2015-16
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

Supplement your answers with neat circuit/block diagrams
Notations used have their usual meaning.

Q.No. | Question | M.M.
--- | --- | ---
1(a) | How can a single transistor (BJT or MOS) be used as a Current Conveyor? | [03]
1(b) | What characterize a current mode circuit? | [03]
1(c) | What design considerations are required to justify the utility of the circuit shown in Fig. 1 as CCII? Support your answer with necessary derivation(s). | [06]

![Figure 1](image)

1(d) | Suggest a high frequency model of the circuit shown in Fig. 1 | [03]
2(a) | Design a differential voltage current conveyor using second generation current conveyors. | [04]
2(b) | Analyze the circuit shown in Figure 2 taking into account the parasitic elements of | [05]

Contd......2.
CCII, for its transfer function and bandwidth.

![CCII Diagram](image)

**Figure 2**

2(c) Perform critical analysis of the circuit of figure 3, assuming non-ideal CCIIIs and suggest possible applications of the circuit.

![Circuit Diagram](image)

**Figure 3**

3(a) Justify the workability of the circuit of Figure 4 as a quadrature oscillator and discuss the effect of parasitic elements on circuit's performance.

![Circuit Diagram](image)

**Figure 4**

*Contd....3.*
3(b) Redesign the circuit topology of Figure 3 using CCCIIIs and capacitors only. Highlight the feasibility issues of the re-designed circuit and draw inference by comparisons with the circuit of Figure 3.

3(c) How can a current conveyor be used as a Comparator?

OR

3'(a) Realize the following interfaces using current mode active building blocks:
(i) Current to Voltage converter
(ii) Voltage to Current converter
(iii) Differential input voltage follower
(iv) Differential input current follower.

3'(b) Systematically design an electronically tunable third order oscillator circuit using current-mode lossy integrators.

4(a) "AD-844 ICs are versatile for realizing current mode analog building blocks". Justify the statement with at least three examples.

4(b) Design an electronically tunable current-mode PID controller circuit.

4(c) With the help of an example, illustrate the procedure for transforming voltage-mode circuits to current-mode circuits.
M.TECH. WINTER (II SEMESTER) EXAMINATION  
(ELECTRONICS ENGINEERING) 
(ELECTRONICS CIRCUITS & SYSTEM DESIGN) 
ADVANCED ANALOG IC DESIGN 
(EL-622)

Maximum Marks: 60  
Credits: 04  
Duration: Three Hours

Answer all questions. Use the following values of NMOS and PMOS transistors and the supply voltage of 3V unless otherwise specified.

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

PMOS: $V_{th} = -0.7V$, $\gamma = 0.40 \text{ V}^{1/2}$, $\lambda = 0.2 \text{ V}^{-1}$, $\mu_p \text{Cox} = 25 \mu\text{A/V}^2$

Q.No.  

1(a) Explain the different device capacitances of a MOS transistor in saturation region.  [03]

1(b) What is the importance of subthreshold region of a MOS transistor? What is its disadvantage?  [03]

OR

1'(b) Why is the Analog IC Design more challenging than a Digital IC Design? Justify your answer.  [03]

1(c) Sketch $I_x$ and the transconductance of the transistor as a function of $V_x$ as $V_x$ varies from 0 to 3V in Fig.1.  [04]

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 the devices are in saturation. Calculate the small signal voltage gain and the maximum output voltage swing.  [05]

2(a) How a good quality current source can be designed using a MOS transistor?  [03]

2(b) What is the need of compensation in a CMOS OPAMP?  [03]

OR

2'(b) What is the advantage and disadvantage of a two stage CMOS OPAMP?  [03]

2(c) Describe the design of a Bandgap reference with the help of a circuit diagram.  [05]

2(d) Assuming all MOSFETs are in saturation, calculate the small signal voltage gain of the circuit shown in Fig. 3. Neglect Body effect.  [04]

OR

2'(d) Assuming all MOSFETs are in saturation, calculate the small signal voltage gain of the circuit shown in Fig. 4. Neglect Body effect.  [04]

Contd....2.
3(a) How is it possible to increase the slew rate of a single stage CMOS OPAMP? Justify your answer.

