ELIZADE UNIVERSITY ILARA MOKIN, ONDO STATE

FACULTY OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

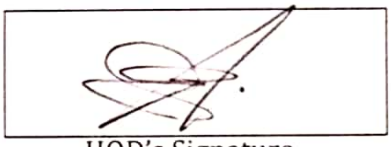
SECOND SEMESTER EXAMINATION, 2020/2021 ACADEMIC SESSION

COURSE TITLE: PHYSICAL ELECTRONICS

COURSE CODE: EEE 319

EXAMINATION DATE: 30TH March, 2021

COURSE LECTURER: DR K. O. TEMIKOTAN/DR. R.O. ALLI-OKE



HOD's Signature

TIME ALLOWED: 3 HOURS

INSTRUCTIONS

1. ANSWER QUESTION ONE AND ANY OTHER FOUR QUESTIONS
2. SEVERE PENALTIES APPLY FOR MISCONDUCT, CHEATING, POSSESSION OF UNAUTHORIZED MATERIALS DURING EXAM.
3. YOU ARE NOT ALLOWED TO BORROW ANY WRITING MATERIALS OR CALCULATORS DURING THE EXAMINATION.
4. SMART WATCHES OR SIMILAR DEVICES ARE NOT ALLOWED IN THE EXAMINATION VENUE.

ANSWER QUESTION ONE AND ANY OTHER FOUR

QUESTION ONE

a) Briefly discuss the operation of the circuit shown in Figure 1a. [4 marks]

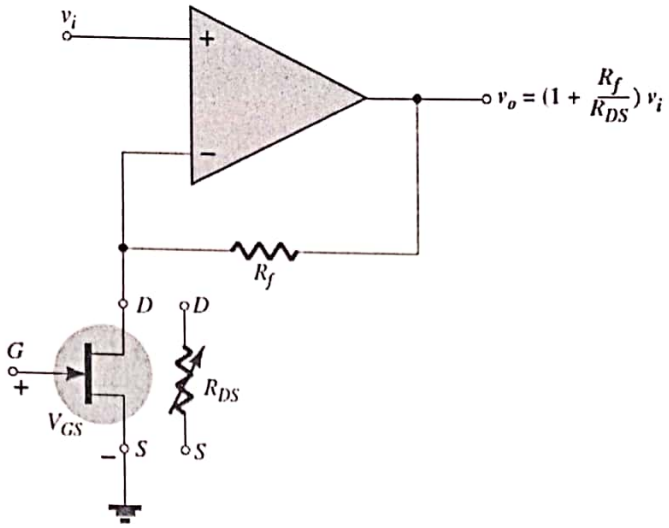


Figure 1a: JFET-Transistor Application

b) The capacitance of a varactor varies from 5 to 50 pF. Two such varactor diodes are used in the tuning circuit of Figure. Q 1b. If L = 10 mH, determine the tuning range of the circuit. [8 marks]

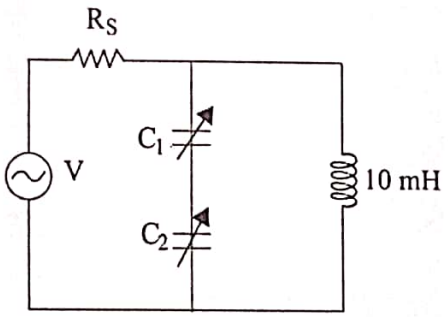


Figure Q 1b Tuning Circuit

QUESTION TWO

a) Explain the operation of the dark-operated relay shown in Figure Q2. Re-draw the circuit with a snubber circuit included, and explain why it is needed. A diode can be used instead of the snubber circuit. Re-draw the circuit with a diode included instead of a snubber circuit, and state the conditions where a diode cannot replace a snubber circuit.

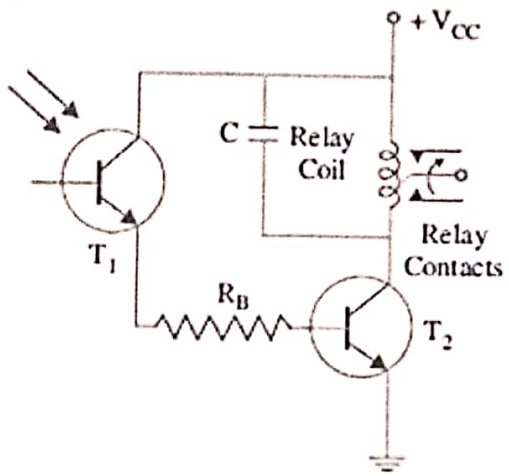


Figure Q2: Dark-Operated Relay

b) A germanium diode draws 40 mA with a forward bias of 0.25 V. The junction is at room temperature of 293ºK. Calculate the reverse saturation current of the diode. [6 Marks]

