SE | Sem-IV | ETRX | C-2019 | Dec-2023

**Paper / Subject Code: 40921 / Engineering Mathematics-IV**

**Max. Marks: 80** **Time: 3 hrs.**

**N.B.** : 1. Q1 is compulsory
2. Attempt any three questions from Q2 to Q6.
3. Figures to the right indicate full marks.

Q1. (a) A r.v. X has the distribution [5]

| X: | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| p(x): | k | 3k | 5k | 7k | 9k | 11k | 13k |

Find i) k ii) $P(3<X\le 6)$.

(b) Evaluate the integral $\int_C \frac{z^2}{(z-3)^2(z+2)}\,dz$, C: $|z+1|=2$. [5]

(c) Using Gram Schmidt method, find an orthonormal set of vectors corresponding to $\{(3,0,4),(1,0,2)\}$. [5]

(d) The given data indicates weight x and heights y of 1000 men. $\bar{x}=150$ lbs, $\bar{y}=68$ inches, $\sigma_x=20$ lbs, $\sigma_y=2.5$ inches, $r=0.6$. Find the line of regression of y on x and estimate the height of a person whose weight is 200 lbs. [5]

Q2. (a) If $f(x)=\begin{cases}\frac{x}{2} & 0<x<2\\ 0 & \text{otherwise}\end{cases}$ is a pdf of a random variable X, then find $E(X)$, $\text{var}(X)$, $\text{var}(3X)$. [6]

(b) Let $W_1=\{(x,y)\mid x,y\in\mathbb{R},\ y=3x+5\}$ and $W_2=\{(x,y)\mid x,y\in\mathbb{R},\ y=2x\}$. [6]

Show that $W_1$ is not a subspace and $W_2$ is a subspaces of $\mathbb{R}^2$ with usual vector addition and scalar multiplication.

(c) A Chemical Engineer is investigating the effect of process operating temperature x on product yield y. The study results in the following data, [8]

| x : | 100 | 110 | 120 | 130 | 140 | 150 | 160 | 170 | 180 | 190 |
|---|---|---|---|---|---|---|---|---|---|---|
| y : | 45 | 51 | 54 | 61 | 66 | 70 | 74 | 78 | 85 | 89 |

Find the equation of the least square lines which will enable us to predict (i) yield on the basis of temperature (ii) temperature on the basis of yield.

Q3. (a) Find the Extremal of [6]

$$\int_0^1 yy'+(y'')^2\,dx,\quad y(0)=0,\ y'(0)=1,\ y(1)=2,\ y'(1)=4.$$

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(b) Three factories A, B, C produce 30%, 50% and 20 % of the total production of an item. Out of their production 80%, 50% and 10% are defective respectively. Find the probability of an item chosen at random is defective. If an item chosen is found to be defective, find the probability that it was produced by the factory B. [6]

(c) Find a singular value decomposition of the matrix $\begin{bmatrix} 1 & 2 \\ 1 & 2 \end{bmatrix}$. [8]

Q4. (a) Evaluate the following integrals using Cauchy Residue theorem, [6]

$$\int_C \frac{\sin \pi z^2 + \cos \pi z^2}{(z-1)(z-2)^2} \, dz, \quad C: |z| = 3.$$

(b) Find the usual inner product between the two vectors, $(1,2,0,1)$ and $(-1,0,1,3)$. Find the norm of each vectors and verify the Cauchy Schwarz inequality. [6]

(c) The income group of 10,000 people were found to be normally distributed with mean Rs. 520 and standard deviation Rs. 60. Find the number of people having income (i) more than Rs 600, (ii) between Rs. 400 and 550, (iii) less than Rs 450. [8]

Q5. (a) Evaluate using Cauchy integral formula, [6]

$$\int_C \frac{(z+4)^2}{z^2\left(z^2+5z+6\right)} \, dz, \quad C: |z| = 1.$$

(b) Calculate the rank correlation coefficient for the following data. [6]

| | | | | | | |
|---|---|---|---|---|---|---|
| x : | 10 | 12 | 18 | 16 | 15 | 40 |
| y : | 12 | 18 | 20 | 15 | 50 | 25 |

(c) Using Rayleigh-Ritz method, find an approximate solution for the extremal of $\int_0^1 2xy - y^2 - (y')^2 \, dx$, $y(0) = 0$, $y(1) = 0$. [8]

