Q. 1 (a) Give the circuit of an **Exclusive-OR** gate in Transistor-Transistor Logic (TTL) family and explain its operation. 

Q. 1 (b) Briefly explain the meaning of the following terms:
- Schottky TTL
- AND-OR-Invert Gates
- Fan-Out
- Power-Delay Product

OR

Q. 1' (a) Give the circuit of an **Exclusive-NOR** gate in Emitter-Coupled Logic (ECL) family and explain its operation.

Q. 1' (b) Briefly explain the meaning of the following terms:
- Tristate TTL
- Open Collector Output
- Fan-In
- Noise Margin

Q. 2 (a) Design a digital logic circuit in **static CMOS** design style, utilizing minimum number of transistors, for obtaining the output Y where

\[ Y = (AB + C) \cdot (C + D) \]

The circuit must exhibit

\[ t_{PHL} = \frac{1}{2} t_{PHL,inv} \quad \text{and} \quad t_{PLH} = 2 t_{PLH,inv} \]

where \( t_{PHL,inv} \) and \( t_{PLH,inv} \) correspond to a static CMOS inverter, and \( t_{PHL,inv} = t_{PLH,inv} \)

Q. 2 (b) Highlight the advantages and limitations offered by Complementary Pass Transistor Logic (CPTL) design style in comparison with Static CMOS design.

OR

Q. 2' (a) A design engineer argues that the resistance \( R \) in the NMOS-R logic inverter (shown in Fig. 1) can be replaced by a current source \( i_b \) (as shown in Fig. 2) with the logic inversion capability still present. The voltage-current characteristic of the current source is shown in Fig. 3.
Will the circuit of Fig. 2 perform logic inversion? If YES, how? If NO, why?

i. Obtain $V_{\text{out}}$ vs. $V_{\text{in}}$ characteristics for the circuit of Fig. 2.

ii. Obtain $V_{\text{out}}$ vs. $V_{\text{in}}$ characteristics for the circuit of Fig. 2.

iii. What is the effect of the internal resistance of the current source on the transfer characteristics?

Q. 2' (b) Give the circuit of a clocked SR Flip-Flop in Static CMOS design and explain its operation.

Q. 3 (a) How can the FLOTOX transistor be employed to provide the feature of 'Electrical Erasability' in ROMs?

Q. 3 (b) Explain the operation of a 6-Transistor SRAM cell.

Q. 3 (c) Charge-Coupled Devices can be used as memory elements.

Is the above statement True or False? Justify your answer.

Q. 4 (a) Consider the Cyclic DAC shown in Fig. 4. ($V_{\text{ref}} = 1.2$ Volts)

i. Find the resolution.

ii. What will be the output voltage for the digital input $[d_5 \ d_4 \ d_3 \ d_2 \ d_1 \ d_0] = [101101]$?

iii. If the 'divide-by-2' circuit is erroneous and actually performs a 'divide-by-2.1' operation, what is the percentage error in the obtained analog voltage?

Q. 4 (b) Design a Charge-Scaling DAC for converting a 4-bit digital input to an equivalent analog voltage. The maximum allowable capacitor and resistor values are 10 pF and 10 kΩ respectively. What will be the output voltage for the digital input $[d_3 \ d_2 \ d_1 \ d_0] = [1101]$?

Q. 4 (c) Explain the working of a Dual Slope Integrated ADC.
B.TECH. AUTUMN (V SEMESTER) EXAMINATION
(ELECTRONICS ENGINEERING)
ACTIVE NETWORK SYNTHESIS

(EL – 312)
Credits: 04

Maximum Marks : 60
Duration : Three Hours

Note: Answer all questions. All parts of question must be answered together.

