UNIVERSITY EXAMINATION 2021/2022

THIRD YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE OF

BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING
&
BACHELOR OF SCIENCE IN TELECOMMUNICATION AND INFORMATION ENGINEERING
&
BACHELOR OF EDUCATION IN TECHNOLOGY (ELECTRICAL AND ELECTRONIC ENGINEERING)

EEE/ETI 3209: ANALOGUE ELECTRONICS II

DATE: JAN 2022 **TIME: 2 HOURS**

Instructions

This examination paper contains **FIVE** questions. Attempt **compulsory QUESTION ONE** and **any other TWO** questions.

QUESTION ONE (Compulsory)

a) By use of sketches, discuss the difference between the following
   i. CE, CB, CC (**3 Marks**)
   ii. Saturation, Cutoff, Linear operation of an amplifier (**3 Marks**)

b) Given β = 200 for both transistor Q1 and 2, determine the following
   i. V_B, V_E, V_C, I_E. (**5 Marks**)
   ii. Voltage gain at first and second (output) stage and output voltage V_o (**5 Marks**)
   iii. Overall gain and output voltage if a 1 kΩ (R_L) is applied at the second stage (**3 Marks**)
   iv. Calculate the input and output impedance and give suggestions on measures to be employed to reduce the mismatch. (**3 Marks**)

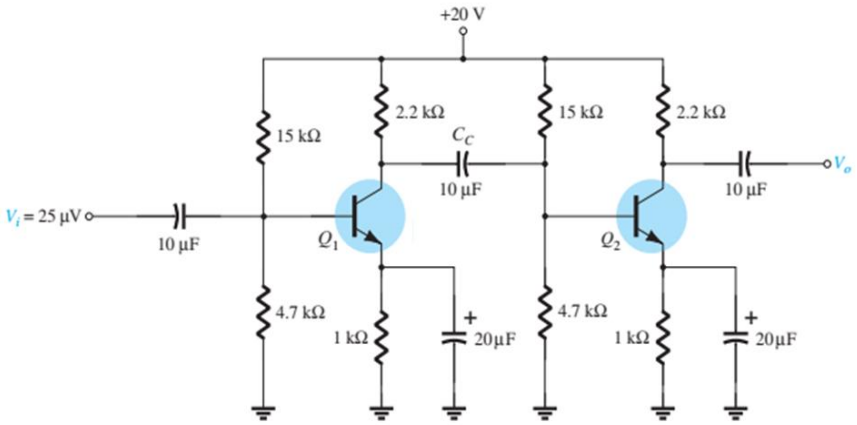

Fig. Q1.b

c) An amplifier operating over the frequency range from 18 to 20 M Hz has a 10 kΩ input resistor. Calculate the rms noise voltage at the input to this amplifier if the ambient temperature is 27℃ (**4 Marks**)

d) Briefly discuss the following amplifiers: Class A, Class B, Class AB and Class C **(4 Marks)**

QUESTION 2

a) A circuit has these values: β_{DC} = 200, R_C = 1.0 kΩ, V_{CC} = 24 V., V_{BB} = 10 V., R_B = 47 kΩ

i. Draw circuit **(1 Mark)**
ii. Find the Q-point **(3 Marks)**
iii. Draw the load line **(3 Marks)**
iv. Determine the maximum peak value of base current for linear operation **(3 Marks)**

b) Starting from the RC circuit shown in Fig. 2b, derive the equations necessary for low frequency response to prove the relation Av(dB) = -20 log10 (f_L/f) **(10 Marks)**

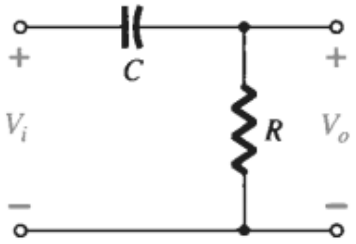

Fig. Q2b

QUESTION 3

a) Determine the cut-off frequencies for the network shown in Fig 3a using the following parameters *Cs* = 10 uF, *CE* = 20 uF, *CC* = 1 uF, *R*1 = 40 kΩ, *R*2 = 10 kΩ, *RL* = 2.2 kΩ, *RE* = 2 kΩ, *RC* = 4 kΩ, *β* = 100, *ro* = ∞Ω, *VCC* = 20 V **(10 Marks)**