3(b) Calculate the differential voltage gain of the circuit shown in Fig. 5 if \( I_{\text{ss}} = 1 \text{mA} \), \((W/L)_{1,2} = 50/0.5\), and \((W/L)_{3,4} = 50/1\). What is the minimum allowable input CM level if \( I_{\text{ss}} \) requires at least 0.4V across it? Using this value of \( V_{\text{in},\text{CM}} \), calculate the maximum output swing.

OR

3'(b) Calculate the differential voltage gain of the circuit shown in Fig. 6 if \( I_{\text{ss}} = 1 \text{mA} \), \((W/L)_{1,2} = 50/0.5\), and \((W/L)_{3,4} = 50/1\). What is the minimum allowable input CM level if \( I_{\text{ss}} \) requires at least 0.4V across it? Using this value of \( V_{\text{in},\text{CM}} \), calculate the maximum output swing.

3(c) Calculate the small signal differential voltage gain of the circuit shown in Fig. 7

OR

3'(c) Assuming \((W/L)_{1,3} = 40/0.5\), \( I_{\text{REF}} = 0.3 \text{mA} \), and \( \gamma = 0 \) in the circuit shown in Fig. 8 determine \( V_b \) such that \( V_X = V_Y \). If \( V_b \) deviates from its calculated value by 100mV, compute the mismatch between \( I_{\text{REF}} \) and \( I_{\text{out}} \).

4(a) Determine the CMRR of an amplifier shown in Fig. 9 with \((W/L)_{1,5} = 50/0.5\) and \( I_{\text{DS}} = 0.5 \text{mA} \).

OR

4'(a) In Fig. 10, current source \( I_1 \) is realized by a PMOS operating in saturation. Assume \((W/L)_{1} = 50/0.5\), \( I_{\text{DI}} = 1 \text{mA} \) and \( R_S = 1 \text{K}\Omega \). Determine the aspect ratios of PMOS for the maximum allowable output level of 2.6V. Also determine the poles and zero.

4(b) Calculate the input-referred 1/f and thermal noise voltage of the circuit depicted in Fig. 11. Assume all the transistors in saturation.

4(c) Design a CMOS differential telescopic OPAMP with \( V_{\text{DD}} = 3 \text{V} \), \( \text{Power} = 15 \text{mW} \), differential output swing=2.5V, \( \text{Gain} = 4000 \) in 0.5um technology. Use the NMOS and PMOS parameters given in the beginning.

Fig. 1  Fig. 2  Fig. 3  Fig. 4

Contd.....3.
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) What is the significance of user-defined primitives (UDPs), which use truth-tables, over modules? Give a truth-table model (UDP) for a J-K flip flop having \textit{preset} and \textit{clear} inputs 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 UDP. [09]  
1(b) Write the test bench of a 4 bit Ripple Counter. Set the clock to toggle every 10 times units and finish the simulation at time 350. Show the output of simulation results. [06]  

OR  
1'(b) What is the significance of \textit{case} statement? Using \textit{case} statement Write the Verilog code to describe 8:3 priority encoder. [06]  

2(a) Using a parameterized \textit{for} loop, conditional operators, and concurrent assignments to the register cells, describe the behavioral model of an 8-bit Linear Feed-back Shift Register (LFSR). Also give the schematic, showing data movement for initial state and 3 cycles of clock in LFSR with modulo-2 (Exclusive-OR) addition. Take two arbitrary 8-bit words for Initial State and

Contd.....2.
Tap Coefficient.

OR

2(a) Discuss the significance of synthesis of combinational and sequential logic. Write a Synthesis-Friendly Verilog code for the module of Seven Segment Display with Counter.

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

3 Sketch the macrocell architecture of Complex Programable Logic Devices (CPLD) for Altera MAX 7000 Series and analyse the function of all combinational and sequential blocks. Also compare it with Altera MAX 7000S Series macrocell architecture.

OR

3' Draw the PAL-like macrocell architecture of CPLD in Xilinx XC9500 Series. Give its salient features and analyse the function of various blocks.

