Electronic Devices & Circuit - II

GN-5603

(3 Hours) [Total Marks : 100

N.B. (1) Question No. **1** is **compulsory**.
(2) Solve any **four** questions from remaining **six** questions.
(3) Assume suitable **data** with **proper** justification.
(4) **Figures** to the **right** indicate **full** marks.

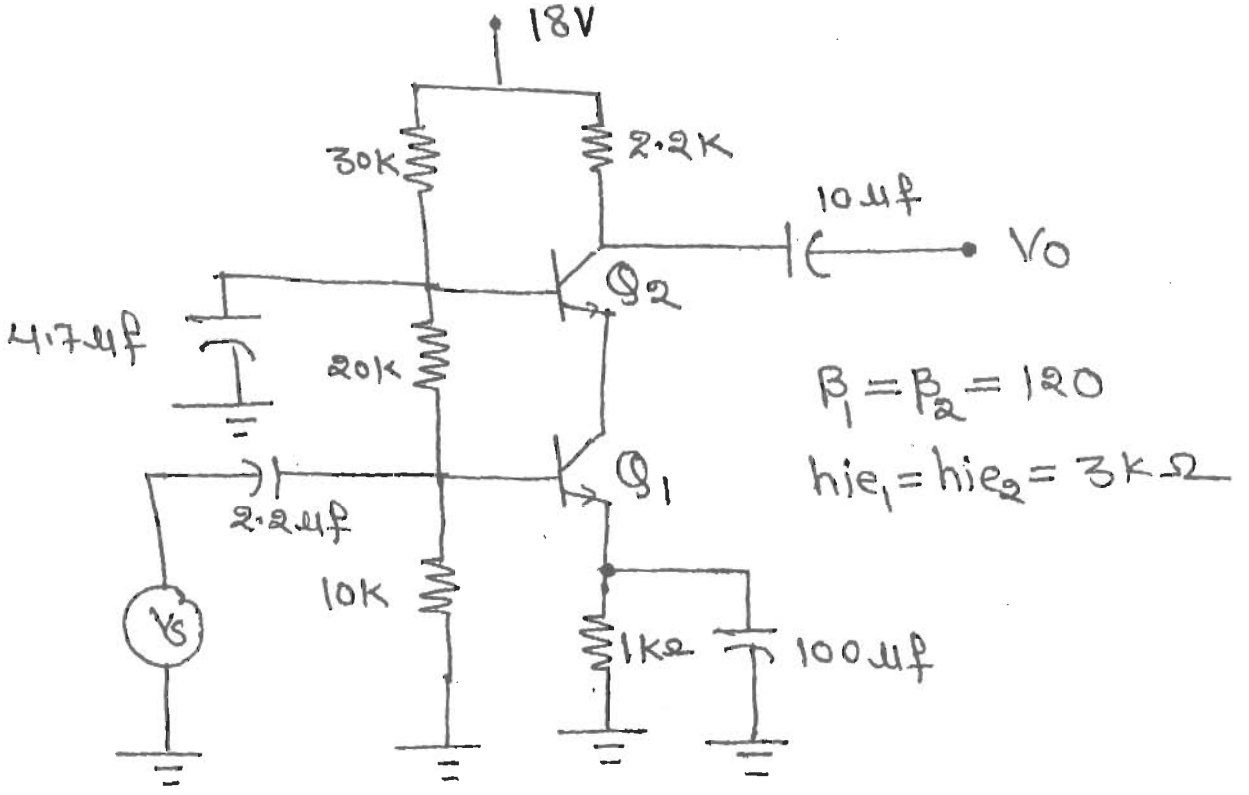
1. Give reasons for the following :—
   (a) When JFET is biased in constant current region the gate source junction capacitor has a higher value compared to gate drain junction capacitor. **5**
   (b) In case of transistorised oscillator circuit the transistor used is generally connected in common emitter mode only. **5**
   (c) In transistorised Monostable and Bistable Multivibrator negative edge triggering is preferred over positive edge triggering. **5**
   (d) Small signal voltage amplifiers does not face problem of harnomic distortion, whereas power amplifiers suffer from the problem of harmonic distortion. **5**

