(3 hours) **[Total Marks: 80]**

N.B.: 1. **Question no. 1 is compulsory.**
2. Attempt **any three** questions from the remaining.
3. Figures to the right indicate full marks.
4. Make and state the assumptions clearly wherever required.
5. Answers to the same questions should be grouped together.
6. Provide neat sketches to illustrate your answers.

Q1. Attempt **any four:** **[20]**

a) Briefly discuss about the concepts, significant benefits and applications of PLC control.

b) Explain open and closed loop control systems giving examples.

c) Explain in brief proximity sensors and their significant benefits.

d) Explain the elements of a microprocessor with block diagrams. How does this differ from a micro controller?

e) What is Bode Plot? Explain the advantages of Bode Plots.

Q2. **a)** Explain with simple sketches the various rules used for block diagram reduction. **[10]**

b) What is transfer function? What are the characteristics of transfer function? **[04]**

c) Explain types of logic gates with Boolean expressions and truth tables. **[06]**

Q3. **a)** A unity feedback control system has **[12]**

$$G(s) = \frac{K}{s(s^2 + 4s + 5)(s + 2)}$$

Determine the ranges of K so that the system is stable.

b) Explain how control systems are classified. Indicate their features and give examples under each. **[08]**

Q4. **a)** Using Routh's Criterion determine whether the system is stable or unstable. **[08]**

$$S^5 + 6S^4 + 15S^3 + 30S^2 + 44S + 24 = 0$$

b) Draw approximate Root Locus diagram for a closed loop system whose loop transfer function is given by the following **[12]**

$$G(s)\,H(s) = \frac{K}{s(s + 5)(s + 10)}$$

Comment on its stability.

Q5. **a)** Design and prepare a pneumatic circuit to perform stamping operation using three cylinders. A, B and C. **[14]**

$$B^+ / B^- C^+ / C^- A^+ / A^-$$

b) Compare between proportional, digital and servo hydraulic controls bringing out advantages and limitations of each. **[06]**

Q6. **a)** Prepare an electro-pneumatic circuit for the sequence **[14]**

$$A^+ B^+ C^- C^+ \text{ Delay } B^- A^-$$

b) Discuss briefly the benefits and impact of automation in manufacturing and process industries. **[06]**
