Code No: R22021 **R10** SET - 1

II B. Tech II Semester, Supplementary Examinations, Dec – 2012
PULSE AND DIGITAL CIRCUITS
(Com. to EEE, ECE, ECC, BME, EIE)

Time: 3 hours Max Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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1. a) Explain the operation of RC high-pass circuit when exponential input is applied.
   b) Verify $V_2 = \left(\frac{V}{2}\right)\frac{\left(e^{2x}-1\right)}{\left(e^{2x}+1\right)} = \frac{V}{2}\tanh x$ for a symmetrical square wave applied to a RC low – pass circuit.

2. a) Draw the circuit diagram of emitter coupled clipper. Draw its transfer characteristics indicating all intercepts, slopes and voltage levels and derive the necessary equations.
   b) Give the circuits of different types of shunt clippers and explain their operation with the help of their transfer characteristics.

3. a) Define i) Rise time ii) Fall time iii) Delay time iv) Storage time
   Explain the factors which contribute to the delay time of transistor.
   b) Draw and explain the circuit diagram of integrated positive RTL NOR gate.

4. a) Draw the circuit and explain the operation of Schmitt Trigger with the help of transfer characteristics. Define UTP & LTP and also explain how the hysteresis can be eliminated.
   b) Design of self-bias bistable multivibrator using silicon n-p-n transistors whose junction voltages are $V_{CE(sat)} = 0.3$ V, $V_{BE\,(sat)} = 0.7$ V, $V_{BE(cut\text{-}off)} = 0$ V and $h_{FE\,(min)} = 50$, $V_{CC} = -V_{BB} = 9$V, $I_C = 4$ mA.

5. a) With the help of a neat circuit diagram, explain the working of an emitter coupled monostable multivibrator. Derive an expression for the gate width of monostable multivibrator.
   b) Design an astable multivibrator to generate a square wave of 2 kHz frequency with a duty cycle of 35%.

6. a) Explain the basic principle of a boostrap sweep generator. Draw the circuit and explain its operation. Derive the expression for its slope error.
   b) Find i) the sweep amplitude and ii) the slope error for the bootstrap sweep generator when a 2 kHz symmetrical square wave is applied as an input to it.
   The typical *h*-parameter values of transistors are $h_{fe} = 90$, $1/h_{oe} = 35\text{k}\Omega$, $h_{ie} = 1\text{k}\Omega$ and $h_{rc} = 1$. Assume all forward-biased junction voltages are zero.

7. a) What is synchronization? Why it is necessary in waveform generators? Explain the synchronization of a sweep circuit with symmetrical signals.
   b) What is phase jitter? Explain the method to eliminate it.

8. a) Describe the operation of a triggered transistor blocking oscillator with emitter timing with the help of circuit diagram & necessary waveforms. Obtain the expression for the pulse width t_p.
   b) Draw the circuit of a bidirectional sampling gate and derive the expression for its gain. Obtain the values of $V_{C(min)}$ and $V_{n\,(min)}$.
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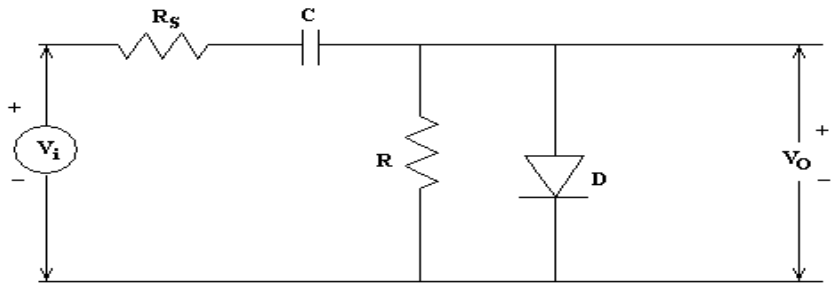
1. a) Prove that a low pass circuit acts as an integrator. Derive an expression for the output voltage levels under steady state conditions of a low pass circuit excited by a ramp input.
   b) What is an attenuator? How can an uncompensated attenuator be modified as a compensated attenuator. Give the comparison between perfect compensation, under compensation and over compensation.

