UNAM
UNIVERSITY OF NAMIBIA

FACULTY	AGRICULTURE, ENGINEERING AND NATURAL SCIENCES		
SCHOOL	ENGINEERING AND THE BUILT ENVIRONMENT		
DEPARTMENT	ELECTRICAL AND COMPUTER ENGINEERING		
SUBJECT	ANALOGUE ELECTRONICS II		
SUBJECT CODE	I3781CA		
DATE	MAY 2024		
DURATION	3 HOURS	**MARKS**	100

First Opportunity Examination

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Internal Moderator: MR. F.M.S ABISAI

External Moderator: PROF. J AGAJO

This Exam consists of 3 pages excluding this front page.

Instructions

1. Answer **ALL** questions.
2. Write your student number on each page.
3. Marks for different sections are shown on the right-hand margin.
4. Clearly show your reasoning.
5. Non-programmable calculators may be used.

Question 1[28 Marks]

(a) (i) State the purpose of biasing in transistors. [1 mark]

(ii) Write down the equation for the drain current of a JFET/D-MOSFET device. Describe what each of the parameters in the equations represent. [4 marks]

(iii) Using the equation in (ii) derive the expression for transconductance of a JFET/D-MOSFET. Show all your steps. [4 marks]

(b) For the network shown in Fig Q1(b), determine the values of R_D and R_S that will result in a gain of -8. For the device I_{DSS} = 10mA, V_P= -4V, V_{GS}=-1V, y_{os} = 20μS and g_{mo}= 5mS. Assume all capacitors to be extremely large. [10 marks]

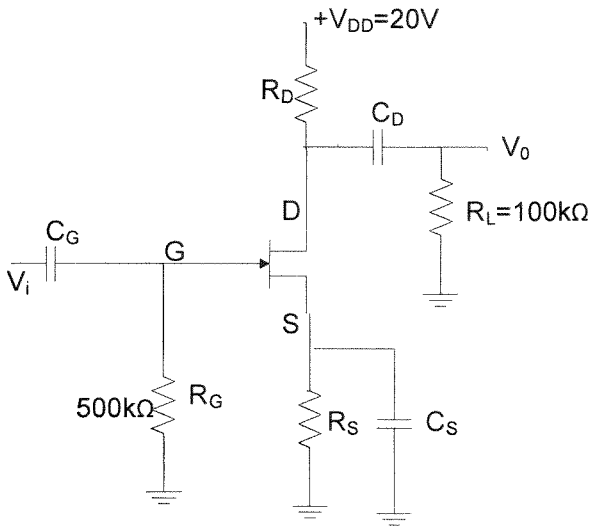

Fig. Q1(b)

(c) (i) Sketch the circuit of a 555-timer connected as an astable multivibrator for operation at 500kHz, and hence determine the value of the capacitor needed using $R_A = R_B$ = 10 kΩ. [5 marks]

(ii) Sketch the input and output waveforms of the astable multi vibrator circuit. [4 marks]

Question 2 [26 marks]

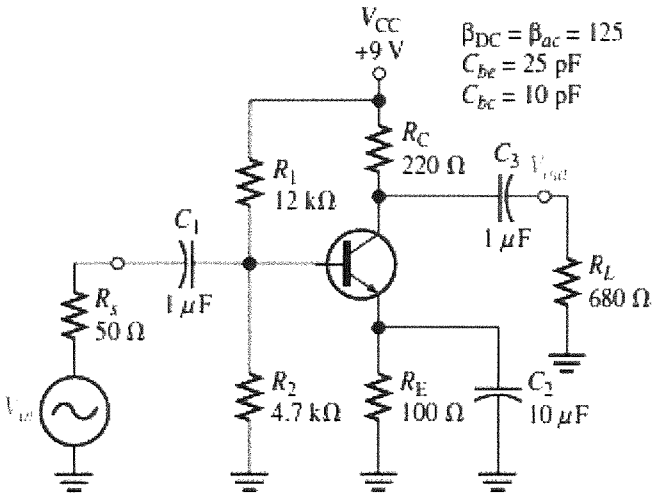

Fig Q2

(a) (i) List the capacitances that affect the circuit of Fig Q2 in low frequency region and the ones that affect it in the high frequency region. Explain your answer. [4 marks]

