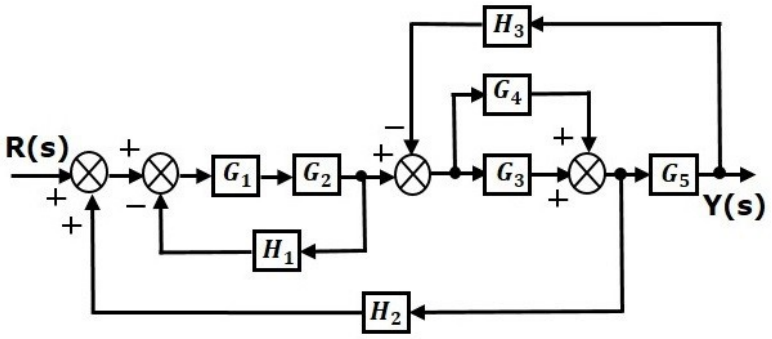
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2018

Course: Control system Engineering, ELEG 273 **Semester: IV**
Program: B.Tech Electrical
Time: 03 hrs. **Max. Marks: 100**

Instructions: Attempt all question, all questions are compulsory.

SECTION A

S. No.		Marks	CO
Q 1	A closed loop system when subjected to a unit step input has an expression for the time response given by $c(t) = 0.5 + 2.25\ e^{-4t} - 3.75\ e^{-15t}$ Determine the overall transfer function of the system.	**5**	**CO1**
Q 2	Define the role of PI controller cascaded with plant transfer function in terms of stability and steady state error.	**5**	**CO5**
Q 3	Derive the transfer function representation from the generalized state space model.	**5**	**CO4**
Q 4	Describe the gain margin and phase margin from sinusoidal response of system.	**5**	**CO3**
	SECTION B		
Q 5	A positional control system has a damping ratio of 0.6. The damped frequency of oscillations is 8 Hz. Derive an expression relating the output and the time when the input is suddenly changed from 0 to θ_r and calculate the percentage maximum overshoot.	**10**	**CO2**
Q 6	The overall transfer function of a unity feedback control system is given by $G(s) = \frac{10}{s^2 + 6s + 10}$ Find (a) K_p, K_v and K_a (b) Determine the steady state error if the input is $r(t) = 1 + t + t^2$	**10**	**CO2**
Q 7	A linear time-invariant system is characterized by the homogeneous state equation, $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ 0 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$ Compute the solution of the homogeneous equation assuming the initial state vector, $x(0) = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$	**10**	**CO5**
Q 8	Determine the transfer function Y/R for the block diagram below by signal flow graph technique	**10**	**CO 1,2**

			
SECTION-C			
Q 9	The open loop transfer function of a control system is given by $G(s)H(s)=\frac{K}{s(s+4)(s^2+4s+13)}$ (-4.2 is one of root of dk/ds equation) Sketch the root locus and determine: (a) The angle of departure from complex poles (b) The stability condition	**20**	**CO3**
Q 10	The open loop transfer function of a unity feedback control system is given by $G(s)=\frac{K}{s(1+0.5s)(1+0.2s)}$ It is desired that (i) For a unit step input the steady state error of the output position be less than 0.125 degrees/(degree/second) (ii) P.M. $\geq 40^0$. Design a suitable compensation network.	**20**	**CO5**