Q6. (a) Find the extremal of $\int_{x_1}^{x_2} \sqrt{1+(y')^2} \, dx$. [6]

(b) Find the Laurent series expansion of $\frac{2}{(z+1)(z+3)}$ convergent in the region i) $|z| < 1$ ii) $|z+1| > 2$. [6]

(c) Reduce the quadratic form $x^2 + 2y^2 + 2z^2 - 2xy - 2yz + xz$ to a diagonal form using congruent transformation and find its rank, index and class value. [8]





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SE / ETRX / SEM-IV / C-2019 / DEC. 2023

Duration: 3Hrs. Max Marks:80

N.B. : (1) Question No 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume suitable data, if required and state it clearly.

1 Attempt any Four. [20]
a Compare voltage amplifier and power amplifier
b Explain crossover distortion with neat sketch
c Write a short note on current mirror circuit
d Draw block diagram of oscillator. State and explain Barkhausens criteria
e Compare all four types of negative feedback amplifiers.

2 a Explain what is a multistage amplifier? Explain the different types of coupling methods. [10]
b Write a short note on FET Cascode amplifier (CS-CG). [10]

3 a Explain different ideal feedback topologies for a negative feedback amplifier using block diagram. [10]
b Explain working of RC phase shift oscillator with the help of circuit diagram. Give expression for frequency of oscillations. [10]

4 a What are the different methods to improve CMRR. Explain any one. [10]
b Explain Class-A power amplifier. Drive expression for its efficiency. [10]

5 a Determine the lower cut off frequency due to the effect of coupling and bypass capacitors for an amplifier in figure 1 with the following specifications: [10]
Vcc = 20V, R1 = 40KΩ, R2 = 10KΩ, Rc = 4KΩ, RE = 2KΩ, RL = 2.2KΩ
CC1 = 10μF, CC2 = 1μF, CE = 20μF, Assume ro = ∞ and β = 100

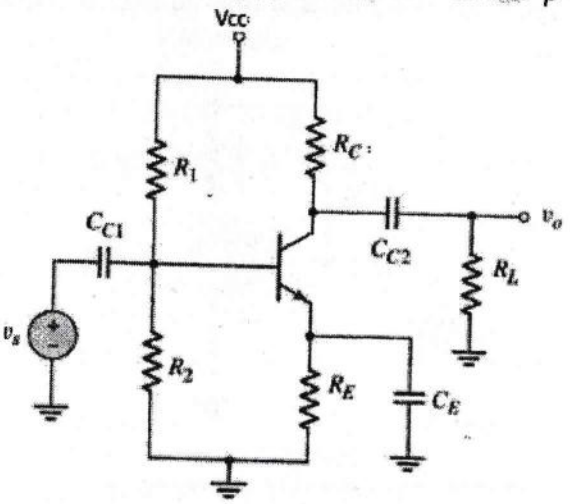


Figure. 1

b Write a short note on types of coupling used in multistage amplifiers [10]

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6 a For the differential amplifier in Figure 2, the parameters are: $V^+ = 5\,\text{V}, V^- = -5\,\text{V}, R_1 = 80\text{k}\Omega$, and $R_D = 40\text{k}\Omega$. The transistor parameters are $\lambda = 0$ and $V_{TN} = 0.8\,\text{V}$ for all transistors, and $K_{n3} = K_{n4} = 100\mu\text{A/V}^2$ and $K_{n1} = K_{n2} = 50\mu\text{A/V}^2$. Determine the range of the common-mode input voltage. [10]

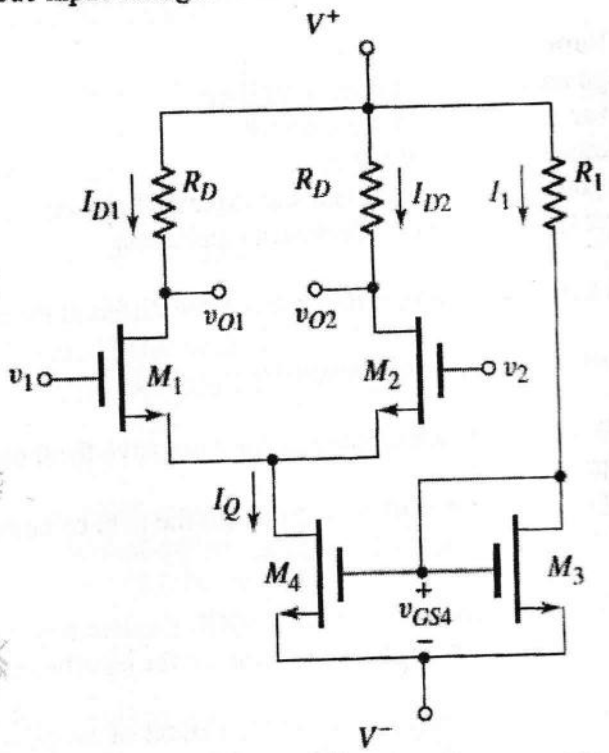


Figure 2.

