



# MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY

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## UNIVERSITY EXAMINATIONS 2022/2023

SECOND YEAR, SECOND SEMESTER EXAMINATION FOR THE DEGREE OF  
BACHELOR OF SCIENCE IN COMPUTER TECHNOLOGY

### SPS 3300: BASIC ELECTRONIC CIRCUIT ANALYSIS AND DESIGN

DATE: APRIL 2023

TIME: 2 HOURS

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INSTRUCTIONS: Answer Question ONE and any other TWO questions.

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#### QUESTION ONE (30 MARKS)

- a) Determine  $V_B$ ,  $V_E$ ,  $I_B$ ,  $I_E$  and  $I_C$  in figure below. The 2N3904 is a general purpose transistor with a typical  $\beta_{DC} = 200$ . (6 Marks)

- b) The figure below shows a circuit and waveforms for charging a 12-V battery. If  $V_s$  battery. If  $V_s$  is a sinusoid with 24-V peak amplitude, find:

- i. The friction of each cycle during which the diode conducts. (2 Marks)
  - ii. The peak value of the diode current. (2 Marks)
  - iii. The maximum reverse-bias voltage across the diode. (2 Marks)
- c) Determine the dc current gain  $\beta_{DC}$  and the emitter current  $I_E$  for a transistor where  $I_B = 50\mu A$  and  $I_C = 3.65 mA$ . (3 Marks)
- d) i. Define the term cascading as used in the multistage design. (2 Marks)
- ii. Explain the purpose of a coupling device in the multistage design. (4 Marks)
- e) draw a block diagram to illustrate the principal of a feedback amplifier. (4 Marks)
- f) with aid of a graph, describe the frequency responses of an amplifier. (5 Marks)

**QUESTION TWO (20 MARKS)**

- a) with aid of a diagram explain the working of a diode to implement the Boolean algebra:  
 $Y = A + B + C$  (6 Marks)
- b) with aid off graph, explain the temperature dependence of the diode on forward bias. (3 Marks)
- c) the figure below, a signal voltage of 50 MV rms is applied to the base

- i. Determine the output signal voltage for the amplifier. (4 Marks)
- ii. Find the dc collector voltage on which the output signal voltage is riding. (5 Marks)
- iii. Draw the output waveform. (2 Marks)

**QUESTION THREE (20 MARKS)**

- a) With aid of a diagram, explain how to BJT is activated as an amplifier. (4 Marks)
- b) Describe the four (4) operation modes of a bipolar junction transistor. (8 Marks)
- c) Design and describe a simple transistor switch that ensures LED blinks. (8 Marks)

**QUESTION FOUR (20 MARKS)**

- a) i. Draw a block diagram of two-stage amplifier connected in cascade. (4 Marks)
- ii. Hence show that the overall gain is the product of voltage gain of individual stages. (4 Marks)
- b) i. Explain how frequency stability affects an oscillator circuit. (8 Marks)
- ii. Show that the low range bandwidth frequency  $f_L(n)$  of a multistage amplifier is given as

$$f_L(n) = \frac{f_L}{\sqrt{\frac{1}{2^n}-1}} \quad (4 \text{ Marks})$$