Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, May 2019

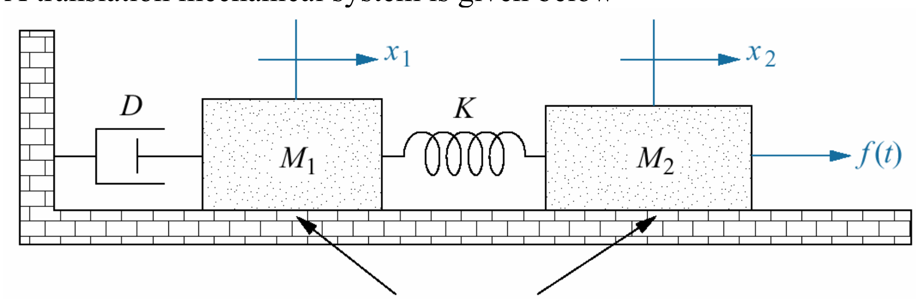
Programme Name: B. Tech. - ICE — **Semester : VIII**
Course Name : Optimal & Adaptive control — **Time : 03 hrs**
Course Code : ICEG 412 — **Max. Marks : 100**
Nos. of page(s) : 2
Instructions: All Questions are compulsory

SECTION A

S. No.		Marks	CO
Q 1	Which approach you will opt for trajectory control and why?	**4**	**CO2**
Q.2	Discuss the role of artificial intelligence for adaptive control.	**4**	**CO1**
Q.3	Write down the cost function for output regulator problem with significance of each weight matrix.	**4**	**CO3**
Q.4	Differentiate hard constraint & soft constraint for optimal control approach with example.	**4**	**CO2**
Q.5	Present the five practical example for adaptive control approach.	**4**	**CO4**

SECTION B

S. No.		Marks	CO
Q .6	Devise the performance index for minimum deviation of state about C with minimun control effort also consider the final state and final time as felxible and initial state and initial time as fixed boundaries.	**10**	**CO3**
Q.7	Explain MRAC adaptive control schema and discuss the advantage over self-tuning adaptive control.	**10**	**CO4**
Q.8	Given the linear continuous-time system $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix}=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ 0 & -2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}=\begin{bmatrix}0\\ 0\\ 1\end{bmatrix}u$ $y=\begin{bmatrix}3 & 4 & 1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}$ Check the observability of the system.	**10**	**CO1**
Q.9	Sketch a schematic diagram of a speed control system using the following units: motor, tacho-generator, A/D convertor, digital computer, D/A converter and power amplifier. Explain the function of each section of the diagram.	**10**	**CO2**

	SECTION-C		
Q .10	Consider a system with the state equation given below $\dot{x}_1(t)=x_2(t)\dot{x}_2(t)=u(t)$ Determine optimal u(t) and x(t) such that P.I.; $J=\frac{1}{2}\int_{t_0}^{t_f} u^2(t)\,dt$ is minimum Boundary condition are $x(0)=[x_1(0)\,x_2(0)]'=[1\,2]$ $x(2)=[x_1(2)\,x_2(2)]'=[0\,0]$ **OR** Write the Euler-Lagrange equation when F is given by (a) $F(\alpha,\beta,\gamma)=\sin\beta$, (b) $F(\alpha,\beta,\gamma)=\alpha^3\beta^3$, (c) $F(\alpha,\beta,\gamma)=\alpha^2-\beta^2$, (d) $F(\alpha,\beta,\gamma)=2\gamma\beta-\beta^2+3\beta\alpha^2$.	**20**	**CO3,4**
Q.11	A translation mechanical system is given below  Form the free body diagram, and select velocity & acceleration of position x_1, x_2 as state variables. Derive the state space model for the selected state variables.	**20**	**CO2**

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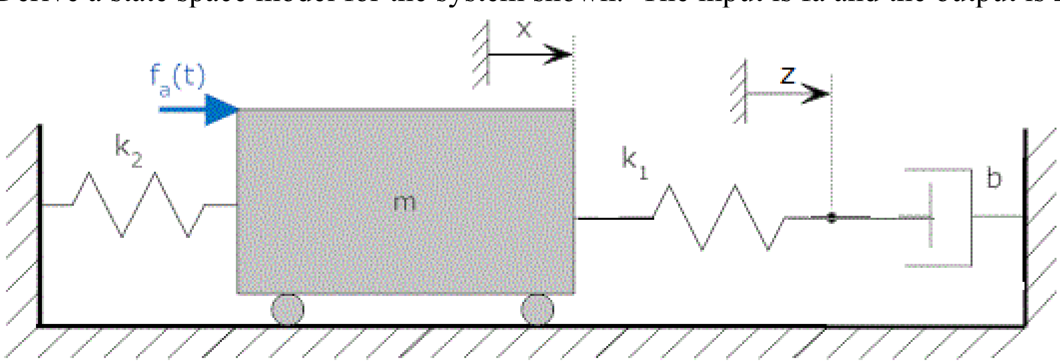
SECTION A

S. No.		Marks	CO
Q 1	Discuss the significance of controllability and observability in designing LQR solution.	4	CO1
Q.2	Present the five practical example for optimal control approach.	4	CO2
Q.3	Write down the cost function for state regulator problem with significance of each weight matrix.	4	CO3
Q.4	Give the state and co-state equation derive from Hamiltonian function.	4	CO3
Q.5	Name the four estimation methods for adaptive control.	4	CO4

SECTION B (Attempt any three question)

Q .6	Design the flow chart of parameter estimation method for adaptive control.	10	CO4
Q.7	Derive the 'Euler-Lagrange' equation for a 'fixed end' problem	10	CO2
Q.8	Given the linear continuous-time system $$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix}=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ 0 & -1 & -2\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}=\begin{bmatrix}0\\ 0\\ 1\end{bmatrix}u$$ $$y=\begin{bmatrix}2 & 4 & 1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}$$ Check the controllability of the system.	10	CO1
Q.9	Devise the performance index for minimum deviation of state about C with minimun control effort also consider the final state and time as felxible and initial state and time as fixed	10	CO3

	boundaries.		
	SECTION-C		
Q .10	Consider a system with the state equation given below $\dot{x}_1(t)=x_2(t)\dot{x}_2(t)=u(t)$ Determine optimal u(t) and x(t) such that P.I.; $J=\frac{1}{2}\int_{t_0}^{t_f} u^2(t)dt$ is minimum Boundary condition are $x(0)=[x_1(0)x_2(0)]'=[12]$ $x(2)=[x_1(2)x_2(2)]'=[0 free]$ OR Find critical curves for the following functions (a) $I(x)=\int_0^{\frac{\pi}{2}}[(x(t))^2-(x'(t))^2]\,dt,\ x(0)=0$ and $x\left(\frac{\pi}{2}\right)$ is free. (b) $I(x)=\int_0^{\frac{\pi}{2}}[(x(t))^2-(x'(t))^2]\,dt,\ x(0)=1$ and $x\left(\frac{\pi}{2}\right)$ is free.	**20**	**CO3,4**
Q.11	Derive a state space model for the system shown. The input is fa and the output is z.  	**20**	**CO 2**