UG TRB PHYSICS

UNIT 9 - ELECTRICAL CIRCUITS AND ELECTRONICS

PRACTICE PROBLEMS WITH SOLUTIONS

QUESTION 1

1. A 12 V DC source is connected across a 4 Ω resistor. Calculate the electrical power dissipated by the resistor.

Given:

V = 12 V

R = 4 Ω

Formula:

$P = V^2 / R$

Substitute:

$P = 12^2 / 4$

$P = 144 / 4$

Answer:

P = 36 W

PRACTICE PROBLEM

Problem 1

A 24 V DC source is connected across a 8 Ω resistor. Calculate the electrical power dissipated by the resistor.

Given:

V = 24 V

R = 8 Ω

Formula:

$P = V^2 / R$

Substitute:

$P = 24^2 / 8$

$P = 576 / 8$

Answer:

$P = 72$ W

Problem 2

A 10 V DC source is connected across a 5 Ω resistor. Calculate the electrical power dissipated by the resistor.

Given:

$V = 10$ V

$R = 5$ Ω

Formula:

$P = V^2 / R$

Substitute:

$P = 10^2 / 5$

$P = 100 / 5$

Answer:

$P = 20$ W

Problem 3

A 6 V DC source is connected across a 2 Ω resistor. Calculate the electrical power dissipated by the resistor.

Given:

$V = 6$ V

$R = 2$ Ω

Formula:

$P = V^2 / R$

Substitute:

$P = 6^2 / 2$

$P = 36 / 2$

Answer:

$P = 18$ W

Problem 4

A 15 V DC source is connected across a 3 Ω resistor. Calculate the electrical power dissipated by the resistor.

Given:

$V = 15$ V

$R = 3$ Ω

Formula:

$P = V^2 / R$

Substitute:

$P = 15^2 / 3$

$P = 225 / 3$

Answer:

$P = 75$ W

Problem 5

A 20 V DC source is connected across a 10 Ω resistor. Calculate the electrical power dissipated by the resistor.

Given:

$V = 20$ V

$R = 10$ Ω

Formula:

$P = V^2 / R$

Substitute:

$P = 20^2 / 10$

$P = 400 / 10$

Answer:

$P = 40$ W

QUESTION 2

2. Two resistors of 10 Ω and 15 Ω are connected in parallel. Calculate their equivalent resistance.

Given:

$R_1 = 10\ \Omega$

$R_2 = 15\ \Omega$

Formula:

$R_eq = (R_1 \times R_2) / (R_1 + R_2)$

Substitute:

$R_eq = (10 \times 15) / (10 + 15)$

$R_eq = 150 / 25$

Answer:

$R_eq = 6\ \Omega$

PRACTICE PROBLEM

Problem 1

Two resistors of 8 Ω and 12 Ω are connected in parallel. Calculate their equivalent resistance.

Given:

$R_1 = 8\ \Omega$

$R_2 = 12\ \Omega$

Formula:

$R_{eq} = (R_1 \times R_2) / (R_1 + R_2)$

Substitute:

$R_{eq} = (8 \times 12) / (8 + 12)$

$R_{eq} = 96 / 20$

Answer:

$R_{eq} = 4.8\ \Omega$

Problem 2

Two resistors of 5 Ω and 10 Ω are connected in parallel. Calculate their equivalent resistance.

Given:

$R_1 = 5\ \Omega$

$R_2 = 10\ \Omega$

Formula:

$R_{eq} = (R_1 \times R_2) / (R_1 + R_2)$

Substitute:

$R_{eq} = (5 \times 10) / (5 + 10)$

$R_{eq} = 50 / 15$

Answer:

$R_{eq} = 3.333\ \Omega$

Problem 3

Two resistors of 6 Ω and 3 Ω are connected in parallel. Calculate their equivalent resistance.

Given:

$R_1 = 6\ \Omega$

$R_2 = 3\ \Omega$

Formula:

$R_{eq} = (R_1 \times R_2) / (R_1 + R_2)$

Substitute:

$R_{eq} = (6 \times 3) / (6 + 3)$

$R_{eq} = 18 / 9$

Answer:

$R_{eq} = 2\ \Omega$

Problem 4

Two resistors of 20 Ω and 30 Ω are connected in parallel. Calculate their equivalent resistance.

Given:

$R_1 = 20\ \Omega$

$R_2 = 30\ \Omega$

Formula:

$R_{eq} = (R_1 \times R_2) / (R_1 + R_2)$

Substitute:

$R_{eq} = (20 \times 30) / (20 + 30)$

$R_{eq} = 600 / 50$

Answer:

$R_{eq} = 12\ \Omega$

Problem 5

Two resistors of 4 Ω and 6 Ω are connected in parallel. Calculate their equivalent resistance.

Given:

$R_1 = 4\ \Omega$

$R_2 = 6\ \Omega$

Formula:

$R_{eq} = (R_1 \times R_2) / (R_1 + R_2)$

Substitute:

$R_{eq} = (4 \times 6) / (4 + 6)$

$R_{eq} = 24 / 10$

Answer:

$R_{eq} = 2.4\ \Omega$

QUESTION 3

3. A 20 V battery is connected in series with two resistors, 6 Ω and 4 Ω. Find the voltage drop specifically across the 4 Ω resistor.

Given:

$V_{total} = 20\ V$

$R_1 = 6\ \Omega$

$R_2 = 4\ \Omega$

Formula:

$V_{R_2} = V_{total} \times [R_2 / (R_1 + R_2)]$

Substitute:

$V_{R_2} = 20 \times [4 / (6 + 4)]$

$V_{R_2} = 20 \times 0.4$

Answer:

$V_{R_2} = 8\ V$

PRACTICE PROBLEM

Problem 1

A 12 V battery is connected in series with two resistors, 3 Ω and 5 Ω. Find the voltage drop across the 5 Ω resistor.

Given:

$V_{total} = 12\ V$

$R_1 = 3\ \Omega$

$R_2 = 5\ \Omega$

Formula:

$V_{R_2} = V_{total} \times [R_2 / (R_1 + R_2)]$

Substitute:

$V_{R_2} = 12 \times [5 / (3 + 5)]$

$V_{R_2} = 12 \times 0.625$

Answer:

$V_{R_2} = 7.5\ V$

Problem 2

A 24 V battery is connected in series with two resistors, 8 Ω and 4 Ω. Find the voltage drop across the 4 Ω resistor.

Given:

$V_{total} = 24\ V$

$R_1 = 8\ \Omega$

$R_2 = 4\ \Omega$

Formula:

$V_{R_2} = V_{total} \times [R_2 / (R_1 + R_2)]$

Substitute:

$V_{R_2} = 24 \times [4 / (8 + 4)]$

$V_{R_2} = 24 \times 0.3333$

Answer:

$V_{R_2} = 8\ V$

Problem 3

A 10 V battery is connected in series with two resistors, 2 Ω and 3 Ω. Find the voltage drop across the 3 Ω resistor.

Given:

$V_{total} = 10\ V$

$R_1 = 2\ \Omega$

$R_2 = 3\ \Omega$

Formula:

$V_R_2 = V_total \times [R_2 / (R_1 + R_2)]$

Substitute:

$V_R_2 = 10 \times [3 / (2 + 3)]$

$V_R_2 = 10 \times 0.6$

Answer:

$V_R_2 = 6\ V$

Problem 4

A 15 V battery is connected in series with two resistors, 5 Ω and 10 Ω. Find the voltage drop across the 10 Ω resistor.

Given:

$V_total = 15\ V$

$R_1 = 5\ \Omega$

$R_2 = 10\ \Omega$

Formula:

$V_R_2 = V_total \times [R_2 / (R_1 + R_2)]$

Substitute:

$V_R_2 = 15 \times [10 / (5 + 10)]$

$V_R_2 = 15 \times 0.6667$

Answer:

$V_R_2 = 10\ V$

Problem 5

A 18 V battery is connected in series with two resistors, 6 Ω and 12 Ω. Find the voltage drop across the 12 Ω resistor.

Given:

$V_{total} = 18\ V$

$R_1 = 6\ \Omega$

$R_2 = 12\ \Omega$

Formula:

$V_{R_2} = V_{total} \times [R_2 / (R_1 + R_2)]$

Substitute:

$V_{R_2} = 18 \times [12 / (6 + 12)]$

$V_{R_2} = 18 \times 0.6667$

Answer:

$V_{R_2} = 12\ V$

QUESTION 4

4. A Thevenin equivalent circuit has a voltage source of 10 V and an internal resistance of 50 Ω. Calculate the maximum power that can be transferred to a load resistor.

Given:

$V_{th} = 10\ V$

$R_{th} = 50\ \Omega$

For maximum power transfer: $R_L = R_{th} = 50\ \Omega$

Formula:

$P_{max} = V_{th}^2 / (4R_{th})$

Substitute:

$P_{max} = 10^2 / (4 \times 50)$

$P_{max} = 100 / 200$

Answer:

$P_{max} = 0.5\ W$

PRACTICE PROBLEM

Problem 1

A Thevenin equivalent circuit has a voltage source of 12 V and an internal resistance of 60 Ω.

Calculate maximum power that can be transferred to a load resistor.

Given:

$V_{th} = 12$ V

$R_{th} = 60$ Ω

For maximum power transfer: $R_L = R_{th} = 60$ Ω

Formula:

$P_{max} = V_{th}^2 / (4R_{th})$

Substitute:

$P_{max} = 12^2 / (4 \times 60)$

$P_{max} = 144 / 240$

Answer:

$P_{max} = 0.6$ W

Problem 2

A Thevenin equivalent circuit has a voltage source of 5 V and an internal resistance of 25 Ω.

Calculate maximum power that can be transferred to a load resistor.

Given:

$V_{th} = 5$ V

$R_{th} = 25$ Ω

For maximum power transfer: $R_L = R_{th} = 25$ Ω

Formula:

$P_{max} = V_{th}^2 / (4R_{th})$

Substitute:

$P_{max} = 5^2 / (4 \times 25)$

$P_{max} = 25 / 100$

Answer:

$P_{max} = 0.25$ W

Problem 3

A Thevenin equivalent circuit has a voltage source of 15 V and an internal resistance of 30 Ω.

Calculate maximum power that can be transferred to a load resistor.

Given:

$V_{th} = 15$ V

$R_{th} = 30$ Ω

For maximum power transfer: $R_L = R_{th} = 30$ Ω

Formula:

$P_{max} = V_{th}^2 / (4R_{th})$

Substitute:

$P_{max} = 15^2 / (4 \times 30)$

$P_{max} = 225 / 120$

Answer:

$P_{max} = 1.875$ W

Problem 4

A Thevenin equivalent circuit has a voltage source of 20 V and an internal resistance of 80 Ω.

Calculate maximum power that can be transferred to a load resistor.

Given:

$V_{th} = 20$ V

$R_{th} = 80$ Ω

For maximum power transfer: $R_L = R_{th} = 80$ Ω

Formula:

$P_{max} = V_{th}^2 / (4R_{th})$

Substitute:

$P_{max} = 20^2 / (4 \times 80)$

$P_{max} = 400 / 320$

Answer:

$P_{max} = 1.25$ W

Problem 5

A Thevenin equivalent circuit has a voltage source of 8 V and an internal resistance of 40 Ω.

Calculate maximum power that can be transferred to a load resistor.

Given:

$V_{th} = 8$ V

$R_{th} = 40$ Ω

For maximum power transfer: $R_L = R_{th} = 40$ Ω

Formula:

$P_{max} = V_{th}^2 / (4R_{th})$

Substitute:

$P_{max} = 8^2 / (4 \times 40)$

$P_{max} = 64 / 160$

Answer:

$P_{max} = 0.4$ W

QUESTION 5

5. The RMS voltage of the household AC mains supply is 230 V. Calculate the peak voltage of the waveform.

Given:

$V_{rms} = 230$ V

Formula:

$V_{peak} = V_{rms} \times \sqrt{2}$

Substitute:

$V_{peak} = 230 \times 1.414$

Answer:

$V_{peak} = 325.22$ V

PRACTICE PROBLEM

Problem 1

The RMS voltage of the household AC mains supply is 120 V. Calculate the peak voltage of the waveform. The source line also contains the text “The RMS voltage is 240 V.”

Given:

$V_{rms} = 120$ V

Formula:

$V_{peak} = V_{rms} \times \sqrt{2}$

Substitute:

$V_{peak} = 120 \times 1.414$

Answer:

$V_{peak} = 169.68$ V

Problem 2

The RMS voltage of the household AC mains supply is 230 V. Calculate the peak voltage of the waveform. The source line also contains the text “The RMS voltage is 240 V.”

Given:

$V_{rms} = 230$ V

Formula:

$V_{peak} = V_{rms} \times \sqrt{2}$

Substitute:

$V_{peak} = 230 \times 1.414$

Answer:

$V_{peak} = 325.22$ V

Problem 3

The RMS voltage of the household AC mains supply is 110 V. Calculate the peak voltage of the waveform.

Given:

$V_{rms} = 110$ V

Formula:

$V_{peak} = V_{rms} \times \sqrt{2}$

Substitute:

$V_{peak} = 110 \times 1.414$

Answer:

$V_{peak} = 155.54$ V

Problem 4

The RMS voltage of the household AC mains supply is 220 V. Calculate the peak voltage of the waveform.

Given:

$V_{rms} = 220$ V

Formula:

$V_{peak} = V_{rms} \times \sqrt{2}$

Substitute:

$V_{peak} = 220 \times 1.414$

Answer:

$V_{peak} = 311.08$ V

Problem 5

The RMS voltage of the household AC mains supply is 100 V. Calculate the peak voltage of the waveform.

