3154(N)

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			CS/B.Tech(ECE-N	N)/SEM	I-3/EC-302/2011-12	
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			SOLID STATI	E DEV	ICES	
Time Allotted : 3 Hours					Full Marks: 70	
		Tł	he figures in the margi	n indica	nte full marks.	
Ca	andid	ates	are required to give th	eir ansv	wers in their own words	
			as far as			
			GROUE	P – A		
			(Multiple Choice T	Type Qu	iestions)	
1.	Cho	ose	the correct alternative	es for a	ny <i>ten</i> of the following : $10 \times 1 = 10$	
	i)	If a	If a voltmeter is connected across the terminal of an unbiased Germanium p - n junction diode, the voltmeter			
			ding will be	1.	0.0.17	
		a)	0 V	,	0·3 V	
	••\	c)		d)	1.0 V.	
	ii)		e capacitance of a var	actor d	iode can be changed by	
		a)		b)	doping level	
		c)	size of the diode	d)	all of these.	
	iii)	Which of the following diodes does not possess a				
		negative resistance region in its characteristics?				
		a)	Tunnel diode	b)	Gunn diode	
		c)	Zener diode	d)	IMPATT diode.	
	iv)	At $T = oK$, the Fermi-Dirac distribution function vs energy plot takes the form				
		a)	step	b)	linear	
		c)	parabolic	d)	exponential.	
		٠,	randone	u,	or-borrows.	

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- v) If ϕ_s and ϕ_F denotes respectively the surface and Fermi potential, strong inversion takes place in an n-channel MOSFET when
 - a) $\phi_s = 0$

b) $\phi_S < \phi_F$

c) $\phi_s = \phi_F$

- d) $\phi_S = 2\phi_F$.
- vi) The basic lattice structure of silicon is
 - a) simple cubic
- b) edge-centered cubic
- c) face-centered cubic
- d) body-centered cubic.
- vii) GaAs is preferred to Si for high temperature operation of semi-conductor device because GaAs
 - a) is direct band gap in nature
 - b) possesses higher energy band gap
 - c) is a compound semi-conductor
 - d) possesses smaller carrier effective mass.
- viii) A bipolar junction transistor, when used as a switch, operates in
 - a) cut-off and active region
 - b) active and saturation region
 - c) cut-off and saturation region
 - d) all of these.
- ix) The quadrant of I-V plot relevant to operation of a solar cell is
 - a) 1st

b) 2nd

c) 3rd

- d) 4th.
- x) Tunnel diode is used in
 - a) audio oscillator
- b) r.f. oscillator
- c) microwave oscillator
- d) mm-wave oscillator.

- xi) A voltage variable capacitance can be realized in
 - a) Zener diode
- b) Avalanche diode
- c) Schottky diode
- d) Varactor diode.
- xii) A BJT used in CE configuration offers
 - a) low input impedance and high output impedance
 - b) high input impedance and low output impedance
 - c) low input and output impedances
 - d) high input and output impedances.

GROUP - B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

- 2. What are direct band gap and indirect band gap semi-conductors? Draw the E K diagrams for Si and GaAs. 3 + 2
- 3. What is ambipolar transport? Why carrier generation and recombination rates are equal in thermal equilibrium? 2 + 3
- 4. What is contact potential? Derive an expression for it involving impurity concentration on either side of the structure. 2+3
- 5. Define mobility and write down its unit. Also give an equation that relates the mobility and diffusivity of carriers in a semi-conductor. What is the significance of the equation? 1+1+2+1
- 6. What do you mean by Pinch-off condition in JFET? Briefly describe the situation. 2 + 3

GROUP - C

(Long Answer Type Questions)

Answer any three of the following. $3 \times 15 = 45$

- 7. a) What is 'law of mass action'? Explain its significance. 4
 - b) Describe different breakdown mechanisms that may occur in a reverse biased semi-conductor *p-n* junction diode.

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- 8. a) With the help of energy band diagram, describe formation of Schottky barrier at the junction between a metal and an *n*-type semi-conductor. Explain why a Schottky diode is faster than a *p-n* junction diode. 6 + 2
 - b) Describe the origin of 'diffusion capacitance' and 'depletion capacitance' in a p-n junction. Also discuss their dependence on the biasing condition of the diode. 5+2
- 9. a) What is early effect? Explain how it influences the input characteristics of a BJT in CB configuration. 3 + 3
 - b) Draw the output characteristics of a BJT used in CB configuration. Indicate different regions in the characteristics and explain them. 3 + 6
- 10. a) With the help of energy band diagram, explain the I-V characteristics of a tunnel diode.
 - b) Describe operation of a *pnpn*-structure on the basis of two-transistor analogy.
 - Sketch the transfer characteristics of a depletion
 MOSFET operated in both depletion mode and enhancement mode.
- 11. Write short notes on any *three* of the following : 3×5
 - a) Solar cell
 - b) Hall effect
 - c) Effective mass
 - d) PIN photodiode
 - e) Gunn diode.