(b) Explain in detail how can you construct a 16:1 MUX using 8:1 MUX and external gate.

(c) Design a combinational circuit that converts a four bit binary number to a four bit Gray code number. Implement the circuit using suitable logic gates.

2 + 5 + 5 = 12

Group – E

8. (a) What is the difference between a latch and an edge triggered flip-flop?

(b) Draw the circuit diagram of a clocked S-R flip-flop using NAND gates and explain its principle of operation.

(c) Design a T flip flop using S-R flip-flop.

2 + 5 + 5 = 12

9. (a) What is the difference between an asynchronous and a synchronous counter?

(b) Design a Mod-8 asynchronous up counter using J-K flip flop and explain its working principle. Draw the timing diagram.

(c) Design a 4 bit shift register using D flip flop and explain its operation for right shift mode.

2 + 5 + 5 = 12

ANALOG & DIGITAL ELECTRONICS
(ELEC 2102)

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 output of a differentiator circuit with square wave input is
(a) triangular wave   (b) impulse
(c) parabola   (d) step.

(ii) Schmitt trigger is also known as
(a) squaring circuit   (b) blocking oscillator
(c) sweep circuit   (d) astable multivibrator.

(iii) Let us consider an op-amp having a slew rate of 6 V/ μS. The undistorted peak-peak output voltage for an input sine wave of 2 MHz frequency is
(a) 1.5 V   (b) 0.95 V
(c) 0.47 V   (d) 3 V.

(iv) Which of the following oscillators uses one inductor and two capacitors in the feedback circuit?
(a) Hartley oscillator   (b) Colpitts oscillator
(c) Wien bridge oscillator   (d) Phase shift oscillator.

(v) The loop gain of an oscillator should be
(a) zero   (b) unity
(c) 29   (d) 3.

(vi) Which of the following is a weighted code?
(a) 2421   (b) Excess-3
(c) Gray   (d) All of the above.

(vii) The minimum number of NAND gates required to construct an XOR gate is
(a) 3   (b) 4   (c) 5   (d) 8.

(viii) 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.

(ix) A latch is _____ sensitive
(a) both level and edge   (b) edge
(c) level   (d) neither level nor edge.

(x) The number of flip-flops required to construct a Mod-32 binary counter is
(a) 3   (b) 4   (c) 5   (d) 8.

Group – B

2. (a) Realize the following linear differential equation using minimum number of OP-AMPS

$$2 \frac{d^2y}{dt^2} + 3 \frac{dy}{dt} + 2y = 10$$

(b) Calculate the load voltage, I_1, I_2 and I_Z for the circuit shown in Fig. 1. Given that breakdown voltage of the zener diode is 5V, $R = 1k\Omega$ and $R_L = 1.2k\Omega$. Also determine the power consumed by the zener diode.
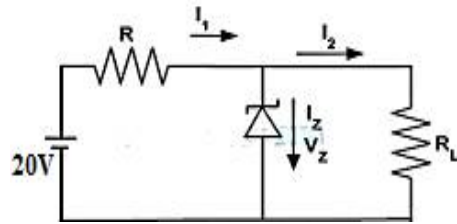

Fig. 1

(c) Define input offset voltage of an OP-AMP.

6 + 5 + 1 = 12

3. (a) Determine the collector current I_c and collector-to-emitter voltage V_{CE} of the circuit shown in Fig. 2.
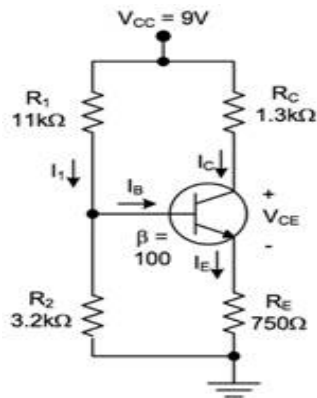

Fig. 2

(b) For the circuit shown in Fig. 3, assuming diodes D_1, D_2 and D_3 to be ideal, determine the DC components of voltages V_1 and V_2.
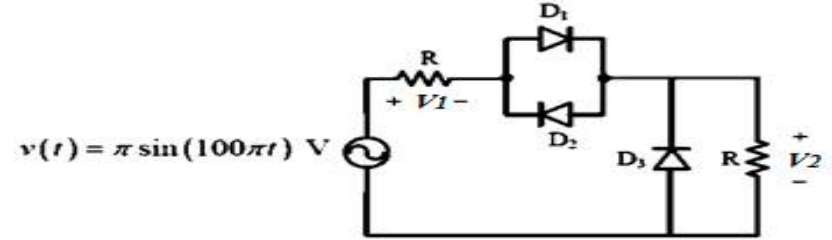

$v(t) = \pi \sin(100\pi t)$ V

Fig. 3

6 + 6 = 12

Group – C

4. (a) Design an RC phase shift oscillator with oscillation frequency, $f_o = 200$ Hz.

(b) State and explain Barkhausen criteria.

(c) Draw a neat diagram of Hartley oscillator and derive the expression of oscillation frequency.

3 + 2 + 7 = 12

5. (a) Draw and explain the circuit of a triangular wave generator using two operational amplifiers where, one is used as a comparator and the other one is used as an integrator.

(b) Draw a neat circuit diagram of a monostable multivibrator using op amp. Explain its principle of operation. Draw the output and capacitor voltage waveforms. Derive the expression of timing period.

4 + 8 = 12

Group – D

6. (a) What do you mean by a combinational circuit? Give two examples of combinational circuits.

(b) Apply the knowledge of K map to simplify the following Boolean function and implement it using suitable logic gates:
$F(A,B,C,D) = \Sigma_m (0,1,2,8,10,11,14,15) + \Sigma_d (3,13)$.

(c) Design a full adder using NAND gate only.

2 + 5 + 5 = 12

7. (a) What is a decoder? What are its applications?