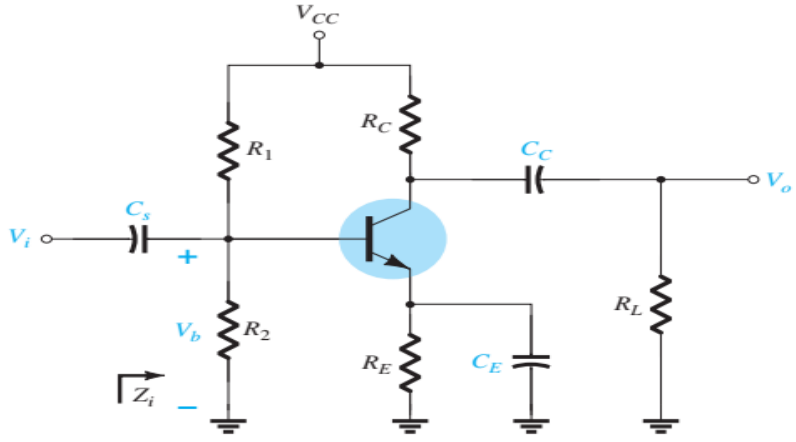

Fig Q3(a)

b) Repeat the analysis of 3a above with a source resistance *Rs* of 1 kΩ and comment on the effects of internal series resistance on gain and operating bandwidth. **(10 Marks)**

QUESTION 4

a) In the circuit shown in Fig. 4a below, Av(mid) gain = -90, r_e = 15.8 Ω, C_{be} = 36 pF, C_{bc} = 4 pF, C_{ce} = 1 pF, C_{Wi} = 6 pF, C_{Wo} = 8 pF, *Cs* = 10 uF, C_E = 20 uF, C_C = 1 uF, R_1 = 40 kΩ, R_2 = 10 kΩ, R_L = 2.2 kΩ, R_E = 2 kΩ, R_C = 4 kΩ, h_{fe} = 100, *ro* = ∞Ω, V_{CC} = 20 V

i. Determine f_{Hi} and f_{Ho} (**7 Marks**)

ii. Find f_B and f_T (**3 Marks**)

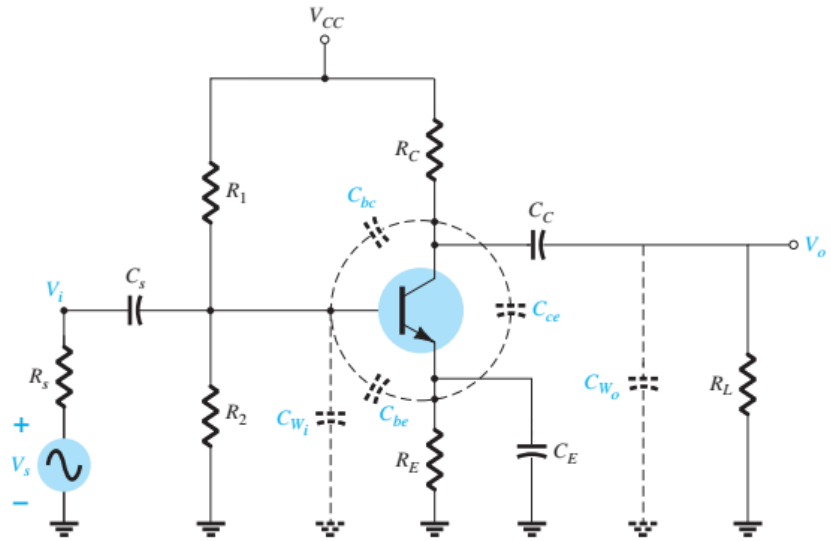

Fig Q4a

b) A certain diff-amp has a differential voltage gain of 2000 and a common-mode gain of 0.2. Determine the CMRR in dB (**2 Marks**)

c) By use of bode plots, explain octave and decade as applied in transistors (**3 Marks**)

d) A class C amplifier with Vcc = 24V and Rc = 100 Ω is driven by a 200 kHz signal. The transistor is on for 1 us, and the amplifier is operating over 100% of its load line. If *Ic*(*sat*) = 100 mA and *Vce*(*sat*) = 0.2 V;

i. What is the average power dissipation of the transistor (**2 Marks**)

ii. The efficiency of the amplifier (**3 Marks**)

