03 Hrs [Total Marks 80]

N.B.:
(1) **Question No.1 is compulsory**
(2) Attempt any **three** questions out of remaining **five** questions
(3) Figures to right indicate full marks
(4) Assume suitable data if **necessary**.
(5) Notations carry usual meaning.

Q.1 (A) Derive an expression for steady state error when step and ramp input is given to the system.   8

(B) Define the following terms with reference to the state space modelling of the system.   06
     (a) State space   (b) State variables

(C) Explain the following terms with reference to static characteristics of the measuring instruments.   06
     (a) Hysteresis   (b) Drift

Q.2 (A) What is mathematical modeling? Explain the importance of mathematical modelling in control systems.   06

(B) Explain the construction, working and theory of thermal conductivity gauges for measurement of vacuum. Explain how radiation effects are minimized.   06

(C) Obtain the state-space equation and output equation for the system defined by the equation,   08

$$\frac{Y(s)}{U(s)} = \frac{2s^3 + s^2 + s + 2}{s^3 + 4s^2 + 5s + 2}$$

Q.3 (A) Explain the construction and working of a d.c. tachogenerator. Explain its advantages and disadvantages.   10

(B) For a system having $G(s) = \dfrac{15}{(s+1)(s+3)}$, $H(s) = 1$, determine   10

(i) Characteristic equation (ii) ω_n and damping ratio (ξ)
(iii) Time at which Ist overshoot will occur
(iv) Time period of oscillations
(v) No. of cycles output will perform before settling down

TURN OVER

Q.4 (A) What are different temperature compensation techniques used in the   10
measurement of strain using strain gauges? Explain any two methods
in detail.

(B) Construct the block diagram that combines the following set of
equations expressed in the "s" notations (Laplace notation).   10
(1) $W = X - Y$, (2) $V = W - Z$, (3) $Z(S + 6) = V(S + 2)$,
(4) $Y(S^2 + 6S + 8) = Z$, Given X is the input to the system and Y is the
output from the block diagram. Find the transfer function.

Q.5(A) For a certain feedback system having,   10
$G(s) H(s) = \dfrac{3\,(s+1)(s+6)}{s^2\,(s^2+18s+400)}$, Sketch Bode plot and comment on G.M.,
P.M and stability.

(B) With a neat sketch explain the constructional feature and working of   10
(i) Piezo- electric accelerometer and (ii) Pyrometers.

Q.6 (A) For a unity feedback system having $G(s) = \dfrac{100(s+1)}{s^2\,(s+2)(s+10)}$, determine   10
(i) Type of system (ii) Error coefficients (iii) Steady state error for
input as $1+4t+\dfrac{t^2}{2}$.

(B) With neat sketches discuss significance of followings aspects of signal   10
conditionings for any one of the sensor: amplification, conversion
filtering, modulation/demodulation, and grounding.