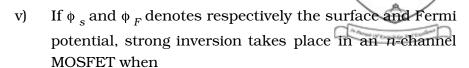
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		•		I-3/EC-302/2011-12	
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		SOLID STAT	re dev	TCES	
Time Allotted : 3 Hours				Full Marks : 70	
	Tł	ne figures in the mar	gin indica	te full marks.	
Candid	ates	are required to give	their ansı	vers in their own words	
			ıs practico		
		GRO	U P – A		
		(Multiple Choice	Type Qu	estions)	
1. Cho	ose	the correct alternat	ives for a	ny ten of the following: $10 \times 1 = 10$	
i)	If a	If a voltmeter is connected across the terminal of an			
	unl	unbiased Germanium p - n junction diode, the voltmeter			
	rea	ding will be			
	a)	0 V	•	0.3 V	
	•	0.6 V	d)	1.0 V.	
ii)	The capacitance of a varactor diode can be changed by				
		ying	1.		
		bias voltage	•	doping level	
	,	size of the diode	,		
iii)		Which of the following diodes does not possess a negative resistance region in its characteristics?			
		-			
	a)	Tunnel diode	b)		
:)	c)	Zener diode	d)		
iv)		At $T = oK$, the Fermi-Dirac distribution function vs energy plot takes the form			
	a)	step	b)		
	c)	parabolic		exponential.	
	Cj	parabone	uj	exponential.	
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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.

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- 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. $3 \times 5 = 15$

- What are direct band gap and indirect band gap semiconductors? 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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2.

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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. 4
 - c) 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.

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