Ref / IV-EXTC / New

SE / Sem IV / ExTC / Choice Based / 07·05-19

**(3 hours)**
**Total marks: 80**

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

(2) Attempt **any Three** from remaining

Q1  a)  If $X_1$ has mean 4 and variance 9 & $X_2$ has mean $-2$ and variance 4    [5]

where $X_1$ & $X_2$ are independent, find $E(2X_1 + X_2 - 3)$ and

$V(2X_1 + X_2 - 3)$.

  b)  Find the extremals of $\int_{x_1}^{x_2}(x + y')y'dx$    [5]

  c)  Verify Cauchy Schwartz inequality for the vectors $u = (-4, 2, 1)$ and    [5]

$v = (8, -4, -2)$

  d)  Check whether $A = \begin{bmatrix} 2 & -2 & 3 \\ 1 & 1 & 1 \\ 1 & 3 & -1 \end{bmatrix}$ is derogatory or not.    [5]

Q2  a)  Using Cauchy's Residue theorem evaluate $\int_C \frac{z-1}{(z+1)^2(z-2)}$ where $C$ is    [6]

$|z| = 4$

  b)  Show that the extremal of the isoperimetric problem    [6]

$I[y(x)] = \int_{x_1}^{x_2}(y')^2 dx$ subject to the condition $\int_{x_1}^{x_2} y\, dx = k$ is a

parabola.

  c)  Is the matrix $A = \begin{bmatrix} 2 & 1 & 1 \\ 1 & 2 & 1 \\ 0 & 0 & 1 \end{bmatrix}$ diagonalisable? If so find the diagonal    [8]

matrix and the transforming matrix.

Q3  a)  Verify Cayley-Hamilton theorem for $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & -1 & 4 \\ 3 & 1 & -1 \end{bmatrix}$    [6]

hence find $A^{-1}$

  b)  Check whether the following are subspaces of $\mathbb{R}^3$    [6]

   (i)  $W = \{(a, 0,0) \mid a \in \mathbb{R}\}$

   (ii)  $W = \{(x, y, z) \mid x = 1, z = 1, y \in \mathbb{R}\}$

  c)  Expand $f(z) = \frac{1}{(z-1)(z-2)}$ in Taylors & Laurent's series indicating    [8]

regions of convergence.

Q4  a)  Using Rayleigh-Ritz method to solve the boundary value problem  [6]

$$I = \int_0^1 (2xy + y^2 - (y')^2) \, dx \; ; \; 0 \le x \le 1 \text{ given } y(0) = y(1) = 0$$

b)  If $A = \begin{bmatrix} -1 & 4 \\ 2 & 1 \end{bmatrix}$ then prove that $3 \tan A = A \tan 3$.  [6]

c)  If sizes of 10,000 items are normally distributed with mean 20 cms & [8] standard deviation of 4 cms. Find the probability that an item selected at random will have size :

(i) between 18 cms and 23 cms , (ii) above 26 cms

Q5  a)  Find orthonormal basis of $\mathbb{R}^3$ using Gram-Schmidt process where  [6]

$$S = \{(1,0,0) , (3,7,-2) , (0,4,1)\}$$

b)  In a factory, machines A , B & C produce 30%, 50% & 20% of the [6] total production of an item. Out of their production 80% , 50% & 10% are defective respectively. An item is chosen at random and found to be defective. What is the probability that it was produced by machine A.

c)  Evaluate $\int_{-\infty}^{\infty} \frac{dx}{(x^2+4)(x^2+9)}$  [8]

Q6  a)  Evaluate $\int_C \frac{dz}{z^3(z+4)}$ where $C$ is the circle  [6]

(i) $|z| = 2$ and (ii) $|z - 3| = 2$

b)  Two unbiased dice are thrown three times, using Binomial distribution [6] find the probability that the sum nine would be obtained (i) once , (ii) twice

c)  For 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 coefficients of regression $b_{xy}$ & $b_{yx}$ and the coefficient of correlation $(r)$

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SE SEM-IV — EXTC — CHOICE BASE —13/05/2019.

(Time: 3 Hours)                                                   Total Marks : 80

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

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

(3) Figures to the right indicate full marks.

(4) Assume suitable data if required and mention the same in answer sheet.

Q.1 Solve any four                                                                              (20)

a) Draw and explain operation of Depletion type MOSFET.
b) Compare RC coupled, TC coupled and DC coupled amplifier.
c) Explain design consideration of heat sinks in power amplifier.
d) Give the advantages of negative feedback .
e) State and explain Barkhausen's Criteria .

Q.2 (a) Design a two stage RC coupled CE Amplifier to meet following specifications:    (15)

$A_v \geq 1000, V_o = 4V, S = 10, f_L = 20$ Hz.Select BC147B.

