UNIVERSITY OF ENERGY AND NATURAL RESOURCES, SUNYANI, GHANA

SCHOOL OF ENGINEERING

DEPARTMENT OF COMPUTER AND ELECTRICAL ENGINEERING

Level 300: First Semester Examinations 2018/2019

Bachelor of Science (Computer Engineering, Electrical & Electronic Engineering)

ELNG 303: LINEAR ELECTRONIC CIRCUITS

DECEMBER, 2018 TIME: 2½ hours

INSTRUCTIONS: ANSWER ALL FIVE QUESTIONS: LECTURE MATERIALS CAN BE USED)

Question 1 [(2x4)+(2+6)=16]

(a) Briefly explain the following terms as applied to IC fabrication

(i) Epitaxial Growth
(ii) Oxidation
(iii) Photolithography
(iv) Thin film deposition

(b) A circuit is built around a bi-polar NPN transistor. The base network has a diode and a capacitor in series while the collector is connected to a power supply through a resistor. If the emitter is connected to ground:

i) Draw the circuit

ii) Provide all the masking layout of the circuit

Question 2 [(4+(4x2)+(2x2)=14]

(a) Given the circuit of Fig. 2.1, draw the small signal equivalent circuit assuming that $r_D = \infty\Omega$ and show that:

$$V_{o1} = -\frac{g_m R_D}{1+g_m R_s} \quad \text{and} \quad V_{o2} = -\frac{g_m R_s}{1+g_m R_s}$$

For gm=2mS, R_G=1MΩ , $R_S = R_D$ = 5kΩ , find V_{o1} and V_{o2} if V_i =20mV Sinωt.

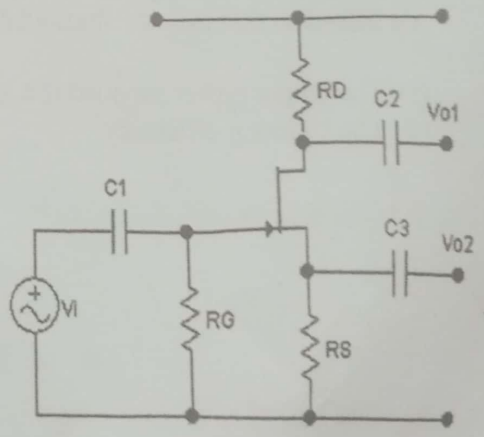

Fig. 2.1

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Question 3 [4+(2x5)=14]

(a) State four characteristics of an ideal op-amp.

(b) For the differential circuit shown in Fig. 3.1, given that β=100, R_{E1}=R_{E2}=250Ω, R_{EE}=10kΩ, R_1=50kΩ, R_S=10kΩ, R_L=10kΩ and Vs =10mV, determine:

i) The current I_E, through R_{EE}
ii) The value of r_e, the emitter resistance
iii) The impedance Z_1 looking through the base
iv) The impedance Z_2
v) The output voltage V_0

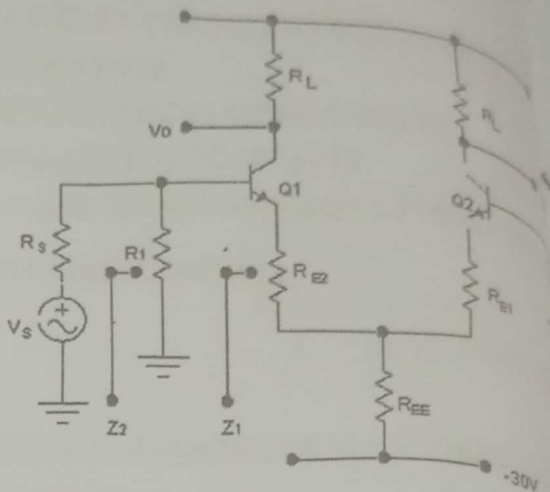

Fig. 3.1

Question 4 [4+4=8]

(a) Distinguish between series and switching voltage regulators

(b) For the series voltage regulator shown in Fig. 4.1, determine the output regulated voltage if V_{Z1} = V_{Z2} = 7.5V, V_{BE} =0.7V, R_1 =930Ω and R_2 =1570Ω.