2. a) Draw the circuit diagram and explain the working of transistor clippers
   b) In the circuit shown below, $R_s = R_f = 100\Omega, R_r = \infty, R = 10K\Omega, C = 1\mu f, V_r = 0$.
   A symmetrical square wave signal of amplitude 20V and frequency 5 KHz is applied at t = 0. Draw the output waveform



3. a) Explain with the help of suitable waveforms the switching times of a diode switch. Derive the expression for reverse recovery time.
   b) Draw the circuit of CMOS NOR gate and explain its operation. Mention the advantages of CMOS over the other digital logic families.

4. a) Define the transition time, resolving time and settling time of a bistable multivibrator.
   b) Draw the circuit and explain the operation of self bias bisable multivibrator. List the advantages of this circuit over a fixed-bias bistable multivibrator. Design a bistable multivibrator to meet the following specifications, $V_{CC} = -V_{BB} = 12V$, $I_C(sat) = 6mA$, $h_{FE}(min) = 25$. Maximum trigger frequency = 25KHz.
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5. a) Draw and explain the working of a collector-coupled Astable multivibrator. Derive the expression for frequency of oscillation.
   b) Calculate the component values of a monostable multivibrator developing an output pulse of 500μs duration. Assume h_{FE} (min)=25, I_{CE} (sat) =5mA, V_{CC}=10V,and V_{BB} = -4V.

6. a) Define the terms slope error, displacement error and transmission error.
   b) Draw the circuit diagram of transistor current sweep generator and explain its working.
   c) Explain the technique used to improve the linearity of current sweeps.

7. a) With the help of a neat circuit diagram and waveforms, explain the method to achieve frequency synchronization using pulse train as sync signals.
   b) Draw and explain the waveforms of a frequency division by an astable multivibrator.

8. a) Draw the circuit of an astable blocking oscillator with a diode control and explain its operation. Plot the waveforms. Derive the expression for its frequency.
   b) With the help of a neat diagram, explain the working of a two-diode sampling gate. Derive expression for i) Gain , ii) $(V_c)_{min}$, and iii) $(V_n)_{min}$.

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1. a) Derive an expression for the output of low pass circuit excited by a step input.
   b) An RC low-pass filter is fed with a symmetrical square wave. The peak-to-peak amplitude of the input waveform is 10 V and its average value is zero. It is given that RC=*T/2* where *T* is the period of the square wave. Determine the peak-to-peak amplitude of the output wave form.

2. a) Explain the working of a two-level diode clipper with the help of circuit diagram, waveform and transfer characteristics.
   b) Draw the basic circuit diagram of negative peak clamper circuit and explain its operation.

3. a) Briefly discuss the influence of breakdown voltages on the choice of supply voltage in a transistor switch.
   b) Explain the characteristics and implementation of the following digital logic family
   i) CMOS, ii) ECL

4. a) With the help of a suitable circuit diagram, explain the methods of symmetric and un symmetric triggering of a bisable multivibrator.
   b) The self-biased flip-flop uses germanium transistors with V_{CE} (sat) = 0.2 V, V_{BE} (sat) =0.6 V and h_{FE}(min) = 20, V_{CC} =10 V, R_C =1 kΩ, R_1 = 5kΩ, R_2 = 10 kΩ and R_E =500 Ω Find
   i) The stable state voltages and currents ii) the maximum value of I_{CBO} required.

5. a) Explain the operation of a collector-coupled monostable multivibrator with the help of a neat circuit diagram and waveform. Derive an expression for the gate width.
   b) A collector –coupled monostable multivibrator using n-p-n silicon transistors has the following parameters. V_{CC} = 12 V, V_{BB} = 4 V, R_C = 1 kΩ, R_1 = R_2 = R = 15 kΩ, h_{FE} = 35, r'_{bb} = 220 Ω and C = 1000 pF. Neglect I_{CBO}. i) Show that in the stable state one transistor is ON and the other is OFF. ii) Find the width of the output pulse.

