Ref. No.: Ex/ET/T/122/2019 (Old)

B.E. Electronics and Tele-Communication Engineering 2019 (Old)

First Year Second Semester

Electron Device

Full Marks: 100 Time: Three hours

The figures in the margin indicate full marks.

(All parts of the same question must be answered together)

1. Fill in the blanks: 10

a) A semiconductor of ---- band gap suits better for high temperature operation.
b) The breakdown voltages of Zener diodes are always ---- than those in Backward diodes.
c) The natural direction of orientation that the molecules in a liquid crystal follow is called ___.
d) The semiconductor used in a blue LED should have a ___ band gap compared to that in a red LED.
e) An FET does not suffer from the problem of Thermal runaway, as it relies on the ___ carriers.
f) In a BJT, if the base doping be lowered, its gain will ___ , the Early voltage will ___.
g) PUT is the full form of ----.
h) The combination of an LED and a Photodetector is called ___.
i) A PIN diode is ___ than a conventional photodiode.

2. Answer <u>any TWO</u>: 2x15

a.i) Derive the *Junction laws* for a step *p-n* junction. 7
ii) Sketch the energy band diagrams for a *p-n* junction at *Equilibrium*, under *Forward bias* and under *Reverse bias*. 8

b) Describe the two primary breakdown mechanisms occurring in a reverse biased *p-n* junction. Also describe what is the other breakdown that may take place in a diode and how does it occur? 12+3

c.i) What is the *Ideal diode approximation*? Write down the *I-V* relation for an ideal diode (no derivation). Describe how the relation gets modified in case of a real diode? 2+2+3

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ii)	Develop the energy band diagram of a junction formed between a Metal (work function φ_m) and an *n*-type semiconductor (work function φ_{sn}), where $\varphi_m > \varphi_{sn}$. Explain the nature of the resulting junction.	8
3.	Answer <u>any TWO</u>	2x20
a.i)	With the help of appropriate band diagrams, explain the origins of different current components and the overall *I-V* characteristic of a Tunnel diode.	12
ii)	Explain the Input and Output characteristics of a BJT in *CE* configuration.	8
b.i)	What is *Gradual channel approximation*? Use it to derive the general *I-V* relationship for a JFET. Also explain its *I-V* characteristic.	1+8+5
ii)	Draw the schematic structures and *I-V* characteristics of DIAC, SCR and TRIAC.	6
c.i)	Explain the operation of a CMOS inverter. Why it is named CMOS?	8+2
ii)	Why a VMOS is called Power FET? Describe its structure and operation.	2+8
4.	Answer <u>any ONE</u>:	10
a)	Draw and explain the equivalent circuits of *p-n* junction diode and Schottky diode. Modify the above circuits under Forward and Reverse biased conditions.	6+4
b)	Define *h*-parameters and draw the general *h*-parameter equivalent circuit for a BJT. Modify the circuit while the transistor is used in *CE* configuration.	8+2
5.	Answer <u>any ONE</u>:	10
a)	Explain why the efficiency of a basic LED is poor and how can it be improved.	
b)	Discuss various approaches for reducing the switching time for a semiconductor diode.	