(b) Explain the effect of source and load resistance on amplifier .                         (05)

Q.3 (a) Draw circuit diagram of Class B Push Pull Power amplifier and explain its working. Find its maximum efficiency and maximum power dissipation in each transistor. What is cross-over distortion? How it can be overcome?                                                                   (10)

(b) Draw and explain Cascode amplfier in detail .                                             (10)

Q.4 (a) Design a class A transformer coupled power amplifier for the following requirements:
Output A.C.power = 5 watts, Load resistance = 12 ohms, DC supply voltage = 12 volts
$S_{ICO} \leq 8$.Calculate overall efficiency at full load.                                     (10)

(b) Explain the different types of biasing of Depletion MOSFET.                             (10)

Q.5 (a) Explain the different feedback topologies in detail.                                 (15)

(b) Write a short notes on Darlington pair amplifier.                                        (05)

Q.6 (a) Draw RC phase shift oscillator using BJT and derive the frequency of oscillation for same.    (15)

(b) For Hartley oscillator calculate the frequency of oscillation if L1=L2= 1 mH and C=0.2 µF.    (05)

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**Paper / Subject Code: 40802 / Electronics Devices and Circuits-II**

| Transistor type | Pd max @25°C Watt | Ic max @25°C Amps | V_CB(on) volts d.c | V_CE volts d.c | V_CB(Sat) volts d.c | V_CE(Sat) volts d.c | V_CER volts d.c | V_EB volts d.c | T_j max °C | D.C. current gain min | typ. | max. | Small Signal min | typ. | max. | f_T max. | V_BE max | θ_jc °C/W | Derate above 25°C W/°C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2N 3055 | 115·5 | 15·0 | 100 | 60 | 70 | — | 90 | 7 | 200 | 20 | 50 | 70 | 15 | 50 | 120 | 1·8 | 1·5 | 0·7 |
| ECN 055 | 50·0 | 5·0 | 60 | 50 | 55 | — | 60 | 5 | 200 | 25 | 50 | 100 | 25 | 75 | 115 | 1·5 | 3·5 | 0·4 |
| ECN 149 | 30·0 | 4·0 | 50 | 40 | — | 65 | — | 8 | 150 | 30 | 50 | 110 | 33 | 60 | 115 | 1·2 | 4·0 | 0·3 |
| ECN 100 | 5·0 | 0·7 | 70 | 60 | — | 50 | — | 6 | 200 | 50 | 90 | 280 | 50 | 90 | 200 | 0·9 | 35 | 0·05 |
| BC147A | 0·25 | 0·1 | 50 | 45 | — | — | — | 6 | 125 | 115 | 180 | 220 | 125 | 220 | 260 | 0·9 | — | — |
| 2N 525(PNP) | 0·225 | 0·5 | 85 | 30 | — | — | — | — | 100 | 35 | — | 65 | — | 45 | — | — | — | — |
| BC147B | 0·25 | 0·1 | 50 | 45 | 50 | 50 | — | 6 | 125 | 200 | 290 | 450 | 240 | 330 | 500 | 0·9 | — | — |

| Transistor type | hie | hoe | hre | θja |
|---|---|---|---|---|
| BC 147A | 2·7 KΩ | 18μ℧ | 1·5 × 10⁻⁴ | 0·4°C/mw |
| 2N 525 (PNP) | 1·4 KΩ | 25μ℧ | 3·2 × 10⁻⁴ | 0·4°C/mw |
| BC 147B | 4·5 KΩ | 30μ℧ | 2 × 10⁻⁴ | — |
| ECN 100 | 500 Ω | — | — | — |
| ECN 149 | 250 Ω | — | — | — |
| ECN 055 | 100 Ω | — | — | — |
| 2N 3055 | 25 Ω | — | — | — |

**BFW 11—JFET MUTUAL CHARACTERISTICS**

| —Vgs volts | 0·0 | 0·2 | 0·4 | 0·6 | 0·8 | 1·0 | 1·2 | 1·6 | 2·0 | 2·4 | 2·5 | 3·0 | 3·5 | 4·0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ids max. mA | 10 | 9·0 | 8·3 | 7·6 | 6·8 | 6·1 | 5·4 | 4·2 | 3·1 | 2·2 | 2·0 | 1·1 | 0·5 | 0·0 |
| Ids typ. mA | 7·0 | 6·0 | 5·4 | 4·6 | 4·0 | 3·3 | 2·7 | 1·7 | 0·8 | 0·2 | 0·0 | 0·0 | 0·0 | 0·0 |
| Ids min. mA | 4·0 | 3·0 | 2·2 | 1·6 | 1·0 | 0·5 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 | 0·0 |

