B.E. Sem IV (Choice Base) (Instr. Engg.) May 2018.

Q.P. Code : 37610

Applied Mathematics IV

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

N. B.: 1. Question No. 1 is Compulsory.
2. Attempt any 3 Questions from Question no. 2 to 6.
3. Figures to the right indicate the full Marks.
4. Statistical tables are allowed.

Que. 1 a If λ is an eigen value of nonsingular matrix A then prove that $\frac{|A|}{\lambda}$ is an eigen value of $adj\,A$. 5

b If the random variable X takes the values 1, 2, 3, 4 such that $2P(X=1)=3P(X=2)=P(X=3)=5P(X=4)$, find the probability distribution and cumulative distribution of X. 5

c Find a basis for the orthogonal complement of the subspace in R^3 spanned by the vectors $V_1=(1,-1,\ 3)$, $V_2=(5,-4,\ -4)$, $V_3=(7,-6,\ 2)$. 5

d Evaluate the complex line Integral $\oint_C \log z\,dz$ where C is the unit circle $|z|=1$ 5

Que.2. a If $A=\begin{bmatrix}2&3&4\\0&4&2\\0&0&3\end{bmatrix}$ find eigen values and eigen vectors of A^2-2A+I. 6

b Seven dice are thrown 729 times . How many times do you expect at least 4 dice to show 3 or 5 ? 6

c Find all Taylor and Laurent series expansions for $f(z)=\frac{z}{(z-3)(z-4)}$ about z=1 indicating the region of convergence. 8

Que.3. a A box contains 2^n tickets, among which ${}^nC_i$ tickets bear the number i; i=0,1,2,…n. A group of m tickets are drawn. What is the expectation of their numbers. 6

b Verify Cayley-Hamilton theorem for $A=\begin{bmatrix}3&2&-1\\0&2&0\\1&1&2\end{bmatrix}$ and hence find A^{-1} 6

c Obtain the equations of the lines of regression for the following data. Also obtain the estimate of X for Y=70. 8

X	65	66	67	67	68	69	70	72
Y	67	68	65	68	72	72	69	71

Que.4. a Evaluate $\oint_C \frac{z-1}{(z+1)^2(z-2)}dz$ where C is $|z| = 3$ 6

b Construct an orthonormal basis of R^3 using Gram Schmidt process to S={(3, 0, 4), (-1, 0, 7), (2, 9, 11)} 6

c Determine whether the matrix $A = \begin{bmatrix} 8 & -8 & -2 \\ 4 & -3 & -2 \\ 3 & -4 & 1 \end{bmatrix}$ is diagonalizable, if yes diagonalise it. 8

Que. 5 a Show that the matrix $A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$ is derogatory and find the minimal polynomial of the matrix. 6

b A random variable X has probability density function $\frac{1}{2^x}$, x=1,2,3,.. 6

Find moment generating function and hence find mean and variance of X.

c Of a group of men 5% are under 60 inches height and 40% are between 60 and 65 inches. Assuming a normal distribution find the mean height and standard deviation. 8

Que.6. a If $A = \frac{1}{2}\begin{bmatrix} 3 & 1 \\ 1 & 3 \end{bmatrix}$ find e^A and 4^A 6

b Between 2 pm and 4 pm, the average number of phone calls per minute coming into a switchboard of a company is 2.5. Find the probability that during one particular minute there will be (i) no phone call at all, (ii) at least 5 calls. 6

c By using Cauchy residue theorem, evaluate 8

i. $\int_0^\infty \frac{dx}{x^2+4}$ ii. $\int_0^{2\pi} \frac{1}{5-4\cos\theta}d\theta$

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em-III (choice based) / INST / Transducers - II / M-18

Q.P. Code : 38555

Duration: 3 Hours **Total Marks : 80**

Note:

1. **Question one is compulsory.**
2. **Attempt any three from remaining five questions**
3. **Assume suitable data wherever necessary.**

Q1. Attempt any four **20**

a. State Piezo-resistive effect and piezo electric effect.

b. Explain the principle of strain gauge and derive gauge factor = 1+2 v.

c. In a rotameter the density of a float is always less than that of flowing fluid. State true or false and justify your answer.

d. Compare orifice and venturi meter.

e. Draw and explain pressure measurement scheme using bourdon tube and LVDT.

Q2. a Explain different arrangements of strain gauges for better sensitivity and temperature compensation. **10**

Q2. b A strain gauge is bonded to a beam 0.1 m long and has a cross sectional area 4 cm^2. Young's modulus for steel is 207 GN/m^2. The strain gauge has an unstrained resistance of 240 ohm and a gauge factor of 2.2. When a load is applied, the resistance of gauge changes by 0.013 ohm. Solve the change in length of the steel beam and the force applied to the beam. **10**

Q3.a Describe the following transducers in detail: **10**

(i) Bellows (ii) Bourdon tube (iii) Dead weight tester

Q3.b. Describe working of different types of manometer with advantages and limitations of each type. **10**

Q4.a. State basic principle and explain McLeod gauge. **10**

Q4.b. What are the steps in calibration of pH meter? Explain pH measurement setup. **10**

Q5.a. Derive Bernoulli's equation. **10**

Q5.b. A venturi tube of throat diameter 60 mm is placed in a water pipe of diameter 100 mm to measure the volumetric flow. The volumetric flow rate through the tube is 0.08 m^3/s and the water has a density of 10^3 kg/m^3 and viscosity of 10^{-3} Ns/m^2. **10**

i) Determine the Reynold's number for these conditions.

ii) The coefficient of discharge is 0.99. Determine the upstream-to-throat differential pressure.