Q.1 Select the correct answer
(a) The nth order Chebyshev function is characterized by
(i) \( C_n(\Omega) = \cos(n \cos^{-1} \Omega) \quad |\Omega| \leq 1 \) (ii) \( C_n(\Omega) = \cosh(n \cosh^{-1} \Omega) \quad |\Omega| > 1 \)
(iii) \( C_n(\Omega) = \cosh(n \cosh^{-1} \Omega) \quad |\Omega| \geq 1 \) (iv) both (i) and (ii) (v) both (i) and (iii)
(b) For a second order band reject filter, at low frequencies and at high frequencies, the loss approaches i) infinite (ii) unity (iii) maximum (iv) minimum.
(c) Butterworth loss at passband edge frequency is (i) \( 10 \log_{10} (1 + \epsilon^2) \) (ii) \( 20 \log_{10} (1 + \epsilon^2) \) (iii) \( 10 \log_{10} (1 + \epsilon) \) (iv) \( 10 \log_{10} (1 + \epsilon^n) \)
(d) The Butterworth nth order approximation function is denormalized by replacing
(i) \( S \rightarrow s(\frac{\omega}{\omega_p})^{1/n} \) (ii) \( S \rightarrow e^{s^{1/n}} \) (iii) \( S \rightarrow s(\frac{\omega}{\omega_p})^{1/n} \) (iv) \( S \rightarrow s(\frac{\epsilon}{\omega_p})^{1/n} \)
(e) Chebyshev attenuation at high frequencies is (i) \( 10 \log_{10} \xi C_n(\Omega) \)
(ii) \( 20 \log_{10} \xi^2 C_n(\Omega) \) (iii) \( 20 \log_{10} \xi C_n(\Omega) \) (iv) \( 20 \log_{10} \xi (\frac{\omega}{\omega_p})^{1/n} \)
(f) Find the expression for dc gain and infinite frequency gain for the biquadratic transfer function.
(g) It is required to design a low pass filter having \( f_p = 1 \text{kHz} \), \( f_s = 1.5 \text{kHz} \), \( A_{\text{min}} = 1 \text{dB} \) and \( A_{\text{max}} = 50 \text{dB} \). Find the required order of Chebyshev filter.

Q.2 (a) Show that Chebyshev approximation provides more stopband attenuation than Butterworth approximation for the same order of functions.
(b) What do you mean by normalization and denormalization in the circuit design and what is its significance?
(c) Synthesize second order Sallen Key band pass filter with a centre frequency at 1000 rad/sec and a pole Q of 10.
Q.3 (a) Show the block diagram implementation of the following transfer function

\[ \frac{V_{HP}}{V_i} = \frac{Ks^2}{s^2 + s\left(\frac{\omega_c}{Q}\right) + \omega_c^2} \]

Then realize the block diagram to obtain the KHN biquad.

(b) Design the KHN biquad obtained in part (a) to realize a band pass filter with a centre frequency of 1 kHz and a 3db band width of 50Hz, use 10nF capacitor. What will be the value of centre frequency gain obtained? Draw the resulting circuit.

OR

Q.3' (a) Sketch the Antoniou GIC and determine its input impedance. Also show that GIC can realize ideal grounded FDNR and ideal grounded inductor. Use the realized inductor to implement active RC low pass filter.

(b) Design the Antoniou GIC based low pass notch filter with \(f_0 = 4\text{kHz}, f_n = 5\text{kHz}\) \(Q = 10\) and a dc gain of unity. (Select \(C_4 = 10\text{nF}\)). Also draw the resulting low pass notch filter circuit.

Q.4 (a) Convert an opamp RC Sallen Key low pass filter circuit into \(g_m-C\) filter using OTAs and Capacitors and find the transfer function of \(g_m-C\) Sallen Key low pass filter.

(b) Convert the OTA-RC circuit of Fig.1 into \(g_m-C\) circuit. Also find the function realized.

(c) Realize the voltage follower and current follower circuit using a CCCII.

OR

Q.4' (a) What is the desirable input and output impedance for cascading of current mode filters?

(b) What are the characteristics of CCCII? Also explain the nonidealities associated with CCCII using its circuit diagram.

(c) Realize CCCII based CM and VM ideal grounded integrator. Also give the realization of grounded and floating resistor using only CCCII.
Maximum Marks: 60

Answer all questions.

