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

CLASS: BE **SEMESTER : VII**
BRANCH: MECH **SESSION : MO/19**

SUBJECT: EE3201 INTRODUCTION TO SYSTEM THEORY

TIME: 3:00 HOURS **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.

Q1. (a) Define the following terms : deterministic system, causal system. [2]

Q1. (b) Sketch the following signals: [4]

(i) u(-t+1) (ii) r(t)u(2-t) (iii) r(-0.5t+2) $(iv)\ x_1(t) = r(t-1) + r(t-3)$

Q1. (c) Check whether the following system in linear/nonlinear and time variant/time invariant. [6]

$$y(t)\frac{d^2y(t)}{dt^2} + 5t^2\frac{dy(t)}{dt} + y(t) = x(t)$$

Q2. (a) Discuss the significance of analogous systems. [2]

Q2. (b) Establish the analogy between electrical and mechanical systems using F-V and F-I analogy. [4]

Q2. (c) Draw the electrical analog of the mechanical system shown in Fig. 1 both in F-V and F-I analogy. Write the equation of mechanical system. [6]

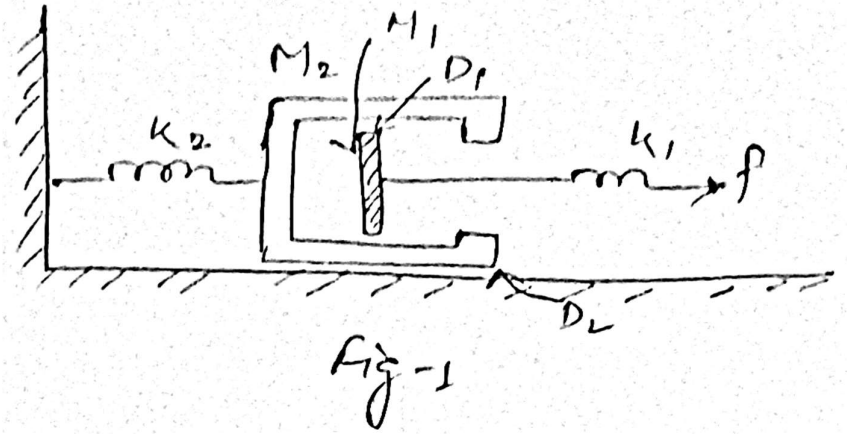

Fig-1

Q3. (a) Mention Dirichlet conditions for a function to be Fourier transformable. [2]

Q3. (b) Find the inverse Fourier transform of $X(j\omega) = \dfrac{1}{(j\omega)^2 + 3j\omega + 2}$ [4]

Q3. (c) Determine the Fourier transform and amplitude spectrum of the function given by $f(t) = e^{-a|t|}$ for all values of t. [6]

Q4. (a) State and prove convolution theorem. [2]

Q4. (b) Obtain the inverse Laplace transform of function $F(s) = \dfrac{1}{(s+1)^2(s+4)}$. [4]

Q4. (c) A voltage Ee^{-at} is applied at $t=0^+$ to a circuit of inductance L and resistance R in series. Show that the current at time t is given by [6]

$$i(t) = \frac{R}{R-aL}\left[e^{-at} - e^{-Rt/L}\right]$$

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Q5. (a) What do you understand by the order of a differential equation? [2]

Q5. (b) For a second order system, $\xi = 0.5$ and $\omega_n = 10$rad/sec. Obtain the rise time, peak time, maximum overshoot and settling time. [4]

Q5. (c) Illustrate with the help of examples clearly, what is meant by free response and forced response of a given system? [6]

Q6. (a) Differentiate between absolute stability and relative stability. [2]

Q6. (b) Check whether or not the system has oscillatory roots. For what values of K will the system is stable $s^5 + s^4 + 4s^3 + 3s^2 + 6s + K = 0$? [4]

Q6. (c) The open loop transfer function of a unity-feedback system is $G(s) = \dfrac{K(s+3)(s+5)}{s(s+4)(s+10)}$. Determine the value of K for which the closed loop system will be stable. [6]

Q7. (a) Discuss the advantages of state variable approach over transfer function approach for analysis of a system. [2]

Q7. (b) What is state transition matrix? What is its importance? Mention its properties. [4]

Q7. (c) Obtain the three different forms of state model for the system given by [6]

$$\dddot{y} + 6\ddot{y} + 11\dot{y} + 6y = 8u$$

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