2. (a) Design a two stage RC coupled CS amplifier using JFET BFW-11 to meet the following specifications :— **15**

   $A_V \geq 100$ $V_{o/p} = 2{\cdot}5$ V $I_{DSQ} = 1{\cdot}38$ mA $F_L \leq 25$ Hz

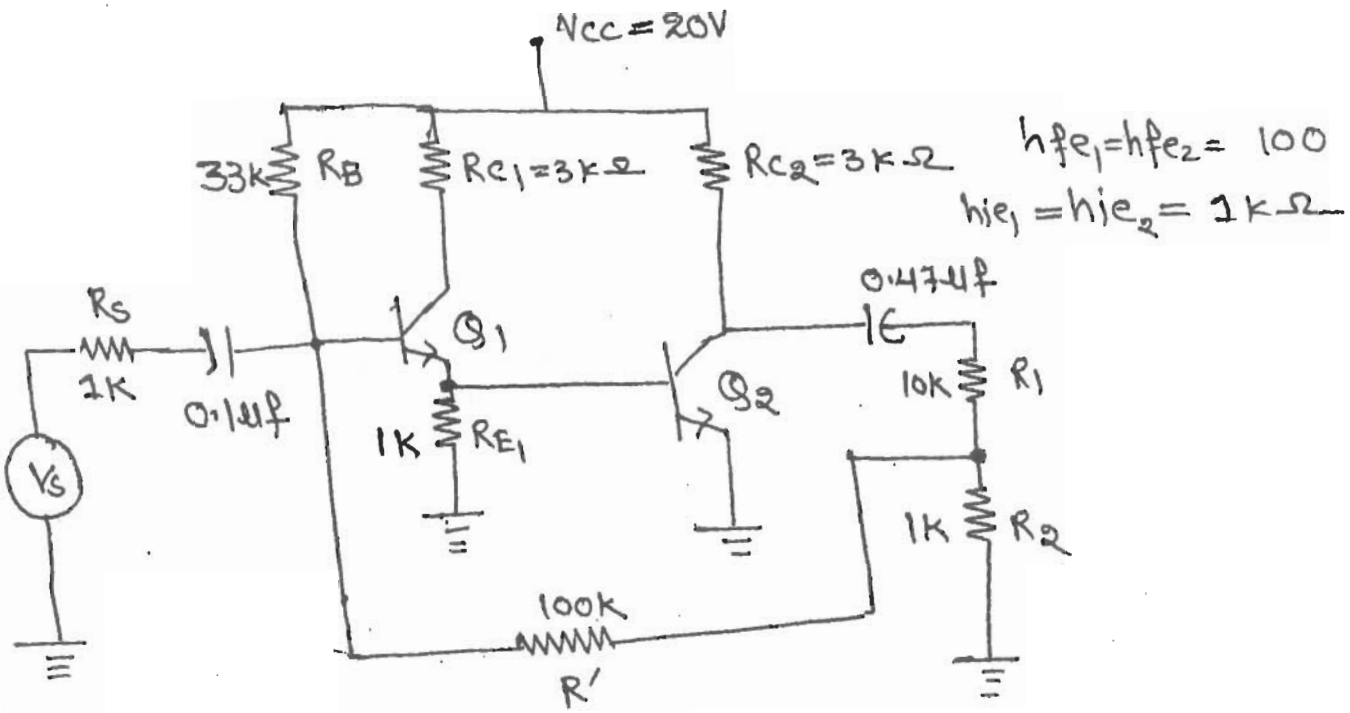
   Neglect r_d for your design.
   Find maximum peak to peak value of undistorted output that the designed circuit can provide.
   (b) For the above designed circuit if $C_{gd} = 0{\cdot}1$ pf, $C_{gs} = 1$ pf. What will be the higher cut-off frequency ? **5**

3. (a) For the given circuit find DC operating point of Q_1 and Q_2. Find mid frequency voltage gain, current gain input and output impedance. Explain importance of Cascode amplifier. **10**