**N-Channel JFET**

| Type | V_GS max. Volts | V_DG max. Volts | V_DS max. Volts | P_t max. @25°C | T_j max. | I_DSS (typical) | g_fs (typical) | -V_P Volts | r_d | Derate above 25°C | θ_jc |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 147822 | 50 | 50 | 50 | 300 mW | 175°C | 2 mA | 3000 μ℧ | 6 | 50 KΩ | 2 mW/°C | 0·59°C/mW |
| BFW 11 (typical) | 30 | 30 | 30 | 300 mW | 200°C | 7 mA | 5600 μ℧ | 2·5 | 50 KΩ | — | 0·59° C/mW |

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SE | SEM-IV | EXTC | choice base | 17th May 2019

(Time: 3 Hours) [Total Marks: 80]

**N.B.:** (1) Question No. 1 is compulsory.
(2) Solve any three questions from the remaining five.
(3) Figures to the right indicate full marks.
(4) Assume suitable data if necessary and mention the same in answer sheet.

Q.1 Attempt any 4 questions:
(a) Give ideal characteristics of op-amp and give their practical values. [05]
(b) Compare linear and switching voltage regulator. [05]
(c) Design a circuit for $V_O = V_1 + V_2$ using single op-amp and few resistors. [05]
(d) What are the advantages of switch capacitor filters? [05]
(e) Explain op-amp as window detector. [05]

Q.2 (a) With the help of a neat diagram and voltage transfer characteristics explain the [10]
working of an inverting Schmitt trigger. Derive the expressions for its threshold
levels.
(b) Draw a neat circuit diagram of a Wien bridge oscillator using op-amp. Derive its [10]
frequency of oscillation. What are the values of $R$ and $C$ for frequency of
oscillation to be 965 Hz?

Q.3 (a) Draw the circuit diagram of a square and triangular waveform generator using op- [10]
amp and explain its working with the help of waveforms.
(b) The circuit given in Fig. 3(b) is similar to that of internal diagram of IC555 with [10]
slight modifications in the internal resistances to value 2R. Analyse this circuit
and draw the waveforms at output terminal $v_{out}$ and across the capacitor $C$.
Comment on the duty cycle of output waveform when i) $R_A$ is less than $R_B$, ii) $R_A$
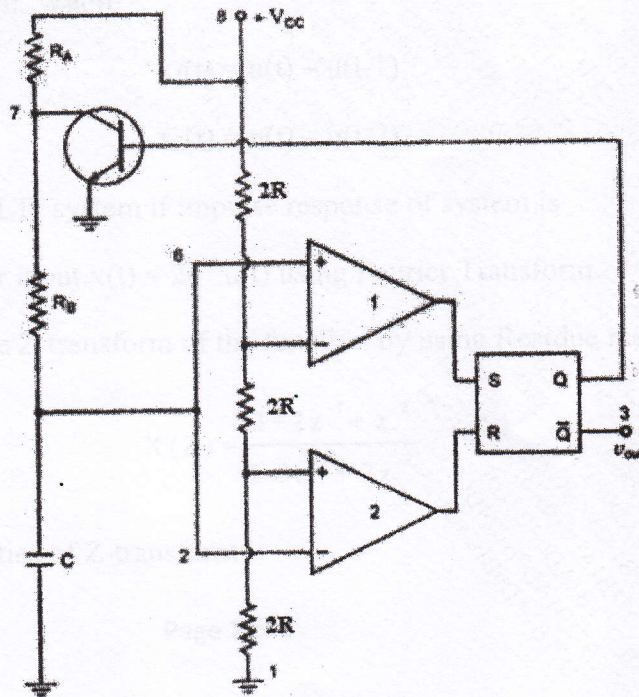is equal to $R_B$, and iii) $R_A$ is greater than $R_B$.



Fig. 3(b)

Q.4 (a) Design a second order Butterworth high pass filter for cut off frequency of 1 kHz and pass-band gain of AF=2. [10]

(b) With a neat circuit derive an expression for the output of an instrumentation amplifier. [10]

Q.5 (a) With neat circuit explain R/2R ladder digital to analog converter. [10]

(b) With the help of a functional block diagram explain the working of voltage regulator LM317 to give an output voltage variable from 6 V to 12 V to handle maximum load current of 500 mA. [10]

Q.6 Short notes on: (Attempt any four)
(a) Effect of swamping resistor. [05]
(b) Current fold-back protection circuit in voltage regulator. [05]
(c) Voltage to Current converter. [05]
(d) Peak detector circuit. [05]
(e) Working of PLL IC 565. [05]

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*SE (EXTC) Sem IV - Choice Based - 23/05/19*
*Paper/Subject code: 40804/Signals & Systems*

(3 Hours) [Total marks: 80]