1.(a) Draw and explain diagram of a microprocessor based computer system showing the address, data and control bus structure. 06

OR

(a') Draw a logic schematic to generate control signals (1) MEMR (2) MEMW (3) IOR and (4) IOW. Also explain the functions of these control signals. 06

(b) Differentiate between CA, LL, JUMP and RST instructions. 04

(c) Write an assembly language program to multiply two 8-bit numbers using shift and add method. Store result at memory location 2100H 05

2.(a) Discuss the actions taken by 8085 when INTR pin is activated. 05

(b) Describe RIM and SIM instructions. 05

(c) Differentiate between Interrupt driven data transfer and direct memory access. 05

OR

(c') Give the difference between the master code and slave mode working of DMA controller (8257). 05

3.(a) Draw a memory address decoder circuit using 3 to 8 decoder (74LS138) for a 2K RAM starting from B000H. 06

(b) Define synchronous and asynchronous serial transmission. 03

(c) Draw the pin diagram of 8251A USART and explain all the pins. 06

OR

(c') Explain the various modes of operation of 8255 PPI. 06

4.(a) Explain Flag Register of 8086. 04

(b) Why even address is preferred in case of 8086? 04

(c) Explain the physical address generation in 8086. 07

OR

(c') Explain the various important points for microprocessor based system. 07
B Tech Autumn (V Semester) Examination  
(Electronics)  
Course No. EL-341  
PRINCIPLES OF COMMUNICATION ENGINEERING  
Credit – 4  

Maximum Marks: 60  
Duration: Three Hours  

Notes:  
1. Answer all questions.  
2. Any missing information can suitably be assumed.  

I (a) What is the need of modulation in a communication system? 
(b) Discuss the effects of small frequency error in the local oscillator on synchronous SSBSC demodulation. 
(c) Consider a real bandpass signal \( s(t) \) whose Fourier transform for positive frequencies is given by  
   \[ \mathcal{F}\{S(f)\} = \begin{cases} 20 \leq f \leq 22 & (\sqrt{2}) \\ 0 & 0 \leq f \leq 20 \text{ and } 22 < f < \infty \end{cases} \]  
   \[ \mathcal{F}\{S(f)\} = \begin{cases} (1-|f-22|)/\sqrt{2} & 21 \leq f \leq 23 \\ 0 & 0 \leq f < 21 \text{ and } 23 < f < \infty \end{cases} \]  

(i) Sketch the real and imaginary parts of \( S(f) \) for both positive and negative frequencies. 
(ii) Specify the time domain waveform that you get when you pass \( \sqrt{2}s(t)\cos 40\pi t \) through a low pass filter.  

OR  

I' (a) Express the spectrum \( Y(f) \) of \( y(t) = x(t)\cos 2\pi f_c t + \ddot{x}(t) \sin 2\pi f_m t \) in terms of the spectrum \( X(f) \) of \( x(t) \), where \( X(f) \) is lowpass with bandwidth \( W < f_c \). 
(b) With the help of block diagram discuss the principle of FM stereophonic broadcasting. 
(c) An angle modulated signal has the form, \( s(t) = 100\cos(2\pi f_c t + 4\sin 2\pi f_m t) \), where \( f_c = 10 \text{ MHz} \) and \( f_m = 1000 \text{ Hz} \). 
   (i) Determine the modulation index and the transmitted signal bandwidth if \( s(t) \) is (a) FM, (b) PM. 
   (ii) Repeat (i) if \( f_m \) is doubled.  

2 (a) If \( m(t) \) is bandlimited, that is \( M(f) = 0 \) for \( |f| > W \), show that  
   \[ \int_{-\infty}^{\infty} [m(t)]^2 dt = \frac{1}{2W} \sum_{n=-\infty}^{\infty} \left[ m(n/2W) \right]^2 \]  

... 2
(b) The input to a delta modulator is $m(t) - 0.01t$. The delta modulator operates at a sampling frequency of 20 Hz and has a step size of 2 mV. Sketch the staircase approximation of $m(t)$ as well as the delta modulator output.

