Ref. No.: Ex/PG/IEE/T/129B/2024

M. Tech Ins. & Elec. Engineering 1st Year 2nd Semester Examination 2024

Electronic System Design

Time: 3 hours **Full Marks: 100**

Attempt any five questions from the following

1. Derive the expression for the output voltage of an RC high-pass filter due to a square wave input signal. Draw the output waveform vis-à-vis the input waveform. Hence, calculate the value of rise time and time constant of the circuit. How can the speed of such circuit be calculated?

8+4+4+4

2. How is triangular waveform generated from a rectangular pulse waveform? Synthesize one such circuit for this action and clearly state any assumption in the design. What would be the responses of a low-pass filter due to a ramp input for small and comparable time constant respectively? Derive necessary equations for your justification. How can you generate a sinusoidal signal of variable frequency from a rectangular signal?

8+8+4

3. Show that an FIR filter with perfect symmetric or anti-symmetric impulse response exhibits linear phase characteristics. Make a comparative study between different types of FIR filter in terms of observable frequency response characteristics. Show that the magnitude of frequency response for a real signal is symmetrical about the frequency.

10+6+4

4. Design a length 5-FIR band-pass filter with an anti-symmetric impulse response, satisfying the following magnitude response values: $|H(e^{j\pi/4})| = 0.5$ *and* $|H(e^{j\pi/2})| = 1$. Determine the exact expression for the frequency response of the filter designed and plot its magnitude and phase response using graph paper.

10+10

5. What are the limitations of RTL family? How can these be overcome by DCTL? Design one NOR gate using RTL and explain its principle of operation. Draw and explain a CMOS circuit which outputs $f = (\overline{A+B}).C + \overline{D}.E$ for the Boolean inputs A, B, C, D and E.

2+2+8+8

[Turn over

6. How can a negative resistance converter be implemented using an op-amp? Design a voltage to current converter circuit which involves the use of a negative resistance converter. Draw and explain the operation of an instrumentation amplifier.

5+5+10

----------X----------