Given:

$V_{rms} = 100\ V$

Formula:

$V_{peak} = V_{rms} \times \sqrt{2}$

Substitute:

$V_{peak} = 100 \times 1.414$

Answer:

$V_{peak} = 141.4\ V$

QUESTION 6

6. Calculate the reactance of a 10 mH inductor when connected to a 50 Hz AC supply.

Given:

$L = 10\ mH = 0.01\ H$

$f = 50\ Hz$

$\pi = 3.1416$

Formula:

$X_L = 2\pi fL$

Substitute:

$X_L = 2 \times 3.1416 \times 50 \times 0.01$

Answer:

$X_L = 3.14\ \Omega$

PRACTICE PROBLEM

Problem 1

Calculate the reactance of a 20 mH inductor at 60 Hz AC supply.

Given:

L = 20 mH = 0.02 H

f = 60 Hz

π = 3.1416

Formula:

$X_L = 2\pi fL$

Substitute:

$X_L = 2 \times 3.1416 \times 60 \times 0.02$

Answer:

$X_L = 7.54\ \Omega$

Problem 2

Calculate the reactance of a 5 mH inductor at 50 Hz AC supply.

Given:

L = 5 mH = 0.005 H

f = 50 Hz

π = 3.1416

Formula:

$X_L = 2\pi fL$

Substitute:

$X_L = 2 \times 3.1416 \times 50 \times 0.005$

Answer:

$X_L = 1.57\ \Omega$

Problem 3

Calculate the reactance of a 15 mH inductor at 100 Hz AC supply.

Given:

L = 15 mH = 0.015 H

f = 100 Hz

$\pi = 3.1416$

Formula:

$X_L = 2\pi fL$

Substitute:

$X_L = 2 \times 3.1416 \times 100 \times 0.015$

Answer:

$X_L = 9.42\ \Omega$

Problem 4

Calculate the reactance of a 12 mH inductor at 50 Hz AC supply.

Given:

L = 12 mH = 0.012 H

f = 50 Hz

$\pi = 3.1416$

Formula:

$X_L = 2\pi fL$

Substitute:

$X_L = 2 \times 3.1416 \times 50 \times 0.012$

Answer:

$X_L = 3.77\ \Omega$

Problem 5

Calculate the reactance of a 8 mH inductor at 60 Hz AC supply.

Given:

L = 8 mH = 0.008 H

f = 60 Hz

π = 3.1416

Formula:

$X_L = 2\pi fL$

Substitute:

$X_L = 2 \times 3.1416 \times 60 \times 0.008$

Answer:

$X_L = 3.02\ \Omega$

QUESTION 7

7. Calculate the reactance of a 100 µF capacitor when connected to a 50 Hz AC supply.

Given:

$C = 100\ \mu F = 100 \times 10^{-6}\ F$

f = 50 Hz

Formula:

$X_C = 1 / (2\pi fC)$

Substitute:

$X_C = 1 / (2 \times 3.1416 \times 50 \times 100 \times 10^{-6})$

Answer:

$X_C = 31.83\ \Omega$

PRACTICE PROBLEM

Problem 1

Calculate the reactance of a 50 µF capacitor at 60 Hz AC supply.

Given:

$C = 50\ \mu F = 50 \times 10^{-6}\ F$

$f = 60\ Hz$

Formula:

$X_C = 1 / (2\pi fC)$

Substitute:

$X_C = 1 / (2 \times 3.1416 \times 60 \times 50 \times 10^{-6})$

Answer:

$X_C = 53.05\ \Omega$

Problem 2

Calculate the reactance of a 200 µF capacitor at 50 Hz AC supply.

Given:

$C = 200\ \mu F = 200 \times 10^{-6}\ F$

$f = 50\ Hz$

Formula:

$X_C = 1 / (2\pi fC)$

Substitute:

$X_C = 1 / (2 \times 3.1416 \times 50 \times 200 \times 10^{-6})$

Answer:

$X_C = 15.92\ \Omega$

Problem 3

Calculate the reactance of a 150 µF capacitor at 100 Hz AC supply.

Given:

$C = 150\ \mu F = 150 \times 10^{-6}\ F$

$f = 100\ Hz$

Formula:

$X_C = 1 / (2\pi fC)$

Substitute:

$X_C = 1 / (2 \times 3.1416 \times 100 \times 150 \times 10^{-6})$

Answer:

$X_C = 10.61\ \Omega$

Problem 4

Calculate the reactance of a 100 µF capacitor at 60 Hz AC supply.

Given:

$C = 100\ \mu F = 100 \times 10^{-6}\ F$

$f = 60\ Hz$

Formula:

$X_C = 1 / (2\pi fC)$

Substitute:

$X_C = 1 / (2 \times 3.1416 \times 60 \times 100 \times 10^{-6})$

Answer:

$X_C = 26.53\ \Omega$

Problem 5

Calculate the reactance of a 75 µF capacitor at 50 Hz AC supply.

Given:

$C = 75\ \mu F = 75 \times 10^{-6}\ F$

$f = 50\ Hz$

Formula:

$X_C = 1 / (2\pi fC)$

Substitute:

$X_C = 1 / (2 \times 3.1416 \times 50 \times 75 \times 10^{-6})$

Answer:

$X_C = 42.44\ \Omega$

QUESTION 8

8. Find the resonant frequency of an LC tank circuit containing a 0.1 H inductor and a 10 µF capacitor.

Given:

$L = 0.1\ H$

$C = 10\ \mu F = 10 \times 10^{-6}\ F$

Formula:

$f_r = 1 / (2\pi\sqrt{(LC)})$

Substitute:

$f_r = 1 / [2 \times 3.1416 \times \sqrt{(0.1 \times 10 \times 10^{-6})}]$

Answer:

$f_r = 159.15\ Hz$

PRACTICE PROBLEM

Problem 1

Find the resonant frequency of an LC tank circuit containing a 0.05 H inductor and a 20 µF capacitor.

Given:

$L = 0.05\ H$

$C = 20\ \mu F = 20 \times 10^{-6}\ F$

Formula:

$f_r = 1 / (2\pi\sqrt{(LC)})$

Substitute:

$f_r = 1 / [2 \times 3.1416 \times \sqrt{(0.05 \times 20 \times 10^{-6})}]$

Answer:

$f_r = 159.15$ Hz

Problem 2

Find the resonant frequency of an LC tank circuit containing a 0.2 H inductor and a 5 μF capacitor.

Given:

$L = 0.2$ H

$C = 5\ \mu F = 5 \times 10^{-6}$ F

Formula:

$f_r = 1 / (2\pi\sqrt{(LC)})$

Substitute:

$f_r = 1 / [2 \times 3.1416 \times \sqrt{(0.2 \times 5 \times 10^{-6})}]$

Answer:

$f_r = 159.15$ Hz

Problem 3

Find the resonant frequency of an LC tank circuit containing a 0.1 H inductor and a 5 μF capacitor.

Given:

$L = 0.1$ H

$C = 5\ \mu F = 5 \times 10^{-6}$ F

Formula:

$f_r = 1 / (2\pi\sqrt{(LC)})$

Substitute:

$f_r = 1 / [2 \times 3.1416 \times \sqrt{(0.1 \times 5 \times 10^{-6})}]$

Answer:

$f_r = 225.08$ Hz

Problem 4

Find the resonant frequency of an LC tank circuit containing a 0.05 H inductor and a 10 μF capacitor.

Given:

$L = 0.05$ H

$C = 10\ \mu F = 10 \times 10^{-6}$ F

Formula:

$f_r = 1 / (2\pi\sqrt{(LC)})$

Substitute:

$f_r = 1 / [2 \times 3.1416 \times \sqrt{(0.05 \times 10 \times 10^{-6})}]$

Answer:

$f_r = 225.08$ Hz

Problem 5

Find the resonant frequency of an LC tank circuit containing a 0.2 H inductor and a 10 μF capacitor.

Given:

$L = 0.2$ H

$C = 10\ \mu F = 10 \times 10^{-6}$ F

Formula:

$f_r = 1 / (2\pi\sqrt{(LC)})$

Substitute:

$f_r = 1 / [2 \times 3.1416 \times \sqrt{(0.2 \times 10 \times 10^{-6})}]$

Answer:

$f_r = 112.54$ Hz

QUESTION 9

9. A series resonant circuit has an inductance of 2 mH, capacitance of 5 µF, and a resistance of 10 Ω. Calculate its Q-factor.

Given:

$L = 2\ mH = 2 \times 10^{-3}\ H$

$C = 5\ \mu F = 5 \times 10^{-6}\ F$

$R = 10\ \Omega$

Formula:

$Q = (1/R)\sqrt{(L/C)}$

Substitute:

$Q = (1/10)\sqrt{[(2 \times 10^{-3})/(5 \times 10^{-6})]}$

Answer:

$Q = 2$

PRACTICE PROBLEM

Problem 1

A series resonant circuit has an inductance of 1 mH, capacitance of 10 µF, and a resistance of 5 Ω. Calculate its Q-factor.

Given:

$L = 1\ mH = 1 \times 10^{-3}\ H$

$C = 10\ \mu F = 10 \times 10^{-6}\ F$

$R = 5\ \Omega$

Formula:

$Q = (1/R)\sqrt{(L/C)}$

Substitute:

$Q = (1/5)\sqrt{[(1 \times 10^{-3})/(10 \times 10^{-6})]}$

Answer:

$Q = 2$

Problem 2

A series resonant circuit has an inductance of 5 mH, capacitance of 20 μF, and a resistance of 10 Ω. Calculate its Q-factor.

Given:

$L = 5\ mH = 5 \times 10^{-3}\ H$

$C = 20\ \mu F = 20 \times 10^{-6}\ F$

$R = 10\ \Omega$

Formula:

$Q = (1/R)\sqrt{(L/C)}$

Substitute:

$Q = (1/10)\sqrt{[(5 \times 10^{-3})/(20 \times 10^{-6})]}$

Answer:

$Q = 1.581$

Problem 3

A series resonant circuit has an inductance of 2 mH, capacitance of 10 μF, and a resistance of 20 Ω. Calculate its Q-factor.

Given:

$L = 2\ mH = 2 \times 10^{-3}\ H$

$C = 10\ \mu F = 10 \times 10^{-6}\ F$

$R = 20\ \Omega$

Formula:

$Q = (1/R)\sqrt{(L/C)}$

Substitute:

$Q = (1/20)\sqrt{[(2 \times 10^{-3})/(10 \times 10^{-6})]}$

Answer:

$Q = 0.707$

Problem 4

A series resonant circuit has an inductance of 4 mH, capacitance of 5 μF, and a resistance of 8 Ω. Calculate its Q-factor.

Given:

$L = 4\ mH = 4 \times 10^{-3}\ H$

$C = 5\ \mu F = 5 \times 10^{-6}\ F$

$R = 8\ \Omega$

Formula:

$Q = (1/R)\sqrt{(L/C)}$

Substitute:

$Q = (1/8)\sqrt{[(4 \times 10^{-3})/(5 \times 10^{-6})]}$

Answer:

$Q = 3.536$

Problem 5

A series resonant circuit has an inductance of 3 mH, capacitance of 15 μF, and a resistance of 12 Ω. Calculate its Q-factor.

Given:

$L = 3\ mH = 3 \times 10^{-3}\ H$

$C = 15\ \mu F = 15 \times 10^{-6}\ F$

$R = 12\ \Omega$

Formula:

$Q = (1/R)\sqrt{(L/C)}$

Substitute:

$Q = (1/12)\sqrt{[(3 \times 10^{-3})/(15 \times 10^{-6})]}$

Answer:

Q = 1.179

QUESTION 10

10. At room temperature, a forward-biased silicon diode carries a current of 26 mA.

Calculate its AC dynamic resistance.

Given:

$I_D = 26\ mA = 26 \times 10^{-3}\ A$

$V_T = 26\ mV = 26 \times 10^{-3}\ V$

Formula:

$r_d = V_T / I_D$

Substitute:

$r_d = (26 \times 10^{-3}) / (26 \times 10^{-3})$

Answer:

$r_d = 1\ \Omega$

PRACTICE PROBLEM

Problem 1

At room temperature, a forward-biased silicon diode carries a current of 20 mA. Calculate its AC dynamic resistance.

Given:

$I_D = 20\ mA = 20 \times 10^{-3}\ A$

$V_T = 26\ mV = 26 \times 10^{-3}\ V$

Formula:

$r_d = V_T / I_D$

Substitute:

$r_d = (26 \times 10^{-3}) / (20 \times 10^{-3})$

Answer:

$r_d = 1.3\ \Omega$

Problem 2

At room temperature, a forward-biased silicon diode carries a current of 50 mA. Calculate its AC dynamic resistance.

Given:

$I_D = 50\ mA = 50 \times 10^{-3}\ A$

$V_T = 26\ mV = 26 \times 10^{-3}\ V$

Formula:

$r_d = V_T / I_D$

Substitute:

$r_d = (26 \times 10^{-3}) / (50 \times 10^{-3})$

Answer:

$r_d = 0.52\ \Omega$

Problem 3

At room temperature, a forward-biased silicon diode carries a current of 10 mA. Calculate its AC dynamic resistance.

Given:

$I_D = 10\ mA = 10 \times 10^{-3}\ A$

$V_T = 26\ mV = 26 \times 10^{-3}\ V$

Formula:

$r_d = V_T / I_D$

Substitute:

$r_d = (26 \times 10^{-3}) / (10 \times 10^{-3})$

Answer:

$r_d = 2.6\ \Omega$

Problem 4

At room temperature, a forward-biased silicon diode carries a current of 100 mA. Calculate its AC dynamic resistance.

