2014-15
M.TECH. II semester (WINTER SEMESTER) EXAMINATION
ELECTRONICS ENGINEERING
(Electronics Circuit and System Design)
CURRENT-MODE CIRCUITS & APPLICATIONS
EL-618

Maximum Marks: 60 Credits: 04 Duration: Three Hours

Answer any FIVE questions.
Assume suitable data if missing.
Answer parts of a question together.

Q.No. Question M.M.
1(a) How can a single transistor be used as a Current Conveyor? [03]
1(b) What are the cascading requirements for voltage-mode circuits [03]
1(c) What are the cascading requirements for current-mode circuits [03]
1(d) What are the advantages of current mode circuits? [03]
2(a) Prove that the gain-bandwidth product of a CFOA based inverting amplifier is not constant. [06]
2(b) Explain the function performed by the circuit shown in Figure 1. [06]

![Diagram of CCII± and current flows](image)

Figure 1

3(a) Realize an instrumentation amplifier using AD-844 ICs and obtain the expression [06]
for its CMRR.

3(b) Justify the workability of Figure 2 as a square-rooting circuit. [06]

![Figure 2](image)

4(a) Realize the given functions using CCCIIIs only; where $I_1$ and $I_2$ are inputs and $I_o$ is the output:

(i) $I_o = (I_1 - I_2)/sR_xC$; (ii) $I_o = (I_1 - I_2)(R_{x1}/R_{x2})$. [06]

4(b) Realize a (i) DVCC, and (ii) DXCCII using AD-844. [06]

5 Suggest suitable scheme for realizing a current conveyor based electronically tunable quadrature oscillator, and implement the actual circuit. [12]

6(a) Show two different implementations of the current scaling scheme of realizing DAC. [06]

6(b) Show a bit cell for realizing Algorithmic ADC, and explain its function. [06]

7(a) What are FPAAs? Suggest a suitable configurable analog block using DVCC. [06]

7(b) Explain the effect of non-ideal transfer gains and parasitic elements in current conveyor based circuits.
Notes: Answer all questions. Use the following values of NMOS and PMOS transistors and the supply voltage of 3V unless otherwise specified.

NMOS: \( V_{th} = 0.7 \text{V}, \gamma = 0.45 \text{V}^{1/2}, \lambda = 0.1 \text{ V}^{-1}, \mu_n \text{Cox} = 50 \mu \text{A/V}^2, 2\Phi_F = 0.7 \text{V} \)

PMOS: \( V_{th} = -0.8 \text{V}, \gamma = 0.40 \text{V}^{1/2}, \lambda = 0.2 \text{ V}^{-1}, \mu_p \text{Cox} = 25 \mu \text{A/V}^2 \)

1 (a) Explain the different device capacitances of a MOS transistor in triode and saturation regions.

1 (b) Explain briefly the subthreshold region of operation of a MOS transistor. What is the importance of the subthreshold slope?

OR

1’ (b) Why is the Analog Circuit Design more challenging than a Digital Circuit Design? Justify your answer. Also describe the different parameters that are to be optimized in an Analog circuit.

1 (c) Sketch \( I_X \) of the transistor as a function of \( V_x \) as \( V_x \) varies from 0 to 3V in Fig. 1.

1 (d) In the circuit of Fig. 2, assume \((W/L)_1 = 50/0.5\), \((W/L)_2 = 50/2\), and \( I_{D1} = I_{D2} = 0.5 \text{mA} \) when both devices are in saturation. Calculate the small signal voltage gain and the maximum output voltage swing.

![Fig. 1](image_url)

![Fig. 2](image_url)
2 (a) How a good quality current source can be designed using a MOS transistor? What is the role of a current mirror in an Analog System?

2 (b) Describe the design of a Bandgap reference with the help of a circuit diagram.

2 (c) Sketch $V_{out}$ and $V_{in}$ for the circuit shown in Fig. 3 as $V_{in}$ varies from 0 to 3V. Identify the important transition points.

