SE | Sem-IV | INST | C-2019 | Dec-2022

Duration: 3 hours **Max. Marks: 80**

N.B. (1) Question No. 1 is **COMPULSORY**.

(2) Answer **ANY THREE** questions from Q.2 to Q.6.

(3) Use of Statistical Tables permitted.

(4) Figures to right indicate full marks.

Q 1

a. Evaluate the complex line Integral $\int_0^{1+i} (x - y + ix^2)dz$ along the straight line from z=0 to z=1+i — 5

b. Find a vector orthogonal to u=(-6, 4, 2) v=(3, 1, 5) — 5

c. The equations of lines of regressions are 2x+3y+8=0 and x+2y-5=0, find means of x and y and coefficient of line of regression between x and y — 5

d. Let W be the set of 2 X 2 matrices of the form $\begin{bmatrix} a & 0 \\ 0 & b \end{bmatrix}$ where a and b are real numbers, Show that W is a subspace of space V of all 2X 2 matrices. — 5

Q 2

a. Find the Spearman's rank coefficient correlation of the following data — 6

X	32	55	49	60	43	37	43	49	10	20
Y	40	30	70	20	30	50	72	60	45	25

b. Find the extremal of $\int_{x_1}^{x_2} \frac{1+y^2}{y'^2} dx$ — 6

c. Obtain Taylor and Laurent series expansion about z=0 of function $f(z)= \frac{z-1}{z^2-2z-3}$ indicating regions of convergence — 8

Q. 3

a. A continuous random variable has probability density function as $f(x) = kx^2 \quad 0 \le x \le 2$, find k, mean and P(0.2 <x<0.5) — 6

b. $\oint_C \frac{\sin \pi z^2 + \cos \pi z^2}{(z-2)(z-3)} dz$ where C is the circle i. |z|=1 ii. |z|=4 — 6

c. Reduce the quadratic form to canonical form, find it's rank and signature $21x_1^2+11x_2^2+2x_3^2-30\,x_1x_2+12\,x_1x_3-8\,x_3x_2$ — 8

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Q 4 a. Using Gram-Schmidt process, construct, an orthonormal basis of (1, 1, 1), (-1, 1, 0) and (1, 2, 1) in R^3 have Euclidian inner product **6**

b. Find the probability that at most 4 defective bulbs will be found in a box of 200 bulbs, if it is known that 2% of the bulbs are defective **6**

c. By Rayleigh -Ritz method, Solve the boundary value problem $y''+y+x=0 \quad 0< x<1 \quad y(0)=y(1)=0$ **8**

Q 5 Ten students got the following percentage of marks in mathematics and statistics **6**

a.

Maths	78	36	98	25	75	82	90	62	65	39
Stats	84	51	91	60	68	62	86	58	53	47

Calculate the coefficient of correlation.

b. In a normal distribution 7% of the items are below 35 and 89% of the items are below 63. Find the mean and standard deviation **6**

c. Find the extremal of $\int_{x_1}^{x_2}(y''^2 - y^2 + x^2)dx$ **8**

Q 6 a. Verify Cauchy -Schwartz inequality for u=(1, 2, 4) and v= (-3, 2, 5) **6**

b. Evaluate $\oint_C \frac{\sin^6 z}{\left(z-\frac{\pi}{6}\right)^3} dz$ where C is a circle |z|=2 **6**

c. Find Singular value decomposition of $\begin{bmatrix} 3 & 1 & 1 \\ -1 & 3 & 1 \end{bmatrix}$ **8**

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(3 Hours) Total Marks: 80

N. B. 1. Question No. 1 is compulsory.
2. Answer any 3 questions from the remaining 5 questions.
3. Assume suitable data wherever necessary.

Q1: Attempt **any four**. 20 M

a) Define Strain or gauge factor. What is Poisson's ratio? Explain why it is always negative?
b) Explain the construction & working of Bourdon tube.
c) Compare variable head meter with variable area meter for flow measurement.
d) Explain vacuum measurement by Pirani Gauge.
e) What is pH? State & explain the types of pH measurement electrodes?
f) State types of Orifice plates.

