University of Swaziland
Faculty of Science
Department of Electrical and Electronic Engineering

Main Examination 2011

Title of Paper:	Analogue Design II
Course Number:	EE323

Time Allowed: 3 hrs

Instructions:

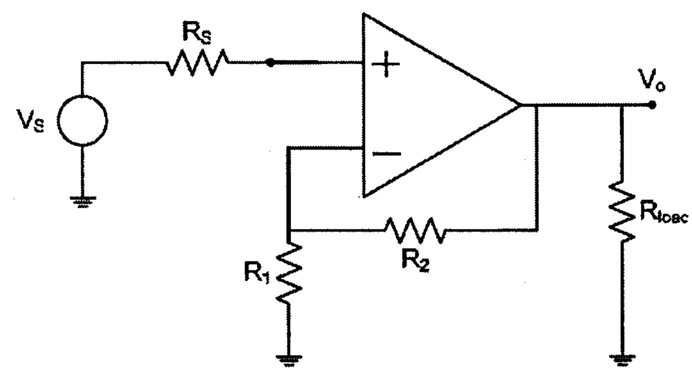
1. Answer any four (4) questions.
2. Each questions carries 25 marks.
3. Useful tables are attached at the end of the question paper

This paper should not be opened until permission has been given by the invigilator.

This paper contains eight (8) pages including this page.

Question 1

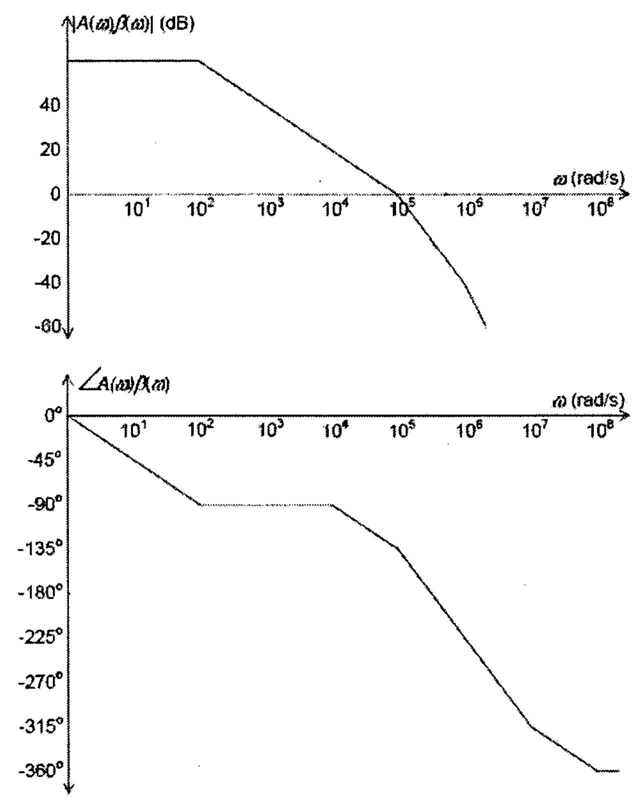
a) What kind of topology is the non-inverting op-amp configuration? (1)



b) From the Bode plots below find the

i) Gain margin (2)

ii) Phase margin (2)



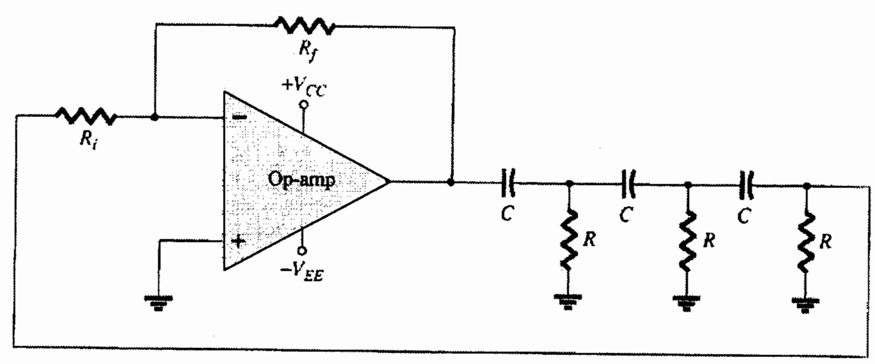
c) What does the Nyquist method state? (2)

d) Calculate the:

i) Voltage gain (5)
ii) Input impedance (5)
iii) Output impedance (5)

