(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) How precision rectifiers are different than simple diode rectifiers? [05]

(b) Compare ideal op-amp with practical op-amp. [05]

(c) Find v_N, v_P, and v_O in the circuit of Fig. 1(c) if v_S is 9 V. [05]

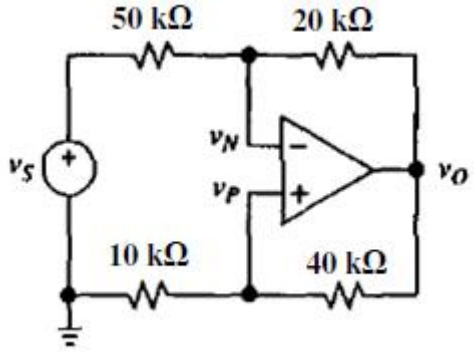

Fig. 1(c)

(d) Design a circuit for $V_O = 2V_1 - 3V_2$ using single op-amp and few resistors. [05]

(e) Explain how a resistor can be simulated by a switch capacitor circuit. [05]

Q.2 (a) Design a voltage regulator using IC 723 to give V_o = 4 V to 32 V and output current of 2 A. [10]

(b) Explain *R*-2*R* ladder type digital to analog convertor. [10]

Q.3 (a) Explain analog to digital conversion using successive approximation method. [10]

(b) Draw a neat circuit diagram of a *RC* phase shift oscillator using op-amp. Derive its frequency of oscillation. What are the values of *R* and *C* for frequency of oscillation to be 1 kHz? [10]

Q.4 (a) What is an instrumentation amplifier? Draw a neat circuit of an instrumentation amplifier using 3 op-amps. Derive its output voltage equation. [10]

(b) 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]

Q.5 (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]

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(b) Analyze the circuit given in Fig. 5(b). Draw the waveforms at output terminal v_O and across the capacitor C. Comment on the duty cycle of output waveform. Take diode D as an ideal diode and assume R_A is equal to R_B. [10]

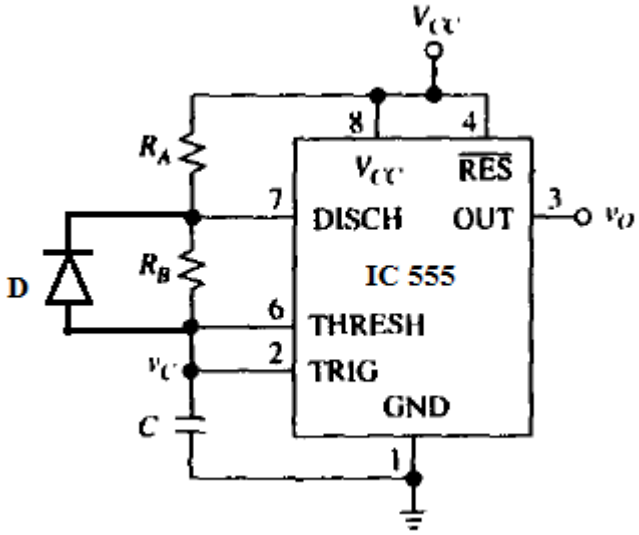

Fig. 5(b)

Q.6 Short notes on: **(Attempt any four)**

(a) Sample and hold circuit. [05]

(b) Three terminal fixed voltage regulator. [05]

(c) Monolithic switching regulator. [05]

(d) XR2206 waveform generator. [05]

(e) Wilson current source. [05]

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(3 Hours) **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 5 questions [20]

a) Compare series and shunt regulator.
b) What are the major limitation of class B power amplifier and how to overcome the same?
c) What is the need of dual power supply biasing for differential amplifier?
d) Which type of biasing technique is used to bias Integrated Circuit
e) Draw and explain frequency response of BJT CE amplifier.
f) Explain line regulation and load regulation of voltage regulator. Draw the line and load regulation characteristics of ideal and practical voltage regulator.

Q.2 a) For the circuit shown in Fig. 2a, the transistor parameters are $V_{BE(on)}$ = 0.7V, β=100, C_π = 2 pF, Cμ = 0.2 pF. Find lower cutoff frequency and midband gain. [10]

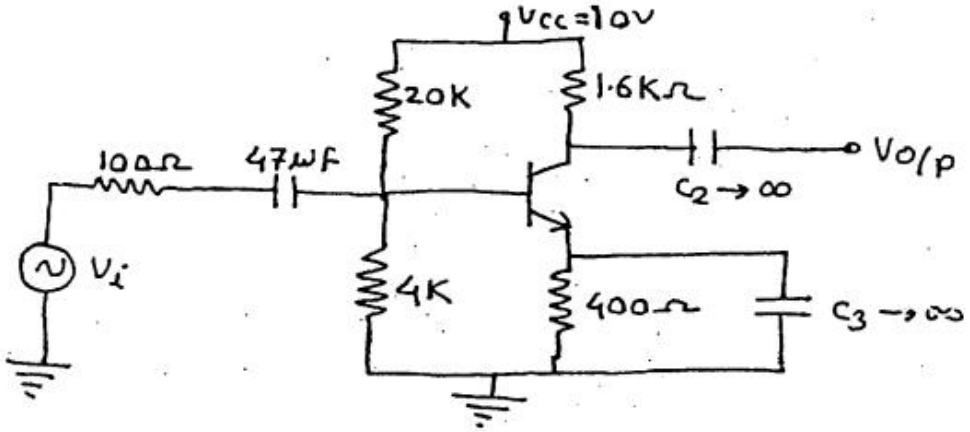

Fig.2a

b) Determine unity gain bandwidth of N channel MOSFET with parameters K_n = 0.25 mA/V^2, V_{TN} = 1V, λ=0, C_{gd} = 0.04 pF, C_{gs} = 0.2 pF, V_{GS} = 3V. If a 10 kΩ load is connected to the output between drain and source determine the Miller capacitance and cut-off frequency. [10]