![Fig. 3](image)

2' (c) What is the advantage and disadvantage of a two stage CMOS OPAMP and a Telescopic cascode opamp?

2 (d) Assuming all MOSFETs are in saturation, calculate the small signal voltage gain of the circuit shown in Fig. 4. Neglect Body effect.

![Fig. 4](image)

2' (d) Assuming all MOSFETs are in saturation, calculate the small signal voltage gain of the circuit shown in Fig. 5. Neglect Body effect.

![Fig. 5](image)

3 (a) How is it possible to increase the slew rate of a single stage CMOS OPAMP? Justify your answer.
3 (b) The cascode of Fig. 6 is designed to provide an output swing of 1.9V with a bias current of 0.5mA. If $\gamma=0$ and $(W/L)_{1,4} = W/L$, calculate $V_{b1}$, $V_{b2}$ and $W/L$. What is the voltage gain if $L=0.5\mu$m?

![Fig. 6]

OR

3' (b) A differential pair uses input NMOS devices with $W/L=50/0.5$ and a tail current of 1mA. Assume $V_{DD}=3V$, $\mu_n\text{Cox}=60\mu A/V^2$, $\mu_p\text{Cox}=30\mu A/V^2$, $\gamma = 0$, $V_{THN}=|V_{THP}|=0.7V$, $\lambda n=0.1V^{-1}$, $\lambda p=0.2 V^{-1}$ for a channel length of 0.5$\mu$m.

(i) What is the equilibrium overdrive voltage of each transistor?
(ii) How is the tail current shared between the two sides if $V_{in1}-V_{in2}=50$mV?

3 (c) Assuming $(W/L)_{1,3} = 40/0.5$, $I_{REF}=0.3mA$, and $\gamma = 0$ in the circuit shown in Fig. 7, determine $V_b$ such that $V_X=V_Y$

![Fig. 7]

4 (a) Determine the CMRR of a differential amplifier with current source load with $(W/L)_{1,5} = 50/0.5$ and $I_{DS}=0.5$mA

4 (b) Explain the concept of frequency compensation in CMOS OPAMP.

4 (c) Calculate the input-referred 1/f and thermal noise voltage of the circuit depicted in Fig. 8. Assume all the transistors in saturation.

![Fig. 8]
2014-15
M.TECH. (WINTER SEMESTER) EXAMINATION
(ELECTRONICS ENGINEERING)
DIGITAL SYSTEM DESIGN USING HDL
(EL-626)

Maximum Marks: 60 Credits: 04 Duration: Three Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No. Question M.M.
1(a) Using appropriate schematic of full and half adders, design a complete Top- [09]
Down Nested Module of a 16-bit ripple carry adder, formed by cascading four 4-bit ripple carry adders.
1(b) Write the test bench of a 4-line-to-1-line MUX, showing the output of simulation for each combination of select signal.

OR

1'(b) Give a truth-table model for a J-K flip flop having preset and clear inputs [06] which are active low, and the output is sensitive to the rising edge of the clock. Use short hand notation (?) in the description of the above model.

2(a) What is the significance of conditional operator “?”. Write a behavioral model [09] of a 4-channel, 32-bit MUX using enable signal at the output.

OR

2'(a) Describe how a for loop executes. Using for statement, write a behavioral model [09] to count majority of bits (1s) in an 8-bit word.

2 (b) Write a Verilog code of a module to find the location of first 1 in a 16-bit word. [06]

3 Draw the macrocell architecture of Complex Programable Logic Devices [10] (CPLD) for Altera MAX 7000S Series and explain its operation.

OR

3' Draw the architecture of Configurable Logic Block (CLB) in the XILINX [10] XC4000 Series FPGA and explain its working.

4(a) Design a Reduced Instruction-Set Computer (RISC) Stored-Program Machine [08] (SPM) for small set of instructions. Draw its full architecture.

