UNIVERSITY OF MINES AND TECHNOLOGY, TARKWA

SECOND SEMESTER EXAMINATIONS, MAY 2019

COURSE NO: MN/MR/GL/GM/MR/PE/ES 162
COURSE NAME: APPLIED ELECTRONICS
CLASS: MN/MR/GL/GM/MR/PE/ES **TIME:** 3 HOURS

Name**:** _____Index Number: _____

Carefully read each question and circle the correct answer.

[40 Marks]

1. The valence electrons possess more energy and are more strongly bound to the atom than inner electrons.
   a. True b. False
2. Mica, copper and silver are all good conductors.
   a. True b. False
3. In the saturation mode of operation of the transistor, both the base-emitter junction and the base-collector (BC) junction are forward-biased and the transistor operates as an amplifier.
   a. True b. False
4. The transfer characteristics of a common-emitter configuration is a graph that shows the relationship between IB and IC.
   a. True b. False
5. The conductivity of insulators and semiconductors increases with decrease in temperature.
   a. True b. False
6. A diode in a half-wave rectifier conducts for 185^{o} of the input cycle.
   a. True b. False
7. The forward voltage drop for a germanium diode is 0.3 V and for a silicon diode is 0.7 V.
   a. True b. False
8. The latching current of a thyristor is minimal in value when compared to the holding current.
   a. True b. False
9. The TRIAC and DIAC are all bidirectional devices.
   a. True b. False
10. When the thyristor is reversed biased junction J1 and J3 becomes reverse biased the thyristor operates in the forward blocking mode.
    a. True b. False
11. Positive feedback drives a circuit into oscillation as in various types of oscillator circuit.
    a. True b. False

12. An application of thyristor is in liquid level regulators.

    a. True b. False

13. If the feedback voltage is in antiphase with the input voltage, the feedback is positive and the overall gain of the amplifier will be reduced.

    a. True b. False

14. Transistors are preferred to thyristors in applications of high voltages and currents.

    a. True b. False

15. The feedback gain of the current-series feedback network is V_f/I_o.

    a. True b. False

16. The transistor-transistor analogy of the thyristor can be viewed as a two-three-layer device.

    a. True b. False

17. With a commutating capacitor, the DC voltage supply for a thyristor can be reversed.

    a. True b. False

18. Pin 2 and 3 are the non-inverting and the inverting inputs respectively of the op-amp 741 while pin 6 is the output.

    a. True b. False

19. When thyristor is triggered at 15° it conducts for 165° of the input AC power supply.

    a. True b. False

20. A push-pull class B amplifier is typically used for the output stage of the op-amp.

    a. True b. False

21. The term differential comes from the operational amplifier's ability to amplify the difference of two input signals applied to its inputs.

    a. True b. False

22. Common-mode rejection means that unwanted signal will not appear on the output and distort the desired signal.

    a. True b. False

23. When zero volts is applied to both inputs, an op-amp ideally should have an output equal to zero volts.

    a. True b. False

24. The differential DC voltage required between the inputs of an Op-amp to force the output to zero volts is known as input forced voltage.

    a. True b. False

25. The input offset current equals the average of both input currents.

    a. True b. False

26. The process of converting DC power to AC power is known as inversion.

    a. True b. False

27. The gate of the thyristor is connected to the P-type layer nearer to the anode.

    a. True b. False

28. Instrument is a device that transforms a physical variable of interest into a form that is suitable for recording.

    a. True b. False

29. Oscilloscope is a device for displaying the waveform of an electrical signal.

    a. True b. False

30. The degree to which an instrument will consistently produce equal measurements is called Accuracy

    a. True b. False

31. Typical values of input offset voltage are in the range of 2 mV or less.

    a. True b. False

32. The controlling device ensures that the pointer comes to rest in its final position quickly and without undue oscillations.

    a. True b. False

33. The electrons in the conduction band are called valence electrons.

    a. True b. False

34. The reason why conductivity increases in conductors is the predominant increase in random variations of the atoms aiding with the flow of electrons at rising temperatures.

    a. True b. False

35. Internal dynamic resistance of a complete diode is the ratio of the change in forward voltage over change in forward current.

    a. True b. False

36. In npn transistor action, conventional current flows in the direction of electron current.

    a. True b. False

37. A Zener diode is destroyed if it carries more than rated current stated in the data sheet.

    a. True b. False

38. The collector of the transistor is moderately doped.

    a. True b. False

39. At the base-emitter junction of a transistor, the finds high resistance.

    a. True b. False

40. A variation in environmental temperature whiles using a measuring instrument can result in measurement errors.

    a. True b. False

SECTION B [50 Marks]

Answer all questions

1. Figure 1 shows a forward biased silicon diode with an internal dynamic resistance r'*d* of 17 Ω and a R_{LIMIT} of 4.5 Ω.

