

**B. ETCE. ENGG. EXAMINATION 2017**4<sup>th</sup> Year, 2<sup>nd</sup> Semester (Old)**ELECTRON DEVICE III**

Full Marks : 100

Time : Three hours

*The figures in the margin indicate full marks.*Answer *any five* questions.*(All parts of the same question must be answered together)*

- 1.(a) Describe the scheme for finding out energy states for an electron confined in a rectangular potential well of finite barrier height. 12
- (b) Verify whether the above analysis yields correct results in the case of 4+4
- (i) an infinite potential well
- (ii) a free electron.
- 2.(a) Prove that the density of states function  $D(E) \propto E^{(N-2)/2}$ , for system dimension  $N = 3, 2$  and  $1$ . 15
- (b) Determine the carrier concentration in a 2D system. 5
- 3.(a) Illustrate a scheme to find out the energies of an electron confined in a multi-layered heterostructure, for which the potential energy variation is given as: 15
- $V(z)=0$  for  $0 < z < a$  and  $b < z < c$ , and
- $V(z)=V_0$  for  $z < 0$ ,  $a < z < b$  and  $z > c$ , where  $0 < a < b < c$ .
- (b) Determine the number of bound electronic states in a *GaAs QW* of width  $30 \text{ nm}$  and depth  $0.25 \text{ eV}$ . Assume  $m_n^* = 0.067m_0$  for *GaAs*. 5

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- 4.(a) With appropriate diagram, describe how various delays appear in switching operation of a *BJT*. Discuss how these delays can be minimized. 8+6
- (b) Explain how a *HBT* can eliminate the above problems and provide high gain, high speed. 6
- 5.(a) What is Modulation doping? How does it help to enhance the mobility of carriers in a semiconductor? What is the significance of the spacer layer? 12
- (b) Describe the structure of an *FET* based on the above principle. Mention one of its important applications. 8
- 6.(a) What is Resonant tunneling? Why it is so named? 3+1
- (b) With the help of energy band diagram, establish the characteristic of a *RTD*. What is the figure of merit of such diode and how can it be improved? 7+5
- (c) Mention different possible configurations for *RTBT*. 4
- 7.(a) What is Exciton? Describe how excitons in a 2D system may survive in presence of an external electric field. 3+5
- (b) What is Quantum Confined Stark Effect (QCSE)? Explain how this effect is utilized in the operation of an optical switch. 3+9
8. Write notes on: 10+10
- (a) Superlattice
- (b) Single Electron Charging.