Q 2:

a) State & Derive Bernoulli's equation. 10 M
b) Explain different arrangements of strain gauges for better sensitivity and Temperature compensation. 10 M

Q 3:

a) An Orifice meter with orifice diameter 15cm is inserted in a pipe of 30 cm diameter. The pressure difference measured by a mercury oil differential manometer on the two sides of the orifice meter gives a reading of 50 cm of mercury. Find the rate of flow of oil flow of oil of specific gravity 0.9 when the Cd is 0.64. 10 M
b) What is a piezoelectric transducer? State its working principle. List the advantages, limitations and applications. 10 M

Q 4:

a) List various techniques of density measurement and explain any two in detail. 10 M
b) Explain the working of variable area flow meter. 10 M

Q 5:

a) State and explain the construction and working of McLeod gauge. 10 M
b) Explain pressure measurement using LVDT. 10 M

Q 6 : Write a short note of any two. 20 M

a) Dynamometer
b) Dead Weight tester
c) Viscosity meter

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Time: 3 Hours **Total Marks: 80**

(1) **Question no.1** is **compulsory**.
(2) Answer any 3 questions from the remaining 5 questions.
(3) Assume suitable data wherever required.

Q.1 Attempt any **four** **20**

a) Explain any two important parameters of op-amp.
b) Explain the applications of data acquisition system.
c) Derive the equation of Wheatstone bridge for resistance measurement.
d) Draw the circuit diagram of Zero crossing detector.
e) Explain the advantages of the Instrumentation amplifier.

Q.2

a) Explain the theory of practical integrator with neat circuit diagram. **10**
b) Explain the working of any one active filter using op-amp and state its advantages. **10**

Q.3

a) Explain the working of full wave rectifier using op-amp. **10**
b) Design Monostable Multivibrator using IC 555 for 80% duty cycle. **10**

Q.4

a) Explain the circuit of current to voltage converter using op-amp and state its application. **10**
b) Explain the working of successive approximation type ADC with circuit diagram. **10**

Q.5

a) Explain square wave generator using op-amp. **10**
b) A thermistor is to monitor room temperature. It has a resistance of 3.5 KΩ at 20°C with a slope of -10%/°C. The power dissipation constant Pd is 5mW/°C. Design the signal conditioning circuit. **10**

Q.6

a) List various types of DACs and explain any type in detail. **10**
b) Explain the signal conditioning required for thermocouple sensor and state the challenges. **10**

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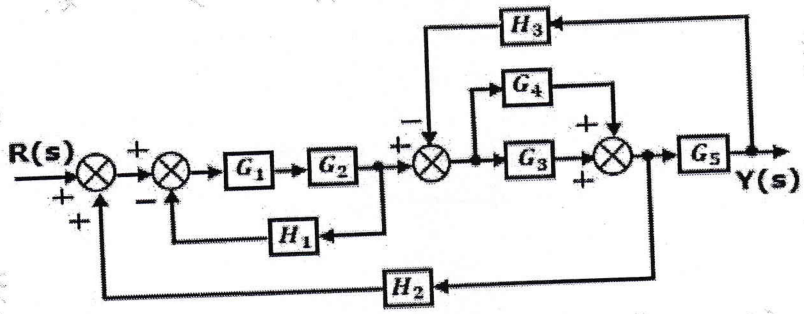
Time: 3 Hrs **Total Marks: 80**

N.B.: 1) Q.1 is compulsory
2) Solve any three from remaining question
3) Right figure indicate the full marks

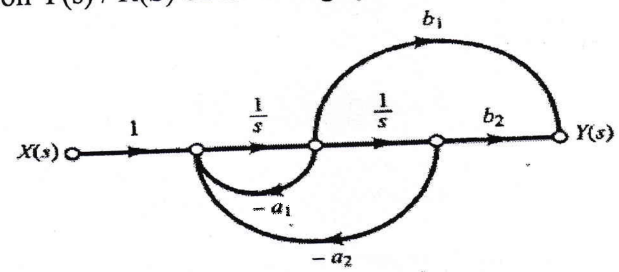
Q.1 solve **any four** [20]

a) Compare open loop and closed loop system
b) Derive transfer function of closed loop system
c) Describe time response specification
d) Explain standard test signals
e) Explain stability of the system