Q.3 a) Draw circuit diagram of MOSFET based differential amplifier and derive the expression for differential gain, common mode gain and CMRR. [10]

b) Determine overall input resistance and output resistance of the circuit as shown below in Fig. 3b. For both the transistors β=120 [10]

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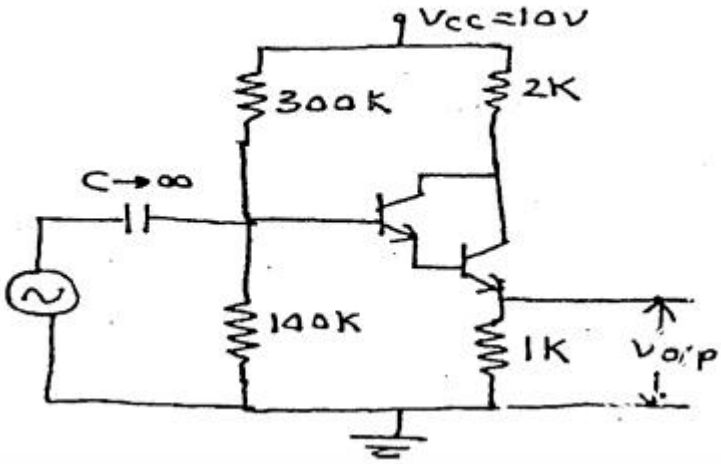

Fig. 3b

Q.4 a) Explain the working of two transistor (BJT) current source with the help of necessary current relationships. Also explain the effect of finite output resistance on current source performance and techniques to improve the same. [10]

b) Draw the circuit of V_{BE} multiplier biased class AB amplifier and explain the working and advantages of V_{BE} multiplier biased class AB amplifier. [5]

c) What are the ideal characteristics of opamp and also explain the effect of high frequency on OPAMP gain and phase. [5]

Q.5 a) Draw the circuit diagram of transformer coupled class A power amplifier. Also draw ac and dc loadlines for the same. Derive the expression for its power conversion efficiency. [10]

b) Explain the working of basic differentiator with the help of input and output waveforms. Also derive the expression for the output voltage. What are the limitations of basic differentiator and how to overcome these limitations. [10]

Q.6 Short notes on: (Attempt any four) [20]

a) Zener voltage regulator
b) Power MOSFET
c) Class AB power amplifier
d) High pass and Low pass filter using OPAMP
e) High Frequency hybrid pi model of BJT

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

Note the following instructions.

1. Question **No. 1** is **compulsory.**
2. Attempt **any three out of the remaining five**
3. Draw neat diagrams wherever necessary.
4. Assume data, if missing, with justification
5. Figures to the Right indicate full marks.

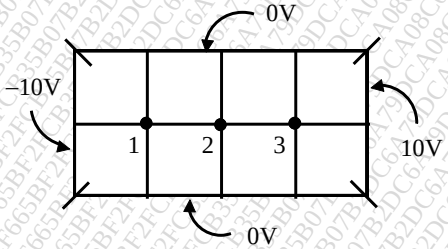
Q1. Attempt ANY FOUR out of the FIVE

(a) Define parallel polarization and perpendicular polarization with the help of a diagram. **[05]**

(b) Find the charge in the volume defined by $0 \leq x \leq 1m$, $0 \leq y \leq 1$ m, if the $\rho v = 120x^2y\ \mu C/m^3$. **[05]**

(c) Explain the term super refraction with a neat labeled diagram. **[05]**

(d) Determine the potential at the free nodes in the potential system of the following figure using Finite Difference Method (Band Matrix Method). **[05]**



(e) State the Maxwell's Equations in free space in terms of E and H only. Explain its significance in wave motion. **[05]**

Q2. (a) Derive boundary conditions for electric field for a dielectric-dielectric interface stating its significance. **[05]**

(b) In free space ($z \leq 0$), a plane wave with $Hi = 10\cos(10^8t - \beta z)a_x$ mA/m is incident normally on a lossless medium ($\varepsilon = 2\varepsilon o$, $\mu = 8\mu o$) in the region $z \geq 0$. Determine the reflected wave Hr, Er and the transmitted wave Ht, Et. **[10]**

(c) Define Polarization of a wave. State the conditions to achieve Linear polarization. **[2+3]**

Q3. (a) A 300MHz wave is propagating through fresh water. Assuming a lossless medium $\mu_r = 1$, $\varepsilon_r = 78$ (at 300MHz). Find the phase constant, the velocity of propagation, the wavelength and the intrinsic impedance. If $E_o = 0.1$V/m, also find E_x and H_y. **[8+2]**

(b) Derive an expression for the Maximum Usable Frequency (MUF) in terms of the skip distance and virtual height. **[05]**

(c) A VHF communication is to be established with a 35W transmitter at 90MHz. Determine the distance up to which LOS communication may be possible if the height of the transmitting and receiving antennae are 40mts and 25mts respectively. **[05]**

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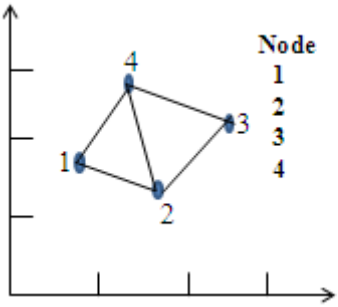
Q4. **(a)** Obtain reflection coefficient and transmission coefficient of perpendicularly polarized wave incident on a dielectric-dielectric boundary with oblique incidence. Define the Brewster angle for this case. **[8+2]**

(b) Consider the two element mesh shown in the fig below. Using the finite element method, determine the potentials within the mesh. **[10]**



Node	(x, y)
1	(0.8, 1.8)
2	(1.4, 1.4)
3	(2.1, 2.1)
4	(1.2, 2.7)

Q5. **(a)** What is the loss tangent of a material? How does it classify materials? **[2+3]**

(b) Derive Helmholtz equations. **[5]**

(c) A point charge $Q_1 = 10\mu C$, is located at $P_1(1, 2, 3)$ in free space, while $Q_2 = -5\mu C$ is at $P_2(1, 2, 10)$. **[5+5]**

(a) Find the vector force exerted on Q_2 by Q_1.