4(b) Give the Verilog model of RISC SPM's processor to describe its architecture, [12] register operations, and data path operations.
2014-15
M.TECH. (WINTER SEMESTER) EXAMINATION
ADVANCED ELECTRONIC INSTRUMENTATION
EL-631

Maximum Marks: 60
Credits: 04
Duration: Three Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No.        Question                                      M.M.
1(a)       Explain how a ratio transformer bridge can be used for measurement of resistance and capacitance. [07]
1(b)       Describe the active bridge technique for the measurement of resistance in terms of capacitance. [05]

OR

1(b)'      What is universal impedance bridge? What are the features incorporated in it. [05]
2(a)       Describe the electrical model of a measurement system when an electrolyte is placed between two electrodes. Also explain its application in measurement. [07]

2(b)       Describe fiber-optic Mach-Zehnder Interferometric sensor. [05]

OR

2(b)'      Define stokes fluorescence and also describe fiber optic fluorescence temperature sensor. [05]
3(a)       Describe different cold junction compensation techniques in thermocouple circuits indicating their advantages and disadvantages. [07]

3(b)       Describe ultrasonic waves, their classification, advantages and their applications. [05]

OR

3(b)'      Explain the measurement of flow rate of liquid, flowing in pipe using ultrasonic technique. [05]
4(a) Show how a capacitive transducer can be used to monitor the thickness of an insulating sheet in motion, without making physical contact; comment on the linearity and sensitivity of the system.

OR

4(a') Describe the techniques of measuring the proximity of a metallic or non-metallic object by means of a capacitive system; comment on the linearity of the systems.

4(b) Define electric field interference? Also explain an scheme of shielding of an amplifier and its equivalent circuit.

5(a) Describe electrical impedance Plethysmography technique for respiratory monitoring.

OR

5(a') Describe tympanometry technique to assess the status of the ear.

5(b) Describe a microcomputer based weighing scale.
1(a) What are the advantages and disadvantages of a Micro-Controller over a Microprocessor?

1(b) What happens when a 1-0-1 pulse is applied to the RESET input of 8048 Microcontroller?

1(c) Explain the function of the following instructions of 8048:
(i) Mov @R1, #data. Assume contents of R1 is 32H and data = '55'
(ii) RETR
(iii) MOV P3 A0, @A
(iv) JMP Address

1(d) What is the maximum addressable ROM area in 8048 Micro-Controller?
Give the organization of Internal ROM in an 8048 Micro-Controller.

OR

Give the block diagram of 8048's architecture and provide a brief explanation of each of its unit.

Give the format of PSW register of 8048. Provide the description of each Flag in it.

What operations are performed by the following pins of 8048 Micro-Controller:

(i) ALE
(ii) PROG
(iii) T0 and T1

2(a) Answer the following in brief:
(i) How many pins are there in 8051 Micro-Controller?
(ii) What is the Maximum value of ROM that can be addressed by 8051 Micro-Controller?
(iii) How many Register banks are there in 8051 Micro-Controller?

Give the format of TMOD, TCON, SCON and PCON Registers of 8051 Micro-Controller.

Write a program using 8051 instructions for receiving bytes of data serially and put them in P1. Set the baud rate to 4800, 8 bit data and 1 stop bit.

OR

Write a program for generating a square wave on Pin P1.5 using Timer1. Assume XTAL frequency =11.0592 MHz.

Give the architectural block diagram of 8051 Micro-controller. Give in brief the significance of each block in it.

How many interrupt sources are there in 8051 Micro-Controller? Give the format of IP register and explain mechanism of setting priorities with reference to power on default
priority.

OR

Write a program to (a) load the accumulator with the value 55H and (b) complement the accumulator 700 times.

How many addressing Modes are supported by 8086 UP? Explain them in brief.

