University of Swaziland
Faculty of Science
Department of Electrical and Electronic Engineering
Main Examination 2016

Title of Paper	**:**	**Analogue Design II**
Course Number	**:**	**EE323**

Time Allowed	**:**	**3 hrs**
Instructions	**:**	

1. **This paper contains five (5) questions**
2. **Answer an four (4) questions**
3. **Each question carries 25 marks**

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The paper consists of seven (7) pages

Question 1 [25]

a) Fill in the blank(s) with appropriate word(s) [10]

i) A MOSFET is a _______________ controlled ___________ carrier device.

ii) Enhancement type MOSFETs are normally _____________ devices while depletion type MOSFETs are normally ______ _______ devices.

iii) The Gate terminal of a MOSFET is isolated from the semiconductor by a thin layer of ____________ .

iv) The MOSFET cell embeds a parasitic _____________ in its structure.

v) The gate-source voltage at which the _____________ layer in a MOSFET is formed is called the __________ voltage.

vi) The thickness of the ___________ layer remains constant as gate source voltage is increased beyond the _____________ voltage.

b) Determine the voltage gain, input and output impedance with feedback for voltage series feedback having $A = -100, R_i = 10k\Omega, R_o = 20k\Omega$ for feedback of $\beta = -0.1$. [9]

c) List out two characteristics of feedback amplifier. [2]

d) How does an oscillator differs from an amplifier [2]

e) Name two low frequency oscillators [2]

Question 2 [25]

a) The feedback amplifier shown in figure 2.1 makes use of an op – amp with an open – loop gain $\boldsymbol{A = 10^5}$.

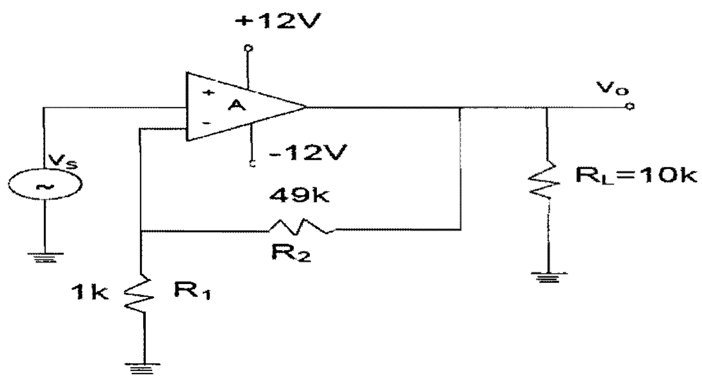

figure 2.1

i) How much is the output voltage (v_o) for input signal $v_s = 2\ mV$ in the circuit shown [6]

b) Figure 2.2 shows an op – amp circuit with voltage series through R_1 *and* R_2. The open – loop gain of the op – amp is $A = 10^4$ and input impedance is $100K\Omega$.

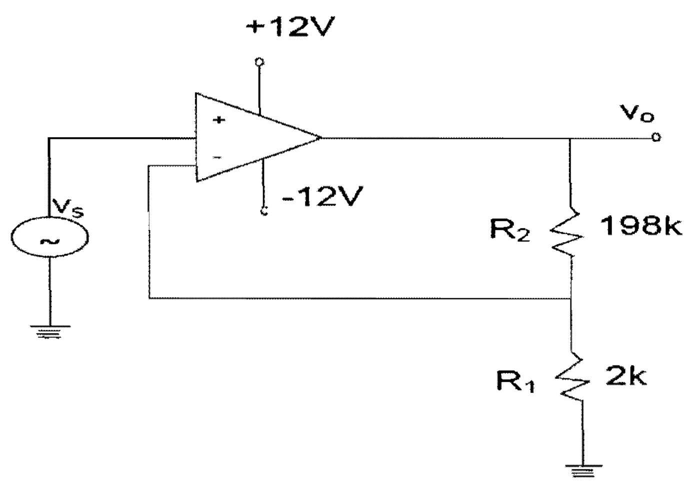

figure 2.2

i) Find the gain and input impedance of the amplifier with feedback. [8]

c) An amplifier has a bandwidth of ***500 KHz*** and an open voltage gain of ***100.***

i) What should be the amount of negative feedback (β) if the bandwidth is extended to ***5 MHz***? [5]

ii) What will be the new gain after negative feedback is introduced? [1]

d) Design a ***Wien-bridge oscillator*** using op-amp to generate a sinusoidal waveform of frequency ***1 KHz.*** [5]

Question 3 [25]

a) For the circuit of figure 3.1.

