CBCS SCHEME

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17ME73

Seventh Semester B.E. Degree Examination, Jan./Feb. 2023
Control Engineering

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Define the terms system and control system with an example. **(04 Marks)**

b. Explain open loop and closed loop systems with an example. **(08 Marks)**

c. What are the requirements of a control system? Explain them briefly. **(08 Marks)**

OR

2 a. Draw the block diagram of proportional plus derivative (PD) controller and explain its effect on the system. **(10 Marks)**

b. Draw the block diagram of proportional plus derivative plus integral (PID) controller and explain its effects on the system. **(10 Marks)**

Module-2

3 a. Write the equilibrium equations for the mechanical system shown in Fig.Q3(a), hence obtain the F – I system.

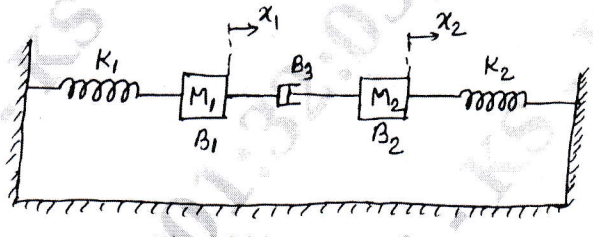

Fig.Q3(a) **(10 Marks)**

b. Derive the transfer function of liquid level system with interaction. **(10 Marks)**

OR

4 a. Reduce the block diagram shown in Fig.Q4(a) and obtain C(s)/R(s).

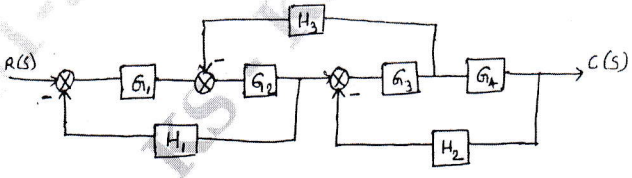

Fig.Q4(a) **(10 Marks)**

b. Find the transfer function by using Mason's gain formula for the signal flow graph shown in Fig.Q4(b).

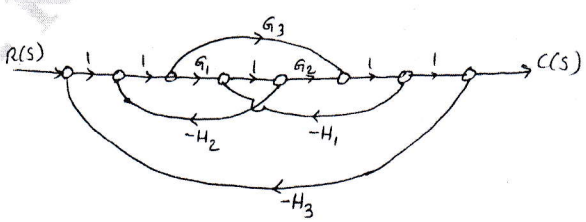

Fig.Q4(b) **(10 Marks)**

Module-3

5 a. Obtain an expression for response of first order system for Ramp input. **(06 Marks)**

b. Determine the damping ratio and natural frequency for the system whose maximum overshoot value is 0.2 and peak time is 1 sec. **(06 Marks)**

c. State whether the system is stable or unstable by using Routh's Criteria.
$s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$. **(08 Marks)**

OR

6 For a unity feedback system,

$$G(s)H(s) = \frac{k}{s(s+2)(s+4)}$$

Sketch the rough nature of the root locus, showing all details on it. **(20 Marks)**

Module-4

7 a. Plot the polar plot of given transfer function :

$$G(s)H(s) = \frac{1}{s(1+3s)}.$$ **(06 Marks)**

b. For a Certain control system :

$$G(s)H(s) = \frac{S}{(s+1)(s+2)(s+3)}$$

Sketch the Nyquist plot and comment on stability. **(14 Marks)**

OR

8 Construct bode diagram for a feedback control system having its open loop transfer function

$$G(s)H(s) = \frac{100(10s+1)}{s(s+0.4)(s+1)(s+10)}$$

Also determine gain margin and phase margin. **(20 Marks)**

Module-5

9 a. What is compensator? How are the compensators classified? **(08 Marks)**

b. Explain lead compensator. **(06 Marks)**

c. Explain lead – lay compensator. **(06 Marks)**

OR

10 a. A system is governed by the differential equation

$$\frac{d^3y}{dt^3} + \frac{6d^2y}{dt^2} + \frac{11dy}{dt} + 10y = 8u(t)$$

Where y is the output and u is the input of the system. Obtain a state space representation of the system. **(08 Marks)**

b. Determine the state controllability and observability of the system described by :

$$\dot{X} = \begin{bmatrix} -3 & 1 & 1 \\ -1 & 0 & 1 \\ 0 & 0 & 1 \end{bmatrix} X + \begin{bmatrix} 0 & 1 \\ 0 & 0 \\ 2 & 1 \end{bmatrix} u, \quad Y = \begin{bmatrix} 0 & 0 & 1 \\ 1 & 1 & 1 \end{bmatrix} x.$$ **(12 Marks)**

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17ME742

Seventh Semester B.E. Degree Examination, Jan./Feb. 2023
Tribology

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Briefly discuss the historical background of bearings. **(06 Marks)**

b. Write a note on Properties of Lubricant. **(08 Marks)**

c. Discuss the effect of temperature and pressure on viscosity. **(06 Marks)**

OR

2 a. Derive an expression for velocity distribution for flow through a capillary tube. **(10 Marks)**

b. With a neat sketch, explain the working of Michell Viscometer. **(10 Marks)**

Module-2

3 a. Briefly explain the Laws of friction. **(10 Marks)**

b. Write a note on:
i) Mechanical Interlocking
ii) Molecular attraction **(10 Marks)**