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

4(b) Give the Verilog model to design control unit of RISC SPM's processor.
2015-16
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 the construction of a ratio transformer and describe its uses. [06]
1(b)   What is LCR meter and describe any one of its application. [06]

OR

1(b)'  Describe the active bridge technique for the measurement of resistance in terms of capacitance. [06]

2(a)   Describe the electrical model of a measurement system when an electrolyte is placed between two electrodes. Also explain its application in measurement. [06]

2(b)   What is a Fiber-optic sensor? Explain a generalized configuration of a fiber-optic sensor. [06]

OR

2(b)'  Describe fiber-optic Gyroscope. [06]

3(a)   Explain how cold junction compensation is achieved in thermocouple using thermister. [06]

3(b)   What are ultrasonic waves also describe the methods of generating ultrasonic waves. [06]

OR

3(b)'  Explain ultrasonic method of flaw detection in railway tracks. [06]

Contd.....2.
4(a) Explain how moisture content in grains, tobacco, wood and granulated powder can be measured by means of a capacitive transducer.

OR

4(a)' Show how a capacitive strain transducer can be designed for measuring the surface strains of large structures.

4(b) Describe the construction of E-Nose and its application in measuring the characteristic of liquids.

5(a) What is an electrocardiogram?

OR

5(a)' Describe in detail the application of measurement of impedance in bio-medical instrumentation.

5(b) Describe the technique of interfacing transducers with microcomputer.
2015-2016
M.Tech (Winter Semester) Examination

Advance Microprocessor System & Design
EL-641

Maximum Marks: 60 
Credits: 04 
Time: 3hrs

Answer All Questions
Assume suitable data if missing
Notations used have their usual meaning.

Qno1(a)
   i) Give a brief account of facilities that are present on board 8048 microcontroller. 
   ii) Give salient features of Intel's Core i3 processor.

(b) Give the pin diagram of 8048 UC and explain the function of various pins in it.

(c)
   i) Assume contents of R1 is 32H, M[32]=78H and A =55H. What will be the contents of A and R1 after the execution of the Instruction XCHD A, @R1?
   ii) In how many groups the Instruction set of 8748 microcontroller is divided? Discuss each group with the help of suitable instructions.

OR

Qno1(c)
Give the block diagram of 8048's architecture. Discuss the function of each of its unit.

Qno2(a)
Answer the following in brief
   (i) What is the size of stack pointer in 8051 Micro-Controller?
   (ii) What is the Maximum value of RAM that can be addressed by 8051 Micro-Controller?
   (iii) Out of the following list of registers, identify the one which is not bit addressable.
       a) ACC    b) PSW    c) TMOD    d) TCON

(b) Attempt any four of the following
   (i) Give the operation of RL and RLC instructions 
   (ii) Difference between SJMP and AJMP instructions 
   (iii) Operation of MOVC A, @A+DPTR and MOVC A, @A+PC 
   (iv) Write a short program for BCD addition of numbers 34H and 49H 
   (v) What alternate functions are assigned to the pins of port 3, give them in brief.
   (vi) The initial contents of Register A and Register B are 20H and 40H respectively, what will be the contents of Register A and B after the execution of
       a) Mul AB    b) DIV AB

(c) Give the format of PSW register of 8051 microcontroller and explain the significance of each bit in it.

OR

(c') Write a program to send text string "WELCOME" serially. Set the baud rate at 9600, 
8-bit and 1 stop bit. Assume the clock frequency as 11.0592Mhz

Qno3(a)
   (i) What is meant by bit addressable RAM?
   (ii) Draw the configuration of bit addressable RAM of 8051 UC
(ii) Which Instruction can be used to set/reset individual bit of bit addressable RAM?
(iii) What is the size of address bus in 80386 UP?
(iv) How many transistors are used in Intel's i7 processor?
(v) How many segment registers are there in 8088 UP?

(b) Give the configuration of timer 0 of 8051 in various modes.

OR

(b') Discuss with the help of suitable flow chart, serial data transmission and reception through 8051's serial port.

(c) How many addressing modes are available in 8086 UP? Differentiate between Intersegment and Intra-segment modes of control transfer.

OR

(c') (i) What do you understand by Hyper-threading technology (HT Technology)? Explain in brief.
(ii) What is the difference between L1, L2 and L 3 Cache? Compare them on the basis of their size and speed.

Qno4(a) Give the register structure of 8086 UP. Discuss the role of General Purpose and Segment Registers.

(b) (i) Write a short program for clearing 1000 words starting at memory location $003000.
(ii) Give the status register format of 68000 microprocessor. Discuss the meaning of each of its bit.