Q.2 a) Consider the block diagram shown in the following figure. Find transfer function using block diagram reduction rules (BDR) [10]



b) Obtain transfer function Y(s) / R(S) of following system using Mason's gain formula [10]



Q.3 a) A feedback system is described by the following transfer function [10]

$$G(s) = \frac{12}{s^2 + 4s + 16} \quad \text{and } H(s) = Ks$$

The damping factor of the system is 0.8. Determine the overshoot of the system and value of K

b) Derive error and error constant of type 0, type 1 and type 2 system for step , ramp and parabolic input [10]

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Q.4 a) Let us find the stability of the control system having characteristic equation [10]

i) $s^4 + 2s^3 + s^2 + 2s + 1$

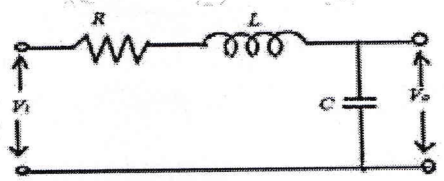
ii) $s^5 + 3s^4 + s^3 + 3s^2 + s + 3 = 0$

b) Consider the open loop transfer function of a closed loop control system [10]

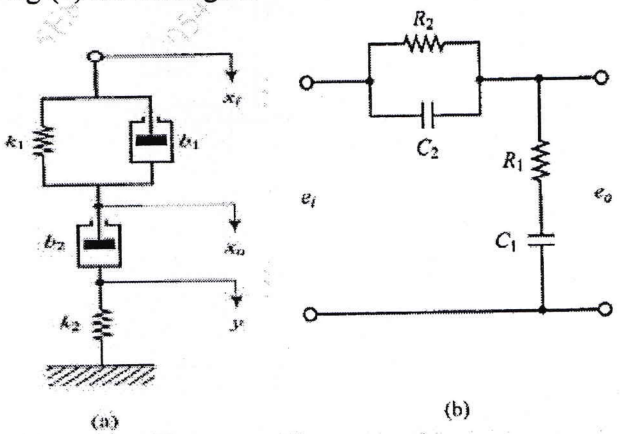
$$\mathbf{G(s)H(s) = \frac{1}{s(1+Ts)}}$$

Draw Nyquist plot of above system and hence determine the stability of the system.

Q.5 a) Obtain the transfer function of the electrical circuit shown in the fig below *[10]*



b) Prove that fig (a) and fig (b) are analogous [10]



Q.6 a) Draw Bode plot and hence determine the stability of the system [10]

$$\mathbf{G(s)H(s) = \frac{10}{s(0.1s+1)}}$$

b) Determine the stability of the following system using root locus [10]

$$\mathbf{OLTF = G(s) = \frac{K}{s^2+4s+5} \quad where \ K = 5 \ and \ H(s) = 1}$$

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3 Hours Total Marks : 80

N.B. : (1) Question No. 1 is compulsory.

(2) Attempt any three questions from the remaining five questions.

(3) Assume suitable data wherever necessary.

(4) Draw neat circuit diagram and waveforms wherever applicable.

(5) Figures to the right indicate full marks

Q 1) Solve any 5 questions 20

i) Compare pneumatic, hydraulic and electrical systems.
ii) Write a note on the need of a valve positioner.
iii) Explain a pressure switch.
iv) Explain time delay valve.
v) Compare transmitter with smart transmitter.
vi) Explain the need of alarm annunciator.

Q 2) a) Write a note on relay and contactor. 10

b) Explain how pressure regulation is achieved in hydraulic system. 10

Q 3) a) Explain the construction and working of gate valve in detail. 10

b) Explain the inherent and installed flow characteristics of the control valve. 10

Q 4) a) Explain 2-wire, 3-wire and 4-wire transmitters.

b) Compare direct and reverse acting actuators. 10

b) Explain the working of light dimmer circuit along with waveforms. 10

Q5) a) Explain the construction and working of temperature switch. 10

b) Write a note on solid state relays.

Q 6) Write short notes on **(any 2)** 20

i) Receiver pressure control techniques
ii) I/P converter
iii) Control valve selection criteria

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