TE/INST/SEM-V/C-2019/NOV-2023

Duration: Three Hours **Total Marks : 80**

N.B. : (1) Question No. 1 is compulsory.
(2) Attempt any three questions from the remaining five questions.
(3) Assume suitable data wherever necessary.
(4) Draw neat circuit diagram and waveforms wherever applicable.
(5) Figures to the right indicate full marks

Q.1. Attempt **any four** of the following: 20
a) Describe PowerMOSFET in detail.
b) Explain why DCseries motor should not be started at no load.
c) Draw & explain capacitor start induction motor.
d) Explain the importance of freewheeling diode.
e) Explain the importance of Drives.

Q.2. a) Explain the construction and working of 3 phase induction motor. 10
b) A 500 V shunt motor runs at its normal speed of 250 r.p.m. when the armature current is 200 A. The resistance of armature is 0.12 ohm. Calculate the speed when a resistance is inserted in the field reducing the shunt field to 80% of normal value and the armature current is 100A. 10

Q.3. a) Explain semi- converter bridge rectifier using inductive load for 120 degree mode of operation. 10
b) Explain stepper motor in detail. 10

Q.4. a) Explain the significance of backemf. Explain the characteristics of DC series motor. 10
b) Explain any one type of AC motor drive. 10

Q.5. a) What is chopper ? Explain its types. 10
b) Explain the need of inverters, its types. Explain full bridge inverter in detail. 10

Q.6. Write short notes on:- 20
a) Power stages in 3-phase induction motor and losses taking place in motor
b) Comparison of power BJT, power diodes and IGBT

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(3 Hours) **Total Marks: 80**

N.B.: (1) **Question No. 1 is compulsory.**
(2) **Attempt any Three questions from remaining.**
(3) **Figures to the right indicate full marks.**

1. Answer the following: - **(Any Four)** **[20]**
   (a) Explain the difference between Microprocessor and Microcontroller.
   (b) Explain the stack related Instructions.
   (c) Write an assembly language program for Subtraction two 8, bits numbers.
   (d) Explain the Following Instruction.
   i) ORL A, #0FH ii) MUL AB iii) MOV A, @R0 iv) DJNZ R7, BACK
   (e) Explain the importance of SBUF register in Serial Communication.
   (f) Explain PCON register in 8051.

2. (a) Explain Programming Model of 8051 Microcontroller. **[10]**
   (b) Explain Internal RAM structure of 8051 Microcontroller. **[10]**

3. (a) Draw and Explain interfacing diagram of DAC and 8051 Microcontroller. Write a program to send data to the DAC to generate a Triangular Waveform **[10]**
   (b) Write an assembly language program for conversion of Packed BCD to two ASCII numbers. **[10]**

4. (a) Write a program to transmit message "INSTRUMENTATION" serially at 9600 baud rates. **[10]**
   (b) Write an assembly language or C Language program to generate 33% duty cycle rectangular waveform by using timers. **[10]**

5. (a) Interface Seven segment display with 8051 Microcontroller. Write a Program to display 0 to 9 on it.
   (b) Explain Arduino and Raspberry Pi Architecture. **[10]**

6. Write short notes **(Any Two)** **[20]**
   (a) Addressing Modes of 8051 Microcontroller.
   (b) Stepper motor interfacing with 8051 Microcontroller.
   (c) TMOD and TCON registers of 8051 Microcontroller.
   (d) Power saving and Power Down modes.

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38814

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[Time: 3 Hours] **Total Marks: 80**

Instructions:

- Q1 is compulsory
- Answer any **Three** out of the remaining **Five** questions
- Assumptions made should be clearly stated
- Assume any suitable data wherever required but justify the same
- The figure to the right indicate full marks

Q.1 Solve any Five **[20]**

a) Draw and explain block diagram of state space model

b) Test the system for controllability if

$$\begin{bmatrix}\dot{X}_1\\ \dot{X}_2\end{bmatrix} = \begin{bmatrix}1 & 1\\ -2 & -1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix}u$$

$$Y = \begin{bmatrix}1 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$$

c) Draw Lead compensator and obtain its transfer function

d) Define Observability of the system

e) Derive transfer function from state space model

f) The transfer function of system is given by

$$\frac{Y(s)}{U(s)} = \frac{1.65s^4 + 0.33s^3 - 57s^2 + 9s + 10}{s^6 + 1.9s^5 + 4s^4 + 9s^3 + 12s^2 + 8s}$$

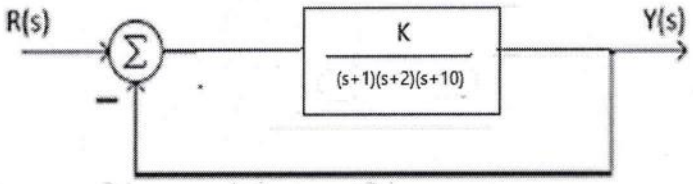
Derive state space model in observable canonical form.