(b) Find the coordinates of P_3 at which a point charge Q_3 experiences no force.

Q6. **(a)** A 5nC point charge is located at A(2, -1, -3) in free space. Find E, at the origin. **[05]**

(b) Define skin depth. Most microwave ovens operate at 2.45GHz. Assume $\sigma = 1.1 \times 10^{6}$mho/m and $\mu_r = 600$ for the stainless steel interior. Find the depth of penetration. **[05]**

(c) Explain Ducting. State the conditions under which a duct is formed. **[05]**

(d) With respect to the application of Electromagnetic Waves, explain the working of an Electromagnetic Pump. **[05]**

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(3 Hours) **Max Marks: 80**

Note:
1. **Question No. 1 is compulsory.**
2. **Out of remaining questions, attempt any three questions.**
3. **Assume suitable additional data if required.**
4. **Figures in brackets on the right hand side indicate full marks.**

1. (A) Explain Mason's Gain Formula. **(05)**

(B) Differentiate between Open Loop and Closed Loop Control System **(05)**

(C) Explain the concept of relative stability. **(05)**

(D) Explain the concept of Neuro-Fuzzy adaptive control system. **(05)**

2. (A) The open-loop transfer function of a unity feedback system is – **(10)**

$$G(s) = \frac{20}{s(1+4s)(1+s)}$$

Evaluate the static error coefficients for the system. Obtain the steady-state error of the system when subjected to an input given by the polynomial –

$$r(t) = 2 + 4t + \frac{t^2}{2}$$

(B) Test the stability of the system represented by following characteristic equations.

i) $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$.

ii) $s^5 + 2s^4 + 3s^3 + 6s^2 + 2s + 1 = 0$.

3. (A) For the given transfer function, find Tp, % MP, Ts, and Tr. **(10)**

$$G(s) = \frac{2s}{s^2 + 6s + 25}$$

(B) Sketch the root locus for the below given System. **(10)**

$$G(s)H(s) = \frac{K}{s(s+3)(s+5)}$$

4. (A) Determine the C(s)/R(s) of the signal flow graph given in Fig. 4(a). **(10)**

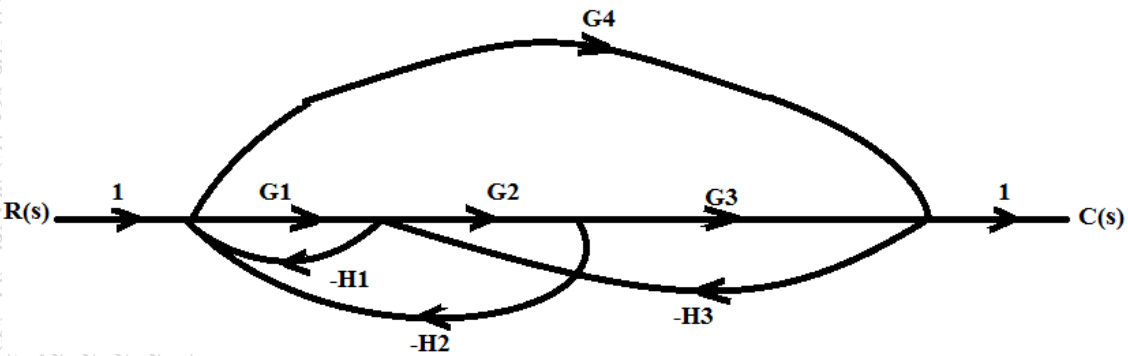

Fig. 4(a): Signal flow graph

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(B) Draw the Bode diagram for the transfer function **(10)**

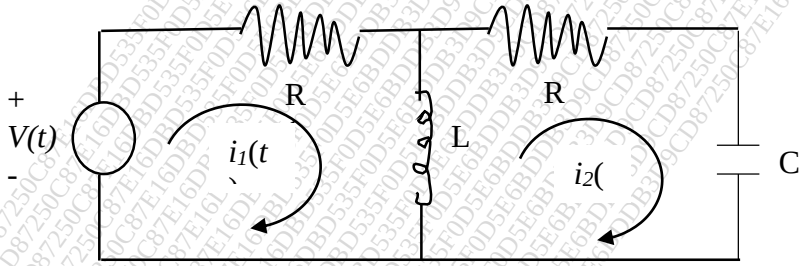
$$G(s) = \frac{Ks^2}{(1+0.2s)(1+0.02s)}$$

Determine gain K for gain cross over frequency ω_{gc} to be 5 rad/sec. Comment on the stability.

5. (A) Explain Controllability and Observability analysis of LTI System using Suitable example. **(10)**

(B) Draw block diagram of Model Reference Adaptive Control and explain its function. **(05)**

(C) Define the transfer function and find the transfer function of following electrical network **(05)**



6. (A) Sketch the polar plot for the following system. **(10)**

$G(s) = \frac{1}{s(1+s)(1+2s)}$. Determine the gain and phase margin of the system.