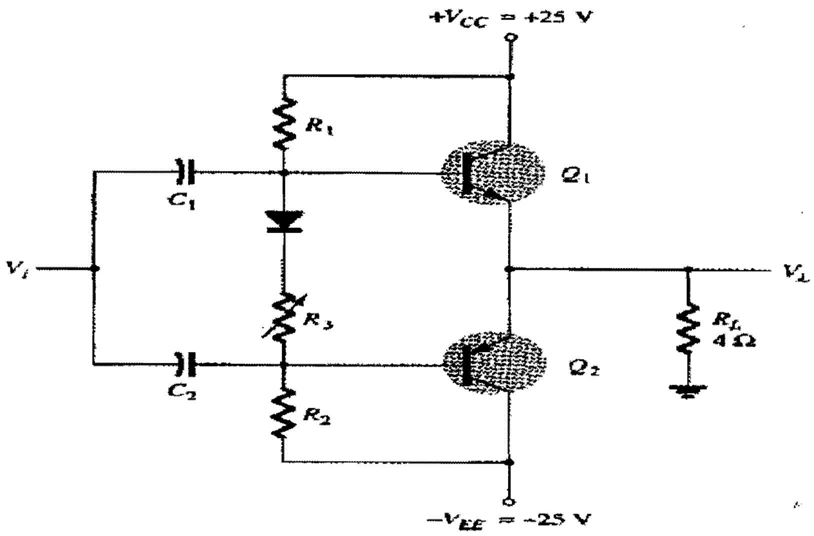

figure 3.1

i) Calculate the:
- Output power [2]
- Input power [2]
- Power handled by each output transistor [2]
- Circuit efficiency for an input of 12 V_{rms} [1]

ii) Calculate the:
- Maximum input power [2]
- Maximum output power [2]
- Input voltage for maximum power operation [2]
- Power dissipated by the output transistors at this [2]

iii) Calculate the maximum power dissipated by the output transistors and the voltage at which this occurs [4]

b) For the Harmonic Distortion reading: $D_2 = 0.1, D_3 = 0.02, and\ D_4 = 0.01, with\ I_1 = 4\ A\ and\ R_c = 8\Omega$. Calculate the:

i) Total Harmonic Distortion [2]

ii) Fundamental power component [2]

iii) Total power [2]

Question 4 [25]

a) Determine the following parameters: $I_{DQ}, V_{DSQ}, V_{DS(sat)}, g_m, r_o$ and A_v of a MOSFET circuit. The circuit in figure 4.1 assumes the following parameters: $V_{GSQ} = 2.12V, V_{DD} = 5V, V_{GS} = 1.82V$ and $R_D = 2.5K\Omega$. The transistor parameters are $V_{TN} = 1V, k_n = 0.80mA/V^2$ and $\lambda = 0.02V^{-2}$. Assume the transistor is biased in the saturation region. [14]

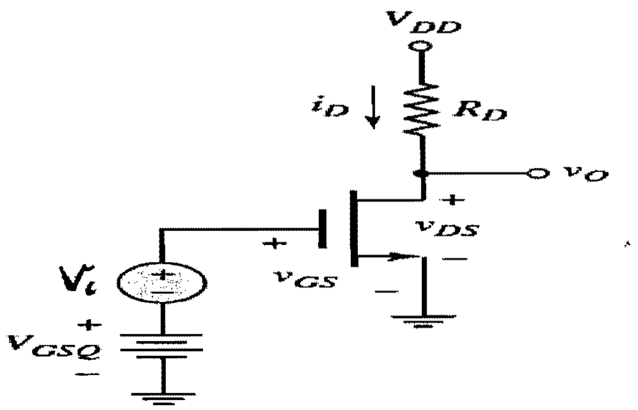

figure 4.1

b) For the circuit in figure 4.2 determine: R_{Thi}, C_i and f_{Hi}. Where $A_v = -3, C_G = 0.01\mu F, C_c = 0.5\mu F, C_s = 2\mu F, C_{gd} = 2pF, C_{gs} = 4pF$. [11]

