MURANG'A UNIVERSITY COLLEGE

FIRST YEAR SECOND SEMISTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN MATHEMATICS AND COMPUTER SCIENCE

ICS 2200: ELECTRONICS SUPPLEMENTARY

DATE: 27TH JUNE 2016 **TIME 2 HOURS**

The paper consists of **FIVE** questions. Answer question **ONE** and any other **TWO** questions

QUESTION ONE

a) What are intrinsic semiconductors? [2mks]

b) State two reasons why silicon transistors are generally preferred to germanium ones. [2mks]

c) Calculate the maximum amount of current a zener diode can pass without damage if its breakdown voltage is 15 V and its maximum power rating is 10W. If this diode is used to supply a constant voltage of 15V from a 20V battery, what is the value of the resistor which must be connected is series with it? [6mks]

d) A field effect transistor operates with a drain current of 100mA and a gate source bias of −1V. The device has a forward transconductance (g_{fs}) value of 0.25. If the bias voltage decreases to −1.1V, determine

   I. the change in drain current, [4mks]

   II. the new value of drain current. [2mks]

e) Explain how you can make an n-type semiconductor from an intrinsic semiconductor. [6mks]

f) Sketch the forward and reverse characteristics of a silicon p-n junction diode and describe the shapes of the characteristics drawn. [8mks]

QUESTION TWO

a) Explain briefly the terms given below when used in semiconductor terminology:

   i. covalent bond [2mks]

   ii. trivalent impurity [2mks]

   iii. pentavalent impurity [2mks]

b) Draw the symbols for
   I. An n – channel JUGFET [2mks]
   II. A p-channel MOSFET. [2mks]

c) With reference to a p-n-p transistor, explain what is meant by the term transistor action and why a bipolar junction transistor is so named. [7mks]

d) To limit the reverse current at breakdown, the power rating of a zener diode is 500mW. If the diode is being used to supply a constant voltage of 5.1V from a 9V dry battery, find the value of the resistor that is connected in series with it. [3mks]

QUESTION THREE

a) What are transistor characteristics? [1mks]

b) Calculate the maximum current a zener diode can pass without damage if its breakdown voltage is 20V and its maximum power rating is 5W. [2mks]

c) The zener diode in b) above is used to supply a constant voltage of 10V from a 12V battery, what is the value of the resistor which is connected in series with it? [3mks]

d) With the aid of a circuit diagram, explain how the input and output characteristics of an n-p-n transistor having a common-base configuration can be obtained. [12mks]

e) Sketch a forward biased p-n junction diode and show effect on the depletion layer. [2mks]

QUESTION FOUR

a) State three reasons why silicon is used rather than germanium to make rectifier diodes for power supplies. [3mk]s

b) State two uses of a zener diode. [2mks]

c) Briefly explain how a bipolar junction transistor is constructed. [3mks]

d) From the data given below for a semiconductor diode, plot its characteristics. [4mks]

forward current (mA)	0	0	0.02	1	100
Forward voltage (V)	0	0.2	0.4	0.6	0.8

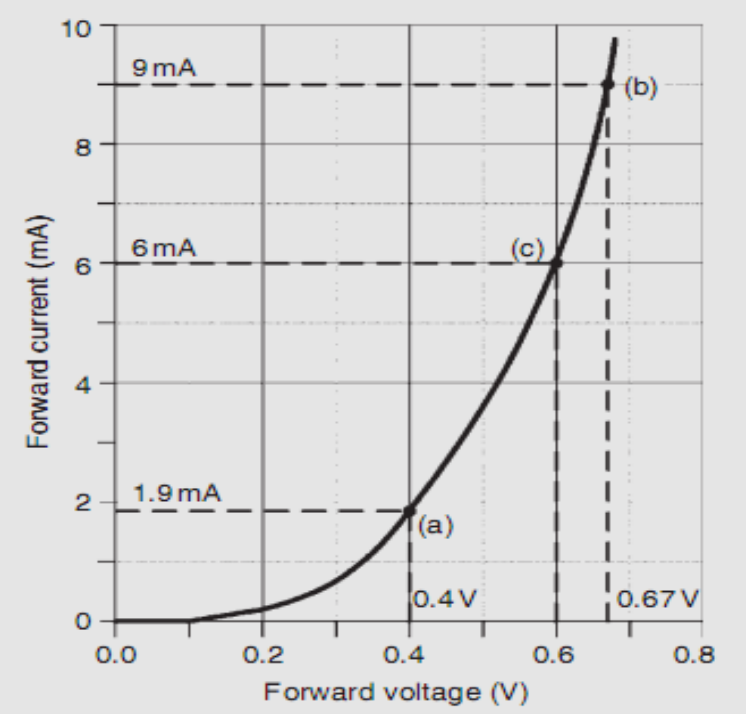
i. Is it a silicon or germanium diode? Give a reason for your answer. [2mks]

ii. What value and power of resistor should be connected in series with it to limit the forward current to 100mA on a 3.0V supply? [2mks]

e) Using a circuit diagram, explain how a bipolar junction can be used as a d.c current amplifier. [4mks]

QUESTION FIVE

a) The forward characteristic of a diode is shown in the figure below.



Use the characteristic to determine

I. the current flowing in the diode when a forward voltage of 0.4V is applied, [1mk]

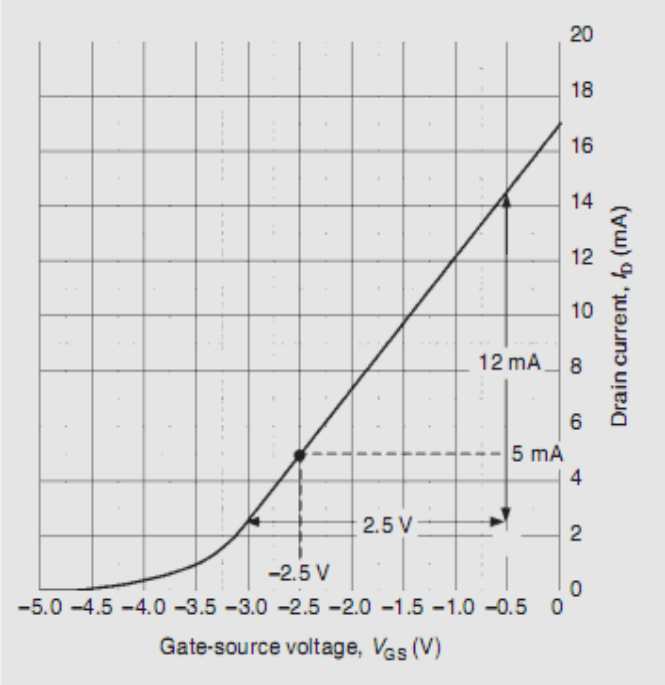
II. the voltage drop across the diode when a forward current of 9mA is flowing in it, [1mk]

III. the resistance of the diode when the forward voltage is 0.6V, [2mks]

IV. whether the diode is a germanium or silicon type. [1mk]

b) A bipolar transistor has a common-emitter current gain of 125. If the transistor operates with a collector current of 50mA, determine the value of base current. [3mks]

c) The figure below shows the mutual characteristic for a junction gate field effect transistor.



When the gate-source voltage is −2.5V, determine

I. the value of drain current, 2mks

II. the dynamic value of forward transconductance. 4mks

d) Distinguish between conductors, semiconductors and insulators in terms of the forbidden gap. 3mks

e) For the transistor shown below what is the value of I_E 3mks