(B) A linear time invariant system is characterized by the state variable model. Examine the observability of the system. **(10)**

$$A = \begin{bmatrix} 0 & 0 & 0 \\ 1 & 0 & -3 \\ 0 & 1 & -4 \end{bmatrix}, \quad B = \begin{bmatrix} 40 \\ 10 \\ 0 \end{bmatrix}, \quad C = \begin{bmatrix} 0 & 0 & 1 \end{bmatrix}$$

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

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

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

(3)**Figures** to the **right** indicate **full** marks.

(4)Assume suitable data if necessary.

1. (a) Find the extremal of $\int_0^1 \left(xy + y^2 - 2y^2 y'\right) dx$. **(5)**

(b) State Cauchy-Schwartz inequality in R^3 and verify it for $u = (-4, 2, 1)$ and $v = (8, -4, -2)$. **(5)**

(c) If $\lambda_1, \lambda_2, \lambda_3, ...\lambda_n$ are eigen values of A, then show that $\frac{1}{\lambda_1}, \frac{1}{\lambda_2}, \frac{1}{\lambda_3}, ... \frac{1}{\lambda_n}$ are the eigenvalues of A^{-1} . **(5)**

(d) A random variable X has the following probability mass distribution;

$X:$	0	1	2
$P(X=x):$	$3c^3$	$4c-10c^2$	$5c-1$

, Find c and determine $P(X<1)$. **(5)**

2. (a) Evaluate $\int_0^{1+i} z^2\, dz$, along (i) the line $y = x$, (ii) the parabola $x = y^2$, Is the line integral independent of the path ? Explain. **(6)**

(b) A random variable X has the following density function

$$f(x) = \begin{cases} 2e^{-2x} & , x > 0 \\ 0 & , x \le 0 \end{cases}$$, Find the m.g.f. and hence, its mean and variance. **(6)**

(c) Calculate R (Spearman's rank correlation) and r (karl-pearson's)from the following data:

$X:$	12	17	22	27	32
$Y:$	113	119	117	115	121

, Interpret your result. **(8)**

3. (a) Let $V = R^3$, Show that W is a subspace of R^3 , where $W = \{(a,b,c): a+b+c = 0\}$, that is W consists of all vectors where the sum of their components is zero. **(6)**

(b) Evaluate $\oint_C \frac{e^{2z}}{(z+1)^4} dz$ where C is the circle $|z-1| = 3$. **(6)**

(c) Show that the matrix A is diagonalizable. Also find the transforming matrix and the diagonal matrix where $A = \begin{bmatrix} 4 & 1 & -1 \\ 2 & 5 & -2 \\ 1 & 1 & 2 \end{bmatrix}$. **(8)**

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4.(a) Find the extremals of $\int_{x_0}^{x_1}\left(2xy+y'''^2\right)dx$. **(6)**

(b) A transmission channel has a per-digit error probability $p=0.01$. Calculate the probability of more than 1 error in 10 received digits using (i) Binomial and (ii) Poisson distribution. **(6)**

(c) Obtain Taylor's series and two distinct Laurent's series expansion of

$f(z)=\dfrac{z-1}{z^2-2z-3}$, indicating the region of convergence. **(8)**

5.(a) Verify the Cayley-Hamilton Theorem for matrix A and hence find A^{-1} if it exists.

where $A=\begin{bmatrix}0 & c & -b\\ -c & 0 & a\\ b & -a & 0\end{bmatrix}$ **(6)**

(b) Let R^3 have the Euclidean inner product. Use Gram-Schmidt process to transform the basis $\{u_1,u_2,u_3\}$ in to an orthonormal basis where $u_1=(1,1,1),\ u_2=(-1,1,0),\ u_3=(1,2,1)$ **(6)**

(c) The marks obtained by 1000 students in an examination are found to be normally distributed with mean 70 and standard deviation 5. Estimate the number of students whose marks will be (i) between 60 and 75 (ii) more than 75. **(8)**

6. (a) Using Rayleigh-Ritz method, solve the boundary value problem using a two degree polynomial as initial solution.

$I=\int_0^1\left(2xy+y^2-y'^2\right)dx;\ 0\le X\le 1,$ given $y(0)=y(1)=0$. **(6)**

(b) Show that $A=\begin{bmatrix}4 & -2 & 2\\ 6 & -3 & 4\\ 3 & -2 & 3\end{bmatrix}$. is derogatory and find its minimal polynomial. **(6)**

(c) Using Cauchy residue theorem, evaluate the following integrals:

(i) $\int_0^{2\pi}\dfrac{d\theta}{5+3\sin\theta}$ **(4)**

(ii) $\int_{-\infty}^{\infty}\dfrac{x^2}{\left(x^2+a^2\right)\left(x^2+b^2\right)}\,dx, a>0, b>0.$ **(4)**

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(3 Hours) **Max Marks: 80**

Note:
1. **Question No. 1 is compulsory.**
2. **Out of remaining questions, attempt any three questions.**
3. **Assume suitable additional data if required.**
4. **Figures in brackets on the right hand side indicate full marks.**

1. (A) Explain memory segmentation of 8086 and its advantages. **(10)**

(B) Explain input output control word format of 8255. **(10)**

Write control word of 8255 to initialize port A as input port, port B and C as output port, Group A and B in mode 0.