The following are the contents of registers & Memory Locations of an 8086 UP:

\[ \text{[Ax]}=5000H, \quad \text{[Bx]}=3000H, \quad \text{[SI]}=1000H, \quad \text{[DI]}=2000H, \quad \text{[BP]}=3000H, \quad \text{[SP]}=4000H, \]
\[ \text{[CS]}=1000H, \quad \text{[DS]}=2000H, \quad \text{[SS]}=3000H, \quad \text{[IP]}=7000H, \]

Memory Locations:

\[ \text{[19000H]}=2508, \quad \text{[20000H]}=3333, \quad \text{[21000H]}=4444, \]
\[ \text{[24000H]}=5544, \quad \text{[25000H]}=AABB, \quad \text{[27000H]}=2100, \quad \text{[28000]}=3322, \quad \text{[29000H]}=1000 \]

What will be the contents of these registers after the execution of the following instructions?

i) \text{MOV Ax, [5000H]}

ii) \text{MOV Ax, Bx}

iii) \text{MOV Ax, 5000H[Bx]}

iv) \text{MOV Ax, [Bx][SI]}

Draw the PIN diagram of an 8086 Microprocessor. Clearly differentiate between the pins of 8086 in MAX and MIN mode.

OR

Draw the block diagram for Architecture of 8087 Coprocessor. Explain the functions of Control Unit and Numeric Extension Unit in it.

Qno5(a)

Give the programming Model of MC 68000 UP and explain Supervisor and User Modes.

The following are the initial contents of Registers and Memory locations of a 68000 based UP system.

\[ \text{002000}=3456, \quad \text{D}_0=44556789 \]
\[ \text{002002}=AA67, \quad \text{D}_1=AABBCCDD \]
\[ \text{002004}=BADC, \quad \text{A}_0=00002006 \]
\[ \text{002006}=ABCDA, \quad \text{A}_1=00002004 \]

Give the contents of Registers and Memory locations when each of the following instruction is executed:

i) \text{MOVEA.B D}_1, D_0

ii) \text{ADDW (A}_0, D_0

iii) \text{MOVE.L -(A}_0, D_4

iv) \text{MOVE.L -(A}_1, -(A}_0

OR

Give the Programming Model of Intel 8086UP to 80486UP based on the Flag registers.
2014-15
M.TECH. (WINTER SEMESTER) EXAMINATION
ELECTRONICS ENGINEERING
DATA TRANSMISSION SYSTEMS
EL-652

Maximum Marks: 60  Credits: 04  Duration: Three Hours

Answer any FOUR questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No.  Question  M.M.
1(a)  It is often said that bipolar NRZ signaling for baseband data transmission has an inherent but small amount of error detection capability. Why? [5]
1(b)  NRZ-M uses an ex-OR gate while NRZ-S uses an ex-NOR gate in the encoder. Would the NRZ-M encoder output be an inverted form of NRZ-S encoder output, for the same input data sequence? Give justification for your answer. [5]
1(e)  What are the advantages of biphase signaling schemes, in general? Give at least one example of its use in a system standard for communication/networking. [5]
2(a)  Draw the frequency spectra of the commonly used baseband signaling formats, and give your comments on the same. [5]
2(b)  Explain briefly how the ISI can be minimized by pulse and channel shaping. [5]
2(c)  The sampled impulse response of a baseband channel is given by \( V = \begin{bmatrix} 1 & 1/2 \end{bmatrix} \).  (i) Design a single tap linear feedback transversal equalizer for the given channel. (ii) Find the impulse response of the channel and the equalizer taken together. [5]
3(a)  Assume that a wireless system is such that the various multi-path components (corresponding to the instantaneous value of the transmitted signal) always reach the receiver terminal at the same time instant. How much will be the time delay spread in this case? Is equalization required in this case? [5]
3(b)  With regard to time varying channels, explain the working of a receiver which is employing combined detector and estimator. [5]
3(c)  Give a brief account of computational complexity of Maximum Likelihood detectors. [5]
4(a) Describe the importance of training signals in data transmission systems. [5]