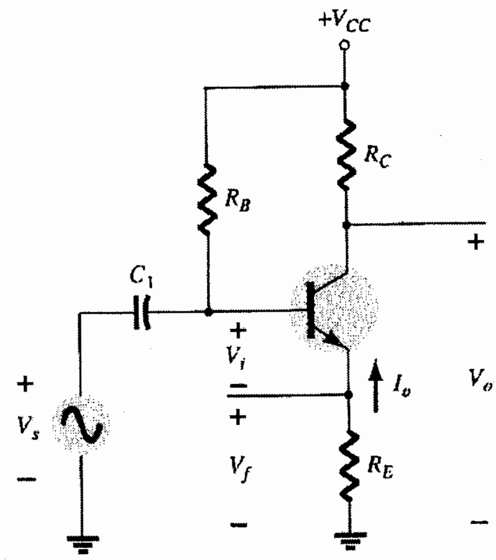
of a voltage-series feedback amplifier having $A = -300$, $R_i = 1.5k\Omega$, $R_o = 50k\Omega$ and $\beta = \frac{-1}{15}$.

e) Give the name of the following oscillator and write down an expression for its frequency of oscillation. (3)



Question 2

a) For the current-series feedback circuit shown below with the following values: $R_B = 600k\Omega$, $R_E = 1.2k\Omega$, $R_C = 4.7k\Omega$, $C_1 = 0.5\mu F$, $V_{CC} = 16V$, $h_{ie} = 900\Omega$ and $h_{fe} = 75$.



Calculate the:

i) Gain with feedback. (5)
ii) Input impedance with feedback. (5)
iii) Output impedance with feedback. (5)

b) Calculate the harmonic distortion components for an output signal having fundamental amplitude of $2.5V$, second harmonic amplitude of $0.25V$, third harmonic amplitude of $0.1V$ and fourth harmonic amplitude of $0.05V$. (6)

c) Determine what maximum dissipation will be allowed for an $80W$ silicon transistor (rated at $25°C$) if derating is required above $25°C$ by a derating factor of $0.5W/°C$ at a case temperature of $125°C$. (4)

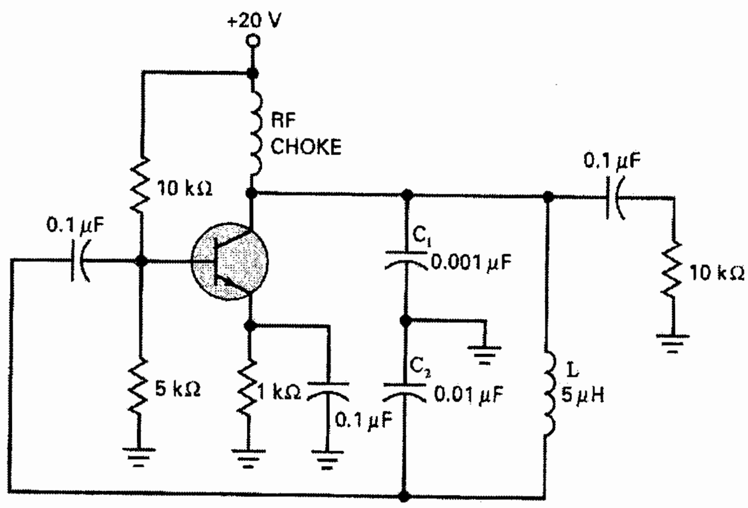
Question 3

a) A crystal oscillator has these values: $L = 3H$, $C_s = 0.05pF$, $R = 2k\Omega$, $C_p = 10pF$.
Calculate:

