

**Bengal Engineering and Science University, Shibpur**  
**B.E (ETC) 3<sup>rd</sup> Semester Final Examination, 2013**  
**Subject: Electron Devices**  
**Code No-ET 303**

Time: 3 hours

Full marks: 70

Use Separate Answer Script for each group

**Group A**

(Answer question no. 1 and any other question from this group)

1. a) Differentiate between optical phonons and acoustic phonons.  
b) Differentiate between lattice scattering and impurity scattering.  
c) "A doped semiconductor does not necessary always imply an extrinsic semiconductor"—explain.  
d) Differentiate between an undoped and an equally doped (both n and p) semiconductor.  
e) Discuss the nature of variation of conductivity of a doped semiconductor as a function of temperature. 5x4=20
  
2. a) A uniformly doped infinite length n type semiconductor bar, in a field free condition, is injected with minority carriers from one side. Plot the variation of minority carrier as a function of distance (length).  
b) Discuss band to band recombination and trap assisted recombination in semiconductors. 10+5=15
  
3. a) In case of a p-n junction diode, prove that  
i)  $w = \left\{ \frac{(2\epsilon_s V_{bi})}{q} \left[ \frac{(N_A + N_D)}{N_A N_D} \right] \right\}^{1/2}$  ;  
where notations have their standard meanings. What is the importance of c-v characteristics in case of diodes?  
b) Differentiate between Zener and avalanche breakdown mechanism. 10+5= 15
  
4. a) Discuss the current conduction phenomenon in metal semiconductor junction with the help of band diagram. -  
b) What factors determine whether the junction will be Ohmic or rectifying? 10+5= 15

**Group B**

(Answer any three questions from this group)  
(2 marks are reserved for neatness in this half)

5. Explain the two phenomena which are responsible for the development of negative resistance in an IMPATT diode. Write down the significance of negative resistance that develops in an IMPATT diode. Draw the equivalent circuit of an IMPATT diode.

An IMPATT diode has the following parameters:

Carrier drift velocity =  $10^5$  m/s

Length of the drift space = 8  $\mu$ m

Maximum operating current = 160 mA

Maximum operating voltage = 60 V

Efficiency  $\eta$  = 15%

Calculate (a) CW power output and (b) the frequency of oscillation produced.

[4+1+2+4=11]

6.(a). Write down the condition for tunneling in a Tunnel diode. Draw its equivalent circuit and find out the expression for two of its cut-off frequencies.

(b) With necessary derivation explain how negative differential mobility develops in a Gunn diode. Explain different modes of operation of a Gunn diode.

[(2+1+2)+(4+2)=11]

7. Derive Eber-Moll equation and write down its significance. Draw the equivalent circuit of a transistor.

[11]

8. With proper assumptions derive an expression for drain current of an n-channel JFET. Also find out expressions for its drain resistance and trans-conductance.

[7+4=11]

9. Draw the structure of an n-channel MOSFET and explain its operation. Draw its equivalent circuit. Why gate protection of MOSFET is very essential? Make a comparison between a MOSFET and a JFET.

[1+3+3+2+2=11]