QUESTION 5

a) The circuit of Fig. Q5a has an input of 12 V rms

i. Identify the type of amplifier (1 **Mark**)

ii. Calculate the input and output power (**5 Marks**)

iii. Efficiency of the amplifier and compare it with ideal performance (**1 Marks**)

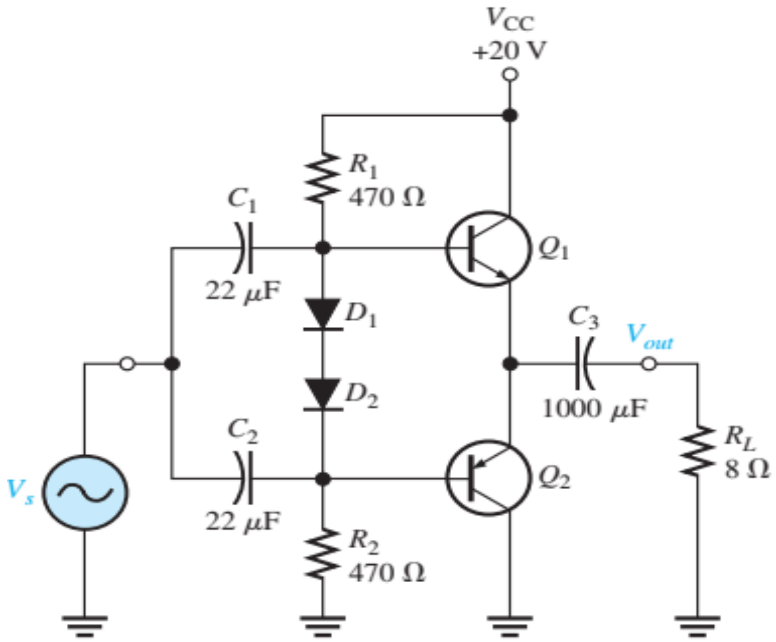

Fig. Q5a

b) For circuit shown in Fig. Q5b,

i. Calculate the relevant dc and ac parameters (5 **Mark**)

ii. Calculate the current, voltage and power gain (5 **Mark**)

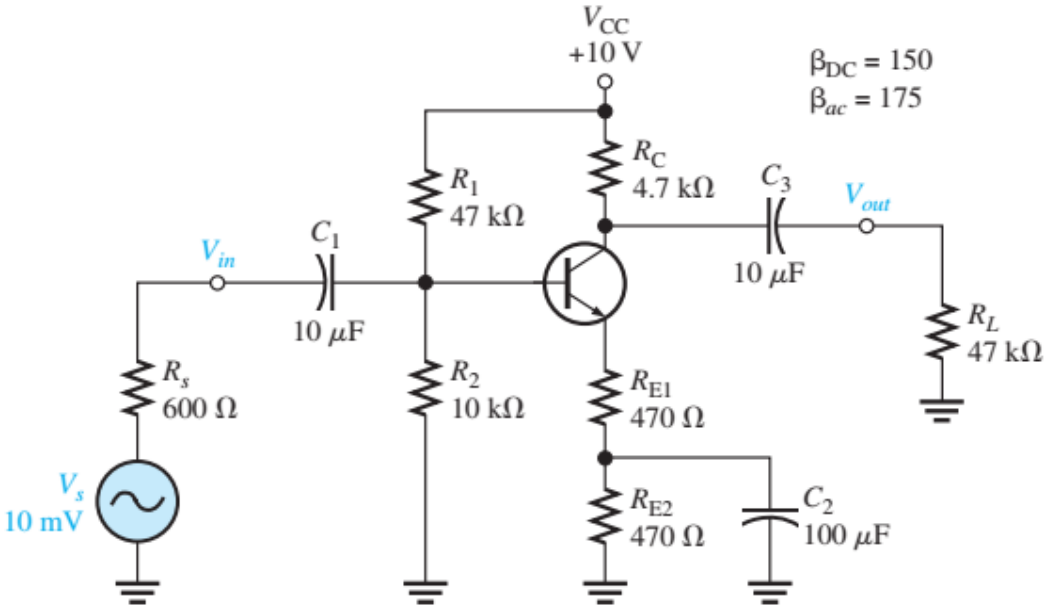

Fig. Q5b

c) Determine the noise figure in dB of an amplifier for which the noise equivalent resistance Req = 2.5 kΩ and Rt = 600 Ω if the driving generator has an output impedance of 50 Ω (Large mismatch). (3 **Mark**)