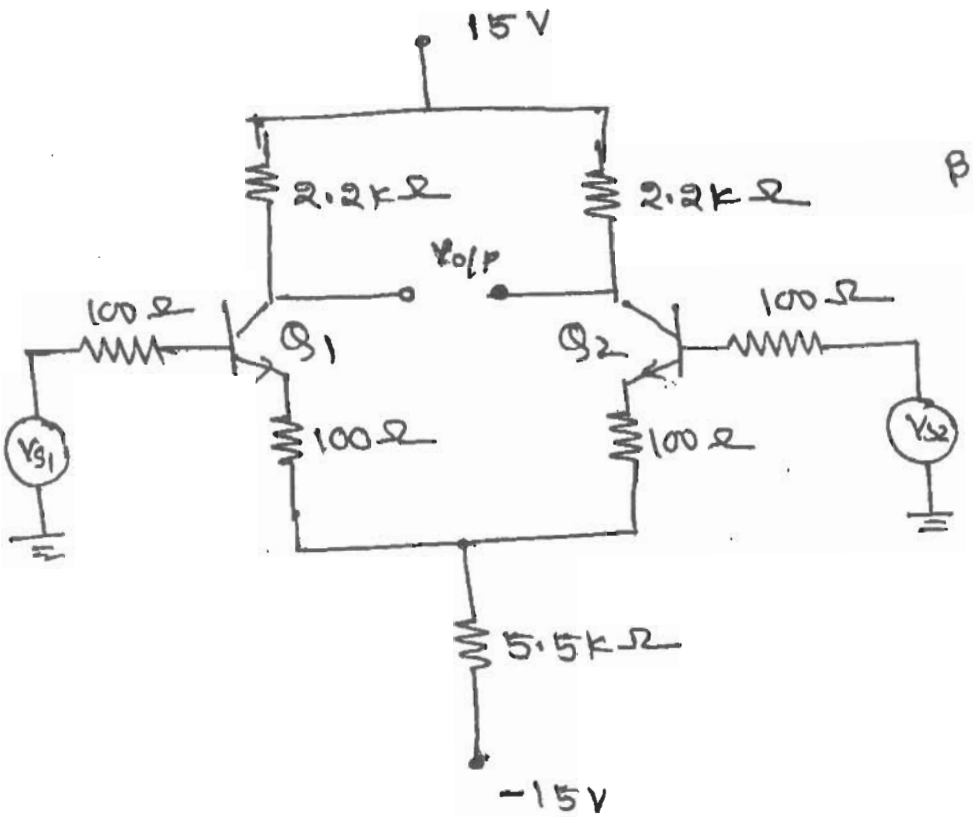
   (b) Draw a neat circuit diagram of a transistorised Schmitt trigger circuit. Explain its working with proper waveforms. Explain the need of speed up capacitor. **10**

4. (a) For the following circuit identify the type of negative feedback (with proper reasoning). Find circuit input impedance, output impedance and voltage gain with feedback. **15**



(b) Draw a current amplifier. State its characteristics. Introduce a negative feedback to it and name the topology. Draw a transistorised circuit to implement the topology. What will be the important characteristics of the circuit ? **5**

5. (a) Determine values of I_{CQ}, V_{CEQ}, differential mode voltage gain, common mode gain, common mode rejection ratio and differential input impedance for the following circuit :— **10**



(b) Draw a neat circuit diagram of Darlington amplifier. Derive expression for its current gain, input impedance and output impedance. Draw mid frequency model for derivation neglect h_{re} and h_{oe}. **10**

6. (a) Draw a neat circuit diagram of a transistorised Wein bridge oscillator. Explain its working. Derive expression for frequency of oscillation and find condition for sustained oscillation. **10**

   (b) Design a RC phase shift oscillator using JFET BFW 11 for frequency of oscillation of 1 kHz. **10**

7. (a) Design a class A transformer coupled power amplifier for the following requirements :— **10**

   o/p ac power = 8 W V_{CC} = 15 V

   Load resistor = 10 Ω S ≤ 8

   Assume transformer efficiency η_T = 90%. Calculate collector efficiency of the designed circuit.