Q6. Write short notes (any two): **20**

a. Radiation and ultrasonic densitometers
b. MEMS
c. Optical fiber sensor
d. Viscosity measurement

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SE/INST/Sem-IV [CHOICE BASED] / Feedback Control System / May 2018

Q. P. Code: 40552

[Time: 3 Hours]

Total Marks: 80

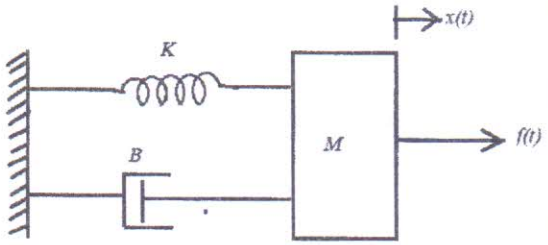
Instructions:

- **Q1** is compulsory
- Answer any **Three** out of remaining **Five** questions
- Assumptions made should be clearly stated
- Assume any suitable data wherever required but justify the same
- Figure to the right indicate gets full marks
- Illustrate answers with sketches wherever required

Q1. Answer the following. (20)

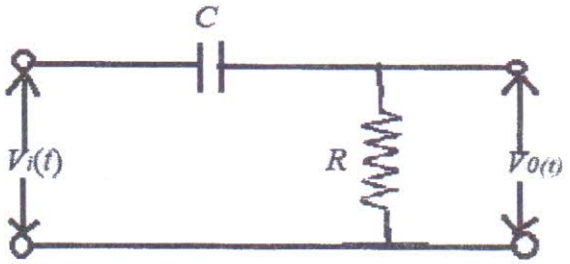
(a) Discuss how are feedback control systems are classified based on – method of analysis and design, on parameter, type of signals, application, number of input/output, number of open-loop poles of the system, order of the system and damping.

(b) Obtain the differential equations governing the mechanical system shown in following figure. Find transfer function X(s)/F(s).



(c) Explain the transient and steady – state response. Draw these responses for first and second – order systems.

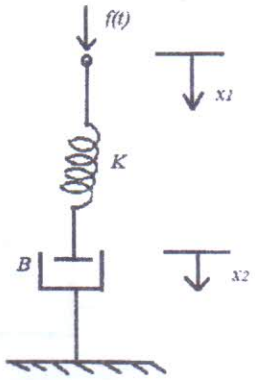
(d) Obtain the time response of the following electrical network.



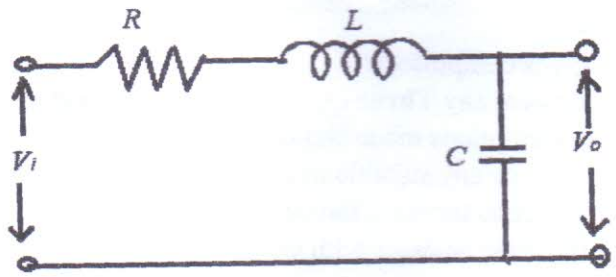
Assume C= 1F, and R= 2Ω

Q2. (a) Define open-loop and closed-loop systems and differentiate between them. (05)

(b) What is meant by analogous systems? Obtain the electrical analogous of following mechanical system using F-V analogy. (05)



(c) Find the transfer function of the network shown in following Figure using Mason's gain formula.

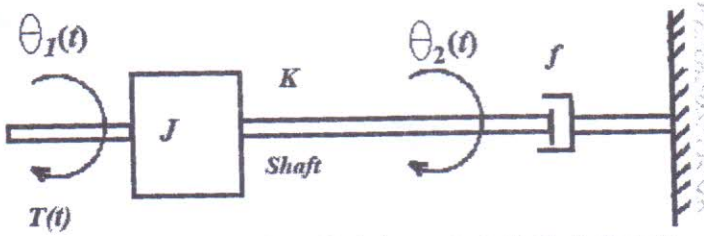


Q3. (a) Explain the correlation between time and frequency response specifications.

(b) Test the stability of the system represented by following characteristic equation.

$$s^5 + s^4 + 3s^3 + 9s^2 + 16s + 10 = 0$$

(c) Write torque equations of the following rotational mechanical system. Obtain the analogous electrical circuit based on Torque-Current and Torque-Voltage analogies.



Q4. (a) Sketch the root-locus of the unity feedback system having

$$G(s) = \frac{k}{s(s+2)(s+4)}$$, where k is varied from $-\infty$ to $+\infty$.