4(b) Distinguish between steady state channel estimators and fast start-up channel estimators. [5]

4(c) With regard to PSTN, distinguish between switched lines and leased lines. Write briefly about the modems used over these two types of lines. [5]

5(a) What are the limitations of RS-232 interface standard? Suggest a way in which some improvement can be obtained. [5]

5(b) With particular reference to bit rates of data transmission, trace the history of narrow band modems used over telephone lines. [5]

5(c) Explain briefly the Inquiry and paging processes in a Bluetooth network. [5]

6 Write short notes on any THREE of the following: [5+5+5]
   (i) Performance Comparison of Linear and Non-linear Equalizers
   (ii) Near Maximum Likelihood Sequence Estimation
   (iii) Asynchronous operation of a modem
   (iv) Bluetooth Baseband layer
   (v) Interference issues in ISM band
1(a) Consider a wideband channel with multipath intensity profile

\[ A_e(\tau) = \begin{cases} 
    e^{-\tau/0.0001} & 0 \leq \tau \leq 20 \mu\text{sec} \\
    0 & \text{else}
\end{cases} \]

Determine the maximum symbol rate such that a linearly modulated signal transmitted through this channel experience negligible ISI.

1(b) Consider a wireless system at 900 MHz with a transmission rate of 64 kbps and multipath fading. Explain which performance metric, average probability of error or outage probability, is more appropriate and why for user speeds of 1 km/h, 10 km/h, and 100 km/h.

1(c) Find the average BER for DPSK signal in flat Rayleigh fading channel. Determine the required SNR to maintain an average BER of $10^{-6}$.

2(a) Consider M-branch receiver diversity with maximal ratio combining (MRC). Each branch receives an independent Rayleigh fading signal. Drive an expression for SNR at the combiner output. Also, compare its performance with selection combining (SC).

2(b) Consider a flat-fading channel with a bandwidth of 30 KHz and three possible SNRs: $\gamma_1 = 0.8333$ with $p(\gamma_1) = 0.1$, $\gamma_2 = 83.33$ with $p(\gamma_2) = 0.5$, and $\gamma_3 = 333.33$ with $p(\gamma_3) = 0.4$. Assume that only receiver has CSI. Find the capacity versus outage for this channel, and find the average rate correctly received for outage probabilities $p_{\text{out}} < 0.1$, $p_{\text{out}} = 0.1$ and $p_{\text{out}} = 0.6$.
2(a) Consider an M-branch transmit diversity with channel state information (CSI) known to the transmitter and receiver. Each branch receives an independent Rayleigh fading signal. Drive an expression for SNR of the received signal. Also, compare its performance with receiver diversity employing MRC.

2(b) Assume a Rayleigh fading channel, where the transmitter and receiver have CSI and the distribution of fading SNR, \( p(\gamma) \), is exponential with mean SNR = 10 dB. Assume a channel bandwidth of 10 MHz. Find the cutoff value \( \gamma_o \) and the corresponding power adaptation that achieves Shannon capacity on this channel. Compute the Shannon capacity of this channel and compare it with the channel capacity in AWGN with the same average SNR.

3(a) What are the key features of OFDM which make it suitable for broadband wireless communications?

3(b) In an OFDM modem with 48 channels, each channel uses 16 QAM modulation. If the overall transmission rate is 10 Mbps, What is the symbol transmission rate per channel? Also, compare the bandwidth efficiency of this OFDM modem with conventional 16 QAM transmission with raised cosine pulse shaping with roll-off factor 0.3.

OR

3(b') Show that appending the all-zero prefix to an OFDM symbol and then adding in the tail of the received sequence, results in the same received sequence as with cyclic prefix.

3(c) Why SC-FDMA is preferred over OFDMA for the reverse link (MS to BS) of LTE system. Discuss briefly the principle of SC-FDMA.