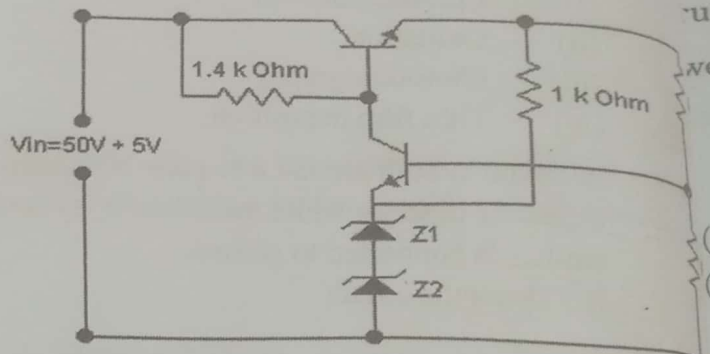

Fig. 4.1

Question 5 [4+(2x2)=8]

(a) State the differences between the various types of power amplifier

(b) A complementary pair class B push-pull amplifier has a supply voltage of 45 V and the transi are biased so that they are sinusoidally driven to provide a current 1.2A. Calculate:

(i) The output power supplied to a speaker having a resistance of 15 Ω
(ii) The collector efficiency

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April, 2021 Time: 2½ hours

Material required: Class material (**To be brought in by students**)

INSTRUCTIONS: ANSWER ALL QUESTIONS (each question carries 15marks)

Question 1

(a) The following processes are used in the fabrication of monolithic ICs, explain each of them in detail:

i. Oxidation
ii. Diffusion
iii. Epitaxy
iv. Photolithography
v. Thin Film Deposition

(b) Using the list in (a) provide a stet-by-step masking levels of the fabrication of NPN transistor indicating the type of photo-resist used.

Question 2

The two-stage amplifier shown in Fig. 2 is designed with a *FET*, TR1 and silicon *BJT*, Q1 with the manufacturer's specifications for β (Q1) at 25°C as 150 and g_m (TR1) as 3500μS. Given Rg=1.5kΩ R_1=6 MΩ, R_2 =4MΩ R_d =2.4kΩ, Rs=500Ω, R_3 =15kΩ, R_4 =4.7kΩ, Rc=2.7kΩ, Re=470Ω, R_L=2.2kΩ and supply voltage as 20V. Using the Fig. 2 and component values given, answer the following questions.

Calculate:

i) Emitter current I_E
ii) Emitter resistance r_e
iii) Voltage gain at stage 2, A_{V2}
iv) Calculate input impedance of the second stage, Z_2
v) Calculate the gain of the first stage, A_{V1}
vi) Calculate the input impedance of the first stage Z_1
vii) Calculate the overall gain, A
viii) If vg is a sinusoidal voltage of 5mVcosωt, what will the output voltage be?

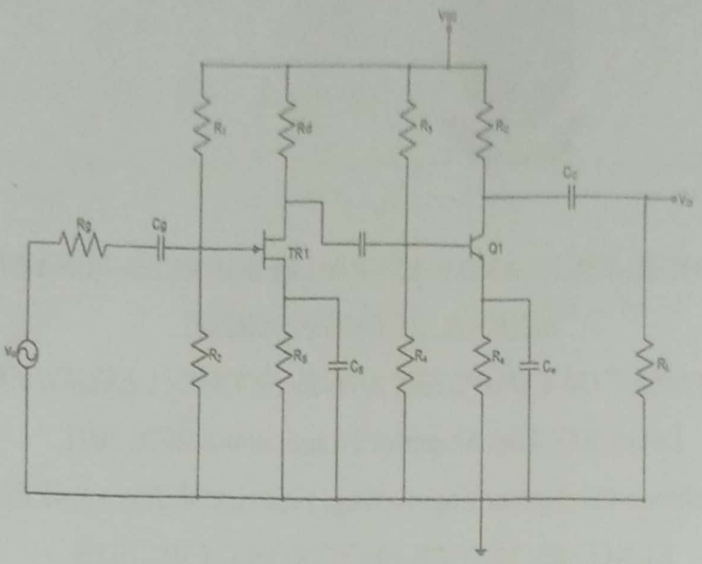

Fig. 2

Question 3

a) State and explain the different types of power amplifiers

b) A complementary pair class B push-pull amplifier has a supply voltage of 45 V and the transistors are biased so that they are sinusoidally driven to provide a current which is 0.75 of the maximum value. Calculate:

(i) The output power supplied to a speaker having a resistance of 15 Ω
(ii) The collector efficiency
(iii) The power dissipation of the transistors.

Question 4

(a) State the characteristics of an ideal op-amp.

(b) Fig. 4 shows the schematic of the two op-amp instrumentation amplifier. Find

i. An expression for V_{01} and V_{02}
ii. Hence or otherwise an expression if $R_1 = R_2 = R_3 = R$
iii. The current through R_L if $R_L = 10K\Omega$ and $Vi = 5V$

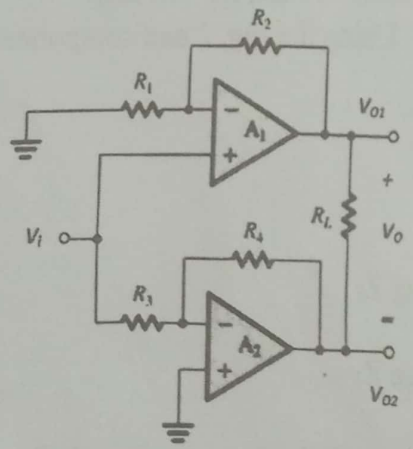

Fig. 4