Given:

$I_D = 100\ mA = 100 \times 10^{-3}\ A$

$V_T = 26\ mV = 26 \times 10^{-3}\ V$

Formula:

$r_d = V_T / I_D$

Substitute:

$r_d = (26 \times 10^{-3}) / (100 \times 10^{-3})$

Answer:

$r_d = 0.26\ \Omega$

Problem 5

At room temperature, a forward-biased silicon diode carries a current of 5 mA. Calculate its AC dynamic resistance.

Given:

$I_D = 5\ mA = 5 \times 10^{-3}\ A$

$V_T = 26\ mV = 26 \times 10^{-3}\ V$

Formula:

$r_d = V_T / I_D$

Substitute:

$r_d = (26 \times 10^{-3}) / (5 \times 10^{-3})$

Answer:

$r_d = 5.2\ \Omega$

QUESTION 11

11. A half-wave rectifier is driven by a sinusoidal voltage with a peak value of 15.7 V.

Assuming an ideal diode, what is the average DC output voltage?

Given:

$V_m = 15.7$ V

$\pi = 3.14$

Formula:

$V_{dc} = V_m / \pi$

Substitute:

$V_{dc} = 15.7 / 3.14$

Answer:

$V_{dc} = 5$ V

PRACTICE PROBLEM

Problem 1

A half-wave rectifier is driven by a sinusoidal voltage with a peak value of 10 V. Calculate the average DC output voltage.

Given:

$V_m = 10$ V

$\pi = 3.14$

Formula:

$V_{dc} = V_m / \pi$

Substitute:

$V_{dc} = 10 / 3.14$

Answer:

$V_{dc} = 3.18$ V

Problem 2

A half-wave rectifier is driven by a sinusoidal voltage with a peak value of 20 V. Calculate the average DC output voltage.

Given:

$V_m = 20$ V

$\pi = 3.14$

Formula:

$V_{dc} = V_m / \pi$

Substitute:

$V_{dc} = 20 / 3.14$

Answer:

$V_{dc} = 6.37$ V

Problem 3

A half-wave rectifier is driven by a sinusoidal voltage with a peak value of 12 V. Calculate the average DC output voltage.

Given:

$V_m = 12$ V

$\pi = 3.14$

Formula:

$V_{dc} = V_m / \pi$

Substitute:

$V_{dc} = 12 / 3.14$

Answer:

$V_{dc} = 3.82$ V

Problem 4

A half-wave rectifier is driven by a sinusoidal voltage with a peak value of 18 V. Calculate the average DC output voltage.

Given:

$V_m = 18$ V

$\pi = 3.14$

Formula:

$V_{dc} = V_m / \pi$

Substitute:

$V_{dc} = 18 / 3.14$

Answer:

$V_{dc} = 5.73$ V

Problem 5

A half-wave rectifier is driven by a sinusoidal voltage with a peak value of 25 V. Calculate the average DC output voltage.

Given:

$V_m = 25$ V

$\pi = 3.14$

Formula:

$V_{dc} = V_m / \pi$

Substitute:

$V_{dc} = 25 / 3.14$

Answer:

$V_{dc} = 7.96$ V

QUESTION 12

12. A bridge rectifier is fed with an AC input having a peak voltage of 31.4 V. Calculate the average DC voltage across the load (ignoring diode drops).

Given:

$V_m = 31.4$ V

$\pi = 3.14$

Formula:

$V_{dc} = 2V_m / \pi$

Substitute:

$V_{dc} = 2 \times 31.4 / 3.14$

Answer:

$V_{dc} = 20$ V

PRACTICE PROBLEM

Problem 1

A bridge rectifier is fed with an AC input having a peak voltage of 20 V. Calculate the average DC voltage across the load (ignoring diode drops).

Given:

$V_m = 20$ V

$\pi = 3.14$

Formula:

$V_{dc} = 2V_m / \pi$

Substitute:

$V_{dc} = 2 \times 20 / 3.14$

Answer:

$V_{dc} = 12.74$ V

Problem 2

A bridge rectifier is fed with an AC input having a peak voltage of 40 V. Calculate the average DC voltage across the load (ignoring diode drops).

Given:

$V_m = 40$ V

$\pi = 3.14$

Formula:

$V_{dc} = 2V_m / \pi$

Substitute:

$V_{dc} = 2 \times 40 / 3.14$

Answer:

$V_{dc} = 25.48$ V

Problem 3

A bridge rectifier is fed with an AC input having a peak voltage of 15 V. Calculate the average DC voltage across the load (ignoring diode drops).

Given:

$V_m = 15$ V

$\pi = 3.14$

Formula:

$V_{dc} = 2V_m / \pi$

Substitute:

$V_{dc} = 2 \times 15 / 3.14$

Answer:

$V_{dc} = 9.55$ V

Problem 4

A bridge rectifier is fed with an AC input having a peak voltage of 30 V. Calculate the average DC voltage across the load (ignoring diode drops).

Given:

$V_m = 30$ V

$\pi = 3.14$

Formula:

$V_{dc} = 2V_m / \pi$

Substitute:

$V_{dc} = 2 \times 30 / 3.14$

Answer:

$V_{dc} = 19.11$ V

Problem 5

A bridge rectifier is fed with an AC input having a peak voltage of 50 V. Calculate the average DC voltage across the load (ignoring diode drops).

Given:

$V_m = 50$ V

$\pi = 3.14$

Formula:

$V_{dc} = 2V_m / \pi$

Substitute:

$V_{dc} = 2 \times 50 / 3.14$

Answer:

$V_{dc} = 31.85$ V

QUESTION 13

13. A Bipolar Junction Transistor (BJT) has a common-base current gain (α) of 0.98.

Calculate its common-emitter current gain (β).

Given:

$\alpha = 0.98$

Formula:

$\beta = \alpha / (1 - \alpha)$

Substitute:

$\beta = 0.98 / (1 - 0.98)$

Answer:

$\beta = 49$

PRACTICE PROBLEM

Problem 1

A BJT has a common-base current gain (α) of 0.95. Calculate its common-emitter current gain (β).

Given:

$\alpha = 0.95$

Formula:

$\beta = \alpha / (1 - \alpha)$

Substitute:

$\beta = 0.95 / (1 - 0.95)$

Answer:

$\beta = 19$

Problem 2

A BJT has a common-base current gain (α) of 0.99. Calculate its common-emitter current gain (β).

Given:

$\alpha = 0.99$

Formula:

$\beta = \alpha / (1 - \alpha)$

Substitute:

$\beta = 0.99 / (1 - 0.99)$

Answer:

$\beta = 99$

Problem 3

A BJT has a common-base current gain (α) of 0.97. Calculate its common-emitter current gain (β). The source line additionally contains "A BJT has $\alpha = 0.96$. Calculate β."; the first stated case is used here.

Given:

$\alpha = 0.97$

Formula:

$\beta = \alpha / (1 - \alpha)$

Substitute:

$\beta = 0.97 / (1 - 0.97)$

Answer:

$\beta = 32.333$

Problem 4

A BJT has a common-base current gain (α) of 0.96. Calculate its common-emitter current gain (β).

Given:

$\alpha = 0.96$

Formula:

$\beta = \alpha / (1 - \alpha)$

Substitute:

$\beta = 0.96 / (1 - 0.96)$

Answer:

$\beta = 24$

Problem 5

A BJT has a common-base current gain (α) of 0.985. Calculate its common-emitter current gain (β).

Given:

$\alpha = 0.985$

Formula:

$\beta = \alpha / (1 - \alpha)$

Substitute:

$\beta = 0.985 / (1 - 0.985)$

Answer:

$\beta = 65.667$

QUESTION 14

14. In a CE amplifier, the collector current is 5 mA and the current gain (β) is 100.

Calculate the base current.

Given:

$I_C = 5$ mA

$\beta = 100$

Formula:

$I_B = I_C / \beta$

Substitute:

$I_B = 5 / 100$

Answer:

$I_B = 0.05$ mA = 50 µA

PRACTICE PROBLEM

Problem 1

In a CE amplifier, the collector current is 10 mA and the current gain (β) is 50. Calculate the base current.

Given:

$I_C = 10$ mA

$\beta = 50$

Formula:

$I_B = I_C / \beta$

Substitute:

$I_B = 10 / 50$

Answer:

$I_B = 0.2$ mA = 200 µA

Problem 2

In a CE amplifier, the collector current is 2 mA and the current gain (β) is 100. Calculate the base current.

Given:

$I_C = 2$ mA

$\beta = 100$

Formula:

$I_B = I_C / \beta$

Substitute:

$I_B = 2 / 100$

Answer:

$I_B = 0.02$ mA = 20 µA

Problem 3

In a CE amplifier, the collector current is 8 mA and the current gain (β) is 80. Calculate the base current.

Given:

$I_C = 8$ mA

$\beta = 80$

Formula:

$I_B = I_C / \beta$

Substitute:

$I_B = 8 / 80$

Answer:

$I_B = 0.1$ mA = 100 µA

Problem 4

In a CE amplifier, the collector current is 6 mA and the current gain (β) is 120. Calculate the base current.

Given:

$I_C = 6$ mA

$\beta = 120$

Formula:

$I_B = I_C / \beta$

Substitute:

$I_B = 6 / 120$

Answer:

$I_B = 0.05$ mA = 50 µA

Problem 5

In a CE amplifier, the collector current is 12 mA and the current gain (β) is 200. Calculate the base current.

Given:

$I_C = 12$ mA

$\beta = 200$

Formula:

$I_B = I_C / \beta$

Substitute:

$I_B = 12 / 200$

Answer:

$I_B = 0.06$ mA = 60 µA

QUESTION 15

15. A transistor has a base current of 40 µA and a collector current of 4 mA. Calculate the total emitter current.

Given:

$I_B = 40$ µA = 0.04 mA

$I_C = 4$ mA

Formula:

$I_E = I_B + I_C$

Substitute:

$I_E = 0.04 + 4$

Answer:

$I_E = 4.04$ mA

PRACTICE PROBLEM

Problem 1

A transistor has a base current of 50 µA and a collector current of 5 mA. Calculate the total emitter current.

Given:

$I_B = 50$ µA $= 0.05$ mA

$I_C = 5$ mA

Formula:

$I_E = I_B + I_C$

Substitute:

$I_E = 0.05 + 5$

Answer:

$I_E = 5.05$ mA

Problem 2

A transistor has a base current of 30 µA and a collector current of 3 mA. Calculate the total emitter current.

Given:

$I_B = 30$ µA $= 0.03$ mA

$I_C = 3$ mA

Formula:

$I_E = I_B + I_C$

Substitute:

$I_E = 0.03 + 3$

Answer:

$I_E = 3.03$ mA

Problem 3

A transistor has a base current of 20 µA and a collector current of 2 mA. Calculate the total emitter current.

Given:

$I_B = 20$ µA $= 0.02$ mA

$I_C = 2$ mA

Formula:

$I_E = I_B + I_C$

Substitute:

$I_E = 0.02 + 2$

Answer:

$I_E = 2.02$ mA

Problem 4

A transistor has a base current of 20 µA and a collector current of 2 mA. Calculate the total emitter current.

Given:

$I_B = 20$ µA $= 0.02$ mA

$I_C = 2$ mA

Formula:

$I_E = I_B + I_C$

Substitute:

$I_E = 0.02 + 2$

Answer:

$I_E = 2.02$ mA

Problem 5

A transistor has a base current of 60 µA and a collector current of 6 mA. Calculate the total emitter current.

Given:

$I_B = 60\ \mu A = 0.06\ mA$

$I_C = 6\ mA$

Formula:

$I_E = I_B + I_C$

Substitute:

$I_E = 0.06 + 6$

Answer:

$I_E = 6.06\ mA$

QUESTION 16

16. An inverting operational amplifier has an input resistor of 10 kΩ and a feedback resistor of 100 kΩ. If an input voltage of 0.5 V is applied, find the output voltage.

Given:

$R_{in} = 10\ k\Omega$

$R_f = 100\ k\Omega$

$V_{in} = 0.5\ V$

Formula:

$V_{out} = -(R_f/R_{in})V_{in}$

Substitute:

$V_{out} = -(100/10) \times 0.5$

Answer:

$V_{out} = -5\ V$

PRACTICE PROBLEM

Problem 1

An inverting operational amplifier has an input resistor of 5 kΩ and a feedback resistor of 50 kΩ.

If an input voltage of 1 V is applied, find the output voltage.

Given:

$R_{in} = 5\ k\Omega$

$R_f = 50\ k\Omega$

$V_{in} = 1\ V$

Formula:

$V_{out} = -(R_f/R_{in})V_{in}$

Substitute:

$V_{out} = -(50/5) \times 1$

Answer:

$V_{out} = -10\ V$

Problem 2

An inverting operational amplifier has an input resistor of 20 kΩ and a feedback resistor of 200 kΩ. If an input voltage of 0.2 V is applied, find the output voltage.

Given:

$R_{in} = 20\ k\Omega$

$R_f = 200\ k\Omega$

$V_{in} = 0.2\ V$

Formula:

$V_{out} = -(R_f/R_{in})V_{in}$

Substitute:

$V_{out} = -(200/20) \times 0.2$

Answer:

$V_{out} = -2$ V

Problem 3

An inverting operational amplifier has an input resistor of 2 kΩ and a feedback resistor of 20 kΩ. If an input voltage of 0.8 V is applied, find the output voltage.