2. (A) Explain addressing modes of 8086 microprocessor. **(10)**

(B) Explain maximum mode of 8086 microprocessor. Draw timing diagram for read operation in minimum mode. **(10)**

3. (A) Draw and explain interfacing of DAC 0808 with 8086 microprocessor using 8255. Write a program to generate square wave. **(10)**

(B) Draw and Explain interfacing of Math co-processor with 8086. **(10)**

4. (A) Describe in brief and compare architecture of 80286 and 80486 microprocessor. **(10)**

(B) Explain how 32 KB EPROM can be interfaced with 8086 that operates at frequency of 10 MHz using 4 KB device. **(10)**

5. (A) Explain 8086 interrupt structure and its method of interfacing with 8086 microprocessors with suitable example. **(10)**

(B) Write a program to set up 8253 as square wave generator, assume suitable data. **(10)**

6. (A) Explain in brief HOLD, HLDA, TRAP, RESET IN, RD, WR, SID, SOD pins of 8085. **(10)**

(B) Discuss the functions of general purpose registers of 8086. Explain the function of each register and instruction support for these function. **(10)**

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

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

2) Answer **any THREE** questions from Q.2 to Q.6.

3) Figures to the right indicate full marks.

Q.1 (a) Verify Cauchy-Schwartz inequality for u= (2, 1,-3) v= (3, 4,-2). Also find angle between u & v. (5)

(b) If $A = \begin{bmatrix} 2 & 0 & 0 \\ 5 & -1 & 0 \\ 2 & 3 & 3 \end{bmatrix}$ find Eigen values of $A^2 + 6A^{-1} - 3I$. (5)

(c) Evaluate $\int_c \frac{z^3+2Z}{(Z-1)^2} dz$ when C is $|z| = 2$. (5)

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

Q.2 (a) Verify Cayley-Hamilton theorem & hence find A^{-1} , where $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & -1 & 4 \\ 3 & 1 & -1 \end{bmatrix}$. (6)

(b) Find the extremal of $\int_{x_1}^{x_2} (2xy - y''^2)$ dx. (6)

(c) Obtain Laurent's series expansion of $f(z) = \frac{Z+2}{(Z-3)(Z-4)}$ about $z = 0$. (8)

Q.3 (a) Evaluate $\int_0^{1+i} z^2 \, dz$ along the parabola $x = y^2$. (6)

(b) Show that $A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$ is derogatory & find its minimal polynomial. (6)

(c) Reduce the following quadratic form into canonical form & hence find it's rank, index, signature &value class (8)
$x^2 + 2y^2 + 3z^2 + 2yz + 2xy - 2zx$.

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Q.4 (a) Find unit vector orthogonal to both $u = (-6,4,2)$ $v = (3,1,5)$. (6)

(b) Evaluate $\int_{-\infty}^{\infty} \frac{x^2}{(x^2+1)(x^2+4)}\,dx$. (6)

(c) Show that matrix $A = \begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$ is diagonalizable. Also find its diagonal and transforming matrix. (8)

Q.5 (a) Using Rayleigh-Ritz method find solution for the extremal of the functional $\int_0^1 (2xy + y^2 - (y')^2)\,dx$ given $y(0) = y(1) = 0$. (6)

(b) Find an orthonormal basis for the subspace of IR^3 using Gram-Schmidt process where $s = \{(1,0,0), (3,7,-2), (0,4,1)\}$ (6)

(c) Find the curve C of given length 'l' which encloses a maximum area. (8)

Q.6 (a) If $A = \begin{bmatrix} \pi & \frac{\pi}{4} \\ 0 & \frac{\pi}{2} \end{bmatrix}$ find $cos\ A$. (6)

(b) Check whether the set of all pairs of real numbers of the form $(1, x)$ with operations

$(1, a) + (1, b) = (1, a + b)$ and $k(1, a) = (1, ka)$ is a vector space , where k is real number. (6)

(c) Find the singular value decomposition of $A = \begin{bmatrix} 2 & 3 \\ 0 & 2 \end{bmatrix}$. (8)

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

N.B.:

1. Question No.1 is compulsory.
2. Attempt any three questions out of the remaining five.
3. Assume suitable data wherever necessary.

Q1 a) State and prove time shifting property of Z-transform 20

b) Determine the even and odd part of the following time signals.
i) $x(t) = 3 + 2t + 5t^2$ ii) $x(t) = e^t$

c) Explain in brief ROC (Region of Convergence) condition for Laplace transform.

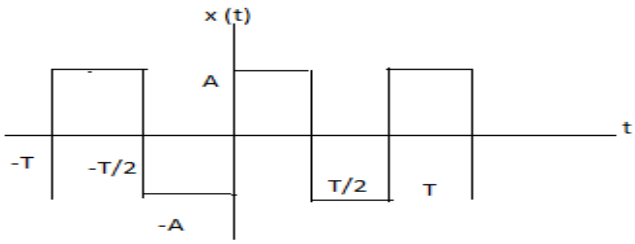
d) Sketch signal $e^{-5t}u(t)$ and determine power and energy of signal.

e) For the unit step response of continuous time signal, determine the transfer function of the system: $s(t) = u(t) + e^{-2t}u(t)$

Q2. a) Define the following Continuous Time signals: 10

i) Deterministic and Non Deterministic Signals
ii) Periodic and Non periodic Signal
iii) Causal and Non causal Signal
iv) Even and odd Signal

b) Determine the Fourier series of the following signal: 10



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Q3. a) Define and prove the following properties of Laplace transforms: 10

i) Time and frequency shifting

ii) Amplitude Scaling and Linearity

b) Find impulse response and step response of continuous time systems governed by 10

Following transfer functions.

$$H(s) = \frac{s+3}{s^2+6s+8}$$

Q4. a) Determine the Laplace transform of the following signals: 5

i) $X(t) = \sin\Omega 0t\ u(t)$

ii) $X(t) = \cos\Omega 0t\ u(t)$

b) Explain Gibbs Phenomenon in detail. 5

c) A stable system has input x (t) and output y (t). Determine transfer function and Impulse response h (t) by using Laplace transform. 10

$x(t) = e^{-2t}u(t)$; $y(t) = -2\,e^{-t}u(t) + 2\,e^{-3t}u(t)$

Q5. a) An LTI system is described by the equation: 10

$y(n) = x(n) + 0.8\,x(n-1) + 0.8\,x(n-2) - 0.49\,y(n-2)$, determine the transfer function of

The system and also sketch the poles and zeros on the z-plane.

b) Determine the Z- transform and ROC of the given discrete time signal: 5

$x(n) = 0.5^{n}\,u(n)$

c) Why linear Convolution is important in signals and System? 5

Differentiate linear Convolution with Circular Convolution.