4(a) Consider a MIMO system with channel gain matrix \( \mathbf{H} \) given by

\[
\mathbf{H} = \begin{bmatrix}
-0.555 & 0.3764 & -0.7418 \\
-0.3338 & -0.9176 & -0.2158 \\
-0.7619 & 0.1278 & 0.6349
\end{bmatrix} \begin{bmatrix}
1.3333 & 0 & 0 \\
0 & 0.5129 & 0 \\
0 & 0 & 0.0965
\end{bmatrix} \begin{bmatrix}
-0.2811 & -0.7713 & -0.5710 \\
0.5679 & -0.3459 & 0.7469 \\
-0.7736 & 0.5342 & -0.3408
\end{bmatrix}
\]

Assume \( \mathbf{H} \) is known at both transmitter and receiver, and that there is a total transmit power of \( P = 10 \text{ mW} \) across the transmit antennas, AWGN with power \( N_0 = 10^{-2} \text{ W/Hz} \) at each receive
antenna, and bandwidth $B = 100$ KHz. Find the optimal power allocation and capacity of the MIMO channel.

**OR**

4(a') Consider a MIMO system with channel gain matrix $H$ given by

$$
H = \begin{bmatrix}
.7 & .9 & .8 \\
.3 & .8 & .2 \\
.1 & .3 & .9 
\end{bmatrix}
$$

Assume $H$ is known at both transmitter and receiver, and that there is a total transmit power of $P = 10$ mW across the transmit antennas, AWGN with power $N_0 = 10^{-8}$ W/Hz at each receive antenna, and bandwidth $B = 100$ KHz. Find the capacity of this channel under beam forming.

4 (b) Consider a two-user uplink channel with power constraints $P_1$ and $P_2$. The capacity region is defined by

$$
R_k < \log \left( 1 + \frac{P_k}{N_0} \right) \quad k = 1, 2
$$

$$
R_1 + R_2 = \log \left( 1 + \frac{P_1 + P_2}{N_0} \right)
$$

Define $\delta > 0$ by

$$
R_1 = \log \left( 1 + \frac{P_1}{\delta + N_0} \right)
$$

Now consider the situation when user 2 splits itself into two users, say 2a and 2b, with power constraints $P_2 - \delta$ and $\delta$ respectively. The users decode with successive interference cancellation (SIC) in the order 2a, 1, 2b. Calculate the rates of reliable communication ($r_{2a}$, $r_1$, $r_{2b}$) for the users 2a, 1 and 2b using SIC. Also, show that $r_1 = R_1$ and $r_{2a} + r_{2b} = R_2$. 


Q1  Compare the single stage, two stage, three stage realizations of the decimator with the following specifications,

Sampling rate of a signal has to be reduced from 10 KHz to 500Hz. The decimation filter $H(z)$ has the passband edge $F_p$ to be 150 Hz, stop band edge $F_s$ to be 180Hz, passband ripple ($\delta_p$) to be 0.002 and stop band ripple ($\delta_s$) to be 0.001.

Q2  An AR process of order 1 is given by $x(n) = \alpha x(n-1) + w(n)$, where $\alpha$ is a constant. and $w(n)$ is white noise process of zero mean and variance $\sigma^2$. Find mean and auto correlation function of $x(n)$.