   (b) Draw a neat circuit diagram of class B push-pull power amplifier. Draw suitable waveforms and graphs showing ac and dc dc load line, input and output waveforms. Derive expression for maximum collector efficiency. **10**

   Why this amplifier face problem of crossover distortion ? Suggest a suitable method to overcome this problem.

DBEC DATA SHEET

r 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_{BEO} volts d.c.	T_j max °C	D.C. current gain min	typ.	max.	Small Signal h_{fe} min.	typ.	max.	V_{BE} max.	θ_{fe} °C/W	Derate above 25°C W/°C
	115·5	15·0	1·1	100	60	70	90	7	200	20	50	70	15	50	120	1·8	1·5	0·7
	50·0	5·0	1·0	60	50	55	60	5	200	25	50	100	25	75	125	1·5	3·5	0·4
	30·0	4·0	1·0	50	40	—	—	8	150	30	50	110	33	60	115	1·2	4·0	0·3
	5·0	0·7	0·6	70	60	65	—	6	200	50	90	280	50	90	280	0·9	35	0·05
	0·25	0·1	0·25	50	45	50	—	6	125	115	180	220	125	220	260	0·9	—	—
PNP)	0·225	0·5	0·25	85	30	—	—	—	100	35	—	65	—	45	—	—	—	—
	0·25	0·1	0·25	50	45	50	—	6	125	200	290	450	240	330	500	0·9	—	—

r type	hie	hoe	hre	θja
	2·7 K Ω	18μ ℧	1·5 × 10⁻⁴	0·4°C/mw
PNP)	1·4 K Ω	25μ ℧	3·2 × 10⁻⁴	—
	4·5 K Ω	30μ ℧	2 × 10⁻⁴	0·4°C/mw
	500 Ω	—	—	—
	250 Ω	—	—	—
	100 Ω	—	—	—
	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

nel *JFET*

pe	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}
	50	50	50	300 mW	175°C	2 mA	3000 μ ℧	6	50 KΩ	2 mW/°C	0·59°C/mW
(typical)	30	30	30	300 mW	200°C	7 mA	5600 μ ℧	2·5	50 KΩ	——	0·59° C/mW

SE | EXTC | IV (Rev) 16/5/12
A. maths - IV

Con. 3576-12.

GN–5600

(3 Hours) [Total Marks : 100

N.B. (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions out of the remaining **six** questions.
(3) **Figures** to the **right** indicate **full** marks.

1. (a) Show that 5

$$J_4(x) = \left(\frac{48}{x^3} - \frac{8}{x}\right) J_1(x) + \left(1 - \frac{24}{x^2}\right) J_0(x)$$

(b) Show that the matrix 5

$$A = \begin{bmatrix} 7 & 4 & -1 \\ 4 & 7 & -1 \\ -4 & -4 & 4 \end{bmatrix}$$ is derogatory

(c) Evaluate $\int_S (\nabla \times \bar{F}) \cdot d\bar{s}$, where s is the surface of the plane $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$ in the first octant and $\bar{F} = y^2 i + zx^2 j + x^2 k$ 5

(d) Evaluate $\oint_C \frac{e^{3z}}{z-i} dz$, where C is the curve $|z-2| + |z+2| = 6$ 5

2. (a) Prove that for positive integer 'n' $J_{-n}(x) = (-1)^n J_n(x)$. 7

(b) Show that the matrix $A = \begin{bmatrix} 8 & -8 & -2 \\ 4 & -3 & -2 \\ 3 & -4 & 1 \end{bmatrix}$ is diagonalizable. Also find the transforming matrix and diagonal matrix. 7

(c) (i) Show that the area bounded by a simple closed curve 'C' is given by 6

$$\frac{1}{2} \oint_C x dy - y dx$$

(ii) Find the area of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$.

3. (a) Verify Cauchy's theorem for function $f(z) = 3z^2 + iz - 4$ if 'C' is the perimeter of square with vertices at $1 \pm i$; $-1 \pm i$. 7

(b) Prove that $J_{1/2}(x) = \sqrt{\frac{2}{\pi x}} \cdot \sin x$ 7

(c) Show that $\bar{F} = (2xy + Z^3)\, i + x^2 j + 3xz^2 k$ 6
(i) is a conservative force field
(ii) find the scalar potential
(iii) find the work done in moving an object in this field from (1, –2, 1) to (3, 1, 4).

