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SARDAR PATEL UNIVERSITY
M.Sc. (PHYSICS) (IV Semester) Examination
Tuesday, 12th April, 2016 2:30 pm to 5:30 pm
Course No.: PS04EPHY04
ADVANCED SOLID STATE ELECTRONIC DEVICES

Total Marks:70

Q.1 Eight multiple choice questions (MCQ) carrying one mark each. **(8)**

- (i) The band gap shrinkage in Si npn transistor with emitter doping of 10^{18} cm^{-3} at room temperature (300K) is
(a) 0.022 eV (b) 0.225eV
(c) 2.2 eV (d) None
- (ii) Which of the following semiconductor is useful to make monolithic optoelectronic integrated circuits (OEIC)?
(a) Ge (b) Si (c) GaAs (d) CdTe
- (iii) For which of the following devices, the channel conductivity is highest?
(a) JFET (b) MESFET (c) MODFET (d) MOSFET
- (iv) MOS capacitor is different from discrete parallel plate capacitor as,
(a) Its capacitance can be varied by varying gate voltage.
(b) Its capacitance is purely a function of oxide thickness.
(c) It is a fixed value three terminal capacitance.
(d) None of the above.
- (v) Which of the following devices depends for its operation on delta doping?
(a) JFET (b) MODFET (c) MESFET (d) MOSFET
- (vi) Which of the following is a most power efficient device?
(a) JFET (b) MODFET (c) MESFET (d) CMOS
- (vii) Which of the following devices is a no gain high speed photodetector?
(a) APD (b) P-I-N (c) photoconductive (d) None
- (viii) At cut-off wavelength, the absorption coefficient of semiconductor is
(a) ∞ (b) 2 (c) 0 (d) 1

Q.2 Short answer questions carrying two marks each **(14)**

(attempt any seven out of nine).

- (i) What is band gap shrinkage? Explain.
- (ii) Discuss advances in Si based HBTs.
- (iii) Write differences between JFET and MESFET.
- (iv) What is HMOS?

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- (v) Write down the important issues of short channel MOSFET.
- (vi) Sketch the energy band diagram of MOS capacitor in inversion region and discuss why it is called so.
- (vii) Write the advantages and limitations of Avalanche photodetector.
- (viii) Discuss Light-Current characteristics of LED.
- (ix) Discuss different materials used for construction of Light Emitting Devices.
- Q.3(a)** Explain how channel length is modulated in FETs. (6)
- (b) Discuss the need for band tailoring and its methods on the basis of BJT design limitations. (6)
- OR**
- (b) Discuss how the active channel in case of MESFET is isolated from the gate and derive an expression for drain current in terms of material parameters. (6)
- Q.4(a)** Discuss the structure and characteristics of SIMOX. (6)
- (b) Describe key motivations of GaAs/AlGaAs MODFET using schematic and energy band profile diagrams. (6)
- OR**
- (b) With the help of charge control model of MODFET derive expression for the 2-D electron gas density n_s introduced in the spacer region of a MODFET. (6)
- Q.5(a)** Distinguish between depletion and enhancement MOSFETs. (6)
- (b) Discuss in detail about the MOS capacitor and its C-V Characteristics (6)
- OR**
- (b) Discuss important effects in long channel MOS devices. (6)
- Q.6(a)** Explain the characteristics of P-I-N Photodetector and discuss its design issues. (6)
- (b) Discuss following LED performance issues in detail. (6)
- (i) Spectral Purity
- (ii) Temporal Response.
- OR**
- (b) Discuss the structure and characteristics of an Edge Emitting LED. (6)

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