Q3  An MA process $x(n)$ of order two is described by the difference equation,

$X(n) = v(n) + 0.75 v(n-1) + 0.25 v(n-2)$

Where $v(n)$ is zero mean white noise process of unit variance. The requirement is to approximate this process by an AR process $u(n)$ of order $M$. Do this approximation for the following cases

(a) $M = 2$  (b) $M = 5$

Q4  The statistical characterization of a multiple linear regression model of order four is as follows

The correlation matrix of the input vector $u(n)$ is

\[ \text{Contd...} \]
\[
R = \begin{bmatrix}
1.1 & 0.5 & 0.1 & -0.1 \\
0.5 & 1.1 & 0.5 & 0.1 \\
0.1 & 0.5 & 1.1 & 0.5 \\
-0.1 & 0.1 & 0.5 & 1.1 \\
\end{bmatrix}
\]

. The cross correlation vector between the observed data and the input vector is

\[P = [0.5, -0.4, -0.2, -0.1]^T\]

. The variance of the observed data \(d(n)\) is \(\sigma_d^2 = 1.0\)

. The variance of additive white noise is \(\sigma_v^2 = 0.1\)

A Wiener filter of varying length \(M\) operates on the input vector \(u(n)\) as input and on the observed data \(d(n)\) as the desired response. Compute the mean square error produced by the wiener filter for \(M = 0, 1, 2, 3, 4\).

Q5 Consider a linear prediction of a stationary AR process \(u(n)\) generated from the first order difference equation

\[u_\xi(n) = 0.9 \, u(n-1) + v(n)\]

Where \(v(n)\) is white noise of zero mean and unit variance.

(a) Determine the tap weights of the forward prediction error filter.

(b) Determine the reflection coefficients of the corresponding lattice predictor.

Q6 Discuss in details the nonparametric methods of power spectrum estimation.
M.TECH. (WINTER SEMESTER) EXAMINATION  
ELECTRONICS ENGINEERING  
SPEECH PROCESSING  
EL-662

Maximum Marks: 60  Credits: 04  Duration: Three Hours

INSTRUCTIONS TO THE EXAMINEES
- Answer ALL the questions.
- Assume suitable data if missing.
- Notations used have their usual meaning.

Q.No.  Question  M.M.
1 (a) Differentiate between pitch frequency and formant frequency. [04]
1(b) Calculate the loudness level in phones and loudness in sones of an acoustic wave with intensity $10^{-10}$ watt/m$^2$. [05]
1 (c) Explain an algorithm used to detect voice activity in speech signal. Also write a pseudo code/ Matlab code. [06]

OR

1' (c) What are the different performance measurement parameters used to evaluate a speech synthesis system? [06]

2 (a) Calculate the vocal tract transfer function and evaluate the first three pole frequencies for a vocal tract length of 17.5 cm. Make necessary assumptions where necessary. [05]
2 (b) How is temporal masking useful in speech coding? Differentiate between pre-masking and post-masking. [04]
2 (c) Explain how the performance of an automatic speech recognition (ASR) can be evaluated. Find the percentage accuracy of an ASR system if the number of words correctly detected is 8930, number of insertions 139, number of deletion 57 and number of deletion 267. [06]

OR
2 (c) What are the different methods of speech synthesis? Explain how formant based speech synthesis is carried out.

3 (a) Prove that the optimum level of a quantizer is at the centroid of the probability density function of the input signal over the interval.

3 (b) Compare the performance of feed-back and feed-forward adaptation carried out during the quantization process of speech signal.

3 (c) Compare different subjective and objective methods used for assessment of speech quality?

4 (a) Explain how coding delay is reduced in the CELP. Draw the block diagram of ITU G.728 coder/decoder and explain its working.

4 (b) A speech signal is sampled at 8kHz followed by a vector quantizer. The code-vector dimension is 10 while 8 bit is used to represent each dimension. Calculate the storage requirement and the computation cost per second if a full search codebook is used.

OR

4* Explain how Hidden Markov Model is used to develop acoustic model of a phoneme in speech recognition application. Draw the trellis diagram of 3 state HMM having 5 observations in a sequence. Evaluate the order of computation required to calculate the probability of an observation sequence given the model and show how it can be efficiently calculated using Forward/Backward algorithm.
Answer ANY FOUR questions.
Assume suitable data if missing.
Notations used have their usual meaning.

