ECEN321: Analogue Electronics
Assignment 1: Power Amplifiers - Submission

Daniel Eisen : 300447549

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Question 1

I. *An audio amplifier operates in the frequency range of..*
a. 20Hz to 20kHz

II. *For maximum peak-to-peak output voltage, the Q point should be..*
c. At the centre of the dc load line

III. *An amplifier has two load lines because..*
d. All of the above

IV. *Push-pull is almost always used with..*
b. Class B

V. *Class C amplifiers are almost always..*
c. Tuned RF amplifiers

VI. *The input signal of a class C amplifier..*
c. Produces brief pulses of collector current

VII. *If RC=100 Ωand RL=180Ω, the ac load resistance equals..*
100Ω

VIII. *In a class A amplifier, the collector current flows for..*
d. The entire cycle

IX. *With class A, the output signal should be..*
a. Unclipped

X. *A small quiescent current is necessary with a class AB push-pull amplifier to avoid..*
a. Crossover distortion

Question 2

a) In the push push-pull configuration, the base-emitter junctions of the transistors have a potential of 0.7V. Thus when the input drops below this, at the **crossover** around the zero-point, the output is cut-off. This introduces a flatline distortion between positive and negative half cycles.

b)

Question 3

$V_{CC} = +20V\ R_{1,2} = 1k\ R_C = 50\Omega\ R_E = 100\Omega\ R_L = 50\Omega$

i)

$$\begin{aligned} P_{i(dc)} &= V_{CC} \cdot I_{CQ} \\ V_B &= \frac{R_2}{R_1 + R_2} V_{CC} = \frac{1k}{1k + 1k} 20V = 10V \\ V_E &= V_B - 0.7 = 9.3V \\ I_E &= \frac{V_E}{R_E} = \frac{9.3}{100} = 93mA \approx I_{CQ} \\ \therefore P_{i(dc)} &= 20 \times 93mA = 1.86W \end{aligned}$$

ii)

$$\begin{aligned} P_{o(ac)} &= \frac{V_{CEQ} \cdot I_{CQ}}{2} \\ V_{CEQ} &= V_C - V_E = (V_{CC} - I_C \cdot R_C) - V_E \\ &= (20V - 93mA \times 50\Omega) - 9.3V = 6.05V \\ \therefore P_{o(ac)} &= \frac{6.05V \times 93mA}{2} = 0.28W \end{aligned}$$

iii)

$$\begin{aligned} \%\eta &= \frac{P_{o(ac)}}{P_{i(dc)}} \times 100 \\ &= \frac{0.28}{1.86} \times 100 = 15\% \end{aligned}$$

Question 4

V_{CC}

i) =

ii) =

iii) =

Question 5

$V_{CC} = +30V$ $V_{BE} = 0.7V$ $R_1 = 300\Omega$ $R_L = 16\Omega$

$$
\begin{aligned}
V_{CC} &= 2R_1 \cdot I + 2V_{BE} \\
30V &= 600\Omega \times I + 1.4V \\
I &= \frac{30V - 1.4V}{600\Omega} = 47.67mA \\
R_2 &= \frac{V_{BE}}{I} = \frac{0.7V}{47.67mA} = 14.67\Omega
\end{aligned}
$$

Question 6

$f = 3\text{MHz}$ $V_{CC} = 20V$ $V_{CE(sat)} = 0.3V$ $I_P = 500mA$

i)

$$
\begin{aligned}
V_P &= V_{CC} - V_{CE(sat)} \\
&= 20V - 0.3 = 19.7V \\
P_) &= \frac{V_P^2}{2R_L} = \frac{388.09}{200} = 1.94W \\
I_{dc} &= \frac{P_O}{V_P} = \frac{1.94}{19.7} = 98.5mA \\
P_{dc} &= V_{CC} \cdot I_{dc} = 20 \times 98.5 = 1.97W \\
\%\eta &= \frac{P_)}{P_{dc}} \times 100 = \frac{1.94}{1.97} \times 100 \\
&= 98.5\%
\end{aligned}
$$

ii)

$$
\begin{aligned}
T &= \frac{1}{f} = \frac{1}{3\times10^6} = 3.33\times10^{-7} \\
t &= \frac{P_O \cdot T}{I_P \cdot V_P} = \frac{1.94\times3.33\times10^{-7}}{500\times19.7} = 6.56\times10^{-8} \\
\phi &= \frac{P_O}{P_{dc}} \times 360 = \frac{6.56\times10^{-8}}{3.33\times10^{-7}} \times 360 \\
&= 70.92^\circ
\end{aligned}
$$