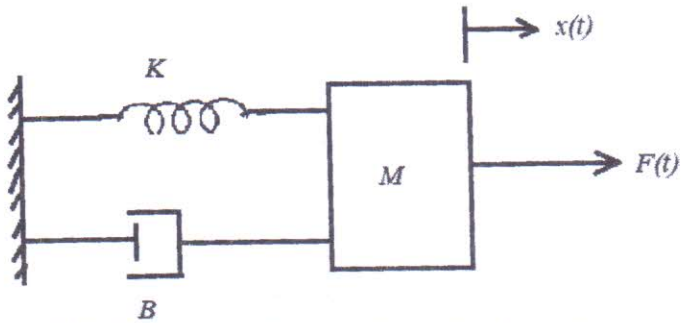
Hence obtain the value of k for which the system is stable.

(b) Determine the position, velocity and acceleration constant of the following feedback control systems for which the open-loop transfer functions are –

i) $$G(s) = \frac{20}{(0.5s+1)(s+10)}$$

ii) $$G(s) = \frac{K}{s(s+5)(s+20)}$$

Q5. (a) For the system shown in following Figure –



Find i) Transfer function, ii) Damping factor, ii) Natural frequency, iii) Percent overshoot, iv) Peak time, Assume: K = 33N/m, B = 15 N-s/m, M = 35kg

S.E. SEM IV (Choice Base) (IHST) May 2018.
Analytical Instrumentation.

Q. P. Code : 37875

(3 Hours) (Total Marks: 80)

Please check whether you have the right question paper.

N.B.: 1) Question number 1 is compulsory.
2) Attempt any three questions from the remaining.
3) Figures to the right indicate full marks.

1. Answer the following: - **[20]**
(a) Explain the block diagram of Analytical Instrument.
(b) Comment on Resolution of Mass Spectrometer.
(c) Explain in brief the principle of paramagnetic oxygen analyser.
(d) Explain the terms: (i) Chemical Shift (ii) Chromatograph & Chromatogram.

2. (a) State Beer – Lambert Law. Prove that A= abc. **[10]**
(b) Explain the instrument of NMR with the aid of a neat sketch. **[10]**

3. (a) With neat schematic diagram, explain the working of GM Counter. **[10]**
(b) With a diagram, explain the Atomic absorption spectroscopy. **[10]**

4. (a) What is Half Life Period? **[10]**
If the half life period of 100 grams of a radioactive isotope is 8 years, how many grams will remain in 32 years?
(b) List the parts of GC. Draw and explain the working of Gas chromatograph. **[10]**

5. (a) Explain the phenomenon of Raman and Rayleigh scattering. **[10]**
With neat block diagram, Explain laser based of Raman Spectrometer.
(b) Explain Time of Flight Mass Spectrometer with neat diagram. **[10]**

6. Write Short Note on: - **[20]**
(a) Difference between Packed Column and Tubular Column.
(b) Photomultiplier tube
(c) Single beam Filter Fluorimeter.
(d) Difference between Filters and Monochromators.

S.E. (INST) SEM IV (Choice Base) May 2018
Signal Conditioning Circuit Design.

Q. P. Code: 37823

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

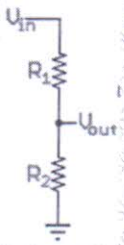
N. B. 1) Question No. 1 is compulsory **(Any Four).**
2) Answer any **3** questions from the remaining **5** questions.
3) Assume suitable data wherever necessary.

Q1 (a) Write a short note on zero crossing detector. **20**
(b) Describe the term loading effect with suitable example.
(c) The resistors in a bridge are given by R1=R2=R3=120 Ω and R4 = 121 Ω. If the supply voltage is 10V. Find the offset voltage.
(d) Draw and explain Sample and Hold circuit.
(e) Design a ±12V power supply using IC 78xx.

Q2 (a) Define multivibrator? Explain astable multivibrator using IC 555 and also design astable multivibrator for 50% duty cycle. **20**

(b) Draw and explain circuit for ideal integrator with waveforms. Discuss the problems associated with ideal integrator and draw the circuit diagram for practical integrator.

Q3 (a) 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 dissipation constant is P_D=5mW/°C. It is proposed to use the thermistor in the divider as shown below to provide a voltage of 5.0V at 20°C. Evaluate the effect of self-heating. (R_2= Thermistor; R_1=3.5KΩ) **20**



(b) Draw and explain the principle and construction of metal strain gauges. What is the signal conditioning associated with it.

Q4 (a) Explain successive approximation analog to digital converter. Find ADC output for a 4-bit converter to a 2.87V input, if the reference is 5V. **20**

(b) Design a second order high pass filter for cutoff frequency equal to 1.5 KHz.

Q5 (a) A potentiometric displacement sensor is to be used to measure work-piece motion from 0 to 10 cm. The resistance changes linearly over this range from 0 to 1KΩ. Develop signal conditioning to provide a linear, 0- to 10-V output. **20**

(b) Explain the absolute value circuit with labelled circuit diagram and its waveform.

Q6 (a) Draw and explain the principle and construction of RTD. What is the signal conditioning associated with it. **10**
(b) Phase Locked loop **5**
(c) SMPS **5**

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