OR

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

<table>
<thead>
<tr>
<th>Address</th>
<th>Register/Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>002000</td>
<td>D0=44556789</td>
</tr>
<tr>
<td>002002</td>
<td>D1=ABBCD</td>
</tr>
<tr>
<td>002004</td>
<td>A0=00002006</td>
</tr>
<tr>
<td>002006</td>
<td>A1=00002004</td>
</tr>
</tbody>
</table>

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

i) MOVEA.B D1, D0
ii) ADD.W (A1), D0
iii) MOVE.L -(A0), D4
iv) MOVE.L -(A1), -(A0)

(c) Write a multiple move instruction to load registers D2, D3, D6, A0, A4, A5, A6 from memory starting from $003000. Explain how it works.
<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)</td>
<td>Why Manchester coded format is referred to as a self-clocking format? What is the disadvantage, if any, of such type of formats? OR</td>
<td>[5]</td>
</tr>
<tr>
<td>1(a)</td>
<td>What is a modified duobinary signal and what are its advantages?</td>
<td>[5]</td>
</tr>
<tr>
<td>1(b)</td>
<td>Draw the frequency spectra of the commonly used baseband signaling formats, and give your comments on the same.</td>
<td>[10]</td>
</tr>
<tr>
<td>2(a)</td>
<td>With regard to data transmission systems, what is meant by timing jitter? OR</td>
<td>[5]</td>
</tr>
<tr>
<td>2(a)</td>
<td>Give a brief account of Nyquist's vestigial symmetry theorem.</td>
<td>[5]</td>
</tr>
<tr>
<td>2(b)</td>
<td>For any given practical channel (or transmission path), illustrate that the problem of distortion (ISI) becomes more and more serious when the transmitted bit rate over this channel is increased.</td>
<td>[10]</td>
</tr>
<tr>
<td>3</td>
<td>Taking the help of appropriate examples and calculations, show that with linear feedforward transversal equalizer, we need infinite number of taps in order to achieve perfect (or ideal) equalization. OR</td>
<td>[10]</td>
</tr>
<tr>
<td>3'</td>
<td>Taking the help of appropriate examples and calculations, show that in the absence of noise and with the exact values of the tap gains, the linear feedback transversal equalizer achieves perfect equalization of the channel with only g taps, where g+1 is the number of components in the sampled impulse response of the baseband channel.</td>
<td>[10]</td>
</tr>
</tbody>
</table>
4(a) How can catastrophic failure occur in the receiver of a data transmission system which employs a combined detector and estimator? How can a receiver avoid such a failure or recover from it quickly?

OR

4 (a) Describe the importance of training signals in data transmission systems.

4(b) Why does Bluetooth employ half-duplex transmission (using time division duplexing) rather than full-duplex transmission (using frequency division duplexing)?

4(c) Consider a Bluetooth piconet consisting of one Master and one Slave. If the level of noise suddenly increases in the wireless channel, what effect will this have:
(i) if speech is being transmitted between Master and Slave,
(ii) if data is being transmitted between master and Slave.
2015-16
M.TECH. (WINTER SEMESTER) EXAMINATION
ELECTRONICS ENGINEERING
WIRELESS COMMUNICATION
EL-658

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)  Prove, for $X$ and $Y$ independent zero-mean Gaussian random variables with variance $\sigma^2$, that the distribution of $Z = \sqrt{X^2 + Y^2}$ is Rayleigh distributed and that the distribution of $Z^2$ is exponentially distributed.  [08]

1(b)  Consider a wideband channel characterized by the autocorrelation function

$$A_c(\tau, \Delta t) = \begin{cases} \sin c(w\Delta t) & 0 \leq \tau \leq 10 \mu sec \\ 0 & \text{else} \end{cases}$$

where $w = 100$Hz. Compute the channel’s RMS delay spread, and Doppler spread. Over approximately what range of data rates will a signal transmitted over this channel exhibit frequency selective fading?  [07]

OR

1(b')  The local average power delay profile in a particular environment is found to be

$$P(\tau) = \sum_{n=0}^{2} \frac{10^{-6}}{n^2 + 1} \delta(\tau - n10^{-6})$$

Sketch the power delay profile of the channel in dBm and calculate the RMS delay spread of the channel.  [07]

2(a)  Given that binary non-coherent FSK modulation has a bit error probability of $P_b = 1/2 e^{-\gamma b}$ in AWGN channel. To achieve a BER of $10^{-4}$, how much additional SNR is required in Rayleigh fading environment compared to the AWGN channel?  [04]

2(b)  Consider M-branch receiver diversity with each branch receiving an independent Rayleigh fading signal. Determine the optimal weights for maximal ration combining (MRC) and also the SNR at the combiner output.  [06]

Contd....2.
2(c) Drive an expression for the SNR of an M-branch transmits diversity system with optimal power allocation in Rayleigh fading environment.