b Calculate the input power, output power and efficiency of the amplifier circuit in the figure for an input voltage that results in base current of 10mA peak. [10]

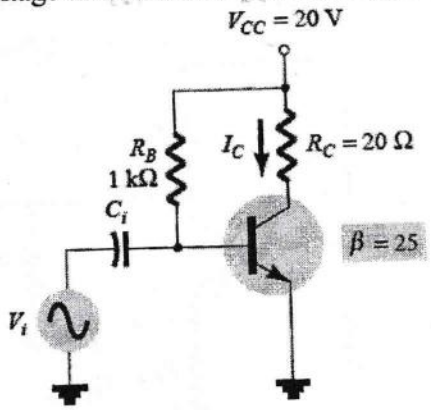


Figure. 3

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Time: 3 Hours) [Total Marks: 80]

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

(2) Attempt any **three** questions out of the remaining **five**.

(3) Each question carries 20 marks and sub-questions carry equal marks.

(4) Assume suitable data if required.

| | | | |
|---|---|---|---|
| 1 | | Attempt any FOUR | 20 |
| | (a) | Differentiate the CISC and RISC microcontroller. | (5) |
| | (b) | Explain PSW of 8051. | (5) |
| | (c) | Explain SCON and TMOD SFR'S of 8051. | (5) |
| | (d) | Explain Embedded C data types in detail. | (5) |
| | e) | a) Explain the following instructions for 8051 microcontrollers.<br>i) MOVX ii) CJNE iii) JB iv) AJMP v) SWAP | (5) |
| 2. | (a) | Draw and explain memory organization of 8051. | (10) |
| | (b) | What are 'Assembler Directives'? Explain with the examples. | (10) |
| 3. | (a) | Explain addressing modes of 8051 with suitable examples. | (10) |
| | (b) | Explain interrupt structure of 8051 with appropriate registers. | (10) |
| 4. | (a) | Design 8051 based system with following specifications.<br>(i) 8051 CPU operating at 6 MHz<br>(ii) 32 KB of RAM using 16 KB chips<br>(iii) 8 KB of EPROM using 4 KB chips<br>Design the system with proper interface diagram and memory map Note: #EA pin is grounded | (10) |
| | (b) | Explain the structure of I/O ports of 8051 with neat diagram. | (10) |
| 5 | (a) | Write 8051 based assembly Program to generate a square wave on P1.0 of 1Khz frequency and 50% duty cycle. | (10) |
| | (b) | Write a program to transfer "A" serially using 8051 with baud rate 9600. | (10) |
| 6. | (a) | Interface 7-segment LED display to 8051 and write a program using Embedded C to display digit 0 to 9. | (10) |
| | (b) | Interface 8bit DAC with 8051, draw the logic interface diagram and write an assembly language program to generate continues rectangular wave form. | (10) |



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Duration: 3hrs [Max Marks: 80]

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

(2) Attempt any three questions out of the remaining five.

(3) All questions carry equal marks.

(4) Assume suitable data, if required and state it clearly.

1 Attempt any FOUR [20]

a Explain the term thermal and shot noise.

b Compare AM, FM and PM.

c Explain the following terms w.r.t. radio receivers: sensitivity, selectivity and image frequency.

d Discuss the importance of quantizer in PCM transmitter and receiver.

e Discuss the need for modulation.

