



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 numbers 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 be 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) $KP \times PB = 0$
 - 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. $3 \times 15 = 45$

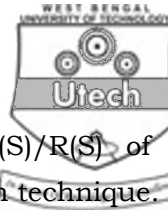
8.
 - a) What is R-S-flip-flop ? What is its drawback ?
 - b) Explain how the drawback of R-S-flip-flop can be overcome by J-K- flip-flop.
 - c) Explain how a 4-bit register can be realized using D flip-flop ?
 - d) What are the advantages of MOSFETs over simple junction transistor ?
 - e) Write a short 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 Boolean equation by the use of Karnaugh Maps
- $$Q = A.B.C + A.B. \bar{C} + A.\bar{B}.C$$
- 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.

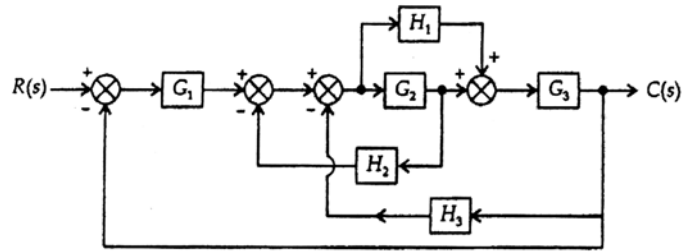
3 + 2 + 3 + 3 + 4

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.
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