3(a) Consider a flat-fading channel where for a fixed transmits power, the received SNR is one of four values: $\gamma_1 = 30 \text{ dB}$, $\gamma_2 = 20 \text{ dB}$, $\gamma_3 = 10 \text{ dB}$, and $\gamma_4 = 0 \text{ dB}$. The probability associated with each state is $p_1 = 0.2$, $p_2 = 0.3$, $p_3 = 0.3$, and $p_4 = 0.2$. Assume both transmitter and receiver has channel state information. Find an optimal power allocation for this channel and its corresponding Shannon capacity.

OR

3(a') Consider a flat-fading channel of bandwidth 20 MHz where for a fixed transmits power, the received SNR is one of six values: $\gamma_1 = 20 \text{ dB}$, $\gamma_2 = 15 \text{ dB}$, $\gamma_3 = 10 \text{ dB}$, $\gamma_4 = 5 \text{ dB}$, $\gamma_5 = 0 \text{ dB}$ and $\gamma_6 = -5 \text{ dB}$. The probability associated with each state is $p_1 = p_6 = 0.1$, $p_2 = p_4 = 0.15$, and $p_3 = p_5 = 0.25$. Assume only the receiver has channel state information. Find the capacity versus outage for $0 \leq P_{out} < 1$.

3(b) Discuss briefly the principle of OFDM. What advantages does it offers in mobile environment?

OR

3(b') Discuss briefly the principles of SC-FDMA.

4(a) It is required to design a system with user data rate of 1Mbps. Typical outdoor channels show RMS delay spread $\sigma = 10\mu$s. Determine whether ISI will occur in a single carrier system? If yes, propose a multicarrier system that would avoid ISI. Please note that channel coherence bandwidth is defined as, $B_C = 1/5\sigma$ and frequency selectivity occurs when $10\sigma >$ symbol duration.

4(b) Consider a 2×2 MIMO system employing Alamouti scheme. Derive the maximum likelihood (ML) detector for the symbols based on the received signals at both receiving antenna. Show that the scheme effectively provides two independent channels. What is the gain of each of the channels?
MTECH. (WINTER SEMESTER) EXAMINATION

ELECTRONICS ENGINEERING (C& IS)

Digital Signal Processing EL-661

Maximum Marks: 60
Credits: 04
Duration: Three Hours

Answer all four questions.
Assume suitable data if missing.
Notations and symbols used have their usual meaning.

QNo Question MM

1 Design a single stage and two stage decimator for the following specifications
   Passband 0<F<50
   Transition band 50<F<55
   Input sampling rate 10,000Hz
   Ripple \( \delta_1 = 10^{-1} \), \( \delta_2 = 1 \), D=100
   OR

   (a) Compare the multi-resolution capabilities of STFT and wavelet transform.
   (b) What are the analysis and synthesis filter banks? What are their applications

2 An AR process \( u(n) \) of order 2, is described by the difference equation
   \[ u(n) = u(n-1) - 0.5u(n-2) + v(n) \]
   Where \( v(n) \) is a white noise process of zero mean and variance 0.5.
   (a) Find the average power of \( u(n) \).
   (b) Find the reflection coefficients \( k_1 \) and \( k_2 \).
   (c) Find the average prediction error powers \( P_1 \) and \( P_2 \).

Contd.....2.
OR

2. An autoregressive process \( u(n) \) of order 2, described by the difference equation

\[
 u(n) = u(n-1) - 0.5u(n-2) + \nu(n)
\]

Where \( \nu(n) \) is a white-noise process of zero mean and variance 1.

Using the one-to-one correspondence between the two sequence of numbers

\( \{P_0, k_1, k_2\} \) and \( \{r(0), r(1), r(2)\} \), compute the autocorrelation function values 

\( r(1) \) and \( r(2) \) that correspond to the reflection coefficients \( k_1 \) and \( k_2 \) for the second-order autoregressive process \( u(n) \).

