MACHAKOS UNIVERSITY

University Examinations for 2021/2022

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

THIRD YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONICS ENGINEERING)

EEE 308: ANALOGUE ELECTRONICS I

DATE: 16/3/2021 **TIME: 2:00 – 4:00 PM**

INSTRUCTIONS:

Answer question **ONE** and **ANY OTHER TWO** questions

QUESTION ONE (COMPULSORY) (30 MARKS)

a) Consider the two circuits in Fig.Q1. The parameters of each transistor are $I_s = 5 \times 10^{-16}$ A and $\beta = 90$. Determine V_{BB} in each circuit such that $V_{CE} = 1.10$ V.

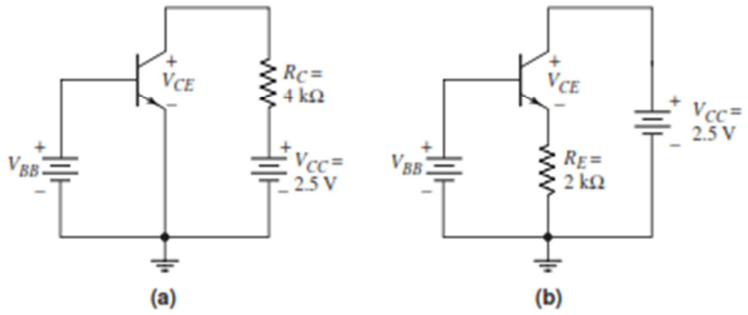

Fig.Q1

(10 marks)

b) Derive the relationship between base current amplification factor β and emitter current amplification factor α. (6 marks)

c) In the circuit shown in Fig.Q2, the values of measured parameters are shown. Determine β ,α, and the other labeled currents and voltages. Sketch the dc load line and plot the Q-point.

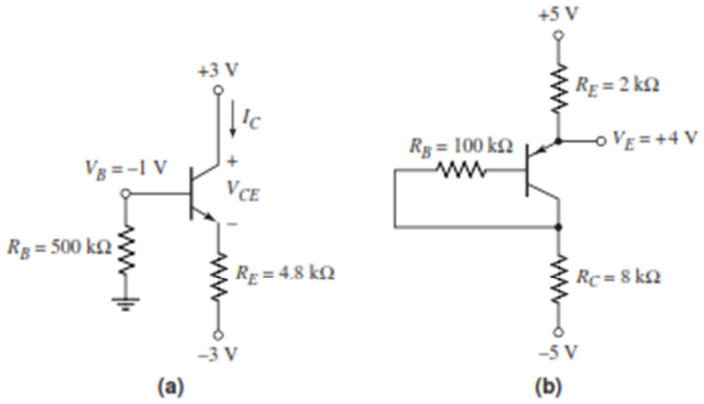

Fig.Q2

(9 marks)

d) Explain the following terms with respect to FETs.

i. Shorted-gate drain current (I_{DSS});
ii. Pinch off voltage (V_P);
iii. Gate-source cut off voltage [$V_{GS(off)}$].

(5 marks)

QUESTION TWO (20 MARKS)

a) A diode operating at 300 ^{o}k at a forward voltage of 0.4 V carries a current of 10 mA. When voltage is changed to 0.42 V, the current becomes twice. Calculate the value of reverse saturation current and η for the diode. (8 marks)

b) The parameters of the zener diode for the voltage regulator of the circuit of Fig. Q2 (c) are $V_Z = 4.7$ V at test current $I_{ZT} = 53$ mA, $R_Z = 8$ Ω, and $R_{ZK} = 500$ Ω at $I_{ZK} = 1$ mA. The supply voltage $v_S = V_S = 12 \pm 2$ V, and $R_s = 220$ Ω.

i. Find the nominal value of the output voltage v_O under no-load condition $R_L = \infty$;
ii. Find the maximum and minimum value of the output voltage for a load resistance $R_L = 470$ Ω;
iii. Find the nominal value of the output voltage v_O for a load resistance $R_L = 100$ Ω;
iv. Find the minimum value of R_L for which the zener diode operates in the breakdown region.

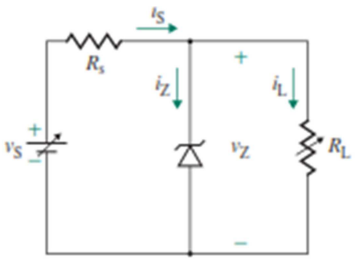

Fig.Q2 (c)

(12 marks)

QUESTION THREE (20 MARKS)

a) A full wave bridge rectifier is supplied from 230 V, 50 Hz and uses a transformer of turns ratio of 15: 1. It uses load resistance of 50 Ω. Calculate load voltage and ripple voltage. Assume ideal diode and transformer. Assume standard value of ripple factor for full wave rectifier. (10 marks)

b) A full wave rectifier circuit is fed from a transformer having a center-tapped secondary winding. The r.m.s. voltage from either end of secondary to center tap is 30 V. If the diode forward resistance is 2 Ω and that of the half secondary is 8 Ω, for a load of 1 kΩ, calculate,

i) Power delivered to load,
ii) % Regulation at full load,
iii) Efficiency of rectification,
iv) T.U.F. of secondary. (10 marks)

QUESTION FOUR (20 MARKS)

a) A PNP transistor is used in self-biasing arrangement the circuit components are V_{cc} = 4.5 V; R_2 = 2.7 KΩ; R_E = 0.27 KΩ ; R_1 = 27 KΩ of β = 44. Find

i. Stability factor.
ii. Quiescent point
iii. Recalculate these values if the base – spreading resistance of 690 Ω is taken in account. (10 marks)

b) Derive the expression for the stability factor for the potential divider method of biasing.

(10 marks)

QUESTION FIVE (20 MARKS)

a) In a self-bias n-channel JFET, the operating point is to be set at $I_D = 1.5$ mA and $V_{DS} = 10$ V. The JFET parameters are $I_{DSS} = 5$ mA and $V_{GS(off)} = -2$ V. Find the values of R_S and R_D given that $V_{DD} = 20$ V. (6 marks)

b) With the aid of a diagram, describe the operation of n-channel JFET. (10 marks)

c) In an n-channel JFET biased by potential divider method, it is desired to set the operating point at $I_D = 2.5$ mA and $V_{DS} = 8$ V. If $V_{DD} = 30$ V, $R_1 = 1$ MΩ and $R_2 = 500$ kΩ, find the value of R_S. The parameters of JFET are $I_{DSS} = 10$ mA and $V_{GS(off)} = -5$ V. (4 marks)