Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

SECOND SEMESTER M.TECH. (CONTROL SYSTEMS)

END SEMESTER EXAMINATIONS, APRIL/MAY 2017

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 2 norm of the function **2**

$$G(s) = \frac{1}{100s + 4}$$

1B. Explain (i) Sensitivity (ii) Complementary sensitivity (iii) Asymptotic tracking theorem. **3**

1C. For a double integrator plant P(s) = $\frac{1}{s^2}$ and controller C(s) = $\frac{3s+1}{s+3}$ as shown in block diagram Fig Q1C. Find the various transfer functions and determine the internal stability of the system. **5**

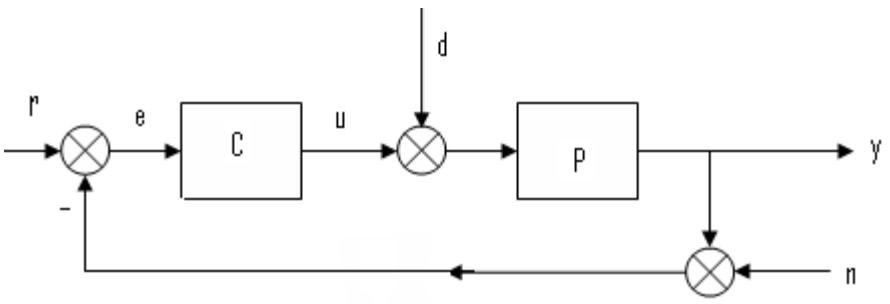

Fig. Q1C

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

2B. Consider the plant $P(s) = \frac{(s-3)(s+5)}{(s-10)(s+7)}$ 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. Given plant $G(s) = \frac{1}{(s-1)(s-2)}$ Prove Bezout Identity **5**

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

(i) $P(s) = \frac{s(s-4)}{(s+1)(s-1)(s-2)}$ (ii) $P(s) = \frac{(s-1)}{s^2 + 8s + 16}$

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

3C. Find the singular value decomposition of matrix $A=\begin{bmatrix}1 & 1\\ 2 & 0\end{bmatrix}$ **5**

4A. Find the inner and outer factorizations of $G(s)=\dfrac{(s-4)(s-8)}{(s+3)(s+5)}$ **2**

4B. In a position control system shown in fig Q4B 'a' ranges [3 5], 'T' ranges [0.05 0.25] and 'K' ranges [2 3]. Using Kharitonov theorem determine the stability of the system. **3**

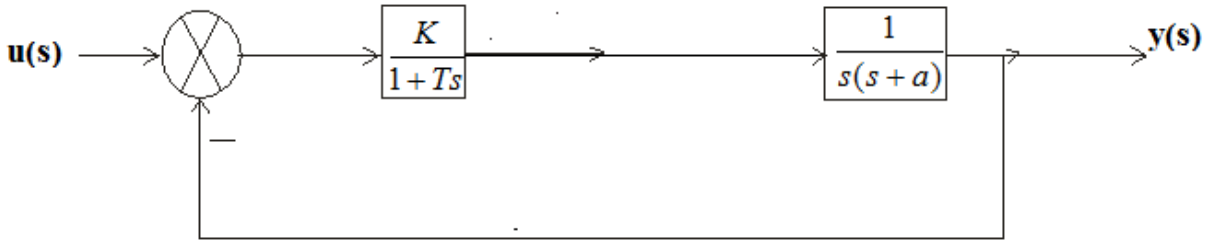

fig Q4B

4C. Determine the minimum model matching error for the plant $P(s)=\dfrac{s-1}{(s+1)(s-0.6)}$ and given $W_2=\dfrac{s+0.2}{s+2}$ **5**

5A. Find the spectral factorization of $G(s)=\dfrac{5(9-s^2)}{s^4+6s^2+25}$ **2**

5B. Find the infinity norm of $G(s)=\begin{bmatrix}\dfrac{3}{s+12}\\ \\ \dfrac{4}{s+2}\end{bmatrix}$ **3**

5C. Given plant P and weighting functions W_1 and W_2, enumerate the steps for solving this modified performance problem. **5**

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