B.TECH/EE/3RD SEM/ELEC 2101/2016

ANALOG & 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 other name of voltage follower is
(a) inverting amplifier (b) differential amplifier
(c) non-inverting amplifier (d) unity gain amplifier.

(ii) An integrator is mostly preferred to a differentiator because of
(a) more stability (b) less noise
(c) less voltage drift (d) all of the above.

(iii) The gain (A_v) of inverting Op-amp in a phase shift oscillator is
(a) $A_v \geq -30$ (b) $A_v \geq -29$ (c) $A_v \geq -31$ (d) $A_v \geq 1$.

(iv) The comparator using Op-amp with input sine waveform produces
(a) cosine waveform (b) sine waveform
(c) triangular waveform (d) square waveform.

(v) The reason for an Op-amp to drive any number of devices connected to its output is
(a) zero output resistance (b) infinite output resistance
(c) infinite input resistance (d) none of these.

(vi) The binary code of $(21.125)_{10}$ is
(a) 10101.001 (b) 10111.011
(c) 11000.001 (d) 10111.101.

(vii) Determine the values of A, B, C, and D such that the sum of the term $A + B^C + C^C + D$ is equal to zero.
(a) A=1, B=1, C=1, D=1 (b) A=1, B=0, C=1, D=0
(c) A=0, B=1, C=1, D=0 (d) A=0, B=0, C=0, D=0.

(viii) NAND gate is called a universal gate because they
(a) have lower fabrication area
(b) can be used to make any gate
(c) consumes least electronic power
(d) none of these.

(ix) Which gate can be used to add two bits?
(a) Ex-OR (b) Ex-NOR (c) NAND (d) NOR.

(x) The hexadecimal equivalent of 1100101000110101_2 is
(a) 121035 (b) CA35 (c) 53AC (d) 530121.

Group – B

2. (a) Explain the function and purpose of the constant current source in the circuit of a differential amplifier using BJT.

(b) Realise the following linear differential equation using Op-amp:

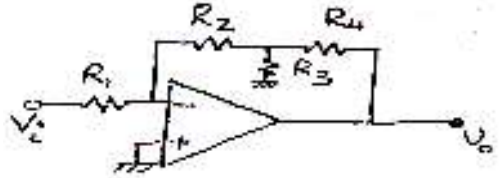
$$\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + y = 5$$

(c) A differential amplifier has two inputs: V_1 = 10mV connected to pin 3 and V_2 = 9mV connected to pin 2 of IC 741 Op-amp. It has a differential mode gain of 60dB and CMRR = 80dB. Determine the output voltage and the percentage error in output voltage.

3 + 5 + 4 = 12

3. (a) Draw the circuit diagram of integrator using Op-amp. Deduce the expression for output voltage. Mention the problems in the circuit and how do we modify the circuit to overcome them?

(b) Determine the voltage gain of the following amplifier:



(c) A non-inverting amplifier using Op-amp has input resistance 1kΩ and feedback resistance 10kΩ. Determine the closed loop gain, input resistance with feedback, output resistance with feedback, total output offset voltage with feedback. Given A = 2,00,000, R_i = 2MΩ, R_o = 75Ω, V_{CC} = 12V, $-V_{EE}$ = -12V.

4 + 4 + 4 = 12

Group – C

4. (a) Show how the trigger and threshold pins of IC 555 timer works?

   (b) Explain with the help of a neat circuit diagram the principle of operation of an astable multivibrator using Op-amp. Sketch the output voltage and the capacitor voltage waveforms. Derive the expression of time period.

2 + 10 = 12

5. (a) Using schematics briefly describe the working principle of a phase – shift oscillator. Derive the expression of oscillation frequency and gain required for sustained oscillation.

   (b) Using 7805C voltage regulator design a current source that will deliver 0.5A current to 100Ω, 10W load.

10 + 2 = 12

Group – D

6. (a) Subtract using 10's complement for the following : (25 - 5), (32 - 19).

   (b) Subtract using 1's complement: $(10010_2 - 01001_2)$, $(1101_2 - 1010_2)$.

   (c) What are the special characteristics of Gray code? Why is it used in K-map reduction technique?

   (d) Realise AND gate function using NOR gates only.

   (e) Convert the following binary to Gray code: 1001_2, 10010_2.

2 + 2 + 3 + 3 + 2 = 12

7. (a) $f(A,B,C,D) = \sum m(1,2,6,7,8,10,12,13,15)$
   Find out the minimal SOP form and POS form of the function.

   (b) Draw the functional diagram of a 4X1 multiplexer.

   (c) Realise the function $f(A,B,C) = \sum m(0,2,3,5,7)$ using 2X1 multiplexer.

   (d) Design a 4-line to 2-line priority encoder. Include an output E to indicate that atleast one input is 1.

(2 + 2) + 2 + 3 + 3 = 12

Group – E

8. (a) Tabulate the next- state of JK flip flop for different input conditions.

   (b) Find out the characteristic equation for JK flip flop.

   (c) How do you realise T flip flop using JK flip flop.

   (d) Realise a 3-bit synchronous binary counter using flip flop and show the logic diagram.

   (e) Why do we prefer synchronous counter to asynchronous counter?

2 + 2 + 2 + 5 + 1 = 12

9. (a) Draw the circuit diagram for R-2R ladder DAC. Explain its principle of operation.

   (b) Write short notes on the following:
   EPROM, ECL

5 + (3 + 4) = 12