i) Series resonant frequency, f_s. (3)

ii) Parallel resonant frequency, f_p. (3)

b) Consider the figure below

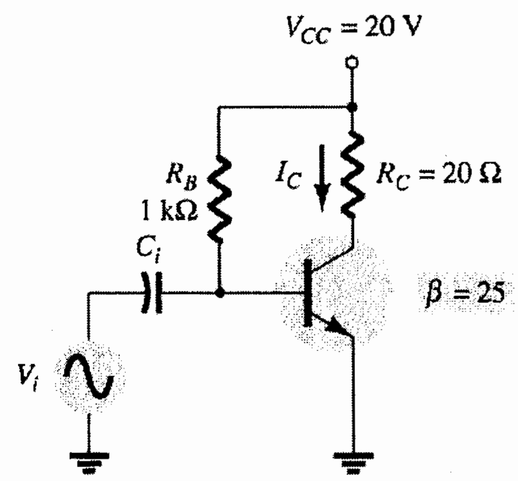


If the value of L is doubled in the figure above, what will be the frequency of oscillation? (4)

c) Calculate the:

i) Input power (5)
ii) Output power (5)
iii) Efficiency (4)

for an input voltage that results in a sinusoidal base current of $10mA$ peak in the circuit below. With $V_{BE} = 0.7V$.



d) Where is positive feedback used in circuit design? (1)

Question 4

a) What transformer turns ratio is required to match a 16Ω speaker load so that the effective load resistance seen at the primary is $10k\Omega$? (3)

b) For a class B amplifier with $V_{CC} = 25V$ driving an 8Ω load, determine:

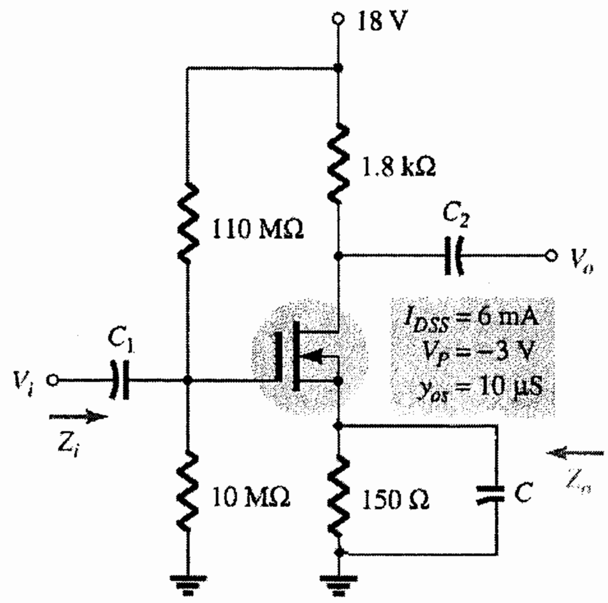
i) Maximum input power. (5)
ii) Maximum output power. (5)
iii) Maximum circuit efficiency. (4)

c) A silicon power transistor is operated with a heat sink $(\theta_{SA} = 1.5°C/W)$. The transistor, rated at $150W\,(25°C)$ has $(\theta_{JC} = 0.5°C/W)$, and the mounting insulation has $(\theta_{CS} = 0.6°C/W)$. What maximum power can be dissipated if the ambient temperature is $40°C$ and $T_{J_{max}} = 200°C$? (4)

d) State four improvements obtained by using negative feedback. (4)

Question 5

For the network below with $V_{GS_Q} = 0.35V$ and $I_{D_Q} = 7.6mA$



a) Determine g_m. (4)

b) Find r_d. (1)

c) Draw the ac small signal equivalent network for the above circuit. (5)

d) Find Z_i. (5)

e) Find Z_o. (5)

f) Calculate A_v. (5)