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

Q.3 (a) Draw the circuit diagram of a square and triangular waveform generator using op-amp and explain its working with the help of waveforms. [10]
(b) The circuit given in Fig. 3(b) is similar to that of internal diagram of IC555 with 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. [10]

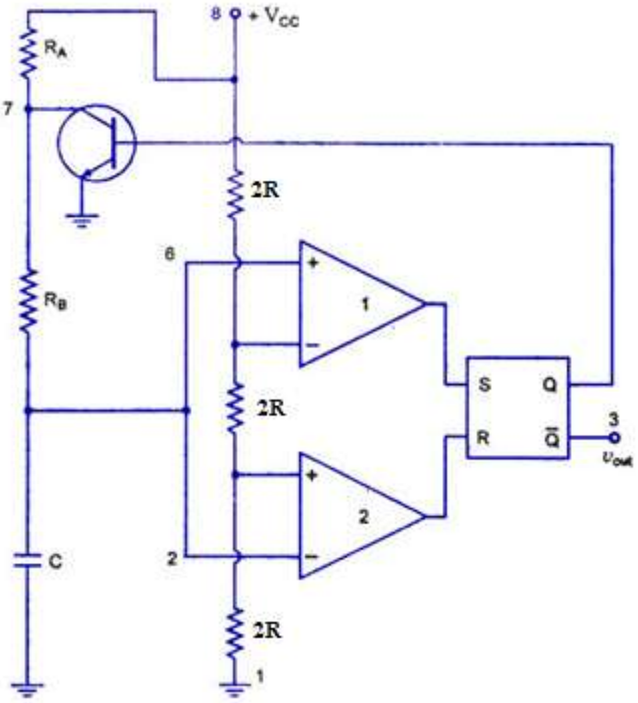

Fig. 3(b)

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

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(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** **20**

(a) Why AGC is required in radio receiver?
(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 with suitable diagram. **10**

(b) The unmodulated carrier power of AM transmitter is 10 Kw and carrier frequency is 2 MHz. The carrier is modulated to a depth of 50% by an audio signal of 5KHz.Assume R=1Ω. **10**

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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(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.

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

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 $x(\infty)$ of given Z-domain signals.

$$X(Z) = \frac{2Z^{-1}}{1-1.8Z^{-1}+0.8Z^{-2}}$$

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 resultant waveform. Where 10

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

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

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

c. Find response of time invariant system with impulse response h(n) = {1, 2, 1, -1} to an input signal x(n) ={1, 2, 3, 1} **06**

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

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

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**

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

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

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

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

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.

Q. P. Code: 37525

(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 where X_1 & X_2 are independent, find $E(2X_1 + X_2 - 3)$ and $V(2X_1 + X_2 - 3)$. [5]

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 $v = (8, -4, -2)$ [5]

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 $|z| = 4$ [6]

b) Show that the extremal of the isoperimetric problem $I[y(x)] = \int_{x_1}^{x_2}(y')^2\, dx$ subject to the condition $\int_{x_1}^{x_2} y\, dx = k$ is a parabola. [6]

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

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

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 regions of convergence. [8]

Q. P. Code: 37525

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

$I = \int_0^1 (2xy + y^2 - (y')^2)\ dx\ ;\ 0 \le x \le 1$ 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 & standard deviation of 4 cms. Find the probability that an item selected at random will have size : [8]

(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 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. [6]

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 find the probability that the sum nine would be obtained (i) once , (ii) twice [6]

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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(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)**

Transistor type	Pdmax @ 25°C Watts	Icmax @ 25°C Amps	V_{CE} (sat) volts d.c.	V_{CBO} volts d.c.	V_{CEO} (Sus) volts d.c.	V_{CER} (Sus) volts d.c.	V_{CEX} volts d.c.	V_{EBO} volts d.c.	T_j max °C	D.C. current gain min	D.C. current gain typ.	D.C. current gain max.	Small Signal h_{fe} min.	Small Signal h_{fe} typ.	Small Signal h_{fe} max.	V_{BE} max	θ_{jc} °C/W	Derate above 25°C W/°C
2N 3055	115·5	15·0	1·1	100	60	70	90	7	200	20	50	70	15	50	120	1·8	1·5	0·7
ECN 055	50·0	5·0	1·0	60	50	55	60	5	200	25	50	100	25	75	125	1·5	3·5	0·4
ECN 149	30·0	4·0	1·0	50	40	—	—	8	150	30	50	110	33	60	115	1·2	4·0	0·3
ECN 100	5·0	0·7	0·6	70	60	65	—	6	200	50	90	280	50	90	280	0·9	35	0·03
BC147A	0·25	0·1	0·25	50	45	50	—	6	125	115	180	220	125	220	260	0·9	—	—
2N 525(PNP)	0·225	0·5	0·25	85	30	—	—	—	100	35	—	65	—	45	—	—	—	—
BC147B	0·25	0·1	0·25	50	45	50	—	6	125	200	290	450	240	330	500	0·9	—	—

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

BFW 11—JFET MUTUAL CHARACTERISTICS

−V_{GS} 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
I_{DS} 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
I_{DS} 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
I_{DS} 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_{DS} max. Volts	V_{DG} max. Volts	V_{GS} max. Volts	P_d max. @25°C	T_j max.	I_{DSS}	g_{mo} (typical)	−V_P Volts	r_d	Derate above 25°C	θ_{ja}
2N3822	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