Q6. a) Compute the convolution $y(n) = x(n) * h(n)$ using tabulation method 10

Where $x(n) = \{1, 1, \underset{\uparrow}{0}, 1, 1\}$ and $h(n) = \{1, -2, -3, \underset{\uparrow}{4}\}$

b) Determine the impulse response h (n) for the system described by 10

Second order difference Equation, $y(n) - 4\,y(n-1) + 4\,y(n-2) = x(n-1)$

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[Time: 3 Hours] **[Marks:80]**

NB:

1. Q. 1 is compulsory
2. Attempt any three questions out of remaining five.
3. Figure to the right indicate full marks.
4. Assume suitable data if required and mention the same in solution.

Q.1 Solve the following 20

a) Distinguish between narrowband and wideband FM.
b) What is companding?
c) Why AGC is required in radio receivers?
d) Explain aliasing error and aperture effect.
e) Explain various types of noise affecting communication system.

Q.2a) What are the drawbacks of delta modulation? Explain adaptive delta modulation in detail. 10

b) What is signal multiplexing? Explain TDM and FDM in detail. 10

Q.3 a) State and prove sampling theorem for low pass bandlimited signals. 10

b) Explain practical diode detector with suitable diagram. 10

Q.4 a) What are different methods of FM generation? Explain reactance modulator in detail. 10

b) Explain how PPM is generated from PWM 10

Q.5 a) Explain superheterodyne receiver 10

b) Explain VSB transmission 10

Q.6 Write note on (any four) 20

1. Quadrature amplitude modulation
2. Amplitude limiting and thresholding
3. Double spotting
4. Low level and high level modulation
5. PCM and DPCM

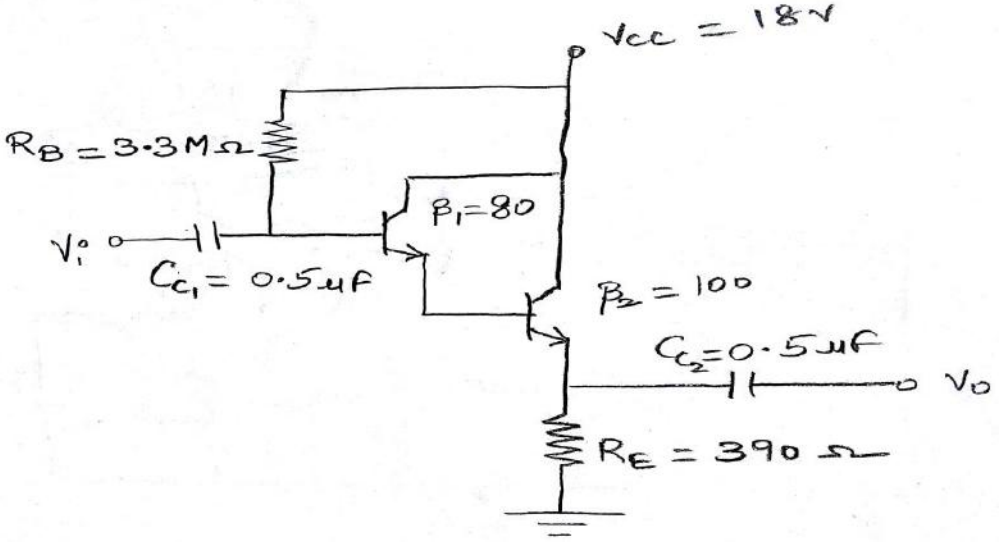
(3 Hours) **[Total Marks: 80]**

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

1. Attempt any **Four** of the following: **20**

(a) Draw a neat labelled diagram of Depletion Type MOSFET and explain its operation.

(b) Find the value of I_E and V_{CE} for the given Darlington configuration:



Given: $\beta_1 = 80$, $\beta_2 = 100$, $V_{BE} = 1.6V$.

(c) Differentiate Small Signal Amplifier and Large Signal Amplifier.

(d) State Barkhausen's Criteria and explain basic principle of an Oscillator.

(e) Give the advantages of negative feedback.

2. (a) Design a two stage RC coupled CS Amplifier to meet following specifications: $A_v \geq 100$, $V_o = 4V$, $I_{DQ} = 1.2\ mA$, $f_L = 20\ Hz$. **15**

Assume: $g_{mo} = 5m\mho, I_{DSS} = 7mA, r_d = 50k\Omega, V_P = -4V$. Assume suitable V_{DD}.

