Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (ME/NEW)/SEM-6/ME-604 B/2013

2013

MECHATRONICS

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 : $10 \times 1 = 10$

   i) Mechatronics is an interdisciplinary subject involving
      a) electrical and mechanical engineering application
      b) electronics and mechanical engineering application
      c) electronics, electrical and mechanical engineering application
      d) none of these.

   ii) The example of solid state switch is
      a) diode b) thyristor
      c) triac d) all of these.

   iii) The 8085 flag register is a register of
      a) 5 bit b) 64 bit
      c) 8 bit d) 16 bit.

iv) Flipflops are

a) asynchronous tristate device

b) synchronous tristate device

c) synchronous bistable device

d) None of these.

v) Programme Counter is a register of

a) 1 bit b) 8 bit

c) 16 bit d) 64 bit.

vi) The basic parts of a mechatronic system is

a) Simulation and modeling

b) Automatic control

c) Optimization

d) All of these.

vii) How many minimum mumbers of NAND Gates required realizing EX-OR Gate ?

a) 4 b) 5

c) 6 d) 3.

viii) Given a function $f(t)$ whose Laplace transform is $F(s)$, the Laplace transform of the first derivative of $f(t)$ may by expressed as

a) $sF(s) - f(0)$ b) $s(F(s) - f(0))$

c) $F(s)/s$ d) $sF(s) - f'(0)$.

ix) An ideal op-amp is an ideal

a) Voltage controlled current source

b) Voltage controlled voltage source

c) Current controlled current source

d) Current controlled voltage source.

x) Given the transfer function, the stability of a system may be determine from

a) Location of only zeroes of the transfer function

b) Location of only the pole of the transfer function

c) 3-dB bandwidth of the transfer function

d) Location of both pole and zeroes of the transfer function.

xi) PLC stands for

a) Programmable Logic controllers

b) programmed Logical Computing

c) Programmable Logic Computing

d) programmed Logic Controllers.

xii) Relation between Proportional Gain (KP) & Proportional Band (PB) is

a) KP = PB b) KP = 1/PB

c) KP × PB = 0 d) None of these.

xiii) Gauge factor of a strain gauge indicates its

a) Accuracy b) Sensitivity

c) Dead zone d) Dead time.

xiv) Small linear displacement may be measured by

a) Capacitive gauge b) LVDT

c) Hall sensor d) Load cell.

GROUP – B

(Short Answer Type Questions)

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

2. Define Mechatronics. How is it related to control ?
3. What is an adaptive control ? Sketch it.
4. What do you mean by closed loop transfer function ? Illustrate your answer.
5. Implement the function $F = \overline{(AB + CD)}$ using NAND Gates.
6. Prove that for a function $F\,(ABC)$, $\Sigma(2,4,5,6) = \Pi(0,1,3,7)$.
7. What is meant by step angle and slew rate. Explain. Explain also how forward and reverse movements are generated in a stepper motor. 2 + 3

GROUP – C

(Long Answer Type Questions)

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

8. a) What is R-S-flip-flop ? What is its drawback ?

   b) Explain how the drawback of R-S-flip-flop can be overcome by J-K- flip-flop.

   c) Explain how a 4-bit register can be realized using D flip-flop ?

   d) What are the advantages of MOSFETs over simple junction transistor ?

   e) Write a short note on multiplexer. 3 + 2 + 4 + 3 + 3

9. a) Explain how NOT, OR, AND gates can be realised using NOR gates.

   b) Why are NOR gates called universal gates ?

   c) Simplify the following Bullean equation by the use of Karnaugh Maps

      Q = A.B.C + A.B. C + A.B.C

   d) Use De-Morgan's Laws to show that NOR gate with inverted inputs is equivalent to an AND gate.

   e) Explain XOR and NAND gate with truth table.

   3 + 2 + 3 + 3 + 4

10. a) State how a PLC works. Mention different components of PLC.

   b) Construct a ladder diagram for automatic level control of on-roof reservoir for the following two conditions :

      i) When water level is below the lower level, switch of the pump should turn on.

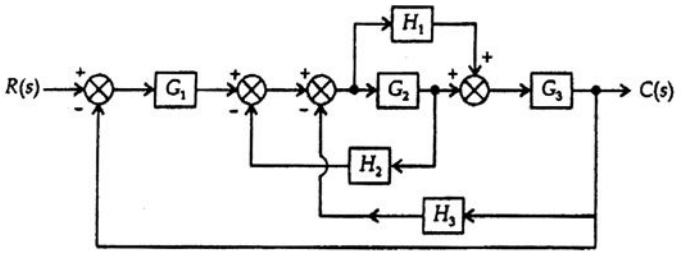
      ii) When water level touches the upper level the pump should turn off : it should remain off until the water level reaches below the level of the switch.

   c) Write the advantages of PLC. 4 + 8 + 3

11. a) Obtain the step response of the 2nd order system. Define delay time, rise time, settling time with proper diagram.

b) Find the overall transfer function C(S)/R(S) of the system by using block diagram reduction technique.

(5 + 6) + 4



12. a) Obtain the transfer function of armature control DC motor. What are the different types of Proximity Sensors ?

b) Explain different types of control valve used in hydraulic system.

c) Explain Servo-mechanism with diagram. (6 + 2) + 4 + 3

13. a) Discuss the differences between 2/2 spool type DC valve and 2/2 seat type DC valve with the help of schematic diagram.

b) Sketch and explain the sequence valve. How the flow control valves control the speed of a double acting cylinder ?

c) Components are to be supplied from a gravity magazine to workstation by using a double acting cylinder. Feeding starts when push button is pressed. The piston returns automatically to start the process again. Design a pneumatic circuit for the above problem and explain its working. 3 + (3 + 3) + 6

14. Write short notes on any *three* of the following : 3×5

a) Z-transform

b) Concurrent engineering promoted by mechatronics

c) Comparative features between vane pump and gear pump

d) Design of S-R Flip-Flop by using NAND Gates only

e) Main components of a PLC

f) NAND and NOR Gates are universal gates.