

Name :

Roll No. :

Invigilator's Signature :

CS / B.Tech(ME / PE) / SEM-6 / ME-602 / 2012

2012

MECHATRONICS AND MODERN CONTROL

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable*

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following questions :

10 × 1 = 10

- i) Thermocouples are
 - a) active transducer
 - b) passive transducer
 - c) output transducer
 - d) both active and passive transducers.
- ii) The minimum number of 2 i/p NAND gates required to realize function $f = (A' + B')(C + D)$ is
 - a) 2
 - b) 3
 - c) 5
 - d) 4.
- iii) The ratio of feedback signal $B(s)$ to the actuating error signal $E(s)$ is known
 - a) open loop transfer function
 - b) closed loop transfer function
 - c) feed forward transfer function
 - d) none of these.

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- iv) A photodiode functions as
 - a) photoconductive device with reverse bias
 - b) photovoltaic device without reverse bias
 - c) photoconductive device with forward bias
 - d) as like as LED.
- v) An ideal OP-AMP has i/p resistance and bandwidth respectively
 - a) infinity and infinity b) zero and infinity
 - c) zero and zero d) infinity and zero.
- vi) A diode which has zero breakdown voltage is known as
 - a) Zener diode b) Schottkey diode
 - c) LED d) Tunnel diode.
- vii) Differential amplifier can be used as Limiter
 - a) as the linear region of transfer characteristics abruptly ends for a specific value of i/p
 - b) as g_m proportional I_E
 - c) as CMRR can be made very large
 - d) as I_E can be made constant.
- viii) The flag register of 8085 microprocessor is
 - a) 5 bit b) 12 bit
 - c) 8 bit d) 16 bit.

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- ix) $1 + A + AB + ABC + \dots =$
- a) 1 b) ABC
- c) B d) A.
- x) In a D type latch Enable *i/p* is HIGH, $D = 1$. The o/p will be
- a) 0 b) 1
- c) don't care d) blo ked.
- xi) The condition of a normal popp t valve is
- a) open b) close
- c) either open or close d) none.
- xii) Laplace transform of Unit step function is
- a) s b) $1/s$
- c) $1/s^2$ d) $1/s^3$.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Explain the different Registers and Flags available in 8085 microprocessor.
3. What is a D-Flip-flop ? How does it work as a latching device in 8085 microprocessor ?

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4. Find the Laplace inverse of $\frac{1}{s(s^2 + 2s + 5)}$
5. Distinguish between an open loop and a closed loop control systems with example.
6. Discuss external initiated signals in 8085 microprocessor.
7. What is check valve ? Show various uses of a check valve in the hydraulic circuit.
8. What is the application of counter balance valve ? Draw a hydraulic circuit using counter balance valve

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

9. a) State the role of sensors and transducers in feedback control system. 4
- b) Explain different Flag registers used in 8085 microprocessor. 3
- c) What are the functions of HOLD, READY, ALE, HLDA and RESET OUT pins in 8085 microprocessor ? And also explain the function of INR M, XCHG, DAD, LHLD and DAA instructions in 8085 microprocessor. 4 + 4

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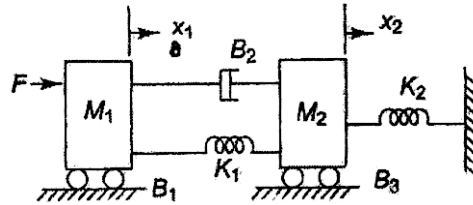
10. a) With a neat sketch explain the working principle of a recirculating ball-screw nut assembly and explain how the backlash can be eliminated. Give two examples where the above assembly is employed. 4 + 3
- b) State the characteristics of stepper motor and brush-less DC motor. 5
- c) Determine the input pulse rate if the stepper motor has 10° per step and rotating at 30 rpm. 3
11. a) Simplify the Boolean function $F(A, B, C, D) = \sum(0, 1, 2, 6, 8, 9, 10)$ using k -map technique.
- b) What is a PLC ? What are its uses ? Explain how a PLC acts as a control system.
- c) A selection committee comprises 3 general members and the chairman. Any decision is passed in the committee if majority of the general members are agreed. However chairman can pass any decision irrespective of general members. Draw the Ladder diagram to support the logic. 5 + 4 + 6

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12. a) Discuss the differences between pressure relief valve and pressure reducing valve with the help of schematic diagram. 4
- b) Sketch and explain the shuttle valve. Draw the standard symbol for non-return type flow control valve and time-delay valve. 3 + 2
- c) There are two cylinders 1 and 2 and it is required that when the start button is pressed, the piston of cylinder 1 extends and when it is fully extended, the piston of cylinder 2 extends. When both cylinders are in extended position, it is required that the piston of cylinder 1 retracts and when the piston of cylinder 1 is in fully retracted position, the piston of cylinder 2 retracts. Draw the hydraulic sequencing circuit for the above sequence. 6
13. a) Write a transfer function of a PID controller. Sketch the step responses of P , PI , PD and PID controllers. (Qualitative sketches would be adequate). 1 + 3
- b) The open loop transfer function of a unity negative feedback system is given below :
- $$G(s) = \frac{500}{s(s + 15)}$$
- Find :
- (i) the transient response for a unit step input
- (ii) the value of rise time and peak time. 5

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- c) Consider the following mechanical translation system shown in figure F denotes the force, X denotes the displacement, M denotes the mass, B denotes friction coefficient and K denotes spring constant, (i) write down the differential equation governing the above system, (ii) draw the corresponding electrical equivalent circuit using force-voltage analogy scheme. 3 + 3



14. Write short notes on any *three* of the following : $3 \times 5 = 15$

- a) Initial and final value theorem
- b) Discrete-time system
- c) Bleed off hydraulic circuit
- d) Programming model of 8085 microprocessor
- e) Thermocouple
- f) Full-Adder Circuit using basic gates.