- Question no. 1 is compulsory.
  Attempt any Three questions from remaining.
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Q. 1    Answer *any 4* questions from the given questions.    20

a.    Determine energy and power of given signal.

$$x(t) = 3 \cos 5\, \Omega o t$$

b.    Test the given system for linearity, causality, stability and time invariance.

$$y(t) = x(t^2)$$

c.    Find the initial value x (0) and final value x(∞) of given Z-domain signals.

$$X(Z) = \frac{2z^{-1}}{1 - 1.8z^{-1} + 0.9z^{-2}}$$

d.    Realize following FIR system with minimum no of multipliers.

$$h(n) = \{-0.5,\ 0.8,\ -0.5\}$$

e.    Explain applications of signals and systems in communication.

f.    Give advantage of state space analysis for system analysis.

Q.2  a.    Perform convolution of $x_1(t)$ and $x_2(t)$ using convolution theorem and sketch    10
          resultant waveform. Where

$$x_1(t) = u(t) - u(t-1)$$

$$x_2(t) = u(t) - u(t-2)$$

b.    Find response of LTI system if impulse response of system is    10

$h(t) = 2e^{-3t}u(t)$ for input $x(t) = 2e^{-5t}u(t)$ using Fourier Transform.

Q.3  a.    Determine inverse Z-transform of the function by using Residue method.    10

$$X(Z) = \frac{3 + 2z^{-1} + z^{-2}}{1 - 3z^{-1} + 2z^{-2}}$$

b.    List any 4 properties of Z-transform.    04

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SE (EXTC) Sem IV Choice Based - 23/05/19

c. Find response of time invariant system with impulse response 06

$h(n) = \{1, 2, 1, -1\}$ to an input signal $x(n) = \{1, 2, 3, 1\}$

Q.4 a. The state space representation of a discrete time system is given by 10

$A = \begin{pmatrix} 2 & -1 \\ 3 & 1 \end{pmatrix}$ $B = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$ $C = [1 \quad 3]$ $D = [3]$

Derive the transfer function of the system.

b. Find the digital network in direct form I and II for the system described by the difference equation 10

$y(n) = x(n) + 0.5\, x(n-1) + 0.4\, x(n-2) - 0.6\, y(n-1) - 0.7 y(n-2)$

Q.5 a. Determine Fourier series representation of the half wave rectifier output given by equation, 10

$$x(t) = A \sin \Omega \text{ot} \quad ; \text{for } t=0 \text{ to } \frac{T}{2}$$

$$= 0 \quad ; \text{for } t = \frac{T}{2} \text{ to } T$$

b. Determine Fourier transform of 10

$$x(t) = 1-t^2 \quad ; \text{for } |t| < 1$$

$$= 0 \quad ; \text{for } |t| > 1$$

Q.6 Write short note on **any two**. 20

a. ROC in Z-transform and Laplace transform.

b. Gibbs Phenomenon.

c. Relation of ESD, PSD with Auto-correlation.

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SE SEM-IV - EXTC - CHOICE BASE - 29/05/2019.

Duration :3hrs

Max.Marks:80

N.B. (1) Question No. 1 is compulsory.
(2) Attempt any three questions out of remaining five.
(3) Figures to the right indicate full marks.
(4) Assume suitable data if required and mention the same in answer sheet.

1. Solve **any four**
   (a) Why AGC is required in radio receiver?                                    20
   (b) Explain Noise figure and noise factor.
   (c) Why IF is selected as 455 KHz in AM?
   (d) Explain natural top and flat top sampling.
   (e) Compare narrow band FM and wideband FM.

2. (a) List the methods used for SSB generation. Explain the third method of SSB generation    10
   with suitable diagram.
   (b) The unmodulated carrier power of AM transmitter is 10 Kw and carrier frequency is 2     10
   MHz. The carrier is modulated to a depth of 50% by an audio signal of 5KHz. Assume
   R=1Ω.
   i) Determine the total transmitted power.
   ii) Determine the SSB power.
   iii) Percentage of power saving if SSB is transmitted.
   iv) Draw the frequency spectrum and find the bandwidth.

3. (a) Explain FM demodulator using PLL with suitable diagram.                    10
   (b) Explain amplitude limiting and thresholding in detail with its significance.    10

4. (a) Explain Varactor diode modulator ?                                        10
   (b) With the help of suitable waveforms explain generation and detection of PPM.    10

5. (a) Explain independent side band receiver in detail with block diagram.        10
   (b) Compare Amplitude, Frequency and phase modulation.                         10

6. Write short note on (any four)                                               20
   (a) Aliasing error and aperture effect
   (b) Applications of Pulse communication
   (c) VSB transmission with its application
   (d) Time division Multiplexing (TDM)
   (e) Low level and high level modulation

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