Given:

$R_{in} = 2$ kΩ

$R_f = 20$ kΩ

$V_{in} = 0.8$ V

Formula:

$V_{out} = -(R_f/R_{in})V_{in}$

Substitute:

$V_{out} = -(20/2) \times 0.8$

Answer:

$V_{out} = -8$ V

Problem 4

An inverting operational amplifier has an input resistor of 10 kΩ and a feedback resistor of 50 kΩ. If an input voltage of 0.6 V is applied, find the output voltage.

Given:

$R_{in} = 10$ kΩ

$R_f = 50$ kΩ

$V_{in} = 0.6$ V

Formula:

$V_{out} = -(R_f/R_{in})V_{in}$

Substitute:

$V_{out} = -(50/10) \times 0.6$

Answer:

$V_{out} = -3$ V

Problem 5

An inverting operational amplifier has an input resistor of 1 kΩ and a feedback resistor of 10 kΩ.

If an input voltage of 0.4 V is applied, find the output voltage.

Given:

$R_{in} = 1$ kΩ

$R_f = 10$ kΩ

$V_{in} = 0.4$ V

Formula:

$V_{out} = -(R_f/R_{in})V_{in}$

Substitute:

$V_{out} = -(10/1) \times 0.4$

Answer:

$V_{out} = -4$ V

QUESTION 17

17. A non-inverting Op-Amp circuit has an input resistance of 5 kΩ and a feedback resistance of 20 kΩ. Calculate its closed-loop voltage gain.

Given:

$R_{in} = 5$ kΩ

$R_f = 20$ kΩ

Formula:

$A_v = 1 + (R_f/R_{in})$

Substitute:

$A_v = 1 + (20/5)$

Answer:

$A_v = 5$

PRACTICE PROBLEM

Problem 1

A non-inverting Op-Amp circuit has an input resistance of 10 kΩ and a feedback resistance of 40 kΩ. Calculate its closed-loop voltage gain.

Given:

$R_{in} = 10\ k\Omega$

$R_f = 40\ k\Omega$

Formula:

$A_v = 1 + (R_f/R_{in})$

Substitute:

$A_v = 1 + (40/10)$

Answer:

$A_v = 5$

Problem 2

A non-inverting Op-Amp circuit has an input resistance of 2 kΩ and a feedback resistance of 8 kΩ. Calculate its closed-loop voltage gain.

Given:

$R_{in} = 2\ k\Omega$

$R_f = 8\ k\Omega$

Formula:

$A_v = 1 + (R_f/R_{in})$

Substitute:

$A_v = 1 + (8/2)$

Answer:

$A_v = 5$

Problem 3

A non-inverting Op-Amp circuit has an input resistance of 4 kΩ and a feedback resistance of 16 kΩ. Calculate its closed-loop voltage gain.

Given:

$R_{in} = 4\ k\Omega$

$R_f = 16\ k\Omega$

Formula:

$A_v = 1 + (R_f/R_{in})$

Substitute:

$A_v = 1 + (16/4)$

Answer:

$A_v = 5$

Problem 4

A non-inverting Op-Amp circuit has an input resistance of 1 kΩ and a feedback resistance of 5 kΩ. Calculate its closed-loop voltage gain.

Given:

$R_{in} = 1\ k\Omega$

$R_f = 5\ k\Omega$

Formula:

$A_v = 1 + (R_f/R_{in})$

Substitute:

$A_v = 1 + (5/1)$

Answer:

$A_v = 6$

Problem 5

A non-inverting Op-Amp circuit has an input resistance of 5 kΩ and a feedback resistance of 25 kΩ. Calculate its closed-loop voltage gain.

Given:

$R_{in} = 5\ k\Omega$

$R_f = 25\ k\Omega$

Formula:

$A_v = 1 + (R_f/R_{in})$

Substitute:

$A_v = 1 + (25/5)$

Answer:

$A_v = 6$

QUESTION 18

18. An operational amplifier has a differential gain of 10^5 and a common-mode gain of 10. Calculate its CMRR in decibels (dB).

Given:

$A_d = 100000$

$A_c = 10$

Formula:

$CMRR(dB) = 20 \log_{10}(A_d/A_c)$

Substitute:

$CMRR = 20 \log_{10}(100000/10)$

Answer:

CMRR = 80 dB

PRACTICE PROBLEM

Problem 1

An operational amplifier has a differential gain of 10000 and a common-mode gain of 10.

Calculate its CMRR in decibels (dB).

Given:

$A_d = 10000$

$A_c = 10$

Formula:

$CMRR(dB) = 20 \log_{10}(A_d/A_c)$

Substitute:

$CMRR = 20 \log_{10}(10000/10)$

Answer:

CMRR = 60 dB

Problem 2

An operational amplifier has a differential gain of 100000 and a common-mode gain of 5.

Calculate its CMRR in decibels (dB).

Given:

$A_d = 100000$

$A_c = 5$

Formula:

$CMRR(dB) = 20 \log_{10}(A_d/A_c)$

Substitute:

$CMRR = 20 \log_{10}(100000/5)$

Answer:

CMRR = 86.02 dB

Problem 3

An operational amplifier has a differential gain of 50000 and a common-mode gain of 10.

Calculate its CMRR in decibels (dB).

Given:

$A_d = 50000$

$A_c = 10$

Formula:

$CMRR(dB) = 20 \log_{10}(A_d/A_c)$

Substitute:

$CMRR = 20 \log_{10}(50000/10)$

Answer:

CMRR = 73.98 dB

Problem 4

An operational amplifier has a differential gain of 200000 and a common-mode gain of 10.

Calculate its CMRR in decibels (dB).

Given:

$A_d = 200000$

$A_c = 10$

Formula:

$CMRR(dB) = 20 \log_{10}(A_d/A_c)$

Substitute:

$CMRR = 20 \log_{10}(200000/10)$

Answer:

CMRR = 86.02 dB

Problem 5

An operational amplifier has a differential gain of 100000 and a common-mode gain of 20.

Calculate its CMRR in decibels (dB).

Given:

$A_d = 100000$

$A_c = 20$

Formula:

$CMRR(dB) = 20 \log_{10}(A_d/A_c)$

Substitute:

$CMRR = 20 \log_{10}(100000/20)$

Answer:

CMRR = 73.98 dB

QUESTION 19

19. A 555 timer is configured as an astable multivibrator with R_A = 10 kΩ, R_B = 10 kΩ, and C = 1 µF. Calculate the frequency of oscillation.

Given:

$R_A = 10\ k\Omega$

$R_B = 10\ k\Omega$

$C = 1\ \mu F$

Formula:

$f = 1.44 / [(R_A + 2R_B)C]$

Substitute:

$f = 1.44 / [((10 + 2\times10)\times10^3) \times (1\times10^{-6})]$

Answer:

f = 48 Hz

PRACTICE PROBLEM

Problem 1

A 555 timer is configured as an astable multivibrator with $R_A = 5\ k\Omega$, $R_B = 10\ k\Omega$, and $C = 1\ \mu F$. Calculate the frequency of oscillation.

Given:

$R_A = 5\ k\Omega$

$R_B = 10\ k\Omega$

$C = 1\ \mu F$

Formula:

$$f = 1.44 / [(R_A + 2R_B)C]$$

Substitute:

$$f = 1.44 / [((5 + 2\times10)\times10^{3}) \times (1\times10^{-6})]$$

Answer:

$f = 57.6\ Hz$

Problem 2

A 555 timer is configured as an astable multivibrator with $R_A = 10\ k\Omega$, $R_B = 20\ k\Omega$, and $C = 2\ \mu F$. Calculate the frequency of oscillation.

Given:

$R_A = 10\ k\Omega$

$R_B = 20\ k\Omega$

$C = 2\ \mu F$

Formula:

$$f = 1.44 / [(R_A + 2R_B)C]$$

Substitute:

$$f = 1.44 / [((10 + 2\times20)\times10^{3}) \times (2\times10^{-6})]$$

Answer:

f = 14.4 Hz

Problem 3

A 555 timer is configured as an astable multivibrator with R_A = 8 kΩ, R_B = 12 kΩ, and C = 1 µF. Calculate the frequency of oscillation.

Given:

R_A = 8 kΩ

R_B = 12 kΩ

C = 1 µF

Formula:

f = 1.44 / [(R_A + 2R_B)C]

Substitute:

f = 1.44 / [((8 + 2×12)×10³) × (1×10⁻⁶)]

Answer:

f = 45 Hz

Problem 4

A 555 timer is configured as an astable multivibrator with R_A = 15 kΩ, R_B = 10 kΩ, and C = 0.5 µF. Calculate the frequency of oscillation.

Given:

R_A = 15 kΩ

R_B = 10 kΩ

C = 0.5 µF

Formula:

f = 1.44 / [(R_A + 2R_B)C]

Substitute:

f = 1.44 / [((15 + 2×10)×10³) × (0.5×10⁻⁶)]

Answer:

f = 82.29 Hz

Problem 5

A 555 timer is configured as an astable multivibrator with R_A = 10 kΩ, R_B = 15 kΩ, and C = 1 µF. Calculate the frequency of oscillation.

Given:

R_A = 10 kΩ

R_B = 15 kΩ

C = 1 µF

Formula:

$f = 1.44 / [(R_A + 2R_B)C]$

Substitute:

$f = 1.44 / [((10 + 2\times15)\times10^{3}) \times (1\times10^{-6})]$

Answer:

f = 36 Hz

QUESTION 20

20. Simplify the Boolean expression $Y = A\bar{B} + AB$.

Given:

$Y = A\bar{B} + AB$

Formula:

$X\cdot\bar{Y} + X\cdot Y = X(\bar{Y} + Y)$

$\bar{Y} + Y = 1$

Substitute:

$Y = A(\bar{B} + B)$

$Y = A \times 1$

Answer:

$Y = A$

PRACTICE PROBLEM

Problem 1

Simplify the Boolean expression $Y = C\bar{A} + CA$.

Given:

$Y = C\bar{A} + CA$

Formula:

$X \cdot \bar{Y} + X \cdot Y = X(\bar{Y} + Y)$

$\bar{Y} + Y = 1$

Substitute:

$Y = C(\bar{A} + A)$

$Y = C \times 1$

Answer:

$Y = C$

Problem 2

Simplify the Boolean expression $Y = D\bar{B} + DB$.

Given:

$Y = D\bar{B} + DB$

Formula:

$X \cdot \bar{Y} + X \cdot Y = X(\bar{Y} + Y)$

$\bar{Y} + Y = 1$

Substitute:

$Y = D(\bar{B} + B)$

$Y = D \times 1$

Answer:

$Y = D$

Problem 3

Simplify the Boolean expression $Y = A\overline{C} + AC$.

Given:

$Y = A\overline{C} + AC$

Formula:

$X \cdot \overline{Y} + X \cdot Y = X(\overline{Y} + Y)$

$\overline{Y} + Y = 1$

Substitute:

$Y = A(\overline{C} + C)$

$Y = A \times 1$

Answer:

$Y = A$

Problem 4

Simplify the Boolean expression $Y = E\overline{F} + EF$.

Given:

$Y = E\overline{F} + EF$

Formula:

$X \cdot \overline{Y} + X \cdot Y = X(\overline{Y} + Y)$

$\overline{Y} + Y = 1$

Substitute:

$Y = E(\overline{F} + F)$

$Y = E \times 1$

Answer:

$Y = E$

Problem 5

Simplify the Boolean expression $Y = G\overline{H} + GH$.

Given:

$Y = G\overline{H} + GH$

Formula:

$X \cdot \overline{Y} + X \cdot Y = X(\overline{Y} + Y)$

$\overline{Y} + Y = 1$

Substitute:

$Y = G(\overline{H} + H)$

$Y = G \times 1$

Answer:

$Y = G$

QUESTION 21

21. A 10 V Zener diode is used in a simple voltage regulator circuit. The input DC voltage is 15 V, and the series resistance is 100 Ω. Calculate the Zener current, assuming there is no load connected.

Given:

$V_{in} = 15\ V$

$V_Z = 10\ V$

$R_S = 100\ \Omega$

Formula:

$I_Z = (V_{in} - V_Z) / R_S$

Substitute:

$I_Z = (15 - 10) / 100$

Answer:

$I_Z = 0.05\ A = 50\ mA$

PRACTICE PROBLEM

Problem 1

A 12 V Zener diode is used in a simple voltage regulator circuit. The input DC voltage is 18 V, and the series resistance is 120 Ω. Calculate the Zener current, assuming there is no load connected.

Given:

$V_{in} = 18\ V$

$V_Z = 12\ V$

$R_S = 120\ \Omega$

Formula:

$I_Z = (V_{in} - V_Z) / R_S$

Substitute:

$I_Z = (18 - 12) / 120$

Answer:

$I_Z = 0.05\ A = 50\ mA$

Problem 2

A 5 V Zener diode is used in a simple voltage regulator circuit. The input DC voltage is 10 V, and the series resistance is 100 Ω. Calculate the Zener current, assuming there is no load connected.

Given:

$V_{in} = 10\ V$

$V_Z = 5\ V$

$R_S = 100\ \Omega$

Formula:

$I_Z = (V_{in} - V_Z) / R_S$

Substitute:

$I_Z = (10 - 5) / 100$

Answer:

$I_Z = 0.05$ A = 50 mA

Problem 3

A 8 V Zener diode is used in a simple voltage regulator circuit. The input DC voltage is 12 V, and the series resistance is 80 Ω. Calculate the Zener current, assuming there is no load connected.

