NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF INDUSTRIAL TECHNOLOGY
BACHELOR OF ENGINEERING DEGREE
SUPPLEMENTARY EXAMINATION - AUGUST 2011
DURATION 3 HOURS

ELECTRONIC DEVICES AND CIRCUITS– TEE 1203

INSTRUCTIONS TO CANDIDATES:

1. ANSWER **ALL** QUESTIONS FROM **SECTION 1** ON THE ANSWER SHEET ATTACHED TO THIS QUESTION PAPER.
2. IF YOU WANT TO CHANGE THE ANSWER CANCEL THE INITIAL ONE BY CROSSING IT OFF AND CIRCLING A NEW ONE.
3. ANSWER **ALL** QUESTIONS FROM **SECTION 2** IN THE ANSWER BOOK PROVIDED.

SECTION 1

1. An electron-volt (eV) is defined as:
   a) The potential difference between the voltage levels of two neighbour atoms in a semiconductor material.
   b) The amount of energy equal to 1.602×10^{-19} J.
   c) The amount of energy needed to keep a silicon atom electrically neutral.
   d) The potential difference to be applied to an intrinsic semiconductor in order electron-hole pair to be generated.

[2 points]

2. The term 'generation of electron-hole pair' means:
   a) Producing a free electron and a hole in an intrinsic semiconductor.
   b) Producing a free electron and a hole in a P-type semiconductor.
   c) Producing a free electron and a hole in an N-type semiconductor.
   d) All of (a), (b) and (c).
   e) None of (a), (b) or (c).

[2 points]

3. An intrinsic silicon semiconductor is one that:
   a) Have silicon and boron atoms in a certain ratio.
   b) Consists of silicon atoms only.
   c) Has equal number of silicon and phosphorus atoms.
   d) Have electrons only as current carriers.

[2 points]

4. At temperature of 0° C a P-type semiconductor:
   a) Has a net positive charge.
   b) Has a net negative charge.
   c) Is electrically neutral.
   d) Has ions as free charge particles.

[2 points]

5. In a P-type semiconductor at temperature of 25° C the majority current carriers are:
a) Positively charged ions.
b) Negatively charged ions.
c) Electrons.
d) Holes.
e) Both electrons and holes. [2 points]

6. Ideally a forward biased diode can be replaced in a circuit with:
a) Open circuit.
b) Short circuit connection.
c) A voltage source and resistor in series.
d) A voltage source and resistor in parallel.

[2 points]

7. A Zener diode is a PN junction device which is designed normally to operate:
a) Under electrical breakdown.
b) Under thermal breakdown.
c) When forward biased.
d) When positive or negative voltages of order of kilovolts are applied across it.

[2 points]

8. The current I_Z in a Zener diode is:
a) The maximum reverse current which should be allowed through the diode.
b) The minimum reverse current which must be allowed through the diode for normal operation.
c) The current through the device when forward biased.
d) The typical value of the reverse current specified by the manufacturer.

[2 points]

9. For most of the Light Emitting Diodes (LEDs) the reverse voltage should not exceed:
a) 11 V.
b) 12.5 V.
c) 5 V.
d) 1000 V.

[2 points]

10. The rms value of a half-wave rectified sinusoidal signal is:
a) $0.5V_m$.
b) $0.318V_m$.
c) $0.707V_m$.
d) $0.636V_m$.

[2 points]

11. A Bipolar Junction Transistor (BJT) mode of operation when the both the Emitter Junction (EJ) and Collector Junction (CJ) are forward biased:
a) Is called the 'saturation mode' of operation.
b) A BJT does not allow both EJ and CJ to be reversed biased.
c) Is called the 'cut-off' mode of operation.
d) Is called 'inverse active' mode of operation.

[2 points]

SECTION 2

18. The reverse current I_R for a Silicon diode at any temperature is calculated with the formula $I_R = \left[I_R(25°C)\right]\left[2^{(T-25)/10}\right]$. If the reverse current of the diode at 25 °C equals to 18 nA, calculate the reverse current at temperature of 135 °C.
[4 points]

19. A forward biased diode operates at temperature of 65° C. If the TKU = - 2.4 mV/°C, calculate the value of the threshold voltage V_T.