6. a) Describe the working principle of a practical transistor Miller sweep voltage waveform generator with the help of its circuit and its practical requirements.
   b) Obtain an expression for slope error in a current sweep circuit employing a practical yoke. Simplify this expression. Also derive an expression for sweep-speed mathematically.

7. a) What is meant by synchronization with frequency division? Explain, with suitable waveforms, the procedure to obtain 3:1 and 5:1 synchronization.
   b) Explain the terms i) Phase delay ii) Phase jitters

8. Write short notes on the following.
   a) Astable blocking oscillators
   b) Four diode sampling gates
   c) Effect of control voltage on bidirectional sampling gates.
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Time: 3 hours Max Marks: 75

Answer any **FIVE** Questions
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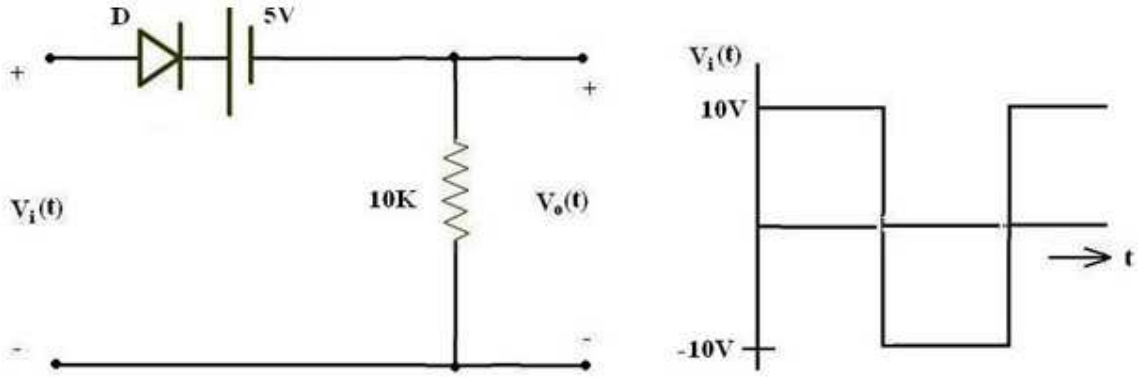
1. a) Draw the output waveform of an RC high-pass circuit with a square wave input under different time constants. Explain the same.
   b) Explain RLC ringing circuit with a neat sketch

2. a) State and prove clamping circuit theorem.
   b) Determine the output waveform for the biased clipping circuit for the square wave input.



3. a) Describe how a transistor functions as a switch in the CE configuration in ON state and in OFF state. How does the temperature affect the saturation junction voltages of a transistor?
   b) Classify the basic families that belong to the bipolar families and to the MOS families. What is the major difference between TTL and ECL? Why does the propagation delay occur in logic circuits?

4. a) Design a fixed-bias bistable multivibrator with supply voltages ±12V, an *n-p-n* silicon device having $V_{CE\,(sat)} = 0.2$ V, $V_{BE\,(sat)} = V$ = o.7 V and $h_{FE\,(min)} = 50$ are used. Assume $I_C =$ 5 mA.
   b) What is necessity of triggering ? Explain about symmetrical and unsymmetrical triggering.
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5. a) Draw the circuit diagram and explain the working of an astable multivibrator with the necessary waveforms.

   b) Design a one shot circuit to produce a pulse width of 5 msec. Assume h_{FE} =30, $V_{CE(sat)}$=0.3V, $V_{BE(sat)}$=0.7V, I_C=5 mA, V_{CC}=6V,V_{BB}=1.5V,Q1 ON and Q2 OFF

6. a) Derive the relation between the slope, transmission and displacement errors.

   b) Explain the basic principles of Miller and Bootstrap time-base generators Compare Miller and Bootstrap time-base generators.

7 a) Mention the principle involved in the synchronization of voltage sweep waveform with a sinusoidal synchronization signal with neat waveforms.

   b) Describe frequency division employing a transistor astable multivibrator

8. Explain the operation of,

   i) Monostable transistor blocking oscillator (base timing) with a circuit diagram and waveforms. Derive an expression for pulse width.

   ii) Four diode sampling gate and discuss its properties.