Given:

$V_{in} = 12$ V

$V_Z = 8$ V

$R_S = 80$ Ω

Formula:

$I_Z = (V_{in} - V_Z) / R_S$

Substitute:

$I_Z = (12 - 8) / 80$

Answer:

$I_Z = 0.05$ A = 50 mA

Problem 4

A 15 V Zener diode is used in a simple voltage regulator circuit. The input DC voltage is 20 V, and the series resistance is 200 Ω. Calculate the Zener current, assuming there is no load connected.

Given:

$V_{in} = 20$ V

$V_Z = 15\ V$

$R_S = 200\ \Omega$

Formula:

$I_Z = (V_{in} - V_Z) / R_S$

Substitute:

$I_Z = (20 - 15) / 200$

Answer:

$I_Z = 0.025\ A = 25\ mA$

Problem 5

A 6 V Zener diode is used in a simple voltage regulator circuit. The input DC voltage is 12 V, and the series resistance is 60 Ω. Calculate the Zener current, assuming there is no load connected.

Given:

$V_{in} = 12\ V$

$V_Z = 6\ V$

$R_S = 60\ \Omega$

Formula:

$I_Z = (V_{in} - V_Z) / R_S$

Substitute:

$I_Z = (12 - 6) / 60$

Answer:

$I_Z = 0.1\ A = 100\ mA$

QUESTION 22

22. An AC circuit has a resistance of 30 Ω and an inductive reactance of 40 Ω in series. Calculate the power factor of the circuit.

Given:

$R = 30\ \Omega$

$X_L = 40\ \Omega$

Formula:

$Z = \sqrt{(R^2 + X_L^2)}$

Power factor = R/Z

Substitute:

$Z = \sqrt{(30^2 + 40^2)} = 50\ \Omega$

pf = 30/50

Answer:

pf = 0.6 (lagging)

PRACTICE PROBLEM

Problem 1

An AC circuit has a resistance of 20 Ω and an inductive reactance of 30 Ω in series. Calculate the power factor of the circuit.

Given:

$R = 20\ \Omega$

$X_L = 30\ \Omega$

Formula:

$Z = \sqrt{(R^2 + X_L^2)}$

Power factor = R/Z

Substitute:

$Z = \sqrt{(20^2 + 30^2)} = 36.056\ \Omega$

pf = 20/36.056

Answer:

pf = 0.555 (lagging)

Problem 2

An AC circuit has a resistance of 50 Ω and an inductive reactance of 50 Ω in series. Calculate the power factor of the circuit.

Given:

$R = 50\ \Omega$

$X_L = 50\ \Omega$

Formula:

$Z = \sqrt{(R^2 + X_L^2)}$

Power factor = R/Z

Substitute:

$Z = \sqrt{(50^2 + 50^2)} = 70.711\ \Omega$

pf = 50/70.711

Answer:

pf = 0.707 (lagging)

Problem 3

An AC circuit has a resistance of 40 Ω and an inductive reactance of 30 Ω in series. Calculate the power factor of the circuit.

Given:

$R = 40\ \Omega$

$X_L = 30\ \Omega$

Formula:

$Z = \sqrt{(R^2 + X_L^2)}$

Power factor = R/Z

Substitute:

$Z = \sqrt{(40^2 + 30^2)} = 50\ \Omega$

pf = 40/50

Answer:

pf = 0.8 (lagging)

Problem 4

An AC circuit has a resistance of 60 Ω and an inductive reactance of 80 Ω in series. Calculate the power factor of the circuit.

Given:

R = 60 Ω

X_L = 80 Ω

Formula:

$Z = \sqrt{(R^2 + X_L^2)}$

Power factor = R/Z

Substitute:

$Z = \sqrt{(60^2 + 80^2)} = 100\ \Omega$

pf = 60/100

Answer:

pf = 0.6 (lagging)

Problem 5

An AC circuit has a resistance of 25 Ω and an inductive reactance of 25 Ω in series. Calculate the power factor of the circuit.

Given:

R = 25 Ω

X_L = 25 Ω

Formula:

$Z = \sqrt{(R^2 + X_L^2)}$

Power factor = R/Z

Substitute:

$Z = \sqrt{(25^2 + 25^2)} = 35.355\ \Omega$

pf = 25/35.355

Answer:

pf = 0.707 (lagging)

QUESTION 23

23. Convert the binary number 1011_2 into its decimal equivalent.

Given:

Binary number = 1011_2

Formula:

Decimal = $\Sigma(d_i \times 2^i)$

Substitute:

Decimal = (1×2^3) + (0×2^2) + (1×2^1) + (1×2^0)

Decimal = 11

Answer:

Decimal = 11_{10}

PRACTICE PROBLEM

Problem 1

Convert the binary number 1101_2 into its decimal equivalent.

Given:

Binary number = 1101_2

Formula:

Decimal = $\Sigma(d_i \times 2^i)$

Substitute:

Decimal = (1×2^3) + (1×2^2) + (0×2^1) + (1×2^0)

Decimal = 13

Answer:

Decimal = 13_{10}

Problem 2

Convert the binary number 1010_2 into its decimal equivalent.

Given:

Binary number = 1010_2

Formula:

Decimal = $\Sigma(d_i \times 2^i)$

Substitute:

Decimal = (1×2^3) + (0×2^2) + (1×2^1) + (0×2^0)

Decimal = 10

Answer:

Decimal = 10_{10}

Problem 3

Convert the binary number 1110_2 into its decimal equivalent.

Given:

Binary number = 1110_2

Formula:

Decimal = $\Sigma(d_i \times 2^i)$

Substitute:

Decimal = (1×2^3) + (1×2^2) + (1×2^1) + (0×2^0)

Decimal = 14

Answer:

Decimal = 14_{10}

Problem 4

Convert the binary number 1001_2 into its decimal equivalent.

Given:

Binary number = 1001_2

Formula:

Decimal = $\Sigma(d_i \times 2^i)$

Substitute:

Decimal = (1×2^3) + (0×2^2) + (0×2^1) + (1×2^0)

Decimal = 9

Answer:

Decimal = 9_{10}

Problem 5

Convert the binary number 0111_2 into its decimal equivalent.

Given:

Binary number = 0111_2

Formula:

Decimal = $\Sigma(d_i \times 2^i)$

Substitute:

Decimal = (0×2^3) + (1×2^2) + (1×2^1) + (1×2^0)

Decimal = 7

Answer:

Decimal = 7_{10}

QUESTION 24

24. The output of an operational amplifier changes by 10 V in 2 μs in response to a step input. Calculate its Slew Rate.

Given:

$\Delta V_out = 10$ V

$\Delta t = 2$ µs

Formula:

Slew Rate = $\Delta V_out / \Delta t$

Substitute:

SR = 10/2

Answer:

SR = 5 V/µs

PRACTICE PROBLEM

Problem 1

The output of an operational amplifier changes by 8 V in 2 µs in response to a step input.

Calculate its Slew Rate.

Given:

$\Delta V_out = 8$ V

$\Delta t = 2$ µs

Formula:

Slew Rate = $\Delta V_out / \Delta t$

Substitute:

SR = 8/2

Answer:

SR = 4 V/µs

Problem 2

The output of an operational amplifier changes by 12 V in 3 µs in response to a step input.

Calculate its Slew Rate.

Given:

$\Delta V_out = 12$ V

$\Delta t = 3$ µs

Formula:

Slew Rate = $\Delta V_out / \Delta t$

Substitute:

SR = 12/3

Answer:

SR = 4 V/µs

Problem 3

The output of an operational amplifier changes by 15 V in 5 µs in response to a step input.

Calculate its Slew Rate.

Given:

$\Delta V_out = 15$ V

$\Delta t = 5$ µs

Formula:

Slew Rate = $\Delta V_out / \Delta t$

Substitute:

SR = 15/5

Answer:

SR = 3 V/µs

Problem 4

The output of an operational amplifier changes by 6 V in 1 µs in response to a step input.

Calculate its Slew Rate.

Given:

$\Delta V_out = 6$ V

$\Delta t = 1\ \mu s$

Formula:

Slew Rate = $\Delta V_out / \Delta t$

Substitute:

SR = 6/1

Answer:

SR = 6 V/μs

Problem 5

The output of an operational amplifier changes by 20 V in 4 μs in response to a step input.

Calculate its Slew Rate.

Given:

$\Delta V_out = 20\ V$

$\Delta t = 4\ \mu s$

Formula:

Slew Rate = $\Delta V_out / \Delta t$

Substitute:

SR = 20/4

Answer:

SR = 5 V/μs

QUESTION 25

25. An oscillator circuit has a feedback fraction (β) of 0.05. For sustained oscillations, what must be the minimum open-loop voltage gain (A_v) of the amplifier?

Given:

$\beta = 0.05$

Formula:

$|A_v\beta| = 1 \rightarrow A_v = 1/\beta$

Substitute:

$A_v = 1/0.05$

Answer:

$A_v = 20$

PRACTICE PROBLEM

Problem 1

An oscillator circuit has a feedback fraction (β) of 0.1. For sustained oscillations, what must be the minimum open-loop voltage gain (A_v) of the amplifier?

Given:

$\beta = 0.1$

Formula:

$|A_v\beta| = 1 \rightarrow A_v = 1/\beta$

Substitute:

$A_v = 1/0.1$

Answer:

$A_v = 10$

Problem 2

An oscillator circuit has a feedback fraction (β) of 0.02. For sustained oscillations, what must be the minimum open-loop voltage gain (A_v) of the amplifier?

Given:

$\beta = 0.02$

Formula:

$|A_v\beta| = 1 \rightarrow A_v = 1/\beta$

Substitute:

$A_v = 1/0.02$

Answer:

$A_v = 50$

Problem 3

An oscillator circuit has a feedback fraction (β) of 0.05. For sustained oscillations, what must be the minimum open-loop voltage gain (A_v) of the amplifier?

Given:

$\beta = 0.05$

Formula:

$|A_v\beta| = 1 \rightarrow A_v = 1/\beta$

Substitute:

$A_v = 1/0.05$

Answer:

$A_v = 20$

Problem 4

An oscillator circuit has a feedback fraction (β) of 0.25. For sustained oscillations, what must be the minimum open-loop voltage gain (A_v) of the amplifier?

Given:

$\beta = 0.25$

Formula:

$|A_v\beta| = 1 \rightarrow A_v = 1/\beta$

Substitute:

$A_v = 1/0.25$

Answer:

$A_v = 4$

Problem 5

An oscillator circuit has a feedback fraction (β) of 0.01. For sustained oscillations, what must be the minimum open-loop voltage gain (A_v) of the amplifier?

Given:

$\beta = 0.01$

Formula:

$|A_v\beta| = 1 \rightarrow A_v = 1/\beta$

Substitute:

$A_v = 1/0.01$

Answer:

$A_v = 100$

QUESTION 26

26. An AM wave has a maximum peak-to-peak voltage of 10 V and a minimum peak-to-peak voltage of 2 V. Calculate the modulation index (μ).

Given:

$V_{max} = 10$ V

$V_{min} = 2$ V

Formula:

$\mu = (V_{max} - V_{min})/(V_{max} + V_{min})$

Substitute:

$\mu = (10 - 2)/(10 + 2)$

Answer:

$\mu = 0.667 = 66.7\%$

PRACTICE PROBLEM

Problem 1

An AM wave has a maximum peak-to-peak voltage of 12 V and a minimum peak-to-peak voltage of 4 V. Calculate the modulation index (μ).

Given:

$V_{max} = 12$ V

$V_{min} = 4$ V

Formula:

$\mu = (V_{max} - V_{min})/(V_{max} + V_{min})$

Substitute:

$\mu = (12 - 4)/(12 + 4)$

Answer:

$\mu = 0.5 = 50\%$

Problem 2

An AM wave has a maximum peak-to-peak voltage of 15 V and a minimum peak-to-peak voltage of 5 V. Calculate the modulation index (μ).

Given:

$V_{max} = 15$ V

$V_{min} = 5$ V

Formula:

$\mu = (V_{max} - V_{min})/(V_{max} + V_{min})$

Substitute:

$\mu = (15 - 5)/(15 + 5)$

Answer:

$\mu = 0.5 = 50\%$

Problem 3

An AM wave has a maximum peak-to-peak voltage of 8 V and a minimum peak-to-peak voltage of 2 V. Calculate the modulation index (μ).

Given:

$V_{max} = 8$ V

$V_{min} = 2$ V

Formula:

$$\mu = (V_{max} - V_{min})/(V_{max} + V_{min})$$

Substitute:

$$\mu = (8 - 2)/(8 + 2)$$

Answer:

$\mu = 0.6 = 60\%$

Problem 4

An AM wave has a maximum peak-to-peak voltage of 20 V and a minimum peak-to-peak voltage of 10 V. Calculate the modulation index (μ).

Given:

$V_{max} = 20$ V

$V_{min} = 10$ V

Formula:

$$\mu = (V_{max} - V_{min})/(V_{max} + V_{min})$$

Substitute:

$$\mu = (20 - 10)/(20 + 10)$$

Answer:

$\mu = 0.333 = 33.3\%$

Problem 5

An AM wave has a maximum peak-to-peak voltage of 9 V and a minimum peak-to-peak voltage of 3 V. Calculate the modulation index (μ).

Given:

$V_{max} = 9$ V

$V_{min} = 3$ V

Formula:

$$\mu = (V_{max} - V_{min})/(V_{max} + V_{min})$$

Substitute:

$$\mu = (9 - 3)/(9 + 3)$$

Answer:

$\mu = 0.5 = 50\%$

QUESTION 27

27. A carrier wave is amplitude modulated by an audio signal with a maximum frequency of 5 kHz. Calculate the bandwidth of the transmitted AM signal.

