(Time: 3 Hours) **[Total marks: 80]**

N.B.: 1. Question No.1 is Compulsory
2. Attempt any three questions out of the remaining five questions.
3. Assume suitable data if required.
4. Figures to the right indicate full marks to that question.
5. Support your answers with appropriate sketches wherever required.

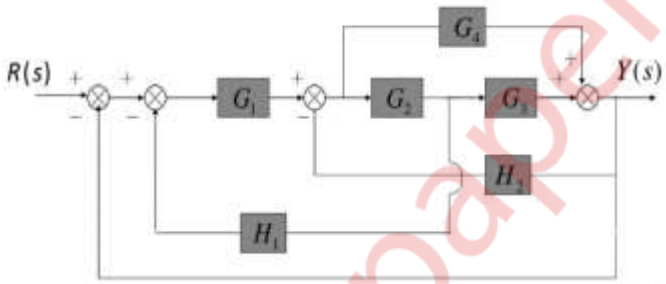
Q1 **a.** Explain the architecture of mechatronics system with neat block diagram. **5**

b. Explain the classification of pressure sensor used in systems depending on range i.e. low, medium & high pressure measurement. **5**

c. Explain with neat sketch architecture of PLC. **5**

d. Write short note on FRL unit. **5**

Q2 **a.** Reduce following block diagram to simplified form **8**



b. Explain working of brushless DC motors (BLDC). **6**

c. Write note on Signal Filters - Low pass, High Pass and Band Pass with circuit diagrams in detail. **6**

Q3 **a.** Two double acting pneumatic cylinders A, B are selected for an industrial application. The sequence of movement for piston of the cylinder is proposed as below— **10**

Delay A+ B+ (AB)-

Develop the electro pneumatic circuit using 5/2 double solenoid as final directional control valves. The piston motions mentioned in bracket is simultaneous. Design for user option single cycle & multi cycle.

b. For the unity feedback system having transfer function as follows Determine **10**

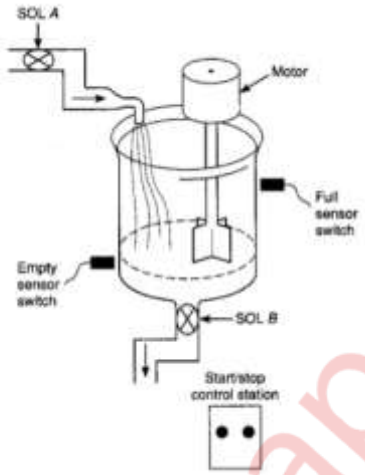
1. Damping ratio & natural frequency
2. Raise time, Peak time, settling time
3. Peak Overshoot

$$G(S) = \frac{1}{S(S+1)}$$

Q4 **a.** A process control system illustrated in figure. The sequence of operation is to be as follows **15**

- when start button is pressed solenoid A energizes to start filling
- As the tank fills, empty level sensor switch closes also solenoid A de-energized
- then motor starts automatically and runs for 5 min to mix liquid
- when motor stops, solenoid B is energized to empty the tank.

Develop a PLC ladder logic diagram for the sequential tasks.



b. What is aliasing? Explain Nyquist sampling theorem in detail **5**

Q5 **a.** Explain with neat sketch classification of stepper motors with its applications, advantages & disadvantages. **10**

b. A system has G(s)H(s) as given below, Draw root locus & comment on stability of a system. **10**

$$G(s)H(s) = \frac{s+3}{s^2 - s - 2}$$

Q6 Write short note on **(5 marks each)** **20**

a. Parameters to be considered for selection of actuators **5**

b. Accumulators used in hydraulic circuits **5**

c. Explain successive approximation A/D convertor. **5**

d Define Mechatronics & explain applications of Mechatronics domestic, industrial one example each. **5**