(b) Compare RC Coupled, Direct Coupled and Transformer Coupled Amplifiers. **05**

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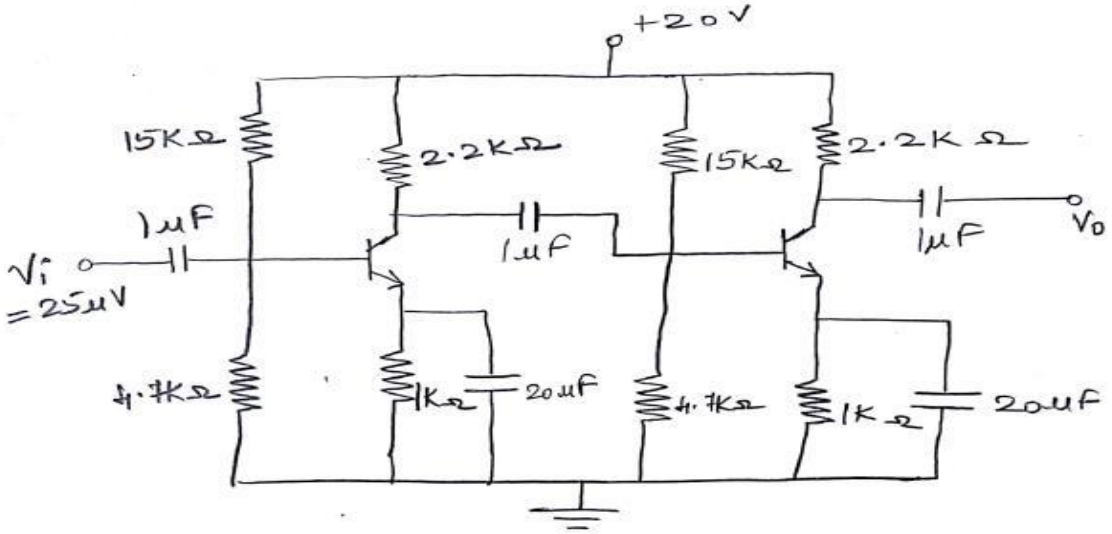
3. (a) Determine input impedance, output impedance, voltage gain and current gain for the given cascaded BJT amplifier as shown in the figure below: **10**



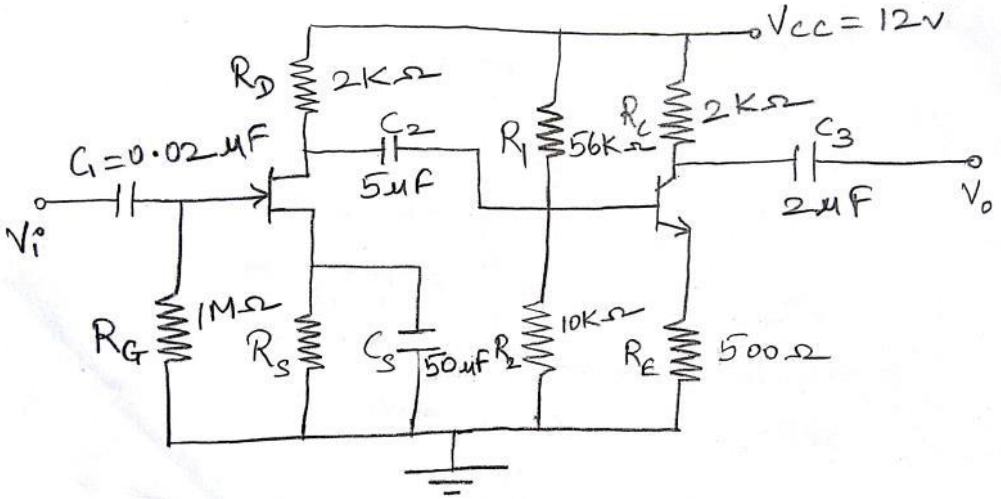
Given: h_{fe} = 200 and h_{ie} = 1.3kΩ.

(b) Find the necessary condition for oscillations to occur and frequency of oscillations of Hartley Oscillator. Also, explain its working. **10**

4. (a) With the help of neat block diagram, derive expression for R_{IF}, R_{OF}, G_{mF} for Current Series Negative Feedback Amplifier. Give significance of the above mentioned parameters. **08**

(b) For the circuit shown below, determine the following: **12**

i. R_S
ii. Q-point of each stage.
iii. AC equivalent model.
iv. Lower Cut-off Frequecny (f_L).



Given: V_{GS} = -1V, I_{DSS} = 8mA, V_P = -4V for JFET and h_{ie} = 1kΩ, h_{fe} = 100, V_{BE} = 0.6V for BJT.

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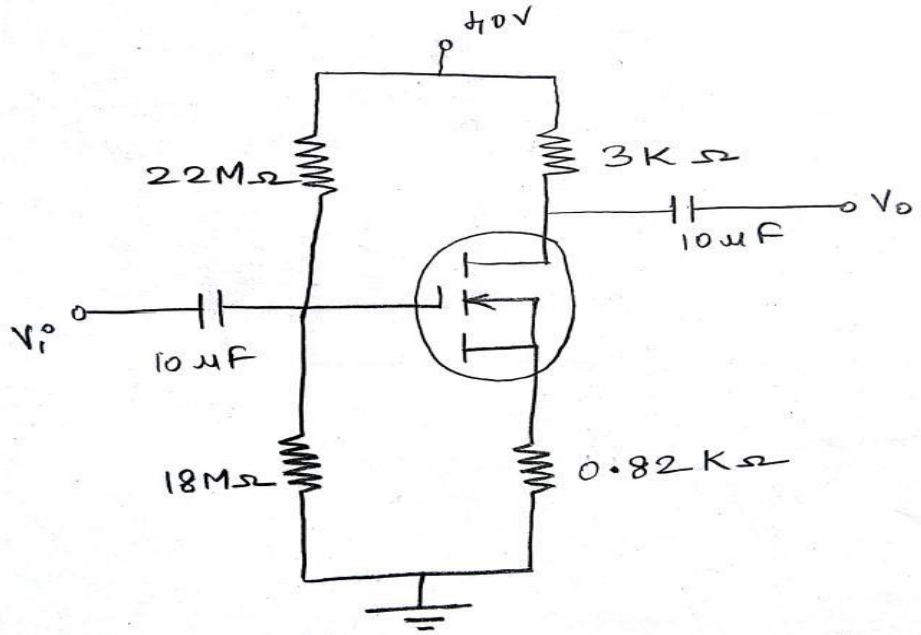
5. (a) Design an RC phase shift Oscillator to generate 5kHz sine wave with 20V peak to peak amplitude. Assume h_{fe} = 150 and h_{ie} = 1kΩ. **10**

   (b) 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**

6. (a) Determine I_{DQ} and V_{DSQ} for the given network of Enhancement type MOSFET arrangement. **05**



Given: $I_D(ON)$ = 3mA, $V_{GS}(ON)$ = 10V, $V_{GS}(Th)$ = 5V.

