

Name :

Roll No. :

Invigilator's Signature :

CS / B.TECH (EE-NEW) / SEM-5 / EE-503 / 2010-11

2010-11

CONTROL SYSTEM-I

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

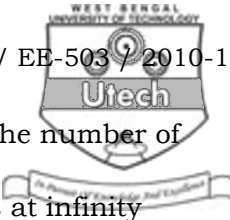
GROUP – A

(Multiple Choice Type Questions)

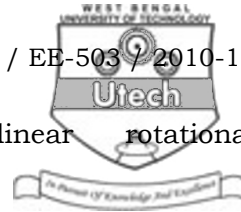
1. Choose the correct alternatives for any *ten* of the following :

$$10 \times 1 = 10$$

- i) The characteristic equation of a system is $s^2 + 2s + 2 = 0$. The system is
- a) critically damped
 - b) underdamped
 - c) overdamped
 - d) unstable.
- ii) Addition of a pole to the closed loop transfer function
- a) increases rise time b) decreases rise time
 - c) increases overshoot d) has no effect.



- iii) The type of transfer function denotes the number of
- a) zeros at origin b) poles at infinity
 - c) poles at origin d) none of these.
- iv) The phase lead compensation is used to
- a) increase rise time & decrease overshoot
 - b) decrease both rise time & overshoot
 - c) increase both rise time & overshoot
 - d) decrease rise time & overshoot.
- v) In torque-current analogy, displacement is analogous to
- a) flux b) moment of inertia
 - c) voltage d) current.
- vi) Phase margin of a system is used to specify
- a) time response b) frequency response
 - c) absolute stability d) relative stability.
- vii) The phase margin of the system $GH(j\omega) = \frac{1}{(1 + j\omega)^3}$ is
- a) $-\pi$ b) π
 - c) 0 d) $\pi/2$.



viii) The potentiometer converts linear displacement into rotational displacement into

- a) current b) power
- c) voltage d) torque.

ix) When a human being tries to approach an object, his brain acts as

- a) an error measuring device
- b) a controller
- c) an actuator
- d) an amplifier.

x) An AC servo motor is basically a

- a) universal motor
- b) single phase induction motor
- c) two phase induction motor
- d) three phase induction motor.

xi) A system has a pole at origin. Its impulse response will be

- a) constant b) ramp
- c) exponential d) oscillatory.



- xii) The natural frequency of oscillation of the output of the equation $\frac{d^2x}{dt^2} + 1.5 \frac{dx}{dt} + 4x = 1$ is

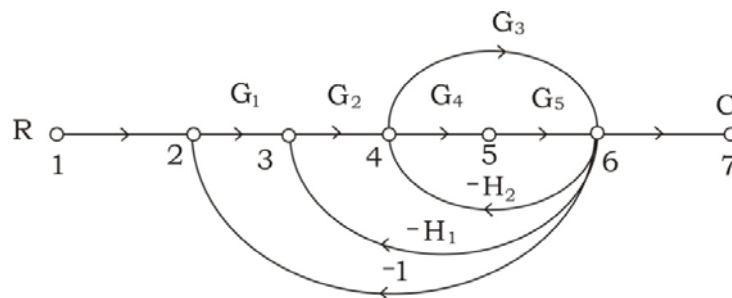
- a) 0 rad / sec b) 1.5 rad / sec
c) 2 rad / sec d) 4 rad / sec.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Find $\frac{C}{R}$ of the following signal flow graph using Mason's gain formula :

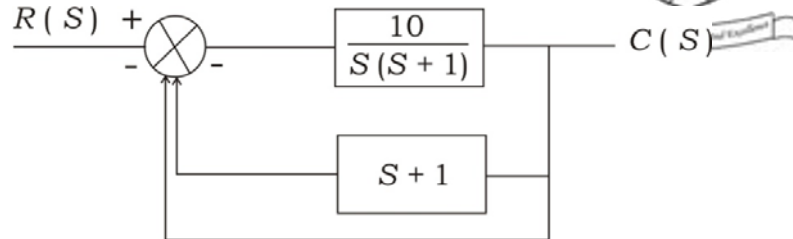


3. Using Routh criterion, determine the range of values of k for stability for the following system :

$$\frac{C(S)}{R(S)} = \frac{k}{S(S^2 + S + 1)(S + 4) + k}$$



4. For the system shown below



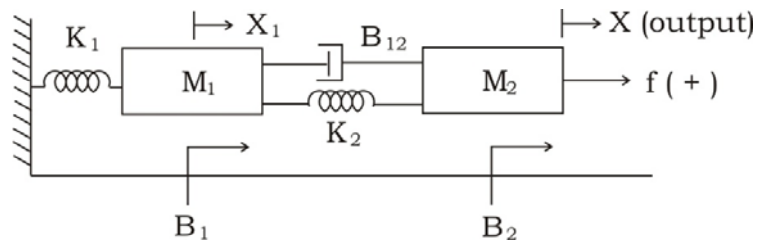
- find K_p, K_v, K_a
 - find steady state error for an input of $5t^2u(t)$.
 - state the system type number.
5. Derive the transfer function of armature controlled DC motor.
6. The open loop transfer function of a system with unity feedback gain is given as $G(S) = \frac{20}{S^2 + 5S + 6}$. Determine the damping ratio, maximum overshoot, rise time & peak time.

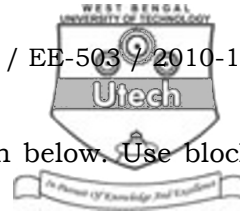
GROUP - C

(Long Answer Type Questions)

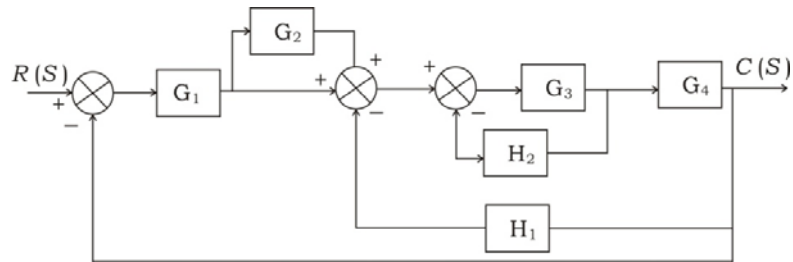
Answer any *three* of the following. $3 \times 15 = 45$

7. a) Obtain the transfer function of the mechanical system shown below :





- b) Find $\frac{C}{R}$ for the block diagram shown below. Use block diagram reduction techniques.



8 + 7

8. Draw the root locus for the unity feedback system whose open loop transfer function is $G(S) = \frac{k(S+1)}{(S-1)(S+2)(S+4)}$

Find the range of k for which the system is stable. Show all relevant steps of calculation.

9. Construct the Bode plots for a unity feedback system whose open loop transfer function is given by

$$G(S) = \frac{10}{S(1+S)(1+0.02S)}$$

From the Bode plot determine

- gain & phase Cross-over frequencies
- gain & phase margin
- stability of the closed loop system.



10. a) What is compensation ? What is compensated system ?
What is compensator ?

b) Write short note on P, PI & PID control. 6 + 9

11. a) State & explain Nyquist stability criterion.

b) Sketch polar plot for the unity feedback system with
open loop transfer function $G(S) = \frac{1}{S(S + 2)}$. 5 + 10

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