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)</td>
<td>What do you mean by the term 'Substrate Current-Induced Body Effect (SCBE)' used in short channel MOSFETs? Explain how SCBE affects the device output impedance.</td>
<td>[5]</td>
</tr>
</tbody>
</table>

1(b) i) Use a simplified model of MOSFET to determine input impedance $Z_{IN}$ of circuit shown in Fig. 1

![Fig. 1](image)

ii) Calculate $S_{11}$ and $S_{22}$ for the circuit shown in Fig. 2

![Fig. 2](image)
<table>
<thead>
<tr>
<th>Question</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>1(c)</td>
<td>What are the important features of common source low noise amplifier? Use relevant theory to explain how noise matching is achieved in this topology.</td>
</tr>
<tr>
<td>2(a)</td>
<td>Calculate transit-time frequency $f_T$ for the MOSFET's rf model shown in Fig. 3. What effect $R_G$ has on $f_T$?</td>
</tr>
<tr>
<td>Fig. 3.</td>
<td><img src="image" alt="Circuit Diagram" /></td>
</tr>
<tr>
<td>2(b)</td>
<td>Draw radio frequency equivalent circuit model of MOSFET by including the effect of source resistance $R_S$ and drain resistance $R_D$. How it is different from low-frequency model? Carry out its $Z$-parameters analysis to develop extraction equation for $R_S$. Make suitable assumptions if any.</td>
</tr>
<tr>
<td>3(a)</td>
<td>Differentiate between transit-time frequency $f_T$ and maximum usable frequency $f_{MAX}$. Explain which one is better figure-of-merit (FoM) for RF device.</td>
</tr>
<tr>
<td>3(b)</td>
<td>How parallel strip-line differ from shielded strip line? A parallel strip line has the following parameters: Relative dielectric constant $\varepsilon_r = 2.25$, Strip width $w = 26.1$ mm, Separation distance $d = 14$ mm, Calculate the (i) Strip-line inductance (ii) Strip-line capacitance</td>
</tr>
<tr>
<td>3(c)</td>
<td>What are image-reject receivers? Use relevant theory to justify why image filter is not required in this kind of receiver.</td>
</tr>
<tr>
<td>4(a)</td>
<td>What is transit frequency $f_T$? Show that for short-channel MOSFET $f_T$ is given as: $f_T \approx v_{sat}/(2\pi L)$; Where $v_{sat}$ = saturation velocity and $L$ = gate length</td>
</tr>
<tr>
<td>4(b)</td>
<td>What do you mean by Global Multimedia Communication Village? State the challenges, which need to be overcome to realize this dream.</td>
</tr>
<tr>
<td>4(c)</td>
<td>Differentiate between 3G &amp; beyond 3G wireless systems. Briefly discuss their device and circuit issues.</td>
</tr>
<tr>
<td>5(a)</td>
<td>What are the advantages of monolithic microwave integrated-circuits (MICs) over hybrid MICs? List the basic characteristics required for an ideal substrate.</td>
</tr>
</tbody>
</table>
5(a) Give the physical origin of the parasitic resistances $R_G$ and $R_{SUB}$ used in the rf model for the MOSFET shown in Fig. 4. Carry out $\gamma$-parameters analysis of the model to show that

$$C_M + C_{GD} = -\frac{\text{Im}(Y_{21})}{\omega} - g_m R_G (C_{GS} + C_{GD})$$

![Fig. 4](image)

6(a) Show that the optimum device width $W_{OPT,P}$ of the MOSFET used for design of a low noise amplifier can be expressed as:

$$W_{opt,P} \times f \equiv 250 \text{ } (\mu m \times \text{GHz}) ; \text{ where } f \text{ is the operating frequency}$$

6(b) What is direct-conversion receiver? Derive O/P signal expression if RF and LO signals are not in phase for direct conversion receiver for circuit shown in Fig. 5.

![Fig. 5](image)

6(c) What is 4G wireless technology? What is the current scenario of this technology in India? Explain.