BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BE **SEMESTER : VII**
BRANCH: MECH **SESSION : MO/18**

SUBJECT: EE3201 INTRODUCTION TO SYSTEM THEORY

TIME: 3 HRS. **FULL MARKS: 60**

INSTRUCTIONS:
1. The question paper contains 7 questions each of 12 marks and total 84 marks.
2. Candidates may attempt any 5 questions maximum of 60 marks.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

Q.1(a) Define and explain the following: (i) Causal system (ii) non causal System. [2]

Q.1(b) Check whether the system is time variant or time invariant. [4]

$$y(n) = x(n+1) - x(n-1)$$

Q.1(c) Plot the following waveforms approximately to scale: [6]
(i) $e^{-2t}u(t)$ (ii) $e^{-2t}u(t-1)$ (iii) $e^{-2(t-1)}u(t)$ (iv) $e^{-2(t-1)}u(t-1)$

Q.2(a) List the advantages of analogous systems. [2]

Q.2(b) Derive the transfer function of the system shown in Fig. 1. [4]

Q.2(c) Draw the electrical analog circuit of the system given in Fig. 2, using both F-V and F-I analogy. Write the equilibrium equations of the system. [6]

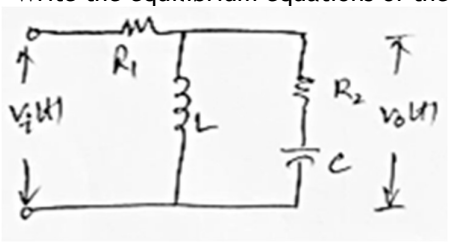

FIG.1

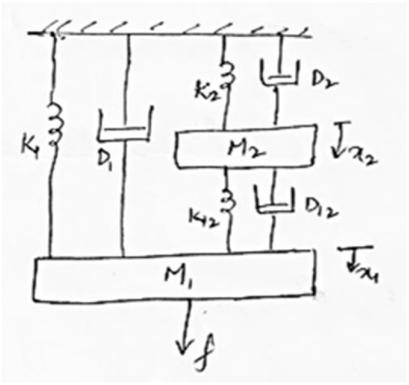

FIG.2

Q.3(a) Mention Dirichlet's conditions for a function to be Fourier transformable. [2]

Q.3(b) Differentiate between Fourier series and Fourier transform. Mention the limitations of Fourier transform. [4]

Q.3(c) Obtain the Fourier transform of the signal $x(t) = e^{-|t|}$ and sketch the magnitude and phase spectrum. [6]

Q.4(a) State and prove the final value theorem. [2]

Q.4(b) Solve the following differential equation using Laplace transform [4]

$$\ddot{y} + 4\dot{y} + 3y = 3, y(0) = \dot{y}(0) = 0$$

Q.4(c) Obtain the inverse Laplace transform of the function given by [6]
(i) $F(s) = \frac{(s+3)e^{-s/2}}{s^2+4s+9}$ (ii) $F(s) = \frac{s}{s^2+5s+4}$

Q.5(a) Draw the pole zero configuration of the system given by [2]

$$T(s) = \frac{5(s+3)(s+5)}{s(s+2)(s+10)}$$

Q.5(b) Differentiate between natural and forced response. [4]

Q.5(c) A rectangular voltage pulse of unit height and duration T is applied to a series R-C combination at t=0. Determine the voltage across the capacitance C as a function of time. Assume R=10kΩ and C=10μF. [6]

Q.6(a) Differentiate between absolute stability and relative stability of a system. [2]

Q.6(b) What is meant by BIBO stability? Explain and prove. [4]

Q.6(c) Examine the stability of the system whose characteristic function is given by $s^5 + 2s^4 + 2s^3 + 4s^2 + 4s + 8 = 0$using R-H criteria. [6]

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Q.7(a) Define (i) state (ii) state variables. [2]

Q.7(b) Determine the transfer function for the system whose state model is given by [4]

$$\dot{X} = \begin{bmatrix} 0 & 1 \\ -3 & -2 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u; y = [1 \quad 0] X$$

Comment on stability of the system.

Q.7(c) Obtain the three different forms of state model for the system given by [6]

$$\dddot{y} + 3\ddot{y} + 2\dot{y} = \dot{u} + u$$

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