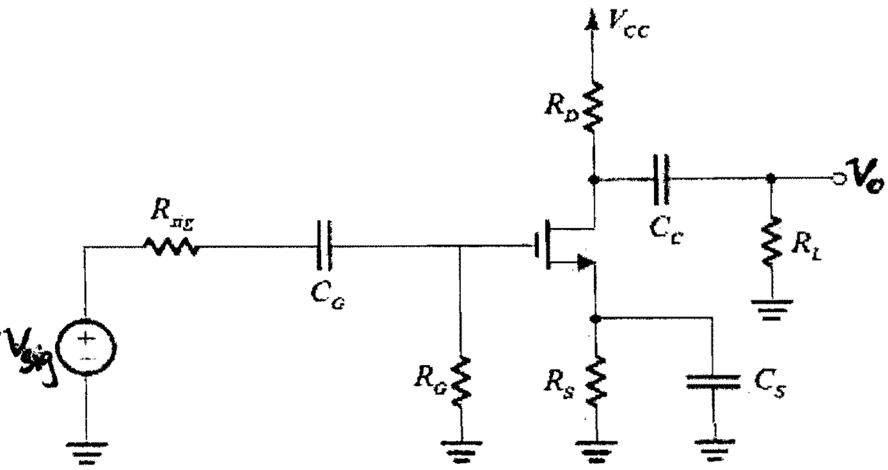

figure 4.2

Question 5 [25]

a) Define the following terms:

i.	Stability	[2]
ii.	Gain Margin	[3]
iii.	Noise	[1]
iv.	Phase Margin	[3]

b) Figure 5.1 shows a shunt-shunt feedback amplifier. The op-amp has an open loop gain A, differential input resistance R_{id} and output resistance r_o. Derive the following expressions:

i.	Open loop gain A	[5]
ii.	Feedback factor β	[3]
iii.	Closed loop gain A_f	[2]
iv.	Input resistance R_{if}	[3]
v.	Output resistance R_{of}	[3]

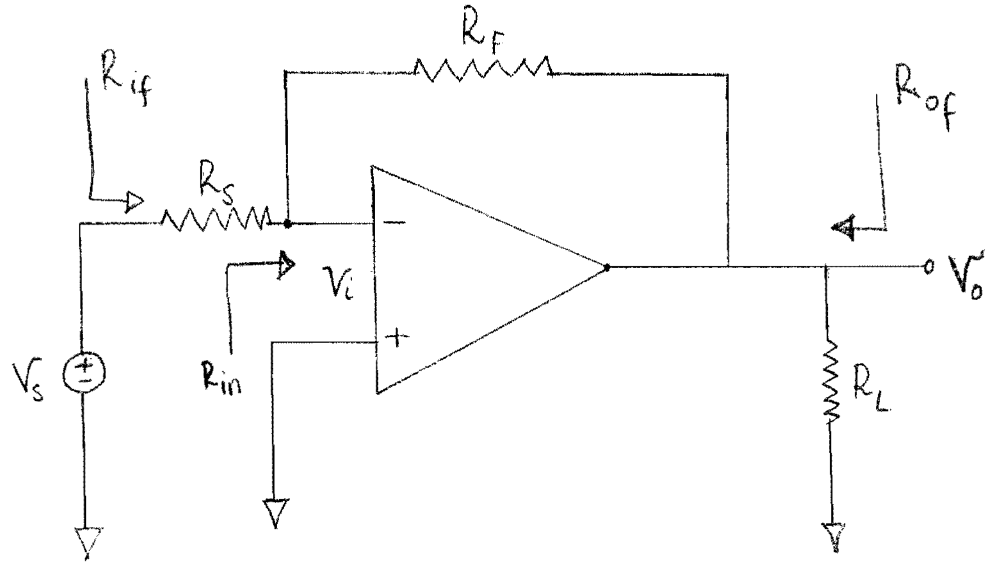

figure 5.1