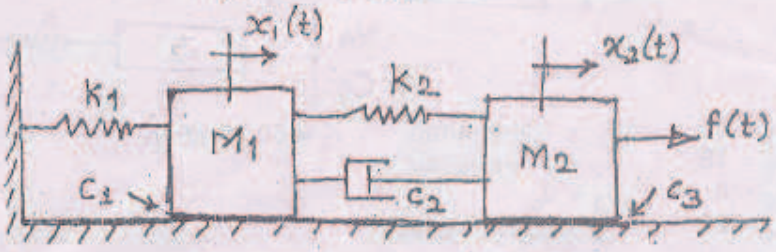
http://www.howtoexam.com

(3) Draw neat sketches wherever necessary.
(4) Figures to the right indicate full marks.
(5) Assume suitable data, if necessary.

M·E(M) ME Design Sem II PTDE System Modelling & Analysis 7/10/10E

1. (a) Explain pointwise, with the help of a field problem, "Dynamic System Modeling and Analysis". 10

(b) Find the Transfer functions $\frac{X_1(s)}{F(s)}$ and $\frac{X_2(s)}{F(s)}$ 10



where,

$K_1 = 2$ N/m $\quad C_1 = 2$ N-s/m $\quad M_1 = 2$ kg
$K_2 = 3$ N/m $\quad C_2 = 1$ N-s/m $\quad M_2 = 3$ kg.
$C_3 = 2$ N-s/m

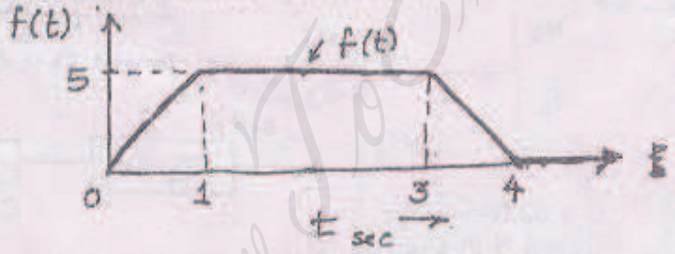
2. (a) Define : Dynamic System, Lumped or Discrete System, Linear Time Invariant Model. 6

(b) Find $L^{-1}\left\{\frac{1}{s^2(s+1)}\right\}$ 9

using : (i) Integration Theorem
(ii) Partial Fraction Method
(iii) Convolution Method.

(c) The governing equation for a mechanical system is $\ddot{x} + 2\dot{x} + x = f(t)$, where x represents the displacement and f the applied force. Initial conditions are $x(0) = 0$ and $\dot{x}(0) = 2$. Assuming the applied force is a unit-step function find the response. Decide whether Final Value Theorem applies to X(s). If so, find the final value of x(t). 5

3. (a) Consider a complex time function as shown below : 6



Express f(t) as a linear combination of step functions and therefrom determine its Laplace Transform. Confirm your answer from Laplace transform taken directly.

(b) Find out the time response for underdamped vibrations of a spring-mass-damper system where initial conditions for displacement and velocity are zero and excitation force is constant. Use L.T. method only. Interprete the answer. 10

OR

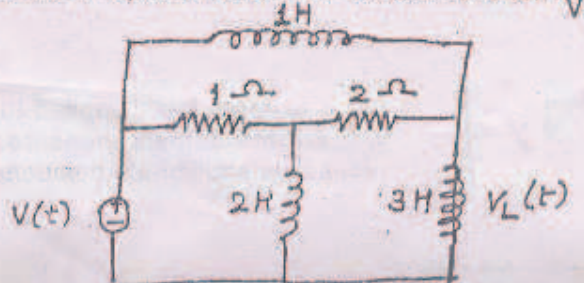
(b) Write a note on Dynamic Modelling (Mathematical) of liquid level systems having two tanks in series. 10

(c) Relate various parameters of a mechanical system to analogous electrical system using voltage-force analogy. Name the law governing each system. 4

4. (a) *Find equivalent spring constant in case of springs working in parallel and in series.* 4

(b) *Tabulate for R-L-C circuit, the relationships between voltage-current, current-voltage, voltage-charge* and write Impedance and Admittance for each of the passive element. Write the units consistent for various terms. 6

(c) Write the Mesh equations and find transfer function $\frac{V_L(s)}{V(s)}$. 10



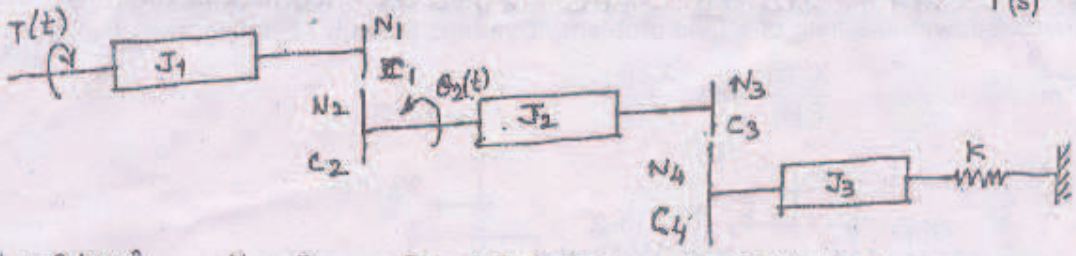
http://www.howtoexam.com

[TURN OVER

http://www.howtoexam.com

Systems. Write the consistent units for various terms involved.

