UNIVERSITY EXAMINATIONS

SECOND SEMESTER 2023/2024 ACADEMIC YEAR

SECOND YEAR EXAMINATION FOR THE DEGREES OF BACHELOR OF SCIENCE (GENERAL), BACHELOR OF EDUCATION (SCIENCE) AND BACHELOR OF INFORMATION AND COMMUNICATION TECHNOLOGY

PHYS 223: BASIC ELECTRONICS

STREAM: R   *TIME: 2 HRS*

DAY: WEDNESDAY [2.30P.M – 4.30P.M]   DATE: 10/04/2024
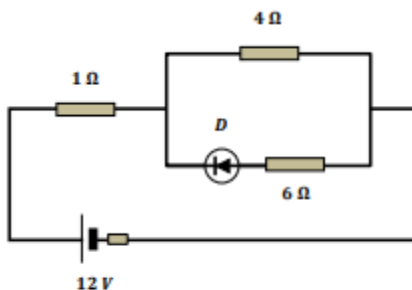
THIS QUESTION PAPER CONSISTS OF FOUR (4) PAGES

PLEASE DO NOT OPEN UNTIL THE INVIGILATOR SAYS SO.

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INSTRUCTIONS TO CANDIDATES

- Answer question **ONE** and any **TWO** questions
- Question one carries **40 marks** while all other carry **15 marks**

QUESTION ONE (40 MARKS)

(a) For a p-n junction, explain how the following are formed

   (i) P-type and N-type semi-conductors (use examples of materials to explain)   (**4 Marks**)

   (ii) Depletion region and Potential barrier   (**2 Marks**)

(b) (i) Name two most commonly used semiconductors materials   (**2 Marks**)

   (ii) Explain the term doping and its need   (**2 Marks**)

(c) (i) Name two main functions of a transistor.   (**2 Marks**)

   (ii) A diode has a certain characteristic when operating. Explain this characteristic.(**2 Marks**)

(d) Explain the two mechanisms responsible for junction breakdown   (**4 Marks**)

(e) Explain what happen to the depletion layer when a diode is:

   (i) Forward biased

   (ii) Reverse biased   (**2 Marks**)

(f) (i) The diagram below shows a 12 V battery of internal resistance 0.6 Ω connected to an

   ideal diode **D**, three resistors 1 Ω , 4 Ω and 6 Ω . Find the current through the 4 Ω resistors.

   (**2 Marks**)

(ii) Distinguish between Unipolar and Bipolar transistor   (**2 Marks**)

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(g) (i) What is the doping level in npn transistor? Draw symbol of npn and pnp transistor. **(3 Marks)**

(ii) Derive the relationship between the parameters α and β **(3 Marks)**

(iii) A BJT has a base current of 250 µA and emitter current of 15mA Determine the collector current and β. **(3 Marks)**

(h) (i) Define Rectification. **(1 Mark)**

(ii) Name three main components of power supply **(3 Marks)**

(i) A negative feedback of β = 2.5 x $10^{-3}$is applied to an amplifier of open loop

gain 1000. Calculate the change in overall gain of the feedback amplifier if

the gain of the internal amplifier is reduce by 20%. **(3 Marks)**

QUESTION TWO (15 MARKS)

(a) Distinguish between semiconductors, insulators and conductors using the energy

bands theory. **(6 Marks)**

(b) (i) Draw a circuit diagrams to distinguish between forward and reverse bias

of a p-n junction diode **(2 Marks)**

(ii) On the same graph draw forward and reverse characteristics of a diode and identify on

the curve the forward region, reverse region, cut in voltage, breakdown voltage **(4 Marks)**

(c) Use a diagram to describe qualitatively the full wave rectifying action of a junction diode
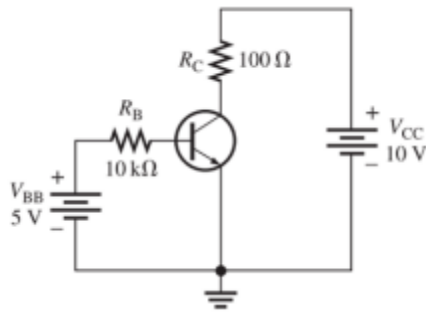
(3 Marks)

QUESTION THREE (15 MARKS)

(a) For a transistor connected in the common-emitter configuration, Sketch

(i) Possible circuit for investigating its characteristics **(3 Marks)**

(ii) The input, output and transfer characteristics **(3 Marks)**

(b) What is a load line? Explain the saturation, active and cut off regions by indicating them

on the characteristics curve. **(5 Marks)**

(c) In a common-Emitter transistor configuration circuit, if β=100 and I_B= 50µA .

Compute the value of α, I_E and I_C . **(4 Marks)**

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QUESTION FOUR (15 MARKS)

(a) List down the factors to be taken into consideration when choosing an operating point of a transistor **(3 Marks)**

(b) Determine I_B, I_C, I_E and V_{CE}, in the circuit below .The transistor has a $\beta = 150$ and $V_{BE}=0.7V$.

(7 Marks)

(c) A transistor in common emitter mode has collector supply voltage of 14V and the voltage drop across the 1.5kΩ load resistance is 0.75V. Determine the collector to emitter voltage and the base current if α is 0.96. **(5 Marks)**

QUESTION FIVE (15 MARKS)

a) Define the following terms with reference to an operational Amplifier (OP Amp)

(i) Open-loop gain

(ii)Input impedance

(iii) Output impedance **(3 Marks)**

b) (i) Briefly explain why negative feedback is preferred to the positive feedback in

Amplifiers **(3 Marks)**

(ii) Derive a general relationship between open loop gain and closed loop gains of an

Amplifier **(3 Marks)**

(c) In an amplifier with negative feedback, the gain of the basic amplifier is 100 and it employs a feedback factor of 0.02. If the input signal is 40mV, determine

(i) Voltage gain with feedback and

(ii) Value of output voltage. **(4 Marks)**

(d) State any **two** applications of an Operational-Amplifier. **(2 Marks)**

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