[TURN OVER

4. (a) Define Analytic function. State and prove Cauchy-Riemann equations in Polar Co-ordinates. 7

(b) Verify Gauss divergence theorem for $\bar{F} = xi + xj - 3y^2zk$, taken over the surface of the cylinder $x^2 + y^2 = 16$ between the planes $z = 0$ and $z = 5$. 7

(c) If $A = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$, find e^{At} 6

5. (a) Define conformal mapping. Find bilinear transformation which maps the points $z = 2, i, -2$ onto the points $w = 1, i, -1$. 7

(b) Evaluate using contour integration $\int_0^\infty \frac{dx}{x^4 + 1}$ 7

(c) Show that $\text{Cos}(x\sin\theta) = J_0(x) + 2\,\text{Cos}2\theta J_2(x) + 2\,\text{Cos}4\theta\, J_4(x) + \ldots$ 6

6. (a) Find all possible Laurent's series expansion of the function $f(z) = \frac{7z-2}{Z\,(z-2)(z+1)}$ 7

about $z = -1$ indicating the region of convergence.

(b) Prove that there does not exist an analytic function whose real part is $3x^3-2x^2y + y^2$ 7

(c) State Cayley-Hamilton theorem. Use it to express $2A^5 - 3A^4 + A^2 - 4I$ as a linear polynomial in A, when $A = \begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix}$. 6

7. (a) Explain removable singularity with example. Evaluate $\int_C \tan z\, dz$, where 'C' is the circle $|z| = 2$, using residue theorem. 7

(b) Find the analytic function whose real part is $e^{-x}\{(x^2-y^2)\,\text{Cos}y + 2xy\,\text{sin}y\}$. 7

(c) Reduce the following quadratic form to canonical form and find its rank and signature. 6

$x^2 + 4y^2 + 9z^2 + t^2 - 12yz + 6zx - 4xy - 2xt - 6zt$.

S.E. Sem IV (Rev) EXTC 8/5/12
Sub:— EWT.

85-1st Half-12 mina (I)

Con. 4817-12. GN-9614

(3 Hours) [Total Marks : 100

N. B. : (1) Question No. 1 is **compulsory**.
(2) Attempt any **four** questions out of remaining **six** questions.
(3) Assume any **suitable data if necessary**.
(4) **Figures** to the **right** indicate **full** marks.

1. Explain the following (any **four**) :— 20
   (a) Continuity equation
   (b) Boundary conditions for electrostatics
   (c) Polarization of electromagnetic waves
   (d) Ampere's circuital law
   (e) Magnetic vector potential.

2. (a) Two conducting cones at $\theta = \frac{\pi}{10}$ and $\theta = \frac{\pi}{6}$ of infinite extent are separated by an infinitesimal gap at r = 0. If $V\left(\theta = \frac{\pi}{10}\right) = 0V$ and $V\left(\theta = \frac{\pi}{6}\right) = 50V$. Find potential V and electic field intensity $\overline{E}$ between the cones. Neglect Fringing effect. 10

   (b) Find electric field intensity $\overline{E}$ due to an infinite line charge. 10

3. (a) A circuit carrying a current of I amp form a regular polygon of 'n' side inscribed in circumscribing circle of radius R. Calculate the Magnetic Flux density $\overline{B}$ at the centre of the polygon and show that $\overline{B}$ approaches that for a circular loop if 'n' tends to infinity. 10

   (b) Give the potential $V = \frac{10}{r^2} \sin\theta \cos\phi$:— 10

   (i) Find the electric flux density $\overline{D}$ at $\left(2, \frac{\pi}{2}, 0\right)$.

   (ii) Calcuate the work done in moving a 5 μC charge from point A (1, 30°, 120°) to B (3, 90°, 60°).

