- (viii) Each statement below can be true (T) or false (F). Figure 1.1 shows a ladder diagram rung for which there is an output when:
  - (i) Inputs 1 and 2 are both activated.
  - (ii) Either input 1 or input 2 is activated. Choose the correct alternative.

(b) (i) T (ii) F

(a) (i) T (ii) T (c) (i) F (ii) T



### Figure 1.1: Diagram for Problem 1.viii.

- (ix) How much external data memory can be interfaced with an 8051? (a) 32K (b) 64K (c) 128K (d) 256K.
- (x) How many parallel I/O ports are available in an 8051 microcontroller?
  (a) 2
  (b) 3
  (c) 4
  (d) 5.

### Group – B

- 2. (a) Define a mechatronic system. Give two examples of such system in daily use.
  - (b) Describe with necessary sketches a recirculating ball screw nut system. Write down the advantages of using such system.
  - (c) Name two mechanisms that convert rotary motion into linear motion. (2+2) + (4+2) + 2 = 12
- 3. (a) Describe with suitable diagram the hydraulic circuit used for operating a hydraulic cylinder for forward and backward motion of its piston rod.
  - (b) What is pilot operated direction control valve? Show a pneumatic circuit to operate a pneumatic cylinder for its automatic forward and reverse motion using such valve and pneumatic limit sensors.

$$6 + (2 + 4) = 12$$

B.TECH/ME/6<sup>TH</sup> SEM/MECH 3252/2018

### Group – C

- 4. (a) What is Transfer Function? Prove that C (S) / G (S) = G (S) / [1 + G (S) H (S)], where C (S) = Output, R (S) = Input, G (S) = Open Loop Transfer Function, H(S) = Feedback Transfer Function.
  - (b) Consider two masses connected by a spring of stiffness K1 and another mass is connected to a frame by a spring of stiffness k2 as shown in following figure. Obtain a differential equation of motion for the system input x (deflection) and output y (deflection).



- 5. (a) Explain with a circuit how op-amp can be used as adder to add three voltages. What are differential gain and common-mode gain of a differential amplifier?
  - (b) Draw the circuit of a monostable multivibrator using 555 timer.

(6+2)+4=12

5 + 7 = 12

### Group – D

- 6. (a) What are ADC and DAC? Explain with a circuit diagram how a summing amplifier can be used to convert a four bit digital signal into analog signal.
  - (b) Design the logic circuit using gates for full adder.

(2+4)+6=12

- 7. (a) Write down the differences between combinational logic circuit and sequential logic circuit.
  - (b) Draw and explain the working of a 3 bit ripple counter using J-K flipflop.

5 + 7 = 12

Group – E

# 8. (a) What are the differences between microprocessor and microcontroller?

(b) Write down all addressing modes of microcontroller 8051, explain with example.

6 + 6 = 12

- 9. (a) What is PLC? Explain its advantages over microcontroller based control?
  - (b) A mixer mixes two liquids by automatically filling a tank with liquids A (up to X1) and B (X1 to X2) in order when START is pressed. A mixer motor is used to stir the liquids automatically in the tank for 30 seconds when the level of liquids in the tank is filled up to a certain level (X2). After stirring, the tank is emptied by opening the solenoid valve 3 for 5 mints. Draw ladder logic for the above system.



## B.TECH/ME/6<sup>TH</sup> SEM/MECH 3252/2018

#### MECHATRONICS (MECH 3252)

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and <u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> from each group.

Candidates are required to give answer in their own words as far as practicable.

### Group – A (Multiple Choice Type Questions)

- 1. Choose the correct alternative for the following:  $10 \times 1 = 10$ A 4/3 direction control valve has (i) (a) 4 ports 3 position (b) 3 ports 4 position (c) 3 ports 3 position (d) none of these. (ii) The shown symbol represents (a) check valve (b) DC valve (c) pressure relief valve (d) flow control valve. (iii) A circuit whose output is proportional to the difference between the input signal is called (a) common mode (b) differentiator (c) differential (d) integrator. (iv) If non-inverting terminal of an OP-AMP is grounded then the inverting terminal will (a) not need an input resistor (b) be virtual ground
  - (a) not need an input resistor
    (b) be virtual ground
    (c) have high reverse current
    (d) not invert the signal.
    (v) An ideal OP-AMP has
    (a) zero open loop gain
    (b) infinite open loop gain
    - (b) infinite open loop gain (d) infinite output impedance.
  - (vi) What logic gate is the sum output of a half adder?
    (a) AND
    (b) EX OR
    (c) EX NOR
    (d) NAND.
  - (vii) Which among the following is not an advantage of an open loop system?(a) Simplicity in construction & design
    - (b) Easy maintenance

(c) zero input impedance

- (c) Rare problems of stability
- (d) Requirement of system recalibration from time to time.

1