Sub Code: BECT063 **ROLL NO……..……..**

VI SEMESTER EXAMINATION, 2023-24

III-Year, Programme – B.Tech. – Electronics and Communication Engineering)

NAME OF SUBJECT: HIGH SPEED ELECTRONICS

Duration: 3:00 hrs **Max Marks: 100**

Note: - Attempt all questions. All Questions carry equal marks. In case of any ambiguity or missing data, the same may be assumed and state the assumption made in the answer.

Q 1.	Answer any four parts of the following. a) How does Emitter Coupled Logic (ECL) achieve high-speed operation? b) What role does the AlGaN/GaN heterostructure play in HEMTs? c) Distinguish between elemental semiconductors and Compound semiconductors. d) In a HEMT, what is the purpose of the spacer layer? Would the device still function without it? e. Compare a Schottky diode with a PN junction diode with the help of energy band digram f) What is the difference between SiC and SiGe? Which is a compound semiconductor and which is an alloy?	5x4=20
Q 2.	Answer any four parts of the following. a) Explain the concept of light hole and heavy hole with appropriate energy band diagrams. b) Describe the process of preparing SOI wafers. c) How do metal-semiconductor field-effect transistors (MESFETs) differ from MOSFETs? d) How do silicon-germanium alloys improve the performance of high-speed silicon-based devices? e) How does the presence of interface states affect the Schottky barrier height? f) What is the significance of the band alignment in HEMTs?	5x4=20
Q 3.	Answer any two parts of the following. a) What is the heterostructure bipolar transistor? Why are the frequency performances of this device better than the ones of a conventional bipolar transistor? b) Draw a basic HEMT structure and systematically explain its formation. c) Describe the method of surface passivation to achieve stable high gain and high-frequency performance in HBT devices made from GaAs and InP.	10x2= 20
Q 4.	Answer any two parts of the following. a) What is the fundamental working principle of a Schottky barrier diode, and how does it differ from a conventional p-n junction diode in terms of structure and electron flow? b) Discuss the role of native oxides in compound semiconductors, such as GaAs, InP, and GaN, when used in MOS devices. How do native oxides influence the electrical properties and reliability of these devices? c) Explain the crystal structure of III-V binary and ternary compound semiconductors compared with Si crystal structure. Also, comment on the doping techniques used for III-V semiconductor-based devices.	10x2= 20

Q 5.	Answer any two parts of the following. a) What is a Heterojunction Bipolar Transistor (HBT), and how does it differ structurally and functionally from a traditional Bipolar Junction Transistor (BJT)? Explain the role of the heterojunction in improving the performance of HBTs. b) Discuss the significance of the two-dimensional electron gas (2DEG) in HEMTs. How is the 2DEG formed, and what are the properties that make it crucial for the high-speed and high-frequency performance of these transistors? c) For a Metal-Silicon (MS) junction, assume a hypothetical metal with a work function of 4.60 eV. Assume that the electron affinity of Si is 4.03 eV. Assume that the Si is N-type with $ND = 10^{17}$ cm^{-3} and draw an energy band diagram. Indicate the Schottky barrier height on your sketch.	10x2= 20

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