3. A wiener filter problem is characterized by the following values for the correlation matrix \( R \) of the tap-input vector \( u(n) \) and the cross-correlation vector \( p \) between \( u(n) \) and the desired response \( d(n) \):

\[
 R = \begin{bmatrix} 1 & 0.5 \\ 0.5 & 1 \end{bmatrix}
\]

\[
 p = \begin{bmatrix} 0.5 \\ 0.25 \end{bmatrix}
\]

(a) Suggest a suitable value for the step-size parameter \( \mu \) that would ensure convergence of the method of steepest descent, based on the given value for matrix \( R \).
(b) Using the value proposed in part (a), determine the recursions for computing the elements \( w_1(n) \) and \( w_2(n) \) of the tap-weight vector \( w(n) \). For this computation, you may assume the initial values \( w_1(0) = w_2(0) = 0 \).

4. (a) Compare the performances of various non parametric methods of power spectrum estimations in details.
(b) Determine the frequency resolution of the Bartlett, Welch and Blackman Tukey methods of power spectrum estimates for a quality factor \( Q = 10 \). Assume that overlap in Welch method is 50% and the length of the sample sequence is 1000.
Q. No. 1a

During an experiment of tone masking by 400 Hz signal following plot was obtained as shown in Figure 1. Give the interpretation of this plot and explain its relevance with reference to speech compression.

![Figure 1: Tone masking curve using 2000 Hz signal](image)

Q. No. 1b

A simplified vocal tract which is modelled as *lossless tube* having *uniform cross section area* is shown in Figure 2. Assume $p(x,t)$ and $u(x,t)$ as the sound pressure and volume velocity flow in the tube at position $x$ and at time $t$ respectively. Calculate the vocal tract transfer function and evaluate the first three pole

*Contd....2.*
frequencies for a vocal tract length of 17.5 cm. Make necessary assumptions where necessary.

![Diagram of a uniform lossless tube with ideal terminations]

Figure 2: A uniform lossless tube with ideal terminations

2 a Differentiate between Phonemes and Visemes used in audio visual speech recognition application.

2 a' Calculate the pitch in Mel's of a signal having frequency equal to 1kHz. What will be the pitch if the frequency is doubled?

2 b Draw the block diagram of G.722 Sub-band coder and explain its working.

3 a Differentiate between Tone and Noise Masking.

3 b Explain how Forward and Backward Algorithm is used to reduce the computational complexity of a Hidden Markov's Model.

OR

3 b' Draw the block diagram and explain the process of extraction of Mel Frequency Cepstral Coefficients based features used in automatic speech recognition.

4 a Differentiate between long term and short term prediction used in Multi-Pulse LPC Encoder.

4 b Write Matlab/pseudo code for voiced and unvoiced classification using short time energy of a speech signal sampled at 8kHz using a non-overlapping Hamming window of 10ms duration.

OR

4 b' Explain briefly how formant based speech synthesis is carried out in a Klatt synthesizer.
2015 – 16
M.TECH. (WINTER SEMESTER) EXAMINATION
ELECTRONICS ENGINEERING
AD HOC AND SENSOR NETWORKS
EL – 686

Maximum Marks: 60 Credits: 04 Duration: Three Hours

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

1(a) Assume that all of a sudden Greenland becomes very populated and that it is quite expensive to build a wired infrastructure for a phone system. Would it be better to use a geostationary satellite and point dishes at it or build base stations and use a cellular system? Discuss advantages and disadvantages. 3

(b) Can authentication be a particularly significant problem in both mobile ad hoc (MANET) and wireless sensor networks (WSN)? Discuss. 4

(c) It is generally believed that TCP protocol is not suited for MANETs. Give your arguments both in favour and against this statement. 4

(d) Compare a proactive routing protocol such as DSDV with a reactive protocol such as DSR with respect to overheads and route optimality. 4

OR

(d') Does DSR incur larger or smaller overheads for route discovery compared to the AODV protocol? Justify your answer. 4

2(a) In a CSMA/CA network, nodes use a random delay before accessing the medium. Why is this being done? Assume that the RTS and CTS frames were as long as the DATA and ACK frames. Would there be an advantage of using the RTS/CTS approach? Explain why or why not. How is it helpful to use busy tone in channel access? What are the limitations of BTMA (b) protocol? Suggest the ways to overcome these limitations. 4

OR

(b') 'Directional MAC protocols solve most of the problems of MAC layer of MANETs.'

