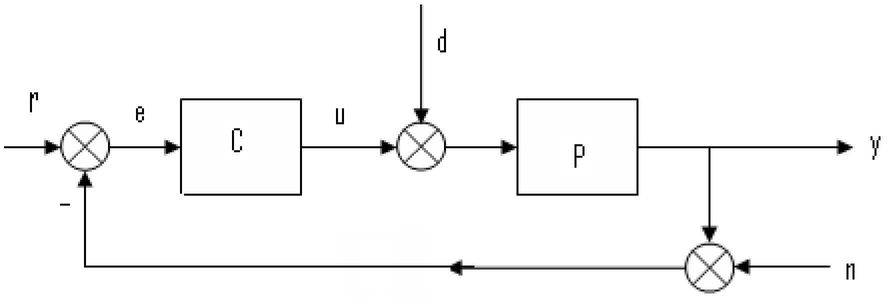

Fig. Q1C

2A. Obtain the state space model of the system $G(s)=\dfrac{1}{s^2+2s+1}$ and calculate $\|G\|_2$ **2**

2B. Consider the plant $P(s)=\dfrac{(s-4)(s+3)}{(s-8)(s+5)}$ for any controller C(s) (i) If s_0 is a zero of P in the RHP then prove that T(s_0) = 0 and S(s_0) = 1. (ii) If s_1 is a pole of P in the RHP then prove that T(s_1) =1 and S(s_1) = 0. **3**

2C. Using state space method obtain the co prime factorization of the plant $P(s)=\dfrac{(s-1)}{(s+1)(s+2)}$. **5**

Given $F=\begin{bmatrix}-1 & -3\end{bmatrix}$; $H=\begin{bmatrix}-6\\-8\end{bmatrix}$ Also prove Bezout Identity.

3A. Indicate which of the plant can be stabilized with stable compensator **2**

(i) $P(s)=\dfrac{(s-1)^2(s^2-s+1)}{(s+1)^3(s-2)^2}$ (ii) $P(s)=\dfrac{(s-3)}{(s-1)(s+2)}$

3B. Explain the basic procedure of loop shaping technique. **3**

3C. Solve the model matching problem, given $T_1(s) = \dfrac{1}{(s+2)}$; $T_2(s) = \dfrac{(s-5)}{(s+1)(s+3)}$ by transfer function method. **5**

4A. Find the inner and outer factorizations of $G(s) = \dfrac{(s-7)(s-9)}{(s+3)(s+5)}$ **2**

4B. In a position control system shown in fig Q4B 'a' ranges [3 5], 'T' ranges [0.1 1] and 'K' ranges [2 6]. Using Kharitonov theorem determine the stability of the system. **3**

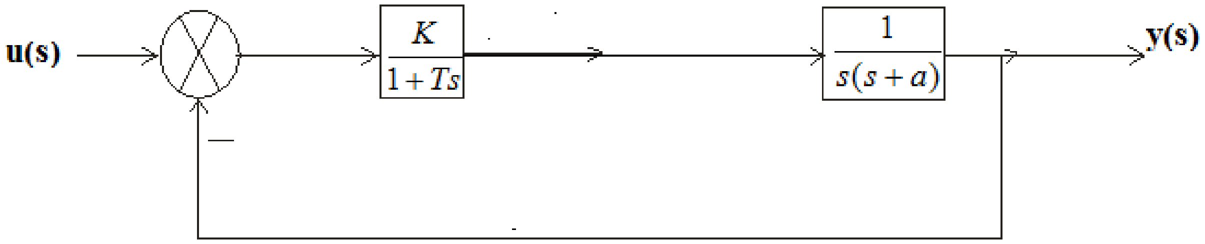

fig Q4B

4C. Write down the step by step procedure for designing the model matching problem by state space methods. **5**

5A. Find the spectral factorization of $G(s) = \dfrac{4(16-s^2)}{s^4 + 6s^2 + 25}$ **2**

5B. Write down the step by step procedure to design a robust controller for the given P *and* P^{-1} unstable plant and weighting function $W_1(s)$ **3**

5C. For the gain margin optimization problem, given $P(s) = \dfrac{(s-1)}{(s+1)(s-0.5)}$ and $W_2(s) = \dfrac{(s-0.1)}{(s+1)}$. Design a controller which satisfy Robust stability. **5**

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