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Note: 1) All questions are compulsory.

2) Figures to the right indicate full marks.

3) Use of non-programmable calculator is allowed.

4) Symbols have their usual meanings.

Q. 1 (A) Chose correct alternative among the four and rewrite the statement. (12)

1) The gradient of a function **(sin x + sin y)** is _____

a) $\cos x\,\hat{\imath} - \sin y\,\hat{\jmath}$ b) $\cos x\,\hat{\imath} + \sin y\,\hat{\jmath}$

c) $\sin x\,\hat{\imath} - \cos y\,\hat{\jmath}$ d) $\sin x\,\hat{\imath} + \cos y\,\hat{\jmath}$

2) The scalar factor of spherical co-ordinates is _____

a) 1, r, r sin θ b) 1 , r , r

c) r, r, 1 d) r, 1, r

3) If base emitter junction is forward biased and base collector junction is reversed biased then operation of transistor is in _____.

(a) active region (b) saturated region

(c) cut-off region (d) none of these

4) An amplifier has a power gain of 100. Its dB gain is _____.

(a) 20 dB (b) 40 dB

(c) 10 dB (d) none of these

5) When we introduce positive feedback to an amplifier the Gain - bandwidth product ----

a) Increases b) decreases

C) remains the same. D) can increase or decrease

6) Which of the following is required for oscillation?

a) $\beta Av > 1$

b) The phase shift around the feedback network must be 0º or 360º.

c) Both $\beta Av > 1$ and the phase shift around the feedback network must be 0º or 360º.

d) None of the above

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Q. 1 (B) Answer the following questions in one statement. (03)

1) Express the unit vectors $\hat{r}$, $\hat{\theta}$, $\hat{\emptyset}$ in terms of cartesian coordinate system
2) What is meaning of phase reversal?
3) What is Op-Amp comparator?

Q. 1 (C) Fill in the blanks. (05)

1) The line integral is also known as _____ integral.

2) Co-ordinate ϕ is the azimuth angle of the plane containing the point P and ____ axis; measured from XZ plane in the right hand screw sense.

3) It should be ensured that collector emitter voltage not fall below ___ V for silicon transistor.
4) A voltage follower has a voltage gain of _____.
5) In an ideal op-amp integrator if the input is square wave then the output waveform will be _____.

Q. 2. (A) Attempt any <u>One</u> (08)

1) State and explain fundamental theorem for curl. Give its geometrical and physical interpretation. Give one example
2) Verify Stoke's theorem for the function $\bar{F} = x\,(x\,\hat{\imath} + y\,\hat{\jmath})$, integration round the square in the plane Z= 0 whose sides are along the lines x= 0 , y = 0, x = a and y = a

Q. 2 (B) Attempt any <u>One</u> (08)

1) With the help of diagram explain cylindrical polar co-ordinates.

2) Obtain an expression for the divergence of a vector function in spherical polar co-ordinates.

Q. 2 (C) Attempt any <u>One</u> (04)

1) Obtain expression for infinitesimal surface area of a sphere of radius 'r' and centre at origin.

2) Find total work-done by the force $\bar{F} = (zy\,\hat{\imath} + xy\,\hat{\jmath})$ N in moving a particle along the straight line path from O (0,0) to P (2 , 1).

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3. (a) **Attempt any <u>One</u>** (8)

(i) Draw voltage divider bias circuit and its Thevenin equivalent circuit. Obtain the expressions for V_{TH} and R_{TH}, base current I_B, collector voltage V_C, V_{CE}, collector current I_C, stability factor S.

(ii) Explain the effect of negative feedback on stability, distortion and output resistance of an amplifier.

3. (b) **Attempt any <u>One</u>** (8)

(i) A base bias circuit is subjected to an increase in temperature from 25° C to 75° C. If β = 100 at 25° C and β = 150 at 75° C, determine the percentage change in Q-point values (I_C and V_{CE}) over this temperature neglecting change in V_{BE} and leakage current. Given: V_{CC} = 9 V, R_B = 200 kΩ and R_C = 1 kΩ

(ii) Write general theory of feedback.

3. (c) **Attempt any <u>One</u>** (4)

(i) Explain the concept of thermal runaway.

(ii) An amplifier has an input signal voltage V_i = 0·2 V and draws 1 mA from the source. The amplifier delivers 10 V to a load at 25 mA. Determine voltage and current gain.

Q.4 A Attempt **Any One** **(8)**

i Draw circuit of RC phase shift oscillator using BJT. Derive the expression for the frequency of oscillation.

ii Describe with neat circuit diagram working of Colpitt's oscillator. Derive the expression for the frequency of oscillation.

B Attempt **Any One** **(8)**

i Explain, with neat circuit diagram, the non-inverting amplifier using OPAMP and derive the expression for the Output Voltage.

ii Describe with neat circuit diagram OPAMP integrator. What is critical frequency of an integrator?

C Attempt **Any One** **(4)**

i A Hartley oscillator produces an output at a frequency of 100KHz. Given L_1=L_2=L and C=0.001μF. find the value of L.

ii Calculate the value of C and feedback resistor R_f for a typical Wien-bridge oscillator, if R = 7950 Ω, R_1 = 10 KΩ and oscillator frequency of 2 KHz.

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Q. 5 Attempt any Four **(20)**

1) Write a note on Surface integrals

2) Obtain the expression for gradient of a scalar function in terms of cylindrical co-ordinates.

3) Write a short note on proper zero signal collector current

4) Explain the concept of input resistance of an amplifier.

5) An op-amp is used as 3 input inverting adder with Ri = R_f = 5 KΩ $V_1 = +1.0V$ $V_2 = -2V$ and $V_3 = +4.5V$ find the output voltage. If the Ri value is reduced to 2 KΩ, keeping R_f the same, what will be new output voltage?

6) Determine the maximum frequency that may be used in op-amp with slew rate of 1V/μs. The amplifier circuit has R_f = 200KΩ and R_i = 10 KΩ and input voltage Vi = 0.02 V having angular frequency of 3 X 10^5 rad/s. State whether this input will give distorted output or not.

---------THE END.--------