OR

4 a. Briefly explain the mechanism of wear. **(10 Marks)**

b. Explain the Delamination theory of wear. **(10 Marks)**

Module-3

5 a. Derive the Petroff's equation for a lightly loaded bearing. Indicate the assumptions made. **(10 Marks)**

b. A lightly loaded journal bearing has the following specifications:
I) Diameter of Journal = 50 mm
II) Bearing length = 80 mm
III) Diametral clearance ratio = 0.002
IV) Radial load = 750 N
V) Absolute viscosity = 10×10^{-3} Pas.
VI) Speed of the Journal = 4000 rpm
Determine
(i) Frictional torque (ii) Co-efficient of friction (iii) Power loss. **(10 Marks)**

OR

6 Derive Reynold's equation in two dimension. Also state the assumptions made. **(20 Marks)**

Module-4

7 a. Deduce and show that the load carrying capacity of a hydrodynamic plane slider bearing with fixed shoe is a function of bearing dimensions, velocity, viscosity of lubricant, angle of inclinations and the film thickness. **(10 Marks)**

b. A rectangular plain slider bearing with fixed shoe with no end leakage has the following data:
I) Bearing length = 90 mm II) Width of shoe = 90 mm
III) Load on bearing = 7800 N , IV) Slider velocity = 250×10^{-2} mts/sec.
V) Inclination α = – 0.88835 radius VI) Viscosity of oil $\eta = 40\times10^{-3}$ Pas.
Determine
(i) Minimum film thickness (ii) Power loss (iii) Co-efficient of friction. **(10 Marks)**

OR

8 a. Derive an expression for load carrying capacity and rate of flow of oil through a hydrostatic step bearing. **(10 Marks)**

b. A hydrostatic circular thrust bearing has the following data. Shaft diameter = 300mm, Diameter of pocket = 200 mm, Shaft speed = 100 rpm, Pressure at the pocket = 500 kN/m^2, Film thickness = 0.07mm, Viscosity of lubricant = 0.05 Pas. Determine
(i) Load carrying capacity (ii) Oil flow rate (iii) Power loss due to friction. **(10 Marks)**

Module-5

9 a. Briefly discuss any ten desirable properties of good bearing material. **(10 Marks)**

b. Briefly explain common bearing alloys that are used in practice. **(10 Marks)**

OR

10 a. Discuss the different surface modifications techniques to enhance the properties of the material. **(10 Marks)**

b. Briefly discuss different coating techniques that are used to protect the surface from corrosion. **(10 Marks)**

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17ME753

Seventh Semester B.E. Degree Examination, Jan./Feb. 2023
Mechatronics

Time: 3 hrs. Max. Marks: 100

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1 a. Explain the objectives of mechatronics. **(05 Marks)**
b. Explain the elements of mechatronics system design. **(08 Marks)**
c. Explain with a neat diagram the working of photoemissive transducer. **(07 Marks)**

OR

2 a. Explain the evolution levels of mechatronics. **(08 Marks)**
b. Explain the specifications of a transducer or sensor. **(06 Marks)**
c. Write a note on proximity switches. **(06 Marks)**

Module-2

3 a. Explain briefly the basic elements of a microprocessor. **(05 Marks)**
b. Explain the requirements for control and their implementation in a micro controller. **(05 Marks)**
c. Explain briefly the following :
i) State ii) Bus iii) Flags iv) Interrupts. **(10 Marks)**

OR

4 a. Distinguish between operand, mnemonics and opcode. **(03 Marks)**
b. Explain the different types of instructions and addressing modes of a microprocessor. **(09 Marks)**
c. Explain the classification of micro controllers. **(08 Marks)**

Module-3

5 a. Write the features of a typical PLC. What is a ladder diagram and explain the various symbols used in a ladder diagram. **(10 Marks)**
b. Explain with a neat diagram the functional requirements of an industrial robot? **(10 Marks)**

OR

6 a. Explain Latching with an example. **(06 Marks)**
b. Explain the methods used for input/output processing **(06 Marks)**
c. Explain with neat sketch a typical pneumatic actuator system for Serco control. **(08 Marks)**

Module-4

7 a. Explain the mechanical aspects of motor selection and also motor torque – speed characteristics. **(09 Marks)**

b. How do you classify electrical systems? **(03 Marks)**

c. Explain with a neat sketch the working of single phase squirrel cage induction motor. **(08 Marks)**

OR

8 a. Write a detailed note on permanent magnet DC motor. **(10 Marks)**

b. Explain with a neat diagram the stepper motor specifications of characteristics. **(10 Marks)**

Module-5

9 a. Compare with neat diagrams the hydraulic and pneumatic power supplies. **(10 Marks)**

b. Explain with neat diagram the working of pressure limiting and pressure sequence valves. **(10 Marks)**

OR

10 a. Explain with neat diagrams the working of lift and pilot operated systems. **(10 Marks)**

b. Explain with a neat diagram the following :

i) Double acting cylinder

ii) Vane motor. **(10 Marks)**

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