2 a Explain the generation of DSB-SC signal using balanced modulator. [05]

An SSB transmitter radiates 0.5kW when the modulation percentage is 60%. How much of the carrier power is required if we want to transmit the same message by an AM transmitter? [05]

b Explain TV broadcasting of video. [05]

c A sinusoidal carrier having amplitude of 12V and frequency 25kHz is amplitude modulated by a sinusoidal voltage of amplitude 5V and frequency 2kHz. Modulated voltage is developed across a 50Ω resistance. i) Write the equation for the modulated wave ii) determine the modulation index and calculate the total power in the modulated wave iv) Draw the spectrum of the modulated wave v) How much is the power saving if the carrier is suppressed? [05]

3 a Draw the block diagram of Armstrong frequency-modulation system and explain its working. [10]

b Compare Narrowband and Wideband FM. [05]

Find the carrier and the modulating frequencies, the modulation index, and the maximum deviation of the FM represented by the voltage equation $v=20\sin(8\times10^{8}t+10\cos2500t)$. What power will this FM wave dissipate in a 10Ω resistor? [05]



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4 a Draw block diagram of superheterodyne receiver and explain its working. **[05]**

In a superheterodyne receiver having no RF amplifier. Find the loaded Q of the antenna coupling circuit if the IF is 455kHz, and the image frequency rejection ratio for the tuning at 1200kHz is 130. 2) hence find the image frequency and its rejection ratio for the tuning at 20MHz. **[05]**

b Draw the block diagram of FM transmitter and explain its working. **[10]**

5 a State sampling theorem and explain the types of sampling. **[10]**

b Explain generation and detection of PWM and PPM. **[10]**

6 a Explain Time Division Multiplexing with proper diagrams. **[10]**

b Explain delta modulation with proper block diagram and waveforms. **[10]**

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SE/Sem-IV/ETRX/C-2019/Dec-2023

Time: 3 Hours

Max. Marks: 80

Note: -1. **Question no. 1 is compulsory.**
2. **Answer any three out of remaining questions.**
3. **Figures to right indicate full marks.**
4. **Assume suitable data wherever necessary.**

Q.1 a) Sketch even and odd components of the following [5]

$X(t) = 1 \quad , 0 \le t \le 1$

$= 2-t \quad , 1 \le t \le 2$

b) Find if the following signal is energy or power signal, if yes determine its energy or power
$x(t) = A \quad , -T_0 \le t \le T_0 \quad = 0$ otherwise [5]

c)Find the Laplace Transform using property of $x(t) = e^{-2t}u(t) - e^{2t}u(-t)$ and plot ROC [5]

d) Find Z transform & sketch the ROC $x(n)=[(-1)^n (2)^{-n}] u(n)$ [5]

Q.2 a) Check whether the system described by $y(t) = x(t+10)+x^2(t)$ is [10]
i) Static/dynamic ii) Causal/non-causal iii) Stable/unstable
iv)Time invariant/Time varient

b) Perform the convolution [10]

$x(t) = u(t) \quad h(t) = 1$ for $-1 \le t \le 1$

Q3 a) State and prove Time Scaling property of Laplace Transform [10]

b) Find the response of system

$\frac{d^2y(t)}{dt^2} + \frac{5dy}{dt} + 6\, y(t) = x(t)$

Subject to initial conditions $y(0)=2$, $y'(0)=1$ and input $x(t)= e^{-t} u(t)$ [10]

Q 4 a) i) State and prove Time Reversal property of Z transform [5]
ii) Obtain Z transform using property of signal $x(n) = n\, u(n)$ [5]

b) Determine an impulse response of system described as [10]
$y(n)= x(n)+ 0.6\, y(n-1)- 0.08\, y(n-2)$

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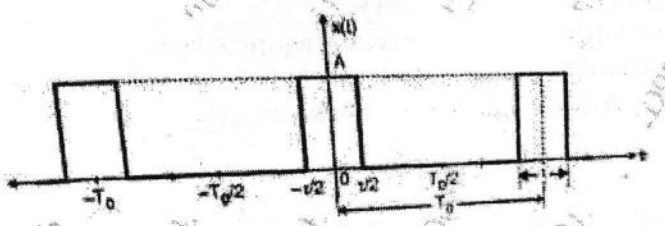
Q5 a) Obtain exponential fourier series for rectangular pulse train shown below and sketch the spectrum [10]




b) i) Obtain Fourier Transform of a unit step function [5]

ii)State and prove time differentiation property of Fourier Transform [5]

Q6 a) Determine the spectra of periodic signal x(n) = {1,1,1,0} with period N=4 using discrete Time Fourier series [10]

Q6 b) i) Explain Relationship between Fourier transform and Laplace Transform [5]

ii) Explain Relation between Z transform and DTFT [5]

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