Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–IV EXAMINATION – WINTER 2015**

**Subject Code: 141701** **Date:01/01/2016**

**Subject Name: Control Theory**

**Time: 02:30pm to 05:00pm** **Total Marks: 70**

**Instructions:**

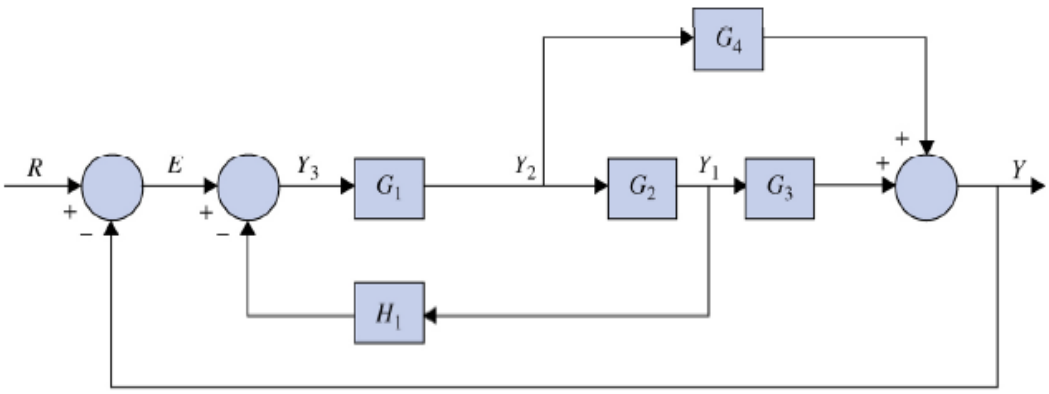
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

**Q.1** **(a)** Describe Correlation between transfer function and state-space equations with suitable examples **07**

**(b)** Explain force current analogy with suitable example. **07**

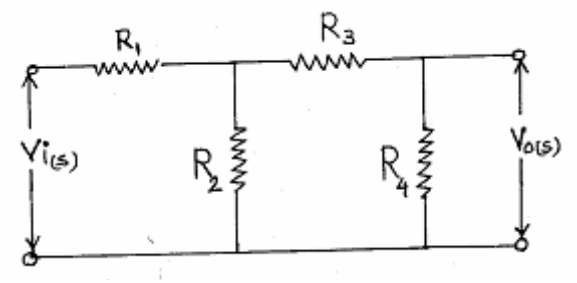
**Q.2** **(a)** Derive transfer function for a field controlled d.c.motor. **07**

**(b)** Determine close loop transfer function of the system shown below using block diagram reduction techniques. **07**

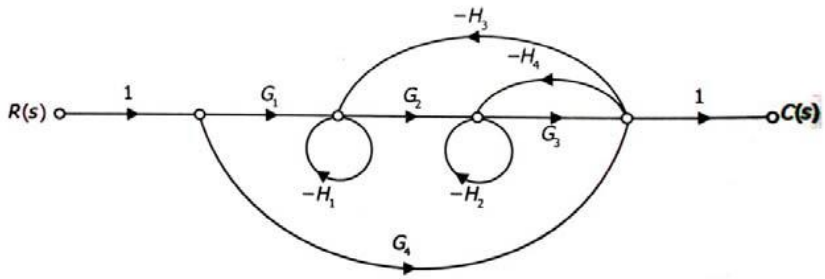



**OR**

**(b)** Find Transfer Function of given network in the following Figure **07**




**Q.3** **(a)** Determine the transfer function of the system with signal flow graph shown below: **07**



**(b)** Sketch the root loci of unity feedback control system on a graph paper using a suitable scale, whose open-loop transfer function is given below. Determine the range of gain for stability and the point at which it crosses the imaginary axis. Determine the value of gain K at the breakaway point. **07**

$$G(s) = \frac{K}{s(s+1)(s^2+4s+5)}$$

**OR**

**Q.3** **(a)** Explain the concept of linearity and time invariance in the context of control systems. Give definition of transfer function and explain the same. State any three advantages of closed loop systems over open loop control systems. **07**

**(b)** Write a short note on thermal system, its modeling and analysis for two different inputs. **07**

**Q.4** **(a)** A unity Feedback system has open loop Transfer Function, **07**
G(s)H(s)= K (S+2) / S(S-2)( S2+ 4 S+16 ). Obtain its Root Locus.

**(b)** The characteristic equation of Feedback control system is **07**
$S^4+20S^3+15S^2+2S+K=0$ .
(1) Determine range of K for system stability.
(1) Can the system be marginally stable ? If so, find the required value of K and Frequency of sustained oscillations.

**OR**

**Q.4** **(a)** Define Following Terms **07**
(1) Transfer Function (2) State (3) Self Loop (4) Source Node
(5) Rise Time (6) Settling Time (7) Peak Time

**(b)** A system has following transfer Function C(s) /R(s) =10 / S+5. Determine its unit impulse, step and ramp response with zero initial conditions. Sketch the response. **07**

**Q.5** **(a)** Explain with suitable example, one method for linearization of nonlinear mathematical model. **07**

**(b)** An open loop transfer function of a system is given by **07**

$$G(s) = \frac{1}{(s+1)^3}$$

Prepare Nyquist plot for it.

**OR**

**Q.5** **(a)** Sketch Bode plot for the transfer function **14**

$$G(s) = \frac{(s+1)(s+2)}{s^2(s+3)(s^2+2s+25)}$$

Determine there from gain margin and phase margin.

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