20. For the circuit shown in Figure 1, calculate the value of the output voltage V_{OUT}.
[5 points]

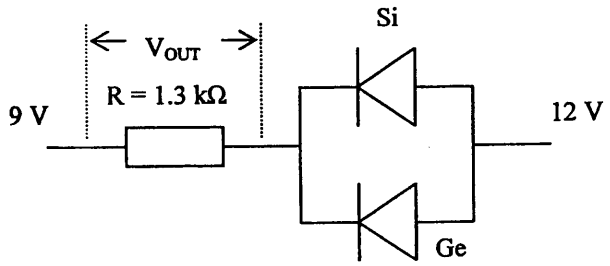

Figure 1

21. Give the circuit diagram for a full-wave bridge rectifier which produces negative only output. Assume that the input voltage is a sine-wave voltage with a maximum value of 12 V and the circuit devices are ideal ones. Clearly indicate the current paths. Sketch the output waveform.
[9 points]

22. With the help of the current-voltage characteristic, explain the operation of a Zener diode.
[5 points]

23. For the clipper circuit shown in Figure 2 assume that the diodes, D_1 and D_2 are ideal ones and the input voltage is a sine-wave voltage with maximum value of 8 V. Draw the output wave-form and the wave-form across the resistor R with respect to the input voltage.
[10 points]

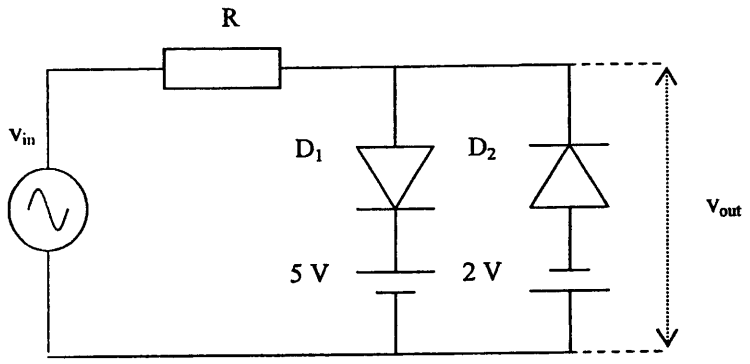

Figure 2

24. The input voltage v_{in} applied to the circuit shown in Figure 3 is a sine-wave voltage with maximum value of 6 V. Draw the output wave-form with respect to the input voltage.

[8 points]

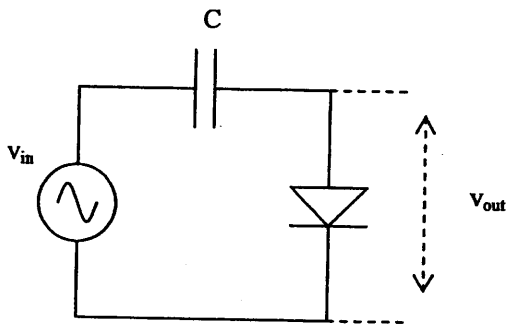

Figure 3

25. Obtain an expression relating a Bipolar Junction Transistor (BJT) α and β.

[4 points]

26. Consider the circuit shown in Figure 4. If R_B = 330 kΩ, R_C = 2.7 kΩ, R_E = 1.2 kΩ, V_{BE} = 0.7 V, β = 120, and V_{CC} = 12 V, calculate I_B, I_C, I_E, I_{CSAT} and V_{CE}.

[10 points]

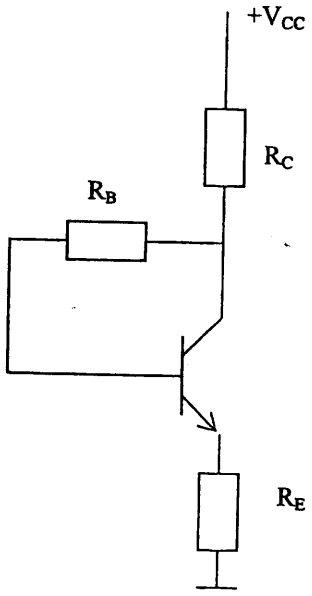

Figure 4

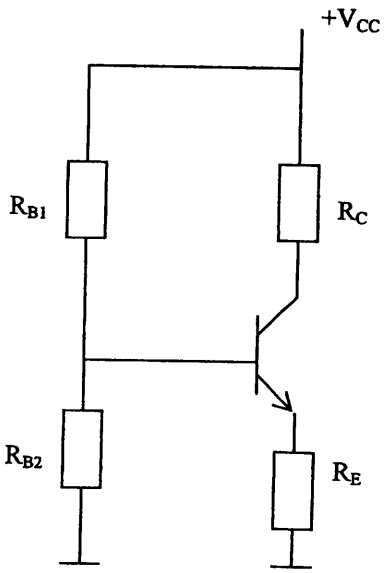

Figure 5

27. Consider the circuit shown in Figure 5, where R_{B1} = 33 kΩ, R_{B2} = 6.2 kΩ, R_C = 2.7 kΩ, R_E = 1.8 kΩ, V_{BE} = 0.7 V, β = 100, and V_{CC} = 18 V. Calculate the V_{CE}.

[6 points]

28. Show the structure for a P-channel Field Effect Transistor (FET) and briefly explain its operation.

[5 points]

TEE 1203 ANSWER SHEET

Student Registration Number.....

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