(ii) The midrange voltage gain of a certain amplifier is 65. At a certain frequency beyond midrange, the gain drops to 25. What is the gain reduction in dB? [3 marks]

(b) (i) Determine the critical frequencies associated with the low-frequency response of the BJT amplifier in Fig Q2. Which one is the dominant critical frequency? [10 marks]

(ii) Sketch the Bode plot. [3 marks]

(c) Determine the voltage gain of the amplifier in FigQ2 at

(i) One-tenth of the dominant critical frequency, i.e. $0.1f_c$. [2 marks]
(ii) The dominant critical frequency, i.e. f_c. [2 marks]
(iii) Ten times the dominant critical frequency for the low-frequency response, i.e. $10f_c$ [2 marks]

Question 3 [20 marks]

(a) The common mode input to a certain differential amplifier, having differential gain of 125 is $4\sin\pi t$ Volts. Calculate the common mode output if CMRR is 60dB. [5 marks]

(b) Given a differential amplifier with the following parameters, CMRR = 80 dB, $A_d = 10^5$, $V_{in1} = 3$mV, $V_{in2} = 2.99$ mV, calculate the output voltage of the op-amp. Assume V_{in1} as the inverting input and V_{in2} as non-inverting input. [6 marks]

(c) (i) Operational amplifiers can be used to form various types of controlled sources. Mention four types of controlled sources. [4 marks]

(ii) Calculate the lower and upper cutoff frequencies of the bandpass filter circuit in Fig Q3. [5 marks]

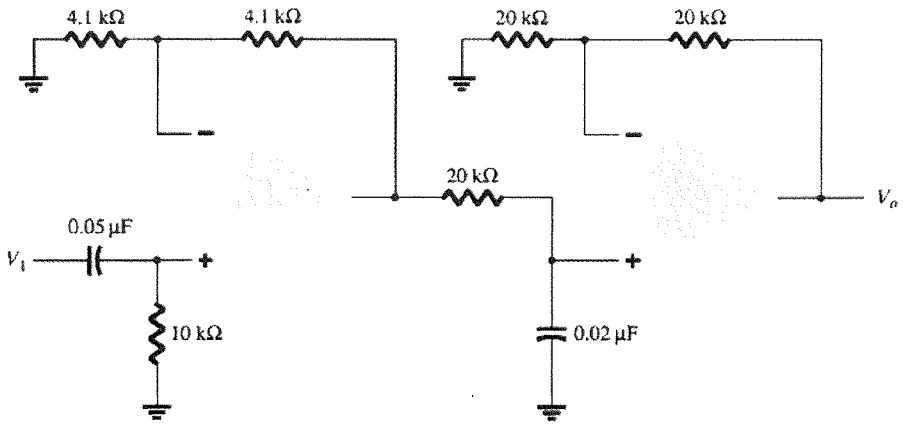

Fig Q3

Question 4 [26 Marks]

(a) A class B, push pull amplifier drives a load of 16Ω, connected to the secondary of an ideal transformer. The supply voltage is 25V. If the number of turns on the primary is 200 and the number of turns on the secondary is 50, calculate:

(i) Maximum power output. [3 marks]

(ii) D.C input power [3 marks]

(iii) Efficiency [3 marks]

(iv) Maximum power dissipation per transistor [3 marks]

(b) (i) In a power supply, explain the purpose of the rectifier, filter and regulator. [6 marks]

(ii) Calculate the ripple factor of a sinusoidal signal having peak ripple of 2V on an average of 50V. [4 marks]

(iii) Given that a filter circuit produces an output of 18V unloaded and 22V under full load operation. Calculate the percentage voltage regulation. [4 marks]