

University of Mumbai
Examinations Summer 2022
Program: Mechanical Engineering
Curriculum Scheme: Rev 2016
Examination: TE Semester V
Course Code: MEC502

Course Name: MECHANICAL MEASUREMENT AND CONTROL

Time: 2 hour 30 minutes

Max. Marks: 80

Q1.	Choose the correct option for following questions. All the Questions are compulsory and carry equal marks .
1.	Which of the following instruments measure amplitude of a vibrating body?
Option A:	LVDT
Option B:	Tachometer
Option C:	Stroboscope
Option D:	Seismometer
2.	The “dead zone” in a certain pyrometer is 0.125 percent of span. The calibration is 400 ° C. to 1000 ° C. What temperature change might occur before it is detected _____
Option A:	0.65° C
Option B:	0.75° C
Option C:	0.35° C
Option D:	0.86° C
3.	Strain gauge is a
Option A:	Active device and converts mechanical displacement into a change of resistance
Option B:	Passive device and converts electrical displacement into a change of resistance
Option C:	Passive device and converts mechanical displacement into a change of resistance
Option D:	Active device and converts electrical displacement into a change of resistance
4.	A moving coil voltmeter has a uniform scale with 100 divisions, the full scale reading is 200 V and 1/10 of a scale division can be estimated with a fair degree of certainty. The resolution of the instrument in volt is
Option A:	0.2 V
Option B:	2 V
Option C:	2.2 V
Option D:	0.4 V
5.	Frequency response means
Option A:	Transient response of a system to a sinusoidal input
Option B:	Steady state response of a system to a sinusoidal input
Option C:	Oscillatory response of a system to a sinusoidal input
Option D:	Oscillatory and transient response of a system to a sinusoidal input
6.	If a pole is located at origin, how does it get represented on the magnitude plot?
Option A:	-10 log (ω) dB
Option B:	-20 log (ω) dB
Option C:	-40 log (ω) dB
Option D:	-60 log (ω) dB

7.	When negative voltage feedback is applied to an amplifier, its voltage gain
Option A:	Is increased
Option B:	Is reduced
Option C:	Remains the same
Option D:	Zero
8.	PID controller is known as
Option A:	Two term controller
Option B:	Four term controller
Option C:	Three term controller
Option D:	Proportional controller
9.	The breakaway points of a root locus occur at
Option A:	Imaginary axis
Option B:	Real axis
Option C:	Multiple roots of characteristic equation
Option D:	At zero
10.	The characteristic equation of a system is given as $3s^4 + 10s^3 + 5s^2 + 2 = 0$. This system is :
Option A:	Stable
Option B:	Marginally stable
Option C:	Unstable
Option D:	Linear

Q2.	Solve any Four out of Six	5 marks each
A	A system is represented by the characteristic equation $P(S) = S^5 + S^4 + 2S^3 + 2S^2 + 3S + 15 = 0$, predict the stability of the system by using Routh's criterion.	
B	Explain elements of the generalized measurement system..	
C	A unity feedback system has $G(S) = \frac{40(S+2)}{S(S+1)(S+4)}$, Determine (i) Type of system , (ii) Static Error Coefficients and (iii) steady state error for a ramp input of magnitude 4.	
D	Illustrate with neat diagrams the working principle of ultrasonic flow meter with its applications	
E	Define the terms ,Resolution, Threshold, Accuracy , Span, And Range w.r.t static characteristics of measuring instruments.	
F	While measuring the speed of a steam turbine with stroboscope single line images were observed for stroboscope setting of 30060, 4000 and 5230 r.p.m. Calculate the speed of the turbine.	

Q3.	Solve any Two Questions out of Three	10 marks each
A	For a system having $G(S) = \frac{15}{(S+1)(S+3)}$, $H(s)=1$. Determine (i) Characteristic equation (ii) ω_n and ζ (iii) Time at which 1 st undershoot will occur (iv) Time period of oscillation (v) Number of cycles output will perform before settling down	

B	Illustrate with neat diagrams the construction and working principle of (i) McLeod Gauge and (ii) Optical pyrometer with its industrial applications.
C	Draw the root locus and predict the stability of the system having $G(S)H(S) = \frac{K}{S(S+5)(S+10)}$.

Q4.	Solve the following.
A	Solve any Two . 5 marks each
i.	A resistance strain gauge with a gauge factor of 1.5 is cemented to a steel member, which is subjected to a strain of 1×10^{-6} . If the original resistance value of the gauge is 100Ω , calculate the change in resistance.
ii.	Explain the terms signal filtering , and modulation with reference to the Signal conditioning
iii.	Differentiate between open and closed loop control system.
B	Solve any One . 10 marks each
i.	A unity feedback control system has $G(S) = \frac{80}{S(S+2)(S+20)}$. Draw the bode plot. Determine GM, PM, ω_{gc} and ω_{pc} . Comment on the stability.
ii.	Obtain the state-space equation and output equation for the system defined by the equation. $\frac{Y(s)}{U(s)} = \frac{2s^3 + s^2 + s + 2}{s^3 + 4s^2 + 5s + 2}$