Q.2 a) Design the state feedback gain control matrix K for the system **[10]**

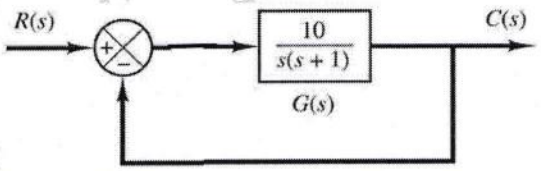
$$\dot{X} = \begin{bmatrix}0 & 1\\ -1.32 & 2.32\end{bmatrix}x + \begin{bmatrix}0\\ 1\end{bmatrix}u$$

to place the pole at -1 and -2.

b) Given system shown below which is operating with a damping ratio of 0.174. Compensate the system to improve the steady-state error by a factor of 10 if the system is operating with a damping ratio of 0.174. **[10]**

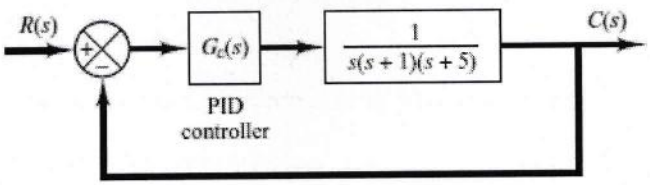


Q.3 a) Consider the position control system shown in fig below **[10]**



Design suitable compensator for desired parameters $\xi = 0.5$ and $\omega_n = 3$ rad/sec

b) For unity feedback system with PID controller is used to control the system as shown in fig. below. Determine PID controller. **[10]**



Q.4 a) Write a design steps of Lag compensator using root locus **[10]**

b) Design a phase lead compensator for unity feedback system whose open loop transfer function is $G(s) = \frac{K}{s(s+1)}$ to satisfy the following specification i) phase margin of the system $\geq 45^0$, ii) steady state error for unit ramp input is $\leq 1/15$, iii) Gain crossover frequency of the system must be less than 7.5 rad/sec **[10]**

Q.5 a) Obtain a state transition matrix if **[10]**

$$\dot{X} = \begin{bmatrix} -1 & 1 \\ 0 & 2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$$

$$Y = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + [0]u$$

b) Obtain transfer function from given state space model **[10]**

$$\dot{X} = \begin{bmatrix} 1 & 2 \\ -4 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 2 \end{bmatrix} u \quad \text{and} \quad Y = \begin{bmatrix} 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + [0]u$$

Q.6 a) Explain Ziegler Nichols method for tuning of PID **[10]**

b) Obtain the state space model from the transfer function using the Jordan canonical form **[10]**

$$\frac{Y(s)}{U(s)} = \frac{s^2 + 6s + 8}{(s+1)^2 (s+3)}$$

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(3 Hours) **Total Marks: 80**

N.B. 1. **Question No.01** is **compulsory**

2. Attempt any **Three** questions from remaining **Five** questions

3. Assume suitable data wherever required

1. Answer the following (Any Four) 20

a. What are the basic elements of process control loop? Draw and explain pressure control loop.
b. What is PD control mode? Draw and explain.
c. What is the concept of auto tuning? Explain in detail.
d. Draw and discuss an interaction among the control loop when one loop is closed.
e. Compare Feedback and Feedforward control scheme.

2. a. Explain relative gain array in detail. 10

b. A liquid-level control system linearly converts a displacement of 2 to 3 meter into a 4 to 20 mA control signal. A relay serves as the two-position controller to open or close an inlet valve. The relay closes at 12mA and opens at 10 mA. Find a) the relation between displacement level and current and b) the neutral zone or displacement gap in meters. 10

3. a. Explain the gain schedule adaptive control scheme with suitable example. 10

b. An integral controller is used for speed control with a set point of 12 rpm within a range of 10 to 15 rpm. The controller output is 22% initially. The constant $K_I = -0.15\%$ controller output per second per percentage error. If the speed jumps to 13.5 rpm, calculate the controller output after 2 second for a constant e_p. 10

4. a. Explain the Cohen-coon method of controller tuning with correction for quarter amplitude. 10

b. Write short note on relay logic symbol. 10

5. a. Explain decoupler design with suitable example. 10

b. Write short note on "dynamic behaviour of first order system". 10

6. a. Explain ratio control scheme with suitable example. 10

b. Write short note on "Smith Predictor Compensator". 10

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Time : 3 Hours **Marks : 80**

N.B. (1) Question **No.1** is compulsory
(2) Attempt any **three** questions out of remaining **five** questions.
(3) Assume any suitable data if necessary
(4) Figures to the right indicates full marks.

Q.1. Answers the following questions **(Attempt any four)** (20)
a) Write about different materials used in sensor fabrications.
b) Explain advantages & disadvantages of smart sensors.
c) Explain in details difference between thin film and thick film sensors.
d) Explain anyone application of optical sensor.
e) Write short note on ADXL345.

Q.2. a) Explain LIGA fabrication technique in detail. (10)
b) Explain photolithography technique used in MEMS. (10)

Q.3. a) Explain selection criteria for various transducers? Also elaborate design considerations for sensor fabrications. (10)
b) Explain working principle of digital humidity temperature smart sensor. (10)

Q.4. a) What is smart sensor? Explain general architectures of smart sensor. (10)
b) Demonstrate wet and dry etching with necessary diagrams (10)

Q.5. a) Explain smart analog IC 500 in detail. (10)
b) Write note on sensors for soil moisture measurement. (10)

Q.6. a) Explain various sensors used in Agriculture. (10)
b) Write short note on, (10)
i) Biological oxygen demand (BOD)
ii) MEMS Gyroscope

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40399