QUESTION THREE

a) The basic construction of a silicon P–N junction solar cell is shown in Figure 2. Briefly discussed the following (i) How this construction differs from that of general-purpose PN diodes (ii) How incident light energy results to increase in the minority-carrier flow. [4 marks]

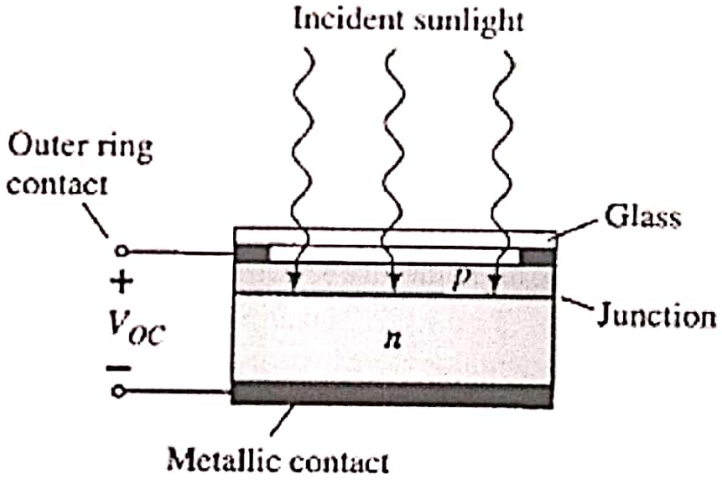


Figure Q3: Construction of Solar Cell

b) Calculate the barrier potential for Silicon junction at (i) 100ºC and (ii) 0ºC if its value at 25ºC is 0.7 V [4 marks]

c) A germanium diode draws 40 mA with a forward bias of 0.25 V. The junction is at room temperature of 293ºK. Calculate the reverse saturation current of the diode. [4 marks]

QUESTION FOUR

a) With the aid of well-labelled diagram, briefly explain the operation of a Bipolar Junction Transistor with (i) forward-biased and (ii) reverse-biased junctions. Explain why the depletion region is wider for the reverse-biased junction and narrower for the forward-biased junction. [6 marks]

b) Draw and explain the forward V-I characteristics of a pn junction. [6 marks]

QUESTION FIVE

a) What is the Hall effect? [2 marks]

b) State five purposes of the Hall effect. [3 marks]

c) A semiconducting crystal 12 mm long, 5 mm wide and 1 mm thick has a magnetic flux density of 0.5 Wb/m2 applied from front to back perpendicular to the largest faces. When a current of 20 mA flows lengthwise through the specimen, the voltage measured across its width is found to be 37 mV. What is the Hall coefficient of the semiconductor? [3 marks]

d) A current of 50 A is passed through a metal strip, which is subjected to a magnetic flux of density 1.2 Wb/m2 . The magnetic field is directed at right angles to the current direction and the thickness of the strip in the direction of magnetic field is 0.5 mm. The Hall voltage is found to be 100 V. Calculate the number of conduction electrons per cubic metre in the metal. [4marks]

QUESTION SIX

a) The probability f(E) of an electron occupying an energy level E is given by Fermi-Dirac distribution function. State the mathematical expression for the function. [2 marks]

b) State the expression for Fermi energy of an intrinsic semiconductor. [2 marks]

c) Explain using the energy band theory the classification of solids as insulators, semiconductors and conductors. [8 marks]

QUESTION SEVEN

a) What is mobility of an electron? [2 marks]

b) The mobility of free electrons and holes in pure germanium are 3800 and 1800 cm^2 /V-s respectively. The corresponding values for pure silicon are 1300 and 500 cm^2 /V-s, respectively. Determine the values of intrinsic conductivity for both germanium and silicon. Assume $n_i = 2.5 \times 10^{13}$ cm^{-3} for germanium and $n_i = 1.5 \times 10^{10}$ cm^{-3} for silicon at room temperature.[4 marks]

c) Calculate forward current in a Germanium diode at 20ºC when forward voltage is 0.3 V. Compare this value with that after a temperature rise of 50ºC. Assume that reverse saturation current doubles for every 10ºC rise in temperature. [6 marks]