



# MDK

UNIVERSITY OF ENERGY AND NATURAL RESOURCES, SUNYANI, GHANA

SCHOOL OF ENGINEERING

DEPARTMENT OF COMPUTER AND ELECTRICAL ENGINEERING

Level 300: First Semester Examinations 2020/2021

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

ELNG 303: LINEAR ELECTRONIC CIRCUITS

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:
- Oxidation
  - Diffusion
  - Epitaxy
  - Photolithography
  - Thin Film Deposition
- (b) Using the list in (a) provide a step-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  $\beta$  (Q1) at 25°C as 150 and  $g_m$  (TR1) as 3500 $\mu$ S. Given  $R_g=1.5k\Omega$ ,  $R_1=6M\Omega$ ,  $R_2=4M\Omega$ ,  $R_d=2.4k\Omega$ ,  $R_s=500\Omega$ ,  $R_3=15k\Omega$ ,  $R_4=4.7k\Omega$ ,  $R_c=2.7k\Omega$ ,  $R_e=470\Omega$ ,  $R_L=2.2k\Omega$  and supply voltage as 20V. Using the Fig. 2 and component values given, answer the following questions.

Calculate:

- Emitter current  $I_E$
- Emitter resistance  $r_e$
- Voltage gain at stage 2,  $A_{v2}$
- Calculate input impedance of the second stage,  $Z_2$
- Calculate the gain of the first stage,  $A_{v1}$
- Calculate the input impedance of the first stage  $Z_1$
- Calculate the overall gain,  $A$
- If  $v_g$  is a sinusoidal voltage of  $5mV \cos \omega t$ , what will the output voltage be?

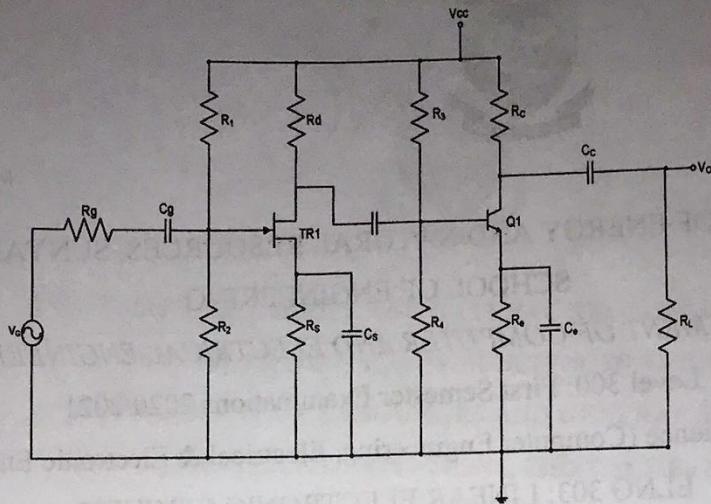


Fig. 2

### Question 3

- State and explain the different types of power amplifiers
- 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:
  - The output power supplied to a speaker having a resistance of  $15\ \Omega$
  - The collector efficiency
  - The power dissipation of the transistors.

$gmV_{ds}$

### 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
- An expression for  $V_{O1}$  and  $V_{O2}$
  - Hence or otherwise an expression if  $R_1 = R_2 = R_3 = R$
  - The current through  $R_L$  if  $R_L = 10K\Omega$  and  $V_i = 5V$

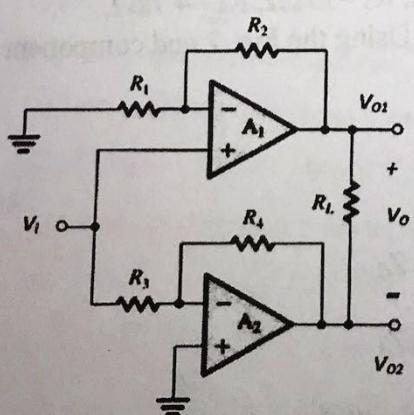


Fig. 4

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$P_{max} = \frac{V_{CL}}{8P_{D}}$   
 $\alpha_{max}$