Question Paper

Exam Date & Time: 28-Nov-2022 (09:00 AM - 12:00 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

SEVENTH SEMESTER B.TECH END SEMESTER EXAMINATIONS, ICE DEPARTMENT, NOV 2022

Robust Control [ICE 4053]

Marks: 50 **Duration: 180 mins.**

A

Answer all the questions.

Instructions to Candidates: Missing data may be suitably assumed

1) Find the general unity negative feedback control system block diagram shown in Fig.1A find (2)

A)

$$(i)\ \frac{y(s)}{d(s)} \qquad (ii)\ \frac{e(s)}{r(s)}$$

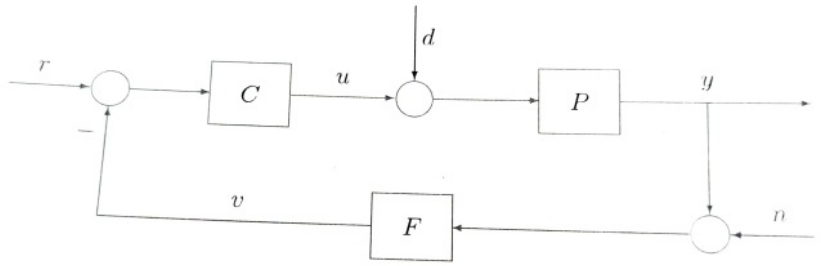

Fig.1A Control system block diagram

[CO1,PO1,PO2,BL1,BL2]

B) Write the steps for Euclid's Algorithm and prove the Bezout- Identity. (3)

[CO2,PO2,PO3,BL2,BL3]

C) Consider a plant (5)

$$P(s) = \frac{(s-1)}{}$$

$$(s-2)^2$$

and a controller

$$C(s) = \frac{X + MQ}{Y - NQ}$$

, find X, Y, M & N. Also, find 'Q' under the condition Y=1, reference input signal R=1 and disturbance d=0.

[CO3,PO4,PO5,BL4,BL5]

2) Using Parity Interlacing property comment on the compensator stability for the following transfer functions (2)

A)

$$(i)\ P(s) = \frac{s^2 - 3s + 2}{s^2 - 3.9s + 2.7}\ (ii)\ P(s) = \frac{s}{(s-1)^3}$$

[CO4,PO3,PO4,PO5,BL4,BL5]

B) Explain the properties of linear fractional transformation with its necessary equations. Also, write the state and output equations. [CO3,PO1,PO2,BL2,BL3] (3)

C) Briefly discuss on the Robust stability and Robust performance graphically using disc analysis. Also, summarize various perturbations and its condition. (5)

[CO4,PO1,PO2,BL2,BL4]

3) Illustrate the loop shaping techniques by summarizing the condition for weighting function W1 and loop transfer function L. [CO3,PO1,PO2,BL2,BL3] (2)

A)

B) Derive the weighting functions of W1 and W2 for advanced loop shaping techniques. (3)

[CO5,PO3,PO4,PO5,BL3,BL4]

C) Explain the controller design procedures for the P inverse stable and unstable processes with the help of filter J and improper transfer function Q [CO5,PO4,PO5,BL5,BL6] (5)

4) Find $F_{l(}$P,K) for the general unity feedback control with r, n and d signals with necessary linear fractional transformation diagram. [CO4,CO5,PO5,PO6,BL4,BL5] (2)

A)

B) Write the partition matrix structures for the following (3)

i. Full information problem.

ii. Disturbance feed-forward problem.

iii. Output estimation problem. [CO2,CO3,PO1,PO2,BL1,BL2]

C) Using a state space method obtain the coprime factorization of the plant (5)

$$P(s) = \frac{s - 1}{s(s - 2)}, \; given \; F = [-1 \; -3] \; \& L = [-4 \; -9]^{-1}$$

. Verify using Bezout's Identity.

[CO5,PO4,PO5,BL3,BL4,BL5]

5) Write the improper transfer function Q formula with the condition involving RHS zero and gamma. [CO4,PO5,PO6,BL3] (2)

A)

B) Address the model mismatch problem using gamma. [CO3,CO4,PO3,PO4,BL2] (3)

C) Derive for the solution for the modified problem involves transforming it into the model mismatch problem. [CO5,PO5,PO6,PO5,BL5] (5)

-----End-----