Given:

$f_m = 5$ kHz

Formula:

$BW = 2f_m$

Substitute:

$BW = 2 \times 5$

Answer:

BW = 10 kHz

PRACTICE PROBLEM

Problem 1

A carrier wave is amplitude modulated by an audio signal with a maximum frequency of 3 kHz.

Calculate the bandwidth of the transmitted AM signal.

Given:

$f_m = 3$ kHz

Formula:

$BW = 2f_m$

Substitute:

$BW = 2 \times 3$

Answer:

$BW = 6$ kHz

Problem 2

A carrier wave is amplitude modulated by an audio signal with a maximum frequency of 8 kHz.

Calculate the bandwidth of the transmitted AM signal.

Given:

$f_m = 8$ kHz

Formula:

$BW = 2f_m$

Substitute:

$BW = 2 \times 8$

Answer:

$BW = 16$ kHz

Problem 3

A carrier wave is amplitude modulated by an audio signal with a maximum frequency of 10 kHz.

Calculate the bandwidth of the transmitted AM signal.

Given:

$f_m = 10$ kHz

Formula:

$BW = 2f_m$

Substitute:

$BW = 2 \times 10$

Answer:

$BW = 20$ kHz

Problem 4

A carrier wave is amplitude modulated by an audio signal with a maximum frequency of 6 kHz.

Calculate the bandwidth of the transmitted AM signal.

Given:

$f_m = 6$ kHz

Formula:

$BW = 2f_m$

Substitute:

$BW = 2 \times 6$

Answer:

$BW = 12$ kHz

Problem 5

A carrier wave is amplitude modulated by an audio signal with a maximum frequency of 12 kHz.

Calculate the bandwidth of the transmitted AM signal.

Given:

$f_m = 12$ kHz

Formula:

$BW = 2f_m$

Substitute:

BW = 2 × 12

Answer:

BW = 24 kHz

QUESTION 28

28. A circuit has a Thevenin equivalent voltage (V_th) of 20 V and a Thevenin resistance (R_th) of 5 Ω. Calculate the Norton equivalent current (I_N).

Given:

V_th = 20 V

R_th = 5 Ω

Formula:

I_N = V_th / R_th

Substitute:

I_N = 20/5

Answer:

I_N = 4 A

PRACTICE PROBLEM

Problem 1

A circuit has a Thevenin equivalent voltage (V_th) of 10 V and a Thevenin resistance (R_th) of 2 Ω. Calculate the Norton equivalent current (I_N).

Given:

V_th = 10 V

R_th = 2 Ω

Formula:

I_N = V_th / R_th

Substitute:

$I_N = 10/2$

Answer:

$I_N = 5$ A

Problem 2

A circuit has a Thevenin equivalent voltage (V_{th}) of 15 V and a Thevenin resistance (R_{th}) of 3 Ω. Calculate the Norton equivalent current (I_N).

Given:

$V_{th} = 15$ V

$R_{th} = 3$ Ω

Formula:

$I_N = V_{th} / R_{th}$

Substitute:

$I_N = 15/3$

Answer:

$I_N = 5$ A

Problem 3

A circuit has a Thevenin equivalent voltage (V_{th}) of 25 V and a Thevenin resistance (R_{th}) of 5 Ω. Calculate the Norton equivalent current (I_N).

Given:

$V_{th} = 25$ V

$R_{th} = 5$ Ω

Formula:

$I_N = V_{th} / R_{th}$

Substitute:

$I_N = 25/5$

Answer:

$I_N = 5$ A

Problem 4

A circuit has a Thevenin equivalent voltage (V_{th}) of 30 V and a Thevenin resistance (R_{th}) of 10 Ω. Calculate the Norton equivalent current (I_N).

Given:

$V_{th} = 30$ V

$R_{th} = 10$ Ω

Formula:

$I_N = V_{th} / R_{th}$

Substitute:

$I_N = 30/10$

Answer:

$I_N = 3$ A

Problem 5

A circuit has a Thevenin equivalent voltage (V_{th}) of 12 V and a Thevenin resistance (R_{th}) of 4 Ω. Calculate the Norton equivalent current (I_N).

Given:

$V_{th} = 12$ V

$R_{th} = 4$ Ω

Formula:

$I_N = V_{th} / R_{th}$

Substitute:

$I_N = 12/4$

Answer:

$I_N = 3$ A

QUESTION 29

29. An Op-Amp integrator circuit uses an input resistor of 100 kΩ and a feedback capacitor of 10 µF. Calculate the time constant of the circuit.

Given:

R = 100 kΩ

C = 10 µF

Formula:

$\tau = RC$

Substitute:

$\tau = (100 \times 10^{3})(10 \times 10^{-6})$

Answer:

$\tau = 1$ s

PRACTICE PROBLEM

Problem 1

An Op-Amp integrator circuit uses an input resistor of 50 kΩ and a feedback capacitor of 10 µF. Calculate the time constant of the circuit.

Given:

R = 50 kΩ

C = 10 µF

Formula:

$\tau = RC$

Substitute:

$\tau = (50 \times 10^{3})(10 \times 10^{-6})$

Answer:

$\tau = 0.5$ s

Problem 2

An Op-Amp integrator circuit uses an input resistor of 200 kΩ and a feedback capacitor of 5 µF. Calculate the time constant of the circuit.

Given:

$R = 200\ k\Omega$

$C = 5\ \mu F$

Formula:

$\tau = RC$

Substitute:

$\tau = (200\times10^{3})(5\times10^{-6})$

Answer:

$\tau = 1\ s$

Problem 3

An Op-Amp integrator circuit uses an input resistor of 100 kΩ and a feedback capacitor of 20 µF. Calculate the time constant of the circuit.

Given:

$R = 100\ k\Omega$

$C = 20\ \mu F$

Formula:

$\tau = RC$

Substitute:

$\tau = (100\times10^{3})(20\times10^{-6})$

Answer:

$\tau = 2\ s$

Problem 4

An Op-Amp integrator circuit uses an input resistor of 150 kΩ and a feedback capacitor of 10 µF. Calculate the time constant of the circuit.

Given:

R = 150 kΩ

C = 10 µF

Formula:

$\tau = RC$

Substitute:

$\tau = (150\times10^{3})(10\times10^{-6})$

Answer:

$\tau = 1.5$ s

Problem 5

An Op-Amp integrator circuit uses an input resistor of 80 kΩ and a feedback capacitor of 12 µF. Calculate the time constant of the circuit.

Given:

R = 80 kΩ

C = 12 µF

Formula:

$\tau = RC$

Substitute:

$\tau = (80\times10^{3})(12\times10^{-6})$

Answer:

$\tau = 0.96$ s

QUESTION 30

30. A Common Emitter transistor amplifier has an AC current gain (β) of 50, an input AC resistance of 1 kΩ, and an effective collector load resistance of 2 kΩ. Calculate the voltage gain.

Given:

$\beta = 50$

$R_{in} = 1\ k\Omega$

$R_C = 2\ k\Omega$

Formula:

$A_v = -\beta(R_C/R_{in})$

Substitute:

$A_v = -50 \times (2/1)$

Answer:

$A_v = -100$

PRACTICE PROBLEM

Problem 1

A Common Emitter transistor amplifier has an AC current gain (β) of 100, an input AC resistance of 2 kΩ, and an effective collector load resistance of 4 kΩ. Calculate the voltage gain.

Given:

$\beta = 100$

$R_{in} = 2\ k\Omega$

$R_C = 4\ k\Omega$

Formula:

$A_v = -\beta(R_C/R_{in})$

Substitute:

$A_v = -100 \times (4/2)$

Answer:

$A_v = -200$

Problem 2

A Common Emitter transistor amplifier has an AC current gain (β) of 40, an input AC resistance of 1 kΩ, and an effective collector load resistance of 2 kΩ. Calculate the voltage gain.

Given:

$\beta = 40$

$R_{in} = 1\ k\Omega$

$R_C = 2\ k\Omega$

Formula:

$A_v = -\beta(R_C/R_{in})$

Substitute:

$A_v = -40 \times (2/1)$

Answer:

$A_v = -80$

Problem 3

A Common Emitter transistor amplifier has an AC current gain (β) of 50, an input AC resistance of 2 kΩ, and an effective collector load resistance of 3 kΩ. Calculate the voltage gain.

Given:

$\beta = 50$

$R_{in} = 2\ k\Omega$

$R_C = 3\ k\Omega$

Formula:

$A_v = -\beta(R_C/R_{in})$

Substitute:

$A_v = -50 \times (3/2)$

Answer:

$A_v = -75$

Problem 4

A Common Emitter transistor amplifier has an AC current gain (β) of 60, an input AC resistance of 1 kΩ, and an effective collector load resistance of 2 kΩ. Calculate the voltage gain.

Given:

$\beta = 60$

$R_{in} = 1\ k\Omega$

$R_C = 2\ k\Omega$

Formula:

$A_v = -\beta(R_C/R_{in})$

Substitute:

$A_v = -60 \times (2/1)$

Answer:

$A_v = -120$

Problem 5

A Common Emitter transistor amplifier has an AC current gain (β) of 80, an input AC resistance of 1 kΩ, and an effective collector load resistance of 2 kΩ. Calculate the voltage gain.

Given:

$\beta = 80$

$R_{in} = 1\ k\Omega$

$R_C = 2\ k\Omega$

Formula:

$A_v = -\beta(R_C/R_{in})$

Substitute:

$A_v = -80 \times (2/1)$

Answer:

$A_v = -160$

QUESTION 31

31. An RC phase shift oscillator uses 3 identical RC sections in its feedback network. If R = 10 kΩ and C = 0.001 µF, find the frequency of oscillation.

Given:

R = 10 kΩ

C = 0.001 µF

Formula:

$f = 1/(2\pi RC\sqrt{6})$

Substitute:

$f = 1/[2 \times 3.1416 \times (10\times10^{3}) \times (0.001\times10^{-6}) \times \sqrt{6}]$

Answer:

f = 6497.46 Hz = 6.497 kHz

PRACTICE PROBLEM

Problem 1

An RC phase shift oscillator uses 3 identical RC sections. If R = 20 kΩ and C = 0.001 µF, find the frequency of oscillation.

Given:

R = 20 kΩ

C = 0.001 µF

Formula:

$f = 1/(2\pi RC\sqrt{6})$

Substitute:

$f = 1/[2 \times 3.1416 \times (20\times10^{3}) \times (0.001\times10^{-6}) \times \sqrt{6}]$

Answer:

f = 3248.73 Hz = 3.249 kHz

Problem 2

An RC phase shift oscillator uses 3 identical RC sections. If R = 10 kΩ and C = 0.002 μF, find the frequency of oscillation.

Given:

R = 10 kΩ

C = 0.002 μF

Formula:

$f = 1/(2\pi RC\sqrt{6})$

Substitute:

$f = 1/[2 \times 3.1416 \times (10\times10^{3}) \times (0.002\times10^{-6}) \times \sqrt{6}]$

Answer:

f = 3248.73 Hz = 3.249 kHz

Problem 3

An RC phase shift oscillator uses 3 identical RC sections. If R = 15 kΩ and C = 0.001 μF, find the frequency of oscillation.

Given:

R = 15 kΩ

C = 0.001 μF

Formula:

$f = 1/(2\pi RC\sqrt{6})$

Substitute:

$f = 1/[2 \times 3.1416 \times (15\times10^{3}) \times (0.001\times10^{-6}) \times \sqrt{6}]$

Answer:

f = 4331.64 Hz = 4.332 kHz

Problem 4

An RC phase shift oscillator uses 3 identical RC sections. If R = 12 kΩ and C = 0.0015 μF, find the frequency of oscillation.

Given:

R = 12 kΩ

C = 0.0015 μF

Formula:

$f = 1/(2\pi RC\sqrt{6})$

Substitute:

$f = 1/[2 \times 3.1416 \times (12\times10^{3}) \times (0.0015\times10^{-6}) \times \sqrt{6}]$

Answer:

f = 3609.7 Hz = 3.61 kHz

Problem 5

An RC phase shift oscillator uses 3 identical RC sections. If R = 8 kΩ and C = 0.001 μF, find the frequency of oscillation.

Given:

R = 8 kΩ

C = 0.001 μF

Formula:

$f = 1/(2\pi RC\sqrt{6})$

Substitute:

$f = 1/[2 \times 3.1416 \times (8\times10^{3}) \times (0.001\times10^{-6}) \times \sqrt{6}]$

Answer:

f = 8121.82 Hz = 8.122 kHz

QUESTION 32

32. Convert the hexadecimal number $1A_{16}$ into its decimal equivalent.

Given:

Hexadecimal number = $1A_{16}$

Formula:

Decimal = $\Sigma(d_i \times 16^i)$

Substitute:

$1A_{16} = 26_{10}$

Answer:

Decimal = 26

PRACTICE PROBLEM

Problem 1

Convert the hexadecimal number $2F_{16}$ into its decimal equivalent.

Given:

Hexadecimal number = $2F_{16}$

Formula:

Decimal = $\Sigma(d_i \times 16^i)$

Substitute:

$2F_{16} = 47_{10}$

Answer:

Decimal = 47

Problem 2

Convert the hexadecimal number $3B_{16}$ into its decimal equivalent.

Given:

Hexadecimal number = $3B_{16}$

Formula:

Decimal = $\Sigma(d_i \times 16^i)$

Substitute:

$3B_{16} = 59_{10}$

Answer:

Decimal = 59

Problem 3

Convert the hexadecimal number $1C_{16}$ into its decimal equivalent.

