JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT
MAKE UP EXAMINATION (NOVEMBER 2025)
B.Tech. - III Semester (ECE-VLSI)

COURSE CODE (CREDITS): 25B11MA312 (2) MAX. MARKS: 25
COURSE NAME: NUMERICAL TECHNIQUES
COURSE INSTRUCTORS: RKB* MAX. TIME: 1 Hour 30 Mins.

***Note:*** *All questions are compulsory. Use of scientific calculator is allowed. The candidate is allowed to make suitable numeric assumptions wherever required for solving problems.*

| Q.No | Question | CO | Marks |
|---|---|---|---|
| Q1 | If for a transistor, the node-voltage equation reduces to a polynomial like $2x^3 - 3x - 4 = 0$ after non-dimensionalization. Solve the polynomial using Newton-Raphson method correct to 3 decimal places to find the node voltage (normalized) at the DC operating point needed before analyzing small-signal behavior or designing bias networks. | CO-2 | 5 |
| Q2 | In VLSI design, propagation delay of a logic gate is often characterized at discrete load capacitance values. The following table shows the measured propagation delay (in nanoseconds) of a CMOS inverter for different load capacitances. Using Newton's Forward Interpolation, estimate the propagation delay at a load capacitance of 5 pF. | CO-3 | 5 |
| Q3 | Suppose we have a gate delay measured at different input transition times The measured gate delays at three input slews are given: | CO-2 | 5 |
| Q4 | Suppose the following data represents the measured NMOS saturation current (Id) versus gate voltage (Vgs) data: | CO-3 | 5 |
| Q5 | In an analog circuit, the instantaneous current through a transistor is given by the function $I(t) = 0.3 + 0.5t + 0.4t^2$ $(in\ mA)$ $0 \le t \le 12\ \mu s$. Using Simpson's 3/8 rule with $n = 6$ equal intervals, estimate the total charge $\int_0^{12} I(t)dt$ (in μC) delivered during the interval [0, 12]. | CO-3 | 5 |

| Load Capacitance (pF) | 2 | 4 | 6 | 8 |
|---|---|---|---|---|
| Propagation Delay (ns) | 0.52 | 0.68 | 0.90 | 1.20 |

| Input Slew (ns) | 0.1 | 0.3 | 0.5 |
|---|---|---|---|
| Delay (ns) | 0.25 | 0.40 | 0.65 |

Using Lagrange Interpolation, estimate the interpolated delay at input slew 0.20.

| Vgs | 0.8 | 1.0 | 1.2 | 1.4 | 1.6 | 1.8 | 2.0 |
|---|---|---|---|---|---|---|---|
| Id | 0.05 | 0.40 | 1.10 | 2.10 | 3.45 | 5.10 | 7.05 |

Using the method of least square, fit a linear order equation to interpolate the value of saturation current at the gate voltage 1.5.

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