U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

July 2023 Semester End Main Examinations

Programme: B.E. **Semester: VI**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 20ME6DCCOE / 16ME6DCCOE **Max Marks: 100**
Course: Control Engineering **Date: 22.07.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	In a nuclear power generating plant, heat from a reactor is used to generate steam for turbines. The rate of the fission reaction determines the amount of heat generated, and this rate is controlled by rods inserted into the radioactive core. The rods regulate the flow of neutrons. If the rods are lowered into the core, the rate of fission will diminish; if the rods are raised, the fission rate will increase. By automatically controlling the position of the rods, the amount of heat generated by the reactor can be regulated. Draw a functional block diagram for the nuclear reactor control system shown in Figure 1a. Show all blocks and signals.	*CO1*	*PO1*	**10**

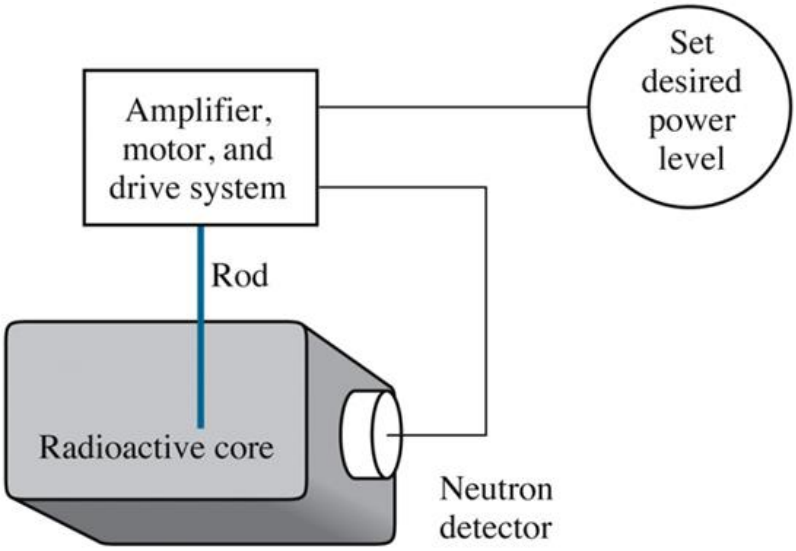
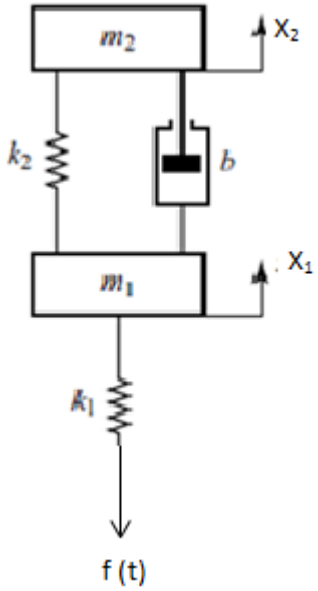


Figure 1a

		b)	Obtain the transfer function for the system shown in Figure 1b.  Figure 1b	*CO2*	*PO2*	**10**
			OR			
	2	a)	Obtain the transfer function of an armature-controlled DC servo motor.	*CO2*	*PO2*	**10**
		b)	Obtain the state-space representation for the system shown in Figure 1b.	*CO2*	*PO2*	**10**
			UNIT - II			
	3	a)	Consider a unity feedback system with closed loop transfer function of the plant is $1/(s^3+3s^2+5s+2+K)$. When the system will become marginally stable and what is the corresponding frequency of oscillation.	*CO4*	*PO2*	**10**
		b)	Consider the second-order system with transfer function $\omega_n^2/(s^2+2\zeta\ \omega_n s+\ \omega_n^2)$. Assume that the requirements for the system unit-step response are overshoot $Mp \leq 20\%$ and 2% settling time $t_s \leq 2$ s. Sketch the allowable region for the poles in the *s*-plane.	*CO3*	*PO2*	**10**
			OR			
	4	a)	Find the steady state errors for unity feedback systems with plants of different types and for different inputs. <table><tr><td>Input</td><td>Type 0</td><td>Type 1</td><td>Type 2</td><td>Type 3</td></tr><tr><td>step</td><td></td><td></td><td></td><td></td></tr><tr><td>ramp</td><td></td><td></td><td></td><td></td></tr><tr><td>parabola</td><td></td><td></td><td></td><td></td></tr></table>	*CO3*	*PO2*	**12**
		b)	Find the unit step response for the transfer function $G(s) = \frac{s+10}{s^2+2s+5}$.	*CO3*	*PO2*	**08**

			UNIT - III			
	5		Sketch the root locus for open loop transfer function K/[(s+1)(s+2)(s+4)] showing the salient points.	*CO4*	*PO2*	**20**
			UNIT - IV			
	6		Draw the bode plots for a unity feedback system with open loop transfer function G(s) = 40/[(s+2)(s+4)(s+5)].	*CO4*	*PO2*	**20**
			UNIT - V			
	7	a)	Sketch the Nyquist diagram for the open loop transfer function 20(s+3)/[s(s+1)(s+4)] and comment on stability.	*CO5*	*PO2*	**10**
		b)	Draw the polar plot for G(s) = 1/[(s+2)(s+4)].	*CO5*	*PO2*	**10**

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