OR

(b') Given the binary sequence 110101001, draw the transmitted signal waveform for

(i) Polar NRZ format
(ii) Bipolar RZ format
(iii) Manchester format

(c) The American Standard Code for Information Interchange (ASCII) has 128 characters, which are binary-coded. If a certain computer generates 100000 characters per second, determine the following:

(i) The number of bits required per character.
(ii) The number of bits per second required to transmit the computer output, and the minimum bandwidth required to transmit the signal.
(iii) For single error detection capability, an additional bit is added to the code of each character. Redo (i) and (ii).

3 (a) Represent the narrow band noise in terms of its quadrature components and also illustrate their properties.

(b) Show that the envelope and the phase of (narrowband) filtered, zero mean, white Gaussian noise are statistically independent.

(c) In commercial FM broadcasting, modulating signal bandwidth = 15 kHz, 3 dB frequency ($f_0$) of the de-emphasis filter = 2100 Hz and the deviation ratio = 5. Assuming that the average to peak power ratio of the message signal = 0.5, find the improvement in output signal to noise ratio of FM with pre-emphasis and de-emphasis filtering corresponding to a baseband system.

(c') Let a message signal $m(t)$ be transmitted using SSB modulation. The power spectral density of $m(t)$ is,

$$S_M(f) = \begin{cases} \frac{\alpha |f|}{W} & |f| \leq W \\ 0 & \text{otherwise} \end{cases}$$

Where $\alpha$ and $W$ are constants. White Gaussian noise of zero mean and power spectral density of $N_0/2$ is added to the SSB signal at the receiver input. Find an expression for the output signal to noise ratio of the receiver.

4 (a) Discuss the Nyquist criterion for distortion-less baseband binary transmission.

(b) In a certain binary communication system that uses Nyquist’s criterion pulse, a received pulse $p(t)$ has the following sample values

$$p(nT_b) = \begin{cases} -0.07 & n = -2 \\ 0.3 & n = -1 \\ 1 & n = 0 \\ -0.02 & n = 2 \\ 0 & \text{elsewhere} \end{cases}$$

(i) Determine the tap coefficients of a three tap zero forcing equalizer.
(ii) Will it remove the total ISI? If not, find the residual ISI.
1 a) Calculate the $S_{11}$ and $S_{12}$ parameters for the circuit shown in Fig. 1.

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\[ S_{11} = \text{Complex value} \]
\[ S_{12} = \text{Complex value} \]
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1b) The TE$_{1,0}$ mode is described as the dominant mode in rectangular waveguide. What property does it have which makes it dominant? Plot the electric field distribution in a rectangular waveguide carrying this mode.

1 c) Define the following terms in context of directional couplers:
   i) Coupling factor
   ii) Isolation factor

The input power in a two-slot directional coupler is 10mW. The coupler has a coupling factor of 20 dB and a directivity of 40 dB. Calculate the power at the various ports.

2 a) How does the function of the magnetic field in a TWT differ from its function in a magnetron? What is the fundamental difference between the electron beam and rf field interaction in the two devices?

2 b) Briefly explain the following terms:
   i) Strapping
   ii) Reentrant Cavity
2 c) Derive an expression for efficiency (η) for klystron amplifier having two-cavities. Briefly explain how it can be maximized.

**OR**

2a') Briefly explain how oscillations are sustained in the cavity magnetron, with suitable sketches, assuming the π-mode oscillation already exist. Make it clear why more energy is given to the rf field than taken from it.

2b') Why is the transit time important for reflex klystron? A reflex klystron has following parameters:
- DC voltage $V_0=500V$;
- repeller space $L=1mm$;
- load resistance $R_{sh}=15\Omega$;
- $e/m$ ratio $=1.759\times10^{19}$ (MKS system);
- oscillation frequency $f_r=9$GHz.
Find the value of the repellar voltage $V_r$ and the efficiency. Assume 1¾ mode of operation.

2c') Why do practical klystron amplifiers generally have more than two cavities? How can broad band operation be achieved in multi-cavity klystrons?