Given:

Hexadecimal number = $1C_{16}$

Formula:

Decimal = $\Sigma(d_i \times 16^i)$

Substitute:

$1C_{16} = 28_{10}$

Answer:

Decimal = 28

Problem 4

Convert the hexadecimal number $4A_{16}$ into its decimal equivalent.

Given:

Hexadecimal number = $4A_{16}$

Formula:

Decimal = $\Sigma(d_i \times 16^i)$

Substitute:

$4A_{16} = 74_{10}$

Answer:

Decimal = 74

Problem 5

Convert the hexadecimal number $5E_{16}$ into its decimal equivalent.

Given:

Hexadecimal number = $5E_{16}$

Formula:

Decimal = $\Sigma(d_i \times 16^i)$

Substitute:

$5E_{16} = 94_{10}$

Answer:

Decimal = 94

QUESTION 33

33. Given the logic equation Y = A + B, calculate the output Y if input A = 0 and B = 1.

Given:

Inputs = 0, 1

Formula:

Y = A + B (OR operation)

Substitute:

Y = 0 + 1

Answer:

Y = 1

PRACTICE PROBLEM

Problem 1

Given the logic equation Y = A + C, calculate the output Y if A = 1 and C = 0.

Given:

Inputs = 1, 0

Formula:

Y = A + B (OR operation)

Substitute:

Y = 1 + 0

Answer:

Y = 1

Problem 2

Given the logic equation Y = B + C, calculate the output Y if B = 0 and C = 1.

Given:

Inputs = 0, 1

Formula:

Y = A + B (OR operation)

Substitute:

Y = 0 + 1

Answer:

Y = 1

Problem 3

Given the logic equation Y = X + Y, calculate the output Y if X = 1 and Y = 0.

Given:

Inputs = 1, 0

Formula:

Y = A + B (OR operation)

Substitute:

Y = 1 + 0

Answer:

Y = 1

Problem 4

Given the logic equation Y = P + Q, calculate the output Y if P = 0 and Q = 0.

Given:

Inputs = 0, 0

Formula:

Y = A + B (OR operation)

Substitute:

Y = 0 + 0

Answer:

Y = 0

Problem 5

Given the logic equation Y = L + M, calculate the output Y if L = 1 and M = 1.

Given:

Inputs = 1, 1

Formula:

Y = A + B (OR operation)

Substitute:

Y = 1 + 1

Answer:

Y = 1

QUESTION 34

34. A full-wave rectifier produces a DC output voltage of 10 V. Given that the theoretical ripple factor for a full-wave rectifier is 0.48, calculate the RMS value of the AC ripple voltage present in the output.

Given:

$V_{dc} = 10\ V$

$\gamma = 0.48$

Formula:

$V_{ac(rms)} = \gamma V_{dc}$

Substitute:

$V_{ac(rms)} = 0.48 \times 10$

Answer:

$V_{ac(rms)} = 4.8\ V$

PRACTICE PROBLEM

Problem 1

A full-wave rectifier produces a DC output voltage of 12 V. The ripple factor is 0.5. Calculate the RMS AC ripple voltage.

Given:

$V_{dc} = 12\ V$

$\gamma = 0.5$

Formula:

$V_{ac(rms)} = \gamma V_{dc}$

Substitute:

$V_{ac(rms)} = 0.5 \times 12$

Answer:

$V_{ac(rms)} = 6\ V$

Problem 2

A full-wave rectifier produces a DC output voltage of 15 V. The ripple factor is 0.45. Calculate the RMS AC ripple voltage.

Given:

$V_{dc} = 15$ V

$\gamma = 0.45$

Formula:

$V_{ac(rms)} = \gamma V_{dc}$

Substitute:

$V_{ac(rms)} = 0.45 \times 15$

Answer:

$V_{ac(rms)} = 6.75$ V

Problem 3

A full-wave rectifier produces a DC output voltage of 20 V. The ripple factor is 0.48. Calculate the RMS AC ripple voltage.

Given:

$V_{dc} = 20$ V

$\gamma = 0.48$

Formula:

$V_{ac(rms)} = \gamma V_{dc}$

Substitute:

$V_{ac(rms)} = 0.48 \times 20$

Answer:

$V_{ac(rms)} = 9.6$ V

Problem 4

A full-wave rectifier produces a DC output voltage of 8 V. The ripple factor is 0.4. Calculate the RMS AC ripple voltage.

Given:

$V_{dc} = 8$ V

$\gamma = 0.4$

Formula:

$V_{ac(rms)} = \gamma V_{dc}$

Substitute:

$V_{ac(rms)} = 0.4 \times 8$

Answer:

$V_{ac(rms)} = 3.2\ V$

Problem 5

A full-wave rectifier produces a DC output voltage of 5 V. The ripple factor is 0.5. Calculate the RMS AC ripple voltage.

Given:

$V_{dc} = 5\ V$

$\gamma = 0.5$

Formula:

$V_{ac(rms)} = \gamma V_{dc}$

Substitute:

$V_{ac(rms)} = 0.5 \times 5$

Answer:

$V_{ac(rms)} = 2.5\ V$

QUESTION 35

35. A ripple counter is constructed by cascading 4 identical Flip-Flops. What is the maximum number of states (MOD number) this counter can have?

Given:

Number of flip-flops, $n = 4$

Formula:

MOD = 2^n

Substitute:

MOD = 2^4

Answer:

MOD = 16

PRACTICE PROBLEM

Problem 1

A ripple counter is constructed by cascading 3 identical Flip-Flops. Find the maximum number of states.

Given:

Number of flip-flops, n = 3

Formula:

MOD = 2^n

Substitute:

MOD = 2^3

Answer:

MOD = 8

Problem 2

A ripple counter is constructed by cascading 5 identical Flip-Flops. Find the maximum number of states.

Given:

Number of flip-flops, n = 5

Formula:

MOD = 2^n

Substitute:

MOD = 2^5

Answer:

MOD = 32

Problem 3

A ripple counter is constructed by cascading 6 identical Flip-Flops. Find the maximum number of states.

Given:

Number of flip-flops, n = 6

Formula:

$MOD = 2^n$

Substitute:

MOD = 2^6

Answer:

MOD = 64

Problem 4

A ripple counter is constructed by cascading 2 identical Flip-Flops. Find the maximum number of states.

Given:

Number of flip-flops, n = 2

Formula:

$MOD = 2^n$

Substitute:

MOD = 2^2

Answer:

MOD = 4

Problem 5

A ripple counter is constructed by cascading 8 identical Flip-Flops. Find the maximum number of states.

Given:

Number of flip-flops, n = 8

Formula:

$MOD = 2^n$

Substitute:

MOD = 2^8

Answer:

MOD = 256

QUESTION 36

36. An ideal transformer has 100 turns on its primary coil and 500 turns on its secondary coil. If a 220 V AC supply is connected to the primary, calculate the secondary voltage.

Given:

N_p = 100

N_s = 500

V_p = 220 V

Formula:

V_s/V_p = N_s/N_p

Substitute:

V_s = 220 × (500/100)

Answer:

V_s = 1100 V

PRACTICE PROBLEM

Problem 1

An ideal transformer has 120 turns on its primary coil and 480 turns on its secondary coil. If a 230 V AC supply is connected to the primary, calculate the secondary voltage.

Given:

$N_p = 120$

$N_s = 480$

$V_p = 230\ V$

Formula:

$V_s/V_p = N_s/N_p$

Substitute:

$V_s = 230 \times (480/120)$

Answer:

$V_s = 920\ V$

Problem 2

An ideal transformer has 150 turns on its primary coil and 600 turns on its secondary coil. If a 110 V AC supply is connected to the primary, calculate the secondary voltage.

Given:

$N_p = 150$

$N_s = 600$

$V_p = 110\ V$

Formula:

$V_s/V_p = N_s/N_p$

Substitute:

$V_s = 110 \times (600/150)$

Answer:

$V_s = 440$ V

Problem 3

An ideal transformer has 80 turns on its primary coil and 400 turns on its secondary coil. If a 240 V AC supply is connected to the primary, calculate the secondary voltage.

Given:

$N_p = 80$

$N_s = 400$

$V_p = 240$ V

Formula:

$V_s/V_p = N_s/N_p$

Substitute:

$V_s = 240 \times (400/80)$

Answer:

$V_s = 1200$ V

Problem 4

An ideal transformer has 200 turns on its primary coil and 1000 turns on its secondary coil. If a 120 V AC supply is connected to the primary, calculate the secondary voltage.

Given:

$N_p = 200$

$N_s = 1000$

$V_p = 120$ V

Formula:

$V_s/V_p = N_s/N_p$

Substitute:

$V_s = 120 \times (1000/200)$

Answer:

$V_s = 600$ V

Problem 5

An ideal transformer has 90 turns on its primary coil and 450 turns on its secondary coil. If a 115 V AC supply is connected to the primary, calculate the secondary voltage.

Given:

$N_p = 90$

$N_s = 450$

$V_p = 115$ V

Formula:

$V_s/V_p = N_s/N_p$

Substitute:

$V_s = 115 \times (450/90)$

Answer:

$V_s = 575$ V

QUESTION 37

37. A total current of 10 A flows into a parallel combination of two resistors: $R_1 = 4\ \Omega$ and $R_2 = 6\ \Omega$. Calculate the current flowing specifically through R_1.

Given:

$I_{total} = 10$ A

$R_1 = 4\ \Omega$

$R_2 = 6\ \Omega$

Formula:

$I_1 = I_{total} \times [R_2/(R_1+R_2)]$

Substitute:

$I_1 = 10 \times [6/(4+6)]$

Answer:

$I_1 = 6$ A

PRACTICE PROBLEM

Problem 1

A total current of 12 A flows into a parallel combination of two resistors: $R_1 = 5\ \Omega$ and $R_2 = 7\ \Omega$.

Calculate the current flowing specifically through R_1.

Given:

I_total = 12 A

$R_1 = 5\ \Omega$

$R_2 = 7\ \Omega$

Formula:

$I_1 = I_total \times [R_2/(R_1+R_2)]$

Substitute:

$I_1 = 12 \times [7/(5+7)]$

Answer:

$I_1 = 7$ A

Problem 2

A total current of 8 A flows into a parallel combination of two resistors: $R_1 = 3\ \Omega$ and $R_2 = 9\ \Omega$.

Calculate the current flowing specifically through R_1.

Given:

I_total = 8 A

$R_1 = 3\ \Omega$

$R_2 = 9\ \Omega$

Formula:

$I_1 = I_total \times [R_2/(R_1+R_2)]$

Substitute:

$I_1 = 8 \times [9/(3+9)]$

Answer:

$I_1 = 6$ A

Problem 3

A total current of 15 A flows into a parallel combination of two resistors: $R_1 = 6\ \Omega$ and $R_2 = 4\ \Omega$.

Calculate the current flowing specifically through R_1.

Given:

I_total = 15 A

$R_1 = 6\ \Omega$

$R_2 = 4\ \Omega$

Formula:

$I_1 = I_total \times [R_2/(R_1+R_2)]$

Substitute:

$I_1 = 15 \times [4/(6+4)]$

Answer:

$I_1 = 6$ A

Problem 4

A total current of 20 A flows into a parallel combination of two resistors: $R_1 = 10\ \Omega$ and $R_2 = 10\ \Omega$. Calculate the current flowing specifically through R_1.

Given:

I_total = 20 A

$R_1 = 10\ \Omega$

$R_2 = 10\ \Omega$

Formula:

$I_1 = I_total \times [R_2/(R_1+R_2)]$

Substitute:

$I_1 = 20 \times [10/(10+10)]$

Answer:

$I_1 = 10$ A

Problem 5

A total current of 9 A flows into a parallel combination of two resistors: $R_1 = 8\ \Omega$ and $R_2 = 12\ \Omega$.

Calculate the current flowing specifically through R_1.

Given:

$I_total = 9$ A

$R_1 = 8\ \Omega$

$R_2 = 12\ \Omega$

Formula:

$I_1 = I_total \times [R_2/(R_1+R_2)]$

Substitute:

$I_1 = 9 \times [12/(8+12)]$

Answer:

$I_1 = 5.4$ A

QUESTION 38

38. Find the frequency of oscillation for a Wien Bridge oscillator if the frequency-determining components are R = 10 kΩ and C = 0.01 µF.

Given:

$R = 10\ k\Omega$

$C = 0.01\ \mu F$

Formula:

$f = 1/(2\pi RC)$

Substitute:

$f = 1/[2 \times 3.1416 \times (10\times10^{3}) \times (0.01\times10^{-6})]$

Answer:

$f = 1591.55$ Hz $= 1.592$ kHz

PRACTICE PROBLEM

Problem 1

Find the frequency of oscillation for a Wien Bridge oscillator if the frequency-determining components are $R = 15$ kΩ and $C = 0.02$ μF.

Given:

$R = 15$ kΩ

$C = 0.02$ μF

Formula:

$f = 1/(2\pi RC)$

Substitute:

$f = 1/[2 \times 3.1416 \times (15\times10^{3}) \times (0.02\times10^{-6})]$

Answer:

$f = 530.52$ Hz $= 0.531$ kHz

Problem 2

Find the frequency of oscillation for a Wien Bridge oscillator if the frequency-determining components are $R = 8$ kΩ and $C = 0.01$ μF.

