Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, May 2019

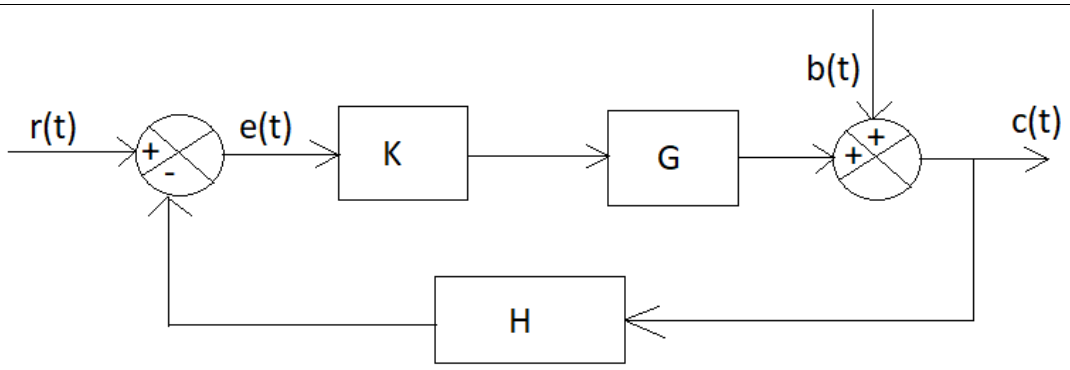
Programme Name: B.Tech. Mechanical | **Semester : VIII**
Course Name : Automatic Control | **Time : 03 hrs**
Course Code : MECH4005 | **Max. Marks : 100**
Nos. of page(s) : 02
Instructions: Assume any missing data.

SECTION A

S. No.		Marks	CO
Q 1	Describe the procedure to perform the frequency response analysis of a control system.	**5**	**CO1**
Q 2	Derive the general expression for output, *c(t)* from a typical feedback system having inputs- *r(t)* and *b(t)*. The controller gain may be taken as K in general and the feedback system is designed for a system with transfer function: $\frac{1}{I D^2+aD}$ where D represents $\frac{d}{dt}$.	**5**	**CO2**
Q 3	Discuss the concept of stability of control systems.	**5**	**CO3**
Q 4	A system is having the characteristic equation: $s^3-4s^2+s+6=0$. Using Routh's criterion state whether the system is stable or unstable. Find out the roots of the equation mathematically and then interpret your results.	**5**	**CO3**

SECTION B

Q 5	Draw a typical polar plot for closed loop frequency for a first order system. Assume the parameters of the control system yourself.	**10**	**CO1**
Q 6	Describe the rectangular plot for a second order system.	**10**	**CO1**
Q 7	a) For the system shown in Fig. 1 below, find out the steady state error due to unit ramp reference input. Take ¿ $\frac{50}{D+5}$, $G=\frac{1}{D(D+10)}$, b(t) = 0 and H = 1.	**10**	**CO2**

	 Fig. 1: A closed loop system **OR** b) If in the closed loop system shown in Fig. 1, a feedback loop transfer function, $H=1+0.1D$ is added, then find the steady state error due to the unit ramp reference input. Take ¿ $\frac{50}{D+5}$, $G=\frac{1}{D(D+10)}$ and b(t) = 0.		
Q 8	Describe the mathematical model of a field-controlled DC motor.	**10**	**CO2**
	SECTION-C		
Q 9	a) Consider the diagram shown in Fig. 1. Taking K = 25, b(t) = 0 and $G=\frac{1}{D(D+2)}$, determine the peak value of 'M'. Corresponding to double the value of peak 'M' as found above, what would be the value of gain 'K'. Draw the polar plot also for the first case. **OR** b) Prepare the Nyquist plot for a control system with open loop transfer function of $GH(s)=\frac{50}{(1+0.2s)(s^2+10s+20)}$ and find if the system is stable or not.	**20**	**CO4**
Q 10	Analyze the following speed control system for a unit step input with following parameters: Load inertia = 10,000 kg cm^2 Load viscous damping coefficient = 0.05 cm kg/rad/sec Motor inertia = 10 kg cm^2 Gear reduction ratio from motor to load = 30 Torque constant = 10 cm kg/ampere of armature current Motor back emf constant = 1.0 volt/rad/sec Motor armature resistance = 25 ohm Amplifier gain = 200 Comparator constant = 1 volt/rpm of motor speed Draw a clear block diagram and derive the transfer function. Identify the reference variable for your system.	**20**	**CO5**