4. (a) A vector field is given by : 10

   $$A(r, \phi, z) = 30\, e^{-r}\, \overline{a}_r - 2z\, \overline{a}\, z.$$

   Verfiy Divergence theorem for the volume enclosed by r = 2 m, z = 0 m and z = 5 m.

   (b) Define Poynting Vector. Obtain the integral form of Poynting theorem and explain each term. 10

[TURN OVER

5. (a) Verify Stoke's theorem for portion of a sphere $r = 4$ m, $0 \leq \theta \leq 0{\cdot}1\ \pi$, $0 \leq \phi \leq 0{\cdot}4\ \pi$. 10

Given : $\overline{H} = 6\, r \sin\phi\, \overline{a}_r + 18\, r \sin\theta \cos\phi\, \overline{a}_p$.

(b) Derive Maxwell's equation in point form and integral form for free space. 10

6. (a) Derive the expression for the potential for the potential energy stored in a static electric field. 10

(b) A charge distribution with spherical symmetry has density : 10

$$\rho_v = \frac{\rho_0\, r}{a} \qquad 0 \leq r \leq a$$

$$= 0 \qquad r > a$$

Determine $\overline{E}$ everywhere.

7. (a) Prove that static electric field is irrotational and the static magnetic field is solenoidal. 10

(b) Derive general wave equations for $\overline{E}$ and $\overline{H}$ fields. Give solution to the wave equation in perfect dielectric for a wave travelling in z-direction which has only x-component of E field. 10

S.E. Sem. IV EXTC. 30/5/12
Principles of comm^n.

Con.4490-12 GN-8447

(3 Hours) [Total Marks 100

N.B. : (1) Question Nos. 1 is compulsory.
(2) Out of remaining questions attempt any four questions.
(3) In all five questions to be attempted.
(4) Assume suitable data wherever necessary.

1 a. List frequency band and communication application of usable frequency spectrum shown below. [05]
i. Voice frequency
ii. Very low frequency
iii. Medium frequency
iv. High frequency
v. Ultra high frequency

b. A three stage amplifier has the following power gains and noise figure (as ratios, not in dB) for each stage. Calculate the power gain, noise figure and noise temperature for the cascaded amplifier, assuming matched condition. [05]

Stage	Power Gain	Noise Figure
1	10	2
2	20	4
3	30	5

c. Compare High level and Low level modulation in terms of power level, types of amplifier used, efficiency, limitation and application. [05]

d. Explain effect of change in modulating frequency for Amplitude, Frequency and Phase modulation. [05]

2 a. Explain Amplitude Modulation (AM) for more than one modulating signal in following terms: [10]
i. Mathematical equation
ii. AM Waveform
iii. AM amplitude and power spectum.
iv. Modulation coefficient
v. Transmission power

b. Draw block diagram of superheterodyne receiver. Write frequency component present at the output of each block if modulating frequency is 2 kHz, carrier frequency 550 kHz and Intermediate frequency (IF) of 455 kHz also sketch waveforms at the output of IF and detector stage. [10]

3 a. With help of a neat block diagram explain the principle and generation of indirect method of FM generation. [10]

b. Explain with block diagram how AFC will counteract a downward drift in frequency oscillator being stabilized. [06]

c. A 20 MHz carrier is modulated by a 400 Hz audio sine wave. If the carrier voltage is 5 volts and maximum deviation is 10 kHz, write an equation for FM wave and calculate the power dissipated across 100 Ω resistor. [04]

4 a. State and prove sampling theorem for low pass band limited signal. [10]

b. With the help of neat circuit diagram explain the generation and detection of Pulse Position Modulation (PPM) signal. [10]

5 a. Draw block diagram of Adaptive Delta Modulator and explain its working. [10]

b. How is Adaptive Delta Modulation (ADM) an improvement over Linear Delta Modulation (DM) in following terms: [05]

i. slope overload
ii. distortion
iii. SNR
iv. BW.

c. Compare DM, ADM, PCM and DPCM in following terms: [05]

i. Number of bits per sample
ii. Step Size
iii. Distortion
iv. Complexity
v. Application