   (b) In Colpitts Oscillator, C_1 = 0.2μF, C_2 = 0.02μF. If the frequency of oscillator is 10 kHz, find the value of inductor. Also, find the required gain for oscillation. **05**

   (c) Write a Short Note on: Cascode Amplifier. **10**

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[Time: 3 Hours] **[Marks: 80]**

Please check whether you have got the right question paper.

N.B:
1. Question No 1. Is compulsory.
2. Attempt any three questions from remaining five questions.
3. Assume suitable data if necessary and state it clearly.
4. Figures to right indicate full marks.

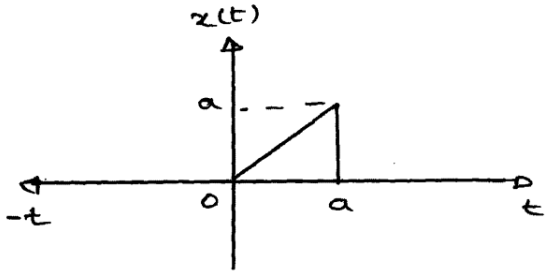
1. Answer **any four** questions from given questions. **20**

(a) Explain any five types of elementary signals with mathematical equations and graphical plot.

(b) Find the fundamental period of the signal $x(t) = \sin\left(\frac{2\pi t}{6}\right) - \cos \pi t$

(c) Explain the application of Signals and System in Multimedia Processing.

(d) Find x(-2t) and x(3t + 2)



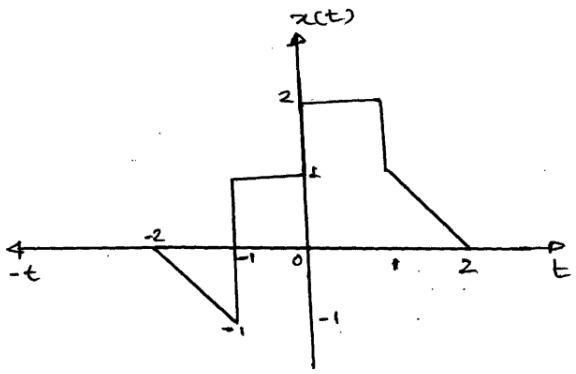
(e) Test the given system for linearity, causality, stability, memory and time variant.

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

(f) If system matrix find the sate transition matrix. $A = \begin{bmatrix} -3 & 1 \\ -2 & 0 \end{bmatrix}$

2. (a) Sketch the following signals for the given signal shown. **10**

a) x(-t) b) x(2t + 5) c) x(2t) d) x(t/2) e) -2x(t)



(b) Using unilateral Laplace transform find the output of the system given by: where and **10**

$\frac{d^3y}{dt^3}+6\frac{d^2y}{dt^2}+11\frac{dy}{dt}+6y(t)=x(t)$ where x(t) = e^{-4t} u(t) & y(0^-) =1, $\left.\frac{dy}{dt}\right|_{t=0^-}=1$ $\left.\frac{d^2y}{dt^2}\right|_{t=0^-}=1$

3. (a) Find inverse Z-Transform of X(z), $X(z)=\frac{1+2z^{-1}+z^{-2}}{1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2}}$ **10**

(b) Given DT sequence: **10**

$x(n)=0.4\delta(n+2)+0.2\delta(n+1)+0.1\delta(n)+0.2\delta(n-1)+0.4\delta(n-2)$

Determine the following:

i. Xe^{jw}

ii. $|Xe^{jw}|$

iii. Phase $\{X(e^{jw})\}$

iv. $\int_0^{2\pi}|X(e^{jw})|^2\,dw$

4. (a) Determine the state model of the governed by the equation. **10**

$y[n]=-2y[n-1]+3y[n-2]+0.5y[n-3]+2x[n]+1.5x[n]+1.5x[n-1]+2.5x[n-2]+4x[n-3]$

(b) Find the Fourier transform of **10**

$$x(t)=\begin{cases}\cos\pi t & -1/2\le t\le 1/2\\ 0 & otherwise\end{cases}$$

i. From the definition of Fourier transform

ii. Using the convolution theorem of Fourier transform

5. (a) Determine DTFS for the sequence x(n) = $\cos^2((\pi/8)n)$ **08**

(b) **04**

i. Find Laplace transform of. $\frac{d}{dt}\sin t\ u(t)$

ii. Find the Z Transform of signal $\cos(\omega_0 n)\ u[n]$ **04**

(c) Find the canonic (direct form II) realization of $H(z)=\frac{1-\frac{7}{4}z^{-1}-\frac{1}{2}z^{-2}}{1+\frac{1}{4}z^{-1}-\frac{1}{8}z^{-2}}$ **04**

6. (a) Find the autocorrelation function $R_{xx}(\tau)$ of sine wave signal. **08**

(b) Explain the concept ROC in Z-Transform and Laplace Transform. **06**

(c) Discuss applications of Signals in Control System. **06**