3 a) What are the applications of micro-strip and strip-line circuits? Explain which is the more convenient to use in MICs.

3 b) Sketch and briefly explain the three-valley model of a Gunn Diode. What are some of the performance figures of which Gunn diodes are capable?

3 c) What is a PIN diode? Sketch its equivalent circuit model at microwave frequencies in both reverse bias and forward bias conditions.

**OR**

3a') Using tunnel diode model shown in Fig. 2, derive an expression for power gain. Discuss the effect of $C_J$ on its power gain performance.

![Fig. 2.](image)
3b') Give **short answer** to the followings:

i) Why parametric devices are excellent in noise?

ii) Why Gunn diode amplifier is called traveling domain amplifier (TDA)?

3c') Briefly describe the basic operation of IMPATT diode, using suitable sketch. Why IMPATT device is faster than TRAPATT?

4a) What functions does an antenna fulfill? What does the principle of reciprocity say about the properties of antenna?

4b) What do you mean by half-power beam-width? An antenna has a field pattern $E(\theta)$ is given as:

$$E(\theta) = \cos \theta \times \cos 2\theta \quad \text{for} \quad 0^\circ \leq \theta \leq 90^\circ$$

Determine the half-power beam width.

4c) Give **short answer** to the followings:

i) Why is the maximum radiation from a half-wave dipole in a direction at right angles to the antenna?

ii) For what reasons are high-frequency antennas likely to differ from antennas used at low frequencies.
Maximum Marks: 60

Answer ALL the questions. Notations used have their usual meaning.

1(a) Explain the difference between orientational, electronic and ionic polarizations in brief. [05]

(b) Define static dielectric constant and obtain the relation \( P = \varepsilon_0(\varepsilon_r-1)E \). [05]

(c) What is piezoelectricity? Give two examples of piezoelectric materials. Draw hysteresis curve for ferroelectric material and discuss it briefly. [05]

OR

(c'') The electronic polarizability of the Ar atom is \( 1.8 \times 10^{-39} \) F.m\(^2\). What is the static dielectric constant of Ar gas at 1 atmospheric pressure at room temperature (300K)? [05]

[Given: \( k_B = 1.38 \times 10^{-23} \) J/K and \( \varepsilon_0 = 8.854 \times 10^{-12} \) F/m]

2(a) What is dipolar relaxation? Obtain the relation for orientational polarization in alternating fields. [07]

(b) Explain the diffusion process in semiconductors and find a relation for diffusion current per unit area for \( n \) and \( p \) type semiconductors. [05]

(c) An intrinsic Si sample is doped with donors from one side such that \( N_d = N_c \exp(-ax) \). [03]

(i) Find an expression for \( E(x) \) at equilibrium over the range for which \( N_d >> n_i \).

(ii) Evaluate \( E(x) \) when \( a = 4 \) (\( \mu \)m)\(^{-1} \).

3(a) How ferromagnetism is explained on the basis of exchange interaction? Give a brief account of Weiss theory of ferromagnetism. [07]

(b) The magnetic field in a diamagnetic material is \( 1000 \) Am\(^{-1} \). Calculate the magnetization and flux density of the material if its susceptibility is \(-0.4 \times 10^{-5}\). [04]

(c) Distinguish between hard and soft magnetic materials. Give two examples for each. [04]

Continued....2
4(a) Derive the London’s equations and explain the term coherence length.

(b) A d.c. voltage of $1 \mu V$ is applied across a Josephson junction. Calculate the frequency of the Josephson current generated. [Given: $h = 6.63 \times 10^{-34}$ J.s]

(c) Discuss briefly the potential applications of superconductors.

OR

4(a') Explain d.c. Josephson effect. Show that the super current of superconducting pairs across the junction depends on the phase difference.

(b') A superconductor sample has a critical temperature of 3.722 K in zero magnetic field of 0.0305 T at 0 K. Evaluate the critical field at 2 K.

(c') Discuss the thermodynamics of superconducting transition in detail.