B.TECH / EE /3RD SEM/ ELEC 2101/2017
ANALOG AND DIGITAL ELECTRONIC CIRCUITS
(ELEC 2101)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) The binary code of $(13.625)_{10}$ is
(a) 1101.101 (b) 1111.111 (c) 1101.011 (d) 1011.101 .

(ii) The slew rate of an Op amp should be
(a) zero (b) as small as possible
(c) unity (d) as large as possible.

(iii) The 1's complement representation of $(-15)_{10}$ is
(a) 1111 (b) 0000 (c) 0001 (d) 0011.

(iv) A zero crossing detector circuit generates
(a) triangular waveform (b) sinusoidal waveform
(c) sawtooth waveform (d) square waveform.

(v) The total output offset voltage with feedback v_{of} for a voltage series feedback amplifier is given by
(a) $v_{of} = \pm\frac{A}{1+A\beta}V_{sat}$ (b) $v_{of} = \frac{A}{1+A\beta}V_{sat}$
(c) $v_{of} = \pm\frac{1}{1+A\beta}V_{sat}$ (d) $v_{of} = \pm\frac{\beta}{1+A\beta}V_{sat}$

(vi) The gray code of $(12)_{10}$ is
(a) 0101 (b) 1100 (c) 0011 (d) 1010.

(vii) The binary equivalent number of $(D5.A2)_{16}$ is
(a) 11100011.10100010 (b) 11010101.10100010
(c) 11010101.10110011 (d) 01011101.00101010.

(viii) The two input terminals of an ideal Op amp are at the same potential because
(a) the two input terminals are directly shorted to ground
(b) the input impedance of the Op amp is infinity
(c) the output impedance of the Op amp is zero
(d) the open loop gain of the Op amp is infinity.

(ix) The fundamental frequency of a crystal oscillator is
(a) directly proportional to the thickness of the crystal
(b) inversely proportional to the thickness of the crystal
(c) independent of the thickness of the crystal
(d) proportional to the temperature of the crystal.

(x) The sum term M11 is represented by
(a) $(A + \overline{B} + C + D)$ (b) $(A + \overline{B} + \overline{C} + D)$
(c) $(A + B + \overline{C} + \overline{D})$ (d) $(\overline{A} + B + \overline{C} + \overline{D})$.

Group - B

2. (a) Realise the following linear differential equation using minimum number of Op-amps:

$$\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 2y = 3$$

(b) Show that the differential gain of a dual input balanced output differential amplifier using BJT is given by

$$|A_d| = g_m * R_c$$

where A_d is the differential gain, g_m is the transconductance and R_c is the collector resistance

(c) Design a non – inverting adder circuit to obtain an output voltage V_o given by

$$V_o = 2V_1 + 3V_2$$

where V_1 and V_2 are the input voltages.

4 + 6 + 2 = 12

3. (a) How does the CMRR of a differential amplifier improve by using a constant current source? Explain with the help of a neat diagram.

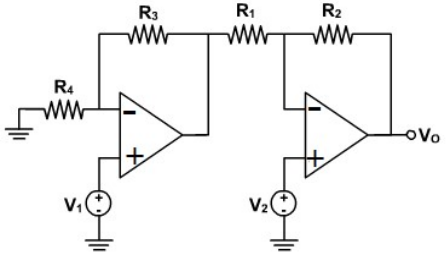
(b) Show that the output resistance with feedback R_{of} for a voltage series feedback amplifier is given by

$$R_{of} = \frac{R_o}{(1 + A\beta)}$$

where R_o is the output resistance without feedback, A is the open loop gain of the Op amp and β is the gain of the feedback circuit.

(c) Show that the output voltage V_o of the circuit as shown below is given by:

$$V_o = \left(1 + \frac{R_2}{R_1}\right)\left(V_2 - \frac{1 + \frac{R_3}{R_4}}{1 + \frac{R_1}{R_2}}V_1\right)$$



4 + 4 + 4 = 12

Group - C

4. (a) Draw a neat circuit diagram of a monostable multivibrator using 555 timer. Explain its principle of operation. Derive the expression of the time period for the metastable state.

(b) Design an astable multivibrator circuit using Op amp so that the oscillation frequency is 1kHz.

(1 + 5 + 3) + 3 = 12

5. (a) Draw a neat circuit diagram of a Wien bridge oscillator using Op amp. Derive the expression for oscillation frequency.

(b) Draw a neat diagram of a Schmitt trigger circuit. Explain its principle of operation. Draw the transfer characteristic for a 10V p-p square wave input.

(2 + 4) + (2 + 3 + 1) = 12

Group – D

6. (a) Design a 2 line to 4 line decoder.

(b) Design a single bit comparator, which can compare A=B, A>B and A<B.

(c) Prove that NOR gate is a universal gate.

4 + 4 + 4 = 12

7. (a) Show that $AB + A\bar{C} + BC = BC + A\bar{C}$

(b) Simplify the Boolean function $Y(A, B, C, D) = \sum m(1,3,5,7,8,9,12,13)$ using Karnaugh map

(c) Realize the function $Y(A, B, C) = \sum(1,3,5,6)$ using 4×1 multiplexer.

4 + 4 + 4 = 12

Group – E

8. (a) Design a J-K flip-flop using basic S-R flip-flop. Tabulate present state and next state table of the J-K flip-flop.

(b) What is meant by race-around condition of a J-K flip-flop? What are the ways to minimize this condition?

(c) Realize a 4 bit ring counter using flip-flops and show its truth table.

(2 + 2) + (2 + 2) + 4 = 12

9. (a) Draw the circuit diagram for an R - 2R ladder DAC. Explain its operating principle in detail.

(b) Explain the working principle of a dual slope ADC with the help of a neat circuit diagram.

(2 + 4) + 6 = 12