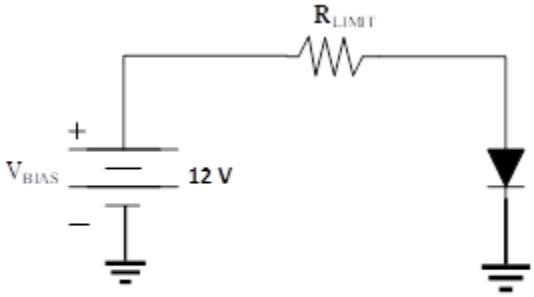

Figure 1 Forward Biased Silicon Diode

Determine the following parameters.

i. Forward current (I_F) for an ideal silicon diode.
ii. Voltage across the limiting resistor for an ideal silicon diode
iii. Forward current (I_F) for a practical silicon diode.
iv. Forward current (I_F) for a complete silicon diode.
v. Forward voltage (V_F) for the complete silicon diode.
vi. Voltage across the limiting resistor for a complete silicon diode

[6 marks]

2. Find the value of I_C and the α_{DC} rating and of the transistor shown in the Figure 2.

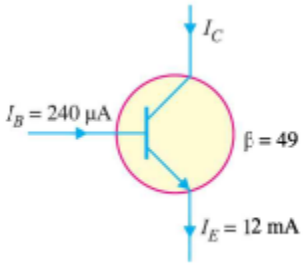

Figure 2

[2 marks]

3. A transistor is connected in common emitter (CE) configuration in which the collector supply is 8 V and the voltage drop across resistance R_C connected in the collector circuit is 0.5 V. The value of R_C=800 Ω. If α_{DC} =0.96, Calculate the collector emitter voltage and the base current. [4 marks]

4. Determine V_{CB} in the transistor circuit shown in figure 3 below. The Transistor is of silicon and has β_{DC}=145. Draw the dc load line

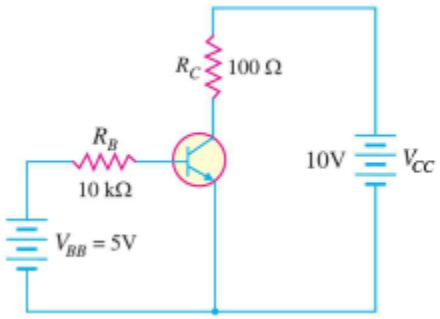

Figure 3

[9 marks]

5. A voltage gain of a voltage series amplifier without feedback is 3000. Calculate the overall voltage gain or the closed loop gain of the amplifier if negative voltage feedback is introduced in the circuit. Given that the feedback gain is 0.01.

[1 mark]

6. Figure 5 shows a non-inverting feedback amplifier. If the gain of the amplifier without feedback is 10,000. find:
   i. Feedback gain β
   ii. The overall voltage gain
   iii. Output voltage if the input voltage is 1 mV

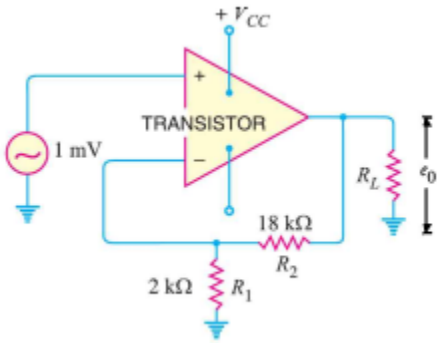

Figure 5

[3 marks]

7. Draw and label the circuit symbol of the following semiconductor device.
   i. Zener diode
   ii. Npn transistor
   iii. Operation amplifier
   iv. Thyristor

[6 marks]

8. Determine the output voltage for the circuit in Figure 6

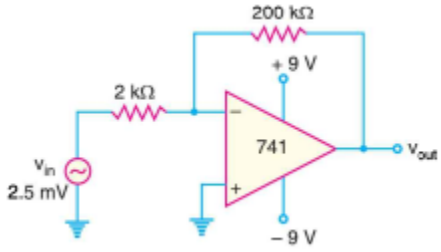

Figure 6

[2 marks]

9. Calculate the output voltage for the circuit in figure 7. The input $V_1 = 100\sin(1000t)\,mV$ and $V_2 = 10\sin(2500t)\,mV$

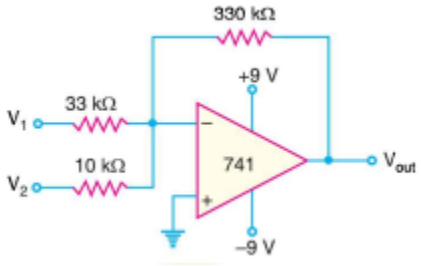

Figure 7

[3 marks]

10. Determine the common-mode gain of an op-amp that has a differential open-loop voltage gain of 200000 and CMRR of 90 decibels.

[2 marks]

11. State four applications of thyristors.

[2 marks]

12. Define the following terms:
    i. Virtual ground
    ii. Instrument
    iii. Common mode rejection ratio
    iv. Input bias current
    v. Accuracy
    vi. DC load line

[6 marks]

13. Draw and label the I-V static characteristics of a thyristor.

[4 marks]

Examiners: I. Aidoo/ R. A. Ofosu