6 a. Draw block diagram of PCM system and explain the function of each block. [10]

b. Draw the block diagram of phase cancellation SSB generator and explain how carrier and unwanted sidebands are suppressed. [10]

7 Write short notes on (any four) [5x4]

i. Independent sideband system
ii. Tracking in AM receiver
iii. Phase Modulation
iv. Noise in communication system
v. Quantization error
vi. Ratio Detector

SE | EXTC | IV (Rev) 21/5/2012
Analog & Digital IC Design Application

Con. 3789–12. GN–5594

(3 Hours) [Total Marks : 100

N.B. : 1. **Attempt question 1 which is compulsory and any 4 questions from the remaining 6 questions.**
2. Draw neat diagrams wherever necessary. Related waveforms should be drawn one below the other.
3. Answer should be brief and to the point.
4. All sub-questions of the same question should be answered at one place only in their serial order, and not scattered.
5. **Write everything in ink only.** Do not use Pencil

1. (a) Design a circuit with Op Amp, resistors and a capacitor that simulates an inductor of 1 H. [5]

(b) Design an Op Amp circuit that simulates the relation $V_o = 2V_1 + 5V_2$ with the minimum number of resistors and Op Amps. [5]

(c) Draw a sample and hold circuit with two buffers: Bi at the input side and Bo at the output side. [1]

Write down the requirements (very high or very low) regarding the rise time, bias current, input impedance and the output impedance for the two buffers and justify. [4]

(d) Differentiate between the static and dynamic RAMs. [5]

2. (a) Draw the circuit of a voltage to current converter (VCC) for a grounded load and derive the condition for it to act as a VCC. [5]

Design a VCC that has a trans-conductance of 1 mA/V. [2]

How VCC can be used to generate a triangular wave from a square wave. [3]

(b) (i) What are the functions of the 'control pin' and the 'discharge transistor' in the astable mode of operation of timer 555? [2]

(ii) Draw the circuit for IC 8038 operating as an astable multi-vibrator with 50% duty cycle. [2]

Derive a relation for the frequency of the square wave. [4]

Design the circuit for a frequency of 20 kHz. [2]

3. (a) (i) Draw a general circuit for a multiple feedback filter. [2]

Obtain its voltage transfer function (in terms of various admittances). [4]

From the transfer function, identify the elements (resistors and capacitors) for a band pass filter. [2]

(ii) Design a band pass filter for a central frequency of 1 kHz and Band width of 200 Hz. [4]

(iii) How can the gain at the centre frequency be reduced by 50% using only one extra resistance? [4]

Modify the above band pass filter to obtain a band reject filter. [4]

[TURN OVER

4, (a) Give a circuit for simulating a resistor using a switched capacitor. [4]

Derive the relation for the simulated resistance. [2]

What are the requirements for the ideal switch, the capacitor and the clock frequency? [6]

(b) An inverting type Schmitt trigger has the following transfer characteristic: Threshold levels are 5 V and -6 V, output voltage ± 10 V. Plot the output voltages when the input voltages are

(i) 8 sin 10t, [4]

(ii) positive half-wave rectified 8 sin 10t. [4]

5. (a) (i) Compare the R-2R ladder (voltage mode) and weighted resistor DACs under the following heads. [4]

Number of resistors, Spread, Number of single-pole single-throw switches and the Speed of operation

(ii) Draw the current mode R-2R digital to analog converter. [2]

Why is it suitable for high speed operation? [4]

(b) 'A multi-meter does not measure the 'true RMS value' of a voltage signal.' Justify. [4]

How can the true RMS value of a voltage signal be measured using analog multipliers? [6]

6 (a) Design a moduo-10 counter with the counting sequence 5, 6, …. , 14, 5, ,6, …., 14 using MSI 74X163. [10]

(b) Draw the block diagram of internal architecture of XC 9500 family CPLD and explain the working of each block. [10]

7. (a) Write VHDL code for a four bit up counter. [6]

(b) Design a Moore machine for overlap sequence detector for the string 1110. The output must be 1 when the input matches this string.

(i) Draw the state diagram. [4]

(ii) Write the transisiton and output tables. [6]

(iii) Draw the logic diagram. [4]