Given:

$R = 8$ kΩ

$C = 0.01$ μF

Formula:

$f = 1/(2\pi RC)$

Substitute:

$f = 1/[2 \times 3.1416 \times (8\times10^{3}) \times (0.01\times10^{-6})]$

Answer:

f = 1989.43 Hz = 1.989 kHz

Problem 3

Find the frequency of oscillation for a Wien Bridge oscillator if the frequency-determining components are R = 12 kΩ and C = 0.015 μF.

Given:

R = 12 kΩ

C = 0.015 μF

Formula:

$f = 1/(2\pi RC)$

Substitute:

$f = 1/[2 \times 3.1416 \times (12\times10^{3}) \times (0.015\times10^{-6})]$

Answer:

f = 884.19 Hz = 0.884 kHz

Problem 4

Find the frequency of oscillation for a Wien Bridge oscillator if the frequency-determining components are R = 5 kΩ and C = 0.025 μF.

Given:

R = 5 kΩ

C = 0.025 μF

Formula:

$f = 1/(2\pi RC)$

Substitute:

$f = 1/[2 \times 3.1416 \times (5\times10^{3}) \times (0.025\times10^{-6})]$

Answer:

f = 1273.24 Hz = 1.273 kHz

Problem 5

Find the frequency of oscillation for a Wien Bridge oscillator if the frequency-determining components are R = 20 kΩ and C = 0.005 μF.

Given:

R = 20 kΩ

C = 0.005 μF

Formula:

$f = 1/(2\pi RC)$

Substitute:

$f = 1/[2 \times 3.1416 \times (20\times10^{3}) \times (0.005\times10^{-6})]$

Answer:

f = 1591.55 Hz = 1.592 kHz

QUESTION 39

39. A transistor has a common-base leakage current (I_CBO) of 2 μA and a common-emitter current gain (β) of 50. Calculate its common-emitter leakage current (I_CEO).

Given:

$I_{CBO} = 2\ \mu A$

$\beta = 50$

Formula:

$I_{CEO} = (1 + \beta)I_{CBO}$

Substitute:

$I_{CEO} = (1 + 50) \times 2$

Answer:

$I_{CEO} = 102\ \mu A$

PRACTICE PROBLEM

Problem 1

A transistor has a common-base leakage current (I_{CBO}) of 3 µA and a common-emitter current gain (β) of 40. Calculate its common-emitter leakage current (I_{CEO}).

Given:

$I_{CBO} = 3\ \mu A$

$\beta = 40$

Formula:

$I_{CEO} = (1 + \beta)I_{CBO}$

Substitute:

$I_{CEO} = (1 + 40) \times 3$

Answer:

$I_{CEO} = 123\ \mu A$

Problem 2

A transistor has a common-base leakage current (I_{CBO}) of 5 µA and a common-emitter current gain (β) of 60. Calculate its common-emitter leakage current (I_{CEO}).

Given:

$I_{CBO} = 5\ \mu A$

$\beta = 60$

Formula:

$I_{CEO} = (1 + \beta)I_{CBO}$

Substitute:

$I_{CEO} = (1 + 60) \times 5$

Answer:

$I_{CEO} = 305\ \mu A$

Problem 3

A transistor has a common-base leakage current (I_{CBO}) of 1 µA and a common-emitter current gain (β) of 100. Calculate its common-emitter leakage current (I_{CEO}).

Given:

$I_{CBO} = 1\ \mu A$

$\beta = 100$

Formula:

$I_{CEO} = (1 + \beta)I_{CBO}$

Substitute:

$I_{CEO} = (1 + 100) \times 1$

Answer:

$I_{CEO} = 101\ \mu A$

Problem 4

A transistor has a common-base leakage current (I_{CBO}) of 4 µA and a common-emitter current gain (β) of 25. Calculate its common-emitter leakage current (I_{CEO}).

Given:

$I_{CBO} = 4\ \mu A$

$\beta = 25$

Formula:

$I_{CEO} = (1 + \beta)I_{CBO}$

Substitute:

$I_{CEO} = (1 + 25) \times 4$

Answer:

$I_{CEO} = 104\ \mu A$

Problem 5

A transistor has a common-base leakage current (I_{CBO}) of 6 µA and a common-emitter current gain (β) of 80. Calculate its common-emitter leakage current (I_{CEO}).

Given:

$I_{CBO} = 6\ \mu A$

$\beta = 80$

Formula:

$I_{CEO} = (1 + \beta)I_{CBO}$

Substitute:

$I_{CEO} = (1 + 80) \times 6$

Answer:

$I_{CEO} = 486\ \mu A$

QUESTION 40

40. A Class A power amplifier draws a DC power of 20 W from its supply. If it operates at its theoretical maximum efficiency, what is the maximum AC power it can deliver to the load?

Given:

$P_{dc} = 20\ W$

$\eta_{max} = 50\% = 0.5$

Formula:

$P_{ac(out)} = \eta P_{dc}$

Substitute:

$P_{ac(out)} = 0.5 \times 20$

Answer:

$P_{ac(out)} = 10$ W

PRACTICE PROBLEM

Problem 1

A Class A power amplifier draws a DC power of 25 W from its supply. If it operates at its theoretical maximum efficiency, what is the maximum AC power it can deliver to the load?

Given:

$P_{dc} = 25$ W

$\eta_{max} = 50\% = 0.5$

Formula:

$P_{ac(out)} = \eta P_{dc}$

Substitute:

$P_{ac(out)} = 0.5 \times 25$

Answer:

$P_{ac(out)} = 12.5$ W

Problem 2

A Class A power amplifier draws a DC power of 30 W from its supply. If it operates at its theoretical maximum efficiency, what is the maximum AC power it can deliver to the load?

Given:

$P_{dc} = 30$ W

$\eta_{max} = 50\% = 0.5$

Formula:

$P_{ac(out)} = \eta P_{dc}$

Substitute:

$P_{ac(out)} = 0.5 \times 30$

Answer:

$P_{ac(out)} = 15\ W$

Problem 3

A Class A power amplifier draws a DC power of 15 W from its supply. If it operates at its theoretical maximum efficiency, what is the maximum AC power it can deliver to the load?

Given:

$P_{dc} = 15\ W$

$\eta_{max} = 50\% = 0.5$

Formula:

$P_{ac(out)} = \eta P_{dc}$

Substitute:

$P_{ac(out)} = 0.5 \times 15$

Answer:

$P_{ac(out)} = 7.5\ W$

Problem 4

A Class A power amplifier draws a DC power of 40 W from its supply. If it operates at its theoretical maximum efficiency, what is the maximum AC power it can deliver to the load?

Given:

$P_{dc} = 40\ W$

$\eta_{max} = 50\% = 0.5$

Formula:

$P_{ac(out)} = \eta P_{dc}$

Substitute:

$P_{ac(out)} = 0.5 \times 40$

Answer:

$P_{ac(out)} = 20\ W$

Problem 5

A Class A power amplifier draws a DC power of 10 W from its supply. If it operates at its theoretical maximum efficiency, what is the maximum AC power it can deliver to the load?

Given:

$P_{dc} = 10\ W$

$\eta_{max} = 50\% = 0.5$

Formula:

$P_{ac(out)} = \eta P_{dc}$

Substitute:

$P_{ac(out)} = 0.5 \times 10$

Answer:

$P_{ac(out)} = 5\ W$

QUESTION 41

41. An Op-Amp difference amplifier has all four resistors set to 10 kΩ. If 2 V is applied to the inverting input and 5 V is applied to the non-inverting input, find the output voltage.

Given:

V_1 (inverting) = 2 V

V_2 (non-inverting) = 5 V

All four resistors are equal

Formula:

$V_{out} = V_2 - V_1$

Substitute:

$V_{out} = 5 - 2$

Answer:

$V_{out} = 3\ V$

PRACTICE PROBLEM

Problem 1

An Op-Amp difference amplifier has all four resistors set to 10 kΩ. If 1 V is applied to the inverting input and 4 V is applied to the non-inverting input, find the output voltage.

Given:

V_1 (inverting) = 1 V

V_2 (non-inverting) = 4 V

All four resistors are equal

Formula:

$V_out = V_2 - V_1$

Substitute:

$V_out = 4 - 1$

Answer:

$V_out = 3$ V

Problem 2

An Op-Amp difference amplifier has all four resistors set to 10 kΩ. If 3 V is applied to the inverting input and 6 V is applied to the non-inverting input, find the output voltage.

Given:

V_1 (inverting) = 3 V

V_2 (non-inverting) = 6 V

All four resistors are equal

Formula:

$V_out = V_2 - V_1$

Substitute:

$V_out = 6 - 3$

Answer:

$V_out = 3\ V$

Problem 3

An Op-Amp difference amplifier has all four resistors set to 10 kΩ. If 0.5 V is applied to the inverting input and 2.5 V is applied to the non-inverting input, find the output voltage.

Given:

V_1 (inverting) = 0.5 V

V_2 (non-inverting) = 2.5 V

All four resistors are equal

Formula:

$V_out = V_2 - V_1$

Substitute:

$V_out = 2.5 - 0.5$

Answer:

$V_out = 2\ V$

Problem 4

An Op-Amp difference amplifier has all four resistors set to 10 kΩ. If 4 V is applied to the inverting input and 7 V is applied to the non-inverting input, find the output voltage.

Given:

V_1 (inverting) = 4 V

V_2 (non-inverting) = 7 V

All four resistors are equal

Formula:

$V_out = V_2 - V_1$

Substitute:

$V_out = 7 - 4$

Answer:

$V_out = 3\ V$

Problem 5

An Op-Amp difference amplifier has all four resistors set to 10 kΩ. If 2.5 V is applied to the inverting input and 5.5 V is applied to the non-inverting input, find the output voltage.

Given:

V_1 (inverting) = 2.5 V

V_2 (non-inverting) = 5.5 V

All four resistors are equal

Formula:

$V_out = V_2 - V_1$

Substitute:

$V_out = 5.5 - 2.5$

Answer:

$V_out = 3\ V$

QUESTION 42

42. Determine the output Y of a 2-input NAND gate if both inputs A and B are HIGH (Logic value = 1).

Given:

A = 1

B = 1

Formula:

$Y = (A \cdot B)'$

Substitute:

$Y = (1 \cdot 1)'$

Answer:

Y = 0 (LOW)

PRACTICE PROBLEM

Problem 1

Determine the output Y of a 2-input NAND gate if inputs A = 1 and B = 0.

Given:

A = 1

B = 0

Formula:

$Y = (A \cdot B)'$

Substitute:

$Y = (1 \cdot 0)'$

Answer:

Y = 1 (HIGH)

Problem 2

Determine the output Y of a 2-input NAND gate if inputs A = 0 and B = 1.

Given:

A = 0

B = 1

Formula:

$Y = (A \cdot B)'$

Substitute:

$Y = (0 \cdot 1)'$

Answer:

Y = 1 (HIGH)

Problem 3

Determine the output Y of a 2-input NAND gate if inputs A = 0 and B = 0.

Given:

A = 0

B = 0

Formula:

$Y = (A \cdot B)'$

Substitute:

$Y = (0 \cdot 0)'$

Answer:

Y = 1 (HIGH)

Problem 4

Determine the output Y of a 2-input NAND gate if inputs A = 1 and B = 1.

Given:

A = 1

B = 1

Formula:

$Y = (A \cdot B)'$

Substitute:

$Y = (1 \cdot 1)'$

Answer:

Y = 0 (LOW)

Problem 5

Determine the output Y of a 2-input NAND gate if inputs A = 1 and B = 0.

Given:

A = 1

B = 0

Formula:

$Y = (A \cdot B)'$

Substitute:

$Y = (1 \cdot 0)'$

Answer:

Y = 1 (HIGH)

QUESTION 43

43. An RLC series circuit resonates at a frequency of 1000 Hz. If the Quality Factor (Q) of the circuit is 50, calculate its bandwidth.

Given:

$f_r = 1000$ Hz

Q = 50

Formula:

$BW = f_r/Q$

Substitute:

BW = 1000/50

Answer:

BW = 20 Hz

PRACTICE PROBLEM

Problem 1

An RLC series circuit resonates at a frequency of 1500 Hz. If the Quality Factor (Q) of the circuit is 60, calculate its bandwidth.

Given:

$f_r = 1500$ Hz

Q = 60

Formula:

BW = f_r/Q

Substitute:

BW = 1500/60

Answer:

BW = 25 Hz

Problem 2

An RLC series circuit resonates at a frequency of 2000 Hz. If the Quality Factor (Q) of the circuit is 40, calculate its bandwidth.

Given:

f_r = 2000 Hz

Q = 40

Formula:

BW = f_r/Q

Substitute:

BW = 2000/40

Answer:

BW = 50 Hz

Problem 3

An RLC series circuit resonates at a frequency of 500 Hz. If the Quality Factor (Q) of the circuit is 25, calculate its bandwidth.

Given:

f_r = 500 Hz

Q = 25

Formula:

BW = f_r/Q

Substitute:

BW = 500/25

Answer:

BW = 20 Hz

Problem 4

An RLC series circuit resonates at a frequency of 1200 Hz. If the Quality Factor (Q) of the circuit is 30, calculate its bandwidth.

Given:

f_r = 1200 Hz

Q = 30

Formula:

BW = f_r/Q

Substitute:

BW = 1200/30

Answer:

BW = 40 Hz

Problem 5

An RLC series circuit resonates at a frequency of 800 Hz. If the Quality Factor (Q) of the circuit is 20, calculate its bandwidth.

Given:

f_r = 800 Hz

Q = 20

Formula:

BW = f_r/Q

Substitute:

BW = 800/20

Answer:

BW = 40 Hz

