B.Tech Even Semester Examination, May, 2025

Electronics & Communication Engineering

(8th Semester)

Course No: ECC-801A

(High Speed Electronics)

Full Marks: 50

Pass Marks: 25

Time: 2 hours

Note:

1. Attempt any five questions.
2. Begin each answer in a new page
3. Answer parts of a question at a place
4. Assume reasonable data wherever required
5. The figure in the right margin indicates full marks for the question
6. All the mathematical symbols and abbreviations have their usual meanings.

1. Discuss Noise factor (F) and Noise figure (NF) of an amplifier. A receiver for satellite transmissions at 4 GHz consists of an antenna preamplifier with a noise temperature of 127 K and a gain of 20 dB. This is followed by an amplifier with a noise figure of 12 dB and a gain of 40 dB. Compute the overall noise figure and equivalent noise temperature of the receiver. What would be the value of the noise figure if the order of the amplifier and preamplifier be exchanged? Assume that the amplifiers are at a physical temperature of 290 K. 2+2+6=10

2. Define Gain compression. Show that as the input amplitude "A" increase, the gain decreases due to the non-linear terms. A non-linear RF-amplifier exhibits a 3rd order non-linearity with given output as $Vout = a_1Vin - a_3Vin^3$ where $a_1 = 5$ and $a_3 =$

0.02. Calculate the 1dB compression point. 2+6+2=10

3. Discuss the four poly types of Silicon Carbide (SiC). (Mention its properties, limitation, application and also draw the Structures.) 2+3+3+2=10

4. List the special consideration one need to take into consideration while designing a High-Speed PCB. State the complexity of the design. 6+4=10

5. Discuss the construction and functionality of depletion-mode High Electron Mobility Transistor (HEMT). Determine typical numerical values of a HEMT device such as pinch-off voltages, threshold voltage and drain current for V_{GS} = -1, -0.75, -0.5, -0.25 and 0V as a function of drain-source voltages V_{DS}. Assume the parameters $N_D = 10^{18}$ CM $^{-3}$, Vb = 0.81V, $\varepsilon_H = 12.5\varepsilon_0$, d= 50nm, $\Delta Wc = 3.5 \times 10^{-20}$ W. s, W = 1O µm, L= 0.5 µm and µn = 8500 cm^2/V. s. 3+4+3=10

6. Discuss the Surface Mount Technology and Through Hole Technology in board assembly of High-Speed PCB. What are the main issues and Limitations. 3+3+2+2=10

7. Why is Silicon Germanium alloys and Silicon Carbide preferred for high speed devices as compared to Silicon-based devices? 5+5=10

8. Explain the concept of a timing path in digital circuit design. Clearly define the terms "start point" and "end point" of a timing path, describe the four types of timing paths found in a synchronous design. Also, differentiate between clock path, data path, launch path, and capture path in the context of Static Timing Analysis (STA). 4+4+2=10

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