Contd.....2.
Comment on the above statement.

(c) Consider the network topology in Figure-1, where circles indicate the communication and interference range of each node, that is, each node can hear the immediate neighbours to the left and right. Assume that RTS/CTS is not being used.

(i) Node B currently sends to node A and node C wants to send to node D. Is node C allowed to do so (i.e., can it do so without causing a collision) and will it decide to do so?

(ii) Node C sends to node B and node E wants to send to node D. Is E allowed to do so and will it do so?

(iii) Node A sends to node B and node D sends to node C. Which other nodes are allowed to send at the same time?

(iv) Node A sends to node B and node E sends to node F. Which other nodes are allowed to send at the same time?

![Figure 1](image)

3(a) Explain the following concepts in Tiny OS

(i) Commands

(ii) Tasks

(iii) Events

(b) How does the S-MAC protocol

(i) reduce the duty cycles of sensor nodes?

(ii) attempt to reduce collisions?

(iii) address the hidden-terminal problem?

Name at least three disadvantages of the S-MAC protocol

(c) The overall energy consumption of transceiver unit of a mote, to transmit a packet, is 87 \( \mu \text{J} \), which transmits data at a rate 1 Mbps up to a distance of 10 m in free space (line of sight path). Given

- Power consumption of circuitry = 1 mW
- Power consumption of remaining active circuitry = 12 mW
- Switching time (from sleep mode to active mode or transmit mode to receive mode) = 6 ms

Continued...
\( \gamma_{PA} \) (factor depends on antenna gain, wavelength and noise power density) = 10^6
Assume the efficiency of power amplifier is 100%
Determine the optimum packet length.

OR

(c') Show that in transceiver unit of a mote, the M-ary modulation is more energy efficient when the overhead of the modulation scheme and the start up power are small, whereas under startup power dominant conditions, the binary modulation scheme will be preferred.

4(a) The relationship between the transmitted and the received power of an RF signal follows the inverse-square law, that is, power density and distance have a quadratic relationship. This can be used to justify multi-hop communication (instead of single-hop), that is, energy can be preserved by transmitting packets over multiple hops at lower transmission power. Assume that a packet \( p \) must be sent from a sender \( A \) to a receiver \( B \). The energy necessary to directly transmit the packet can be expressed as the simplified formula \( E_{AB} = d(A, B)^2 + c \), where \( d(x, y) \) (or simply \( d \) in the remainder of this question) is the distance between two nodes \( x \) and \( y \) and \( c \) is a constant energy cost. Assume that you can turn this single-hop scenario into a multi-hop scenario by placing any number of equidistant relay nodes between \( A \) and \( B \).

(i) Derive a formula to compute the required energy as a function of \( d \) and \( n \), where \( n \) is the number of relay nodes (that is, \( n = 0 \) for the single-hop case).
(ii) What is the optimal number of relay nodes to send \( p \) with the minimum amount of energy required and how much energy is consumed in this optimal case for a distance \( d(A, B) = 10 \) and (i) \( c = 10 \) and (ii) \( c = 5 \)?

OR

(a') For the network topology shown in Figure-2, identify the optimal routes for source \( A \) to sink \( M \) according to the following criteria (describe how you compute the cost for the optimal route). The numbers X/Y along each link indicate the latency (X) and energy cost (Y) for transmitting a single packet over the link. The number Z under each node indicates the node’s remaining energy capacity.
(i) Minimum number of hops
(ii) Minimum energy consumed per packet
(iii) Maximum average energy capacity (eliminate hops that would result in a higher average but unnecessarily add to the route length)
(iv) Maximum minimum energy capacity
(v) Shortest latency

Using the topology in Figure-2, explain the problems of implosion, overlap, and resource blindness.

Figure - 2

(b) Three beacon stations A, B, and C send the information about their locations to a sensor node, N, (to be localized) as (-4, 4\sqrt{3}), (8, -4\sqrt{5}) and (10, 5\sqrt{5}) respectively. The sensor node N estimates the distance from itself to the beacon nodes based on the received signal strengths. The differences of the transmitted and received signal power at the sensor node from A, B and C are 36.1236 dB, 43.1672 and 47.0437 respectively. If the pathloss at reference distance (one meter away from transmitter) is negligible and pathloss exponent \( \eta \) is 4, determine the location of the sensor node N.