भारतीय सूचना प्रौद्योगिकी संस्थान कोटा
INDIAN INSTITUTE OF INFORMATION TECHNOLOGY KOTA

B.Tech. (ECE), Semester – IV
Mid Term Examination, Even Semester 2023-24

Control Systems (ECT210)
Marks: 30 (Weightage – 30%) **Time: 90 minutes** **Date: March 22, 2024**

Note: Attempt all question and their parts in sequence. Show all the steps.

Q1. Define following terms for a closed-loop control system - controlled variable, manipulated variable, plant, disturbance. [1×4 = 4M]

Q2. Mention six important differences between open-loop and closed-loop control systems. [3M]

Q3. Derive the system sensitivity for open-loop and closed-loop control systems. Also mention how system sensitivity is helpful in design of accurate open-loop and closed-loop control systems.

[2+2 = 4M]

Q4. Identify the type of control system (open-loop, closed-loop) for following (Any 6)

(a) Conventional pressure cooker, (b) Screensaver in laptop, (c) Conventional bread toaster, (d) Boiling process of milk in household kitchen, (e) Conventional washing machine, (f) Elevator at Prabha Bhavan, (g) Escalator in shopping mall, (h) Dessert air cooler, (i) Student-teacher learning process, (j) Car moving on national highway, (k) Conventional microwave oven, (l) Split air conditioner. [0.5×6 = 3M]

Q5. The following differential equation represent linear time-invariant systems, where r(t) denotes the input and y(t) the output. (assume zero initial conditions)

$$\frac{d^3y(t)}{dt^3}+2\frac{d^2y(t)}{dt^2}+\frac{dy(t)}{dt}+2y(t)+2\int_{-\infty}^{t} y(\tau)d\tau=\frac{dr(t-2)}{dt}+2r(t-2)$$

(i) Find the transfer function Y(s)/R(s) for the system.

(ii) Draw detailed constant feedback based closed-loop system to obtain the transfer function Y(s)/R(s). [3+2 = 5M]

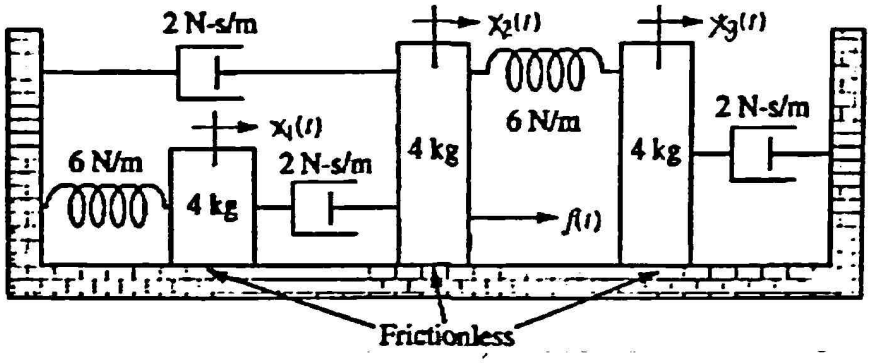
Q6. For a given system, we have following transfer function.

$$Y(s)=\frac{4(s+50)}{s^2+30s+200}R(s)$$

(i) If r(t) is a unit step input, find the output y(t).

(ii) Using final value theorem, determine the final value of y(t). [3+2 = 5M]

Q7. Find the transfer function, $G(s) = X_3(s)/F(s)$, for the translational network shown in figure below. Also draw the analogous electrical circuits using force-voltage analogy. [3+3 = 6M]



*** *Be Good, Do Good* ***