Bengal Engineering and Science University, Shibpur
B.E (ETC) 3rd Semester Final Examination, 2012
Subject: Electron Devices
Code No-ET 303

Time: 3 hours Full marks: 70

Use Separate Answer Script for each group

First Half
(One mark is reserved for neatness in this half)

1. a)Discuss the velocity saturation phenomenon of electrons in semiconductors in the light of acoustic and optical phonon interaction.
b) Discuss the parameters on which mobility of semiconductor depends. 17

2. A finite length (w) semiconductor bar, in a field free condition, is injected with minority carriers from one side (at x=0) and the carriers are withdrawn at x=w . Prove that,

i) $$P_n(x) = P_{n0} + [P_n(0) - P_{n0}]\left[\frac{e^{-\frac{w-x}{L_p}} - e^{\frac{w-x}{L_p}}}{e^{-\frac{w}{L_p}} - e^{\frac{w}{L_p}}}\right]$$

ii) $$J_p(0) = eAD_p \left| \partial P_n/\partial x \right|_{x=0} = \left(e\frac{D_p}{L_p}\right)[P_n(0) - P_{n0}]\left[\frac{e^{-\frac{w}{L_p}} + e^{\frac{w}{L_p}}}{e^{-\frac{w}{L_p}} - e^{\frac{w}{L_p}}}\right]$$

iii) $$J_p(w) = eAD_p \left| \partial P_n/\partial x \right|_{x=0} = \left(e\frac{D_p}{L_p}\right)[P_n(0) - P_{n0}]\left[\frac{2}{e^{-\frac{w}{L_p}} - e^{\frac{w}{L_p}}}\right]$$

iv) $$J_p(0)/J_p(w) = \frac{1}{\cosh\left(\frac{w}{L_p}\right)}$$

17

3. a) In case of a p-n junction diode, prove that
i) $V_{bi} = (KT/q)\ln(N_A N_D/n_i^2)$ and
ii) $w = \{[(2\varepsilon_s V_{bi})/q]^* \left| (N_A+N_D)/N_A N_D \right| \}^{1/2}$;
where notations have their standard meanings.
b) Differentiate between Zener and avalanche breakdown mechanism. 17

4. a)Discuss the current conduction phenomenon in metal semiconductor junction with the help of band diagram. What factors determine whether the junction will be Ohmic or rectifying? 17

Second Half

(Answer any three questions from this half)

(2 marks are reserved for neatness in this half)

5.(a) Explain the two effects that combine to produce 180^0 phase difference between the applied voltage and the resultant current pulse of an IMPATT diode.

An IMPATT diode has the following parameters

Carrier drift velocity = 10^5 m/s

Length of the drift space = 5μm

Maximum operating current = 150mA

Maximum operating voltage = 80 volt

Efficiency η = 10%

Calculate (i) the CW power output and (ii) the frequency of oscillation produced.

[3+3]

(b) Write down the conditions for tunneling in a Tunnel diode. Draw its equivalent circuit. Write down the expression for two of its cut-off frequencies.

[2+1+2]

6. Derive Eber-Moll equation for a transistor and write down its significance. What do you mean by base-width modulation of a transistor.

[8+3]

7.(a) Draw the structure of a Gunn diode and explain how negative differential mobility develops in a Gunn diode? Explain the different modes of operation of a Gunn diode.

[1+4+3]

(b) A Gunn diode is operating in transit time mode at 12 GHz. The domain of charge move at 10^7cm/sec. speed. Calculate (i) the length of the device, and (ii) Can the device work at 10GHz and 14 GHz. Which is the mode of operation in each case.

[3]

8.. Find out an expression for 'drain resistance' and 'trans-conductance' of an n-channel JFET. Define the term 'pinch off'. Explain why a FET is less temperature sensitive than a BJT.

[4+4+1+2]

9. Draw the structure of an p-channel MOSFET and explain its operation. With proper assumptions, find out an expression of its drain current.

[(1+4)+ 6]