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SARDAR PATEL UNIVERSITY
M.Sc. (PHYSICS) (IVth Semester) Examination
Monday, 27th April, 2015 2:30 pm to 5:30 pm
Course No.: PS04EPHY04

ADVANCED SOLID STATE ELECTRONIC DEVICES

Notes: Q.1: Eight multiple choice questions (MCQ) carrying one mark each.

Q.2: Short answer questions carrying two marks each
(attempt any seven out of nine).

Q.3 to Q.6: Long answer questions carrying 12 marks each.

Total Marks:70

- Q.1(i) For high gain p-n-p transistors the Gummel number _____ should be as low as possible. (8)
(a) $p_{co}W_b$ (b) $p_{bo}W_b$ (c) $n_{co}W_b$ (d) $n_{bo}W_b$
- (ii) Use of III-V compound like GaP in Si based HBTs has the main problem of
(a) Bandgap shrinkage (b) cross doping (c) lattice mismatch (d) none.
- (iii) Which of the following material technology favors the development of Opto Electronic Integrated Circuits (OEICs)?
(a) Si (b) GaAs (c) Ge (d) CdSe
- (iv) Which of the following FET device depends for its operation on the formation of high barrier height with gate metal?
(a) FET (b) MOSFET (c) MODFET (d) CMOS
- (v) The inversion region for the p-MOSFET is obtained when
(a) negative bias is applied between the metal and the semiconductor
(b) positive bias is applied to the metal with respect to the semiconductor
(c) more positive bias is applied to the metal with respect to the semiconductor
(d) None
- (vi) CCD makes use of a series of _____ capacitors placed next to each other.
(a) MODFET (b) JFET (c) MIS (d) MESFET
- (vii) At cut-off wavelength, the absorption coefficient is
(a) ∞ (b) 2 (c) 0 (d) 1
- (viii) In case of CdS photodetector the peak current is
(a) 300mA (b) 510mA (c) 610mA (d) 1000mA.
- Q.2(i) Differentiate between JFET and MESFET. (14)
(ii) Show how the band diagram of BJT is different from that of HBT.
(iii) Explain how at pinch-off voltage the I_{DSat} current flows through the channel.
(iv) Explain the channel length modulation in FET devices.
(v) Show how inversion layer is developed in a MOS device. What is its importance?

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- (vi) What are long channel and short channel effects in FET devices?
- (vii) What are the characterizing parameters of a solar cell?
- (viii) What is band gap tailoring? Explain.
- (ix) Define external and internal quantum efficiency.

- Q.3(a)** Discuss the BJT design requirements for high gain transistors. What are its limitations? (6)
- (b) Derive the current-voltage relationship for a MESFET and explain different regions of its operation. (6)

OR

- (b) Show how a 2DEG is developed in a triangular quantum well. Also derive the expression for the sheet charge density of 2DEG in an undoped narrow bandgap region of the MODFET. (6)

- Q.4(a)** Discuss the operation of a MOS capacitor. Draw and explain its C-V characteristics. (6)

- (b) Discuss in detail the high frequency high speed issues in FET devices. (6)

OR

- (b) With the help of a neat circuit diagram explain the working of a CMOS. Also state its advantages and limitations. (6)

- Q.5(a)** What is CCD? Sketch the structure of CCD and explain the process of charge transfer in it. (6)

- (b) Obtain an expression for photocurrent in a P-N photo diode. (6)

OR

- (b) Discuss various LED performance issues. (6)

- Q.6(a)** Discuss various important issues in the PIN device design. (6)

- (b) Write a note on various LED materials. (6)

OR

- (b) Discuss advanced LED structures. (6)

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