Date: 07.10.2019   Time : (3 Hours)   Total Marks: 100

N.B.   (1)   All questions are compulsory.
        (2)   Figures to the right indicate marks for respective sub questions.
        (3)   Use of **Non-programmable** calculators is **allowed.**
        (4)   Draw **neat labeled diagrams** wherever **necessary.**
        (5)   Symbols used have their usual meaning

Q.1)   [A]   Choose correct alternative in each of the following.   (12)
        (i)   Volume element in Cylindrical coordinate system is given as ---
               (a) $r^2 dr d\emptyset dz$ (b) $r^2 \sin\theta \, dr d\emptyset dz$
               (c) $r^2 dr d\theta d\emptyset$ (d) $r dr d\emptyset dz$
        (ii)   A necessary and sufficient condition that line integral $\int \vec{A} \cdot \vec{dr} = 0$ for every
               closed curve is

               (a) Div $\vec{A} = 0$ (b) Div $\neq 0$
               (c) Curl $\vec{A} \neq 0$ (d) Curl $\vec{A} = 0$
        (iii) Operating point represents _____.
               (a) Zero signal values of I_C & V_{CE} (b) high signal values of I_C & V_{CE}
               (c) low signal values of I_C & V_{CE} (d) Current factor
        (iv)   A CE-amplifier produces _____.

               (a) Phase reversal   (b) Shift divider

               (c) Maximum reversal   (d) Minimum reversal

        (v)   An electronic oscillator is an amplifier with _____ feedback.
               (a) Negative   (b) Positive & negative
               (c) positive   (d) zero
        (vi)   An ideal Op-amp has _____ offset voltage.
               (a) Zero input   (b) Low level
               (c) Zero output   (d) Infinite output

        [B]   Answer in One Sentence   (3)
        (i)   What is current gain?
        (ii)   What are coordinates of spherical coordinate system?
        (iii) State any one condition to get sustained oscillations.

        [C]   Fill in the blanks   (5)
        (i)   The input resistance of an ideal op-amp is --------.
        (ii)   Divergence theorem states that $\int (\vec{\nabla} \cdot \vec{A}) dv$ is equal to the _____ integral of $\vec{A}$
               over closed surface.
        (iii) If $\emptyset(x, y, z)$ is a single valued then line integral between two points is path ---------.
        (iv)   An oscillator circuit must satisfy _____.
        (v)   Faithful amplification is the process of raising the strength of a weak signal
               without any change in its _____.

Q.2)   [A]   Attempt **any ONE** of the following.   (8)

(i)   Check the fundamental theorem for Gradient, using $T = x^2 + 4xy + 2yz^3$ the points A=(0,0,0), B = (1,1,1) and the three path are as follows

    a) $(0,0,0) \rightarrow (1,0,0) \rightarrow (1,1,0) \rightarrow (1,1,1)$

    b) $(0,0,0) \rightarrow (0,0,1) \rightarrow (0,1,1) \rightarrow (1,1,1)$

    c)   The parabolic path $z = x^2, y = x$

(ii)   Let $\vec{A} = (2xz + 3y^2)\hat{y} + 4yz^2\,\hat{z}$ check fundamental theorem for curl for plane square surface in YZ – plane such that Y=Z=1 and $x = 0$.

[B]   Attempt **any ONE** of the following.   (8)

(i)   State and explain the fundamental theorem of Divergence. Check the Divergence theorem using vector function $\vec{A} = xy\hat{i} + 2yz\hat{j} + 3xz\hat{k}$ .Consider a cube of side of length two units and having vertex at origin.

(ii)   What is surface integral? Calculate the close surface integral for $\vec{A} = 4xz\hat{i} - y^2\hat{j} + yz\hat{k}$ Consider a cube of side of length two units and having vertex at origine.

[C]   Attempt **any ONE** of the following.   (4)

(i)   Calculate surface area and Volume of sphere having radius R in spherical coordinate system.

(ii)   Find the expression for length and surface element in cylindrical coordinate system.

Q.3)   [A]   Attempt **any ONE** of the following.   (8)

(i)   Draw the circuit diagram of CE amplifier using voltage divider method for transistor biasing. Show that the stability factor is unity. Give one advantage and disadvantage of this method.

(ii)   What are the advantages of negative feedback in an amplifier? State the influence of negative feedback on the various amplifier parameters.

[B]   Attempt **any ONE** of the following.   (8)

(i)   Draw the circuit diagram of CE amplifier using Base Resistor method for transistor biasing. Deduce the equation for stability factor. Give advantages and disadvantages of this method.

(ii)   Derive a general expression for gain of the amplifier with feedback. What is loop gain?

[C]   Attempt **any ONE** of the following.   (4)

(i)   An amplifier has an input signal voltage 0.1 volt and draws 0.1mA from the source. The amplifier delivers 5 volts to a load at 10mA. Determine the voltage gain, current gain and power gain.

(ii)   In base resistor method, if V_{CC} = 12 V, R_B = 300 KΩ, R_C = 2KΩ, β = 100 is used then find V_C. Neglect V_{BE}.

Q.4)   [A]   Attempt **any ONE** of the following.   (8)
   (i)   Draw the circuit diagram and explain the working of Colpitt's oscillator. Write the expression for feedback fraction and frequency of oscillations.
  (ii)   What do you mean by inverting amplifier? Draw the circuit diagram of Inverting amplifier using op-amp. Derive the expression for gain of the circuit.

       [B]   Attempt **any ONE** of the following.   (8)
   (i)   With the help of neat labelled diagram explain the circuit operation of Wien Bridge oscillator. Obtain the expression for frequency of oscillations.
  (ii)   Explain in the action of an Op-amp as an Integrator and Differentiator.

       [C]   Attempt **any ONE** of the following.   (4)
   (i)   A Colpitt's oscillator has L = 1 mH, C_1 = 1000 pF and C_2 = 5000 pF. Find the frequency of oscillation.
  (ii)   In the non-inverting amplifier circuit, R_1 = 1 kΩ, R_f = 10 kΩ. If the input to the non-inverting terminal is 0.2 V, what is the output voltage? If the output saturation voltage is 11 volt, what is the maximum possible input voltage for linear operation?

Q.5)   Attempt **any FOUR** of the following.   (20)
   (i)   Explain the basic concept of amplification.

  (ii)   Write essential of a transistor biasing circuit.

 (iii)   Calculate the volume integral for $v = 4z - y$ by considering volume element as cube with sides of length two units and having one vertex at origin.

  (iv)   Calculate the work done when a force $\vec{F} = 2xy\hat{i} - 3y^2\hat{j}$ moves a particle in the xy-plane from origin to a point P(1,2) along the parabola $y = x^2$.

   (v)   Draw block diagram of oscillator. What are the requirements of sustained oscillations?

  (vi)   Write any Five ideal characteristics of an ideal op-amp.