(3 Hours) **Total Marks - 80**

N.B.
i) Question No. 1 is compulsory.
ii) Attempt any three questions from remaining.
iii) Assume suitable data (mention the same) and use semi log paper wherever necessary.
iv) Figures to the right indicate full marks.

Q.1 Attempt any **Four**
A) What is compensator? Compare lag and lead compensator. [05]
B) Explain different forms of Industrial PID controllers. [05]
C) What is an observer? Explain the different types of observer. [05]
D) Explain the "Tustin transformation" method. [05]
E) Explain the PLC scan cycle. [05]
F) Explain the working principle of "Down Counter" of PLC. [05]

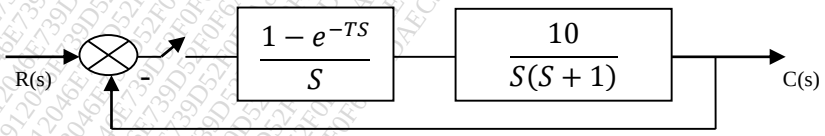
Q.2
A) Find the value of gain "K" for a unity feedback system with a forward transfer function $G(s) = \frac{K}{S(S+36)(S+100)}$, for 20% overshoot . [10]

B) Explain different type of addressing modes used in PLC. [10]

Q.3
A) Design a controller for "controller canonical form" to yield 15% overshoot & a settling time of 0.5 second. The open loop transfer function of a plan is given by, $G(s) = \frac{10}{S(S+5)(S+10)}$. [10]

B) Consider a plant $G(s) = \frac{1}{S(S+3)(S+7)}$, whose state variables are not available. Design an observer for "observer canonical form" to yield transient response described by $\xi = 0.4$ *and* $W_n = 75$ rad/sec. [10]

Q.4
A) For a unit step, ramp and parabolic input .Find the steady state error for the system shown below, [10]



B) Given T(z) = N(z) / D(z), where $D(z) = z^3 - z^2 - 0.2z + 0.1$, use the Routh-Hurwitz criterion to find the number of z-plane poles of T(z) inside, outside and on the unit circle. Is the system stable? [10]

Q.5

A) Explain the timer instruction of PLC. And also explain the working principle of "OFF delay timer "T_{OFF}" with timing diagram. [10]

B) Explain the AC input module of PLC. [10]

Q.6

A) Explain integral windup and anti-windup circuits. [10]

B) Develop and explain a PLC ladder diagram for direction control of DC motor. [10]

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