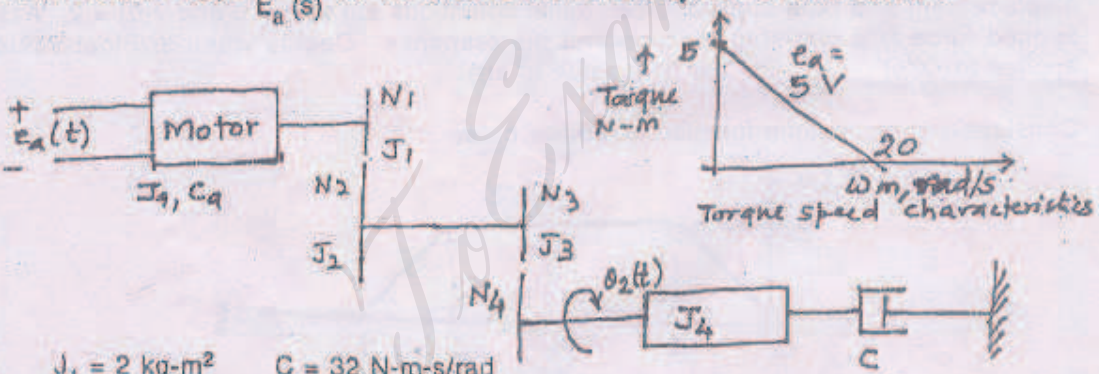
(c) Find transfer function for the gear train shown below. Transfer function $G(s)=\frac{Q_2(s)}{T(s)}$. 10



$J_1 = 2$ kgm^2 $N_1 = 5$ $C_1 = 1$ N-m-s/rad $K = 60$ N-m/rad
$J_2 = 4$ kgm^2 $N_2 = 15$ $C_2 = 2$ N-m-s/rad
$J_3 = 8$ kg-m^2 $N_3 = 5$ $C_3 = 0$
$N_4 = 20$ $C_4 = 20$ N-m-s/rad

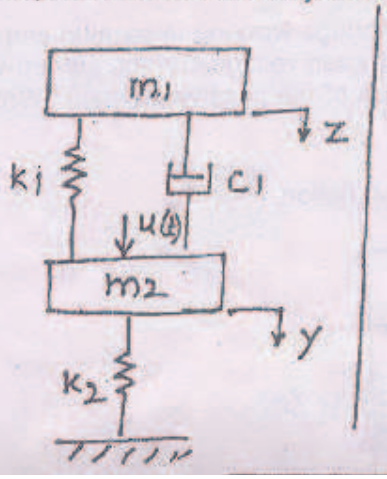
6. (a) Analyses for time response of temperature of a metal block suddenly placed in hot liquid bath of constant temperature T_∞. 8
Determine temperature constant.
Substitute the following values on the final derivation to get the time constant.
Block : sphere
Diameter : 9 cms
Density.= 9000 kg/m^3
Specific heat = 0·4 kJ/kg, °C
Thermal conductivity = 380 W/m, °C
Convective Heat Transfer Co-efficient = 25 W/m^2, °C.
Is it valid to use lumped parameter model ? Justify.

(b) Find transfer function $G(s)=\frac{Q_2(s)}{E_a(s)}$ for the electromechanical system shown below : 12



$N_1 = 10$ $J_1 = 2$ kg-m^2 $C = 32$ N-m-s/rad
$N_2 = 20$ $J_2 = 4$ kg-m^2 $C_a = 8$ N-m-s/rad
$N_3 = 10$ $J_3 = 4$ kg-m^2 $e_a(t) = 5$ V
$N_4 = 20$ $J_4 = 16$ kg-m^2
$J_a = 1$ kg-m^2

7. (a) Compare state space approach with T.F. approach in the modelling of Dynamic Systems. 5
(b) Define : 5
State of Dynamic System
State variable
State-space
State equations
Output equation.
(c) Obtain state space Representation for the system shown below : 10



u(t) = external force applied to mass m_2.
y, z are the outputs measured from the respective equilibrium positions.

http://www.howtoexam.com