B.E. ELECTRONICS AND TELE-COMMUNICATION ENGG. EXAMINATION, 2022

FOURTH YEAR SECOND SEMESTER

ADVANCED ELECTRON DEVICES

Full Marks: 70 **Time: 4 Hours**

Answer any SEVEN questions

(All parts of the same question must be answered together)

Q1.a) Explain how the ordering of atoms in an alloy of two semiconductors, A and B, can be determined. 6

b) What type of ordering is most useful for semiconductor device applications? Describe atomic arrangement in an alloy $A_x B_{1-x}$ $(0 < x < 1)$ of the above category. 1+3

Q2. What is the Quantum Size Effect (*QSE*)? 'A semiconductor Quantum Dot (*QD*) is treated as an artificial atom' – justify the statement. Briefly present one of the schemes for realization of such QD (no processing details needed). 4+3+3

Q3.a) How does a *Multiple Quantum Well* (*MQW*) offer superior performance over that of a *Single Quantum Well* (*SQW*) in practical applications? 3

b) Explain how an appropriate reduction in barrier layer thickness of a MQW results in formation of a *Superlattice* (*SL*) and thus provides additional tuning of the existing energy band structure. 7

Q4. Describe the *Metamorphic growth* of a semiconducting material over a thick semiconductor substrate. Also describe how the resulting structure facilitate use of standard available substrates in realizing novel hetero-structures. 7+3

Q5. Sketch and explain the *Output* and *Transfer characteristics* of a Metal Semiconductor Field Effect Transistor (*MESFET*). Name two most popular materials appropriate for this device. . 6+3+1

Q6. What is *Stimulated Emission* of light? Discuss what are the conditions required for stimulated emission and how they are satisfied in a basic *p-n junction Laser.* 3+2+5

Q7. Explain how a Self Electro-optic Effect Device (*SEED*) can operate as an *optical switch.* 10

Q8. Mention the basic conditions to be fulfilled for Tunneling. Describe the phenomenon of *Resonant tunneling* and differentiate it from *Conventional tunneling.* 2+6+2
What are the prime features of a traditional *Tunnel diode and a Resonant tunneling diode*?

Q9. Write note on ***any ONE*** of the following: 10

a) Comparison of *Conventional doping* and *Modulation doping,*
b) Influence of *Strain* on the *Valence band structure* of a *bulk* semiconducting material.
c) Vertical-Cavity Surface-Emitting Laser (*VCSEL*).