Daffodil International University

Department of Electrical and Electronic Engineering
Faculty of Engineering
Final Examination, Summer 2026

Course Code: 0541-213	Course Title: Numerical Methods	
Section: A, B, C, D, E	Level-Term: L3-T1	Teacher's Initials: AKB, SP
Full Marks: 40	Exam Date: August 19, 2026	Time: 2 Hours

[Questions 1 and 2 are Mandatory. Answer any 3 of the remaining Questions. The second rightmost column indicates the COs (course learning outcomes of the course) with respective Bloom's level, and the rightmost column indicates the assigned marks.]

Q1. A circuit is designed such that the total inductance L_{eq} is dependent upon two of the inductances, L_1 and L_2, and the relation is $L_{eq} = \frac{L_1+2L_2+5}{2+L_2}$. The current through the equivalent circuit is calculated by $I = \alpha\left(L_1 + L_2\right)^2$; where $\alpha = 0.003\ AH^{-2}$ and the stored energy in the circuit is $W = \frac{1}{2} L_{eq} I^2$. Here, L_1 and L_2 are related to each other, and the following data table has been found: CO-2 C(3) 8

$L_1(Henry)$	2	4	6	8	10	12
$L_2(Henry)$	3.6	6.6	12.1	22.1	40.2	73.2

Using exponential curve fitting, **calculate** L_2 and thus **compute** the energy stored in the circuit when $L_1 = 3\ Henry$. If the actual value of the energy is 0.065 J, then **calculate** the absolute error and relative error.

Q2. A 5.0 H inductor in a DC motor starter circuit experiences a voltage surge. A high-speed data logger records the voltage v(t) every 0.1 seconds. CO-2 C(3) 8

Time, t (s)	0.0	0.1	0.2	0.3	0.4	0.5	0.6
Voltage, v (V)	0.0	20.0	35.0	45.0	50.0	52.0	53.0

Assume the initial current i(0) = 0 A. Use Simpson's ⅓ Rule to **compute** the integral of voltage from t = 0 to t = 0.6s also **calculate** the instantaneous current i(0.6) and instantaneous power P(0.6). If the exact value of P(0.6) is 244.2543 W, **determine** the percentage error of your calculated power value

Q3. Given, $\frac{dx}{dt} = x + y,\ \ \frac{dy}{dt} = x - y,\ \ x(0) = 1,\ \ y(0) = 0$ CO-1 C(3) 8

Without eliminating the parameter t, **calculate** $x(0.2)$ and $y(0.2)$ using Euler's method with step size $h = 0.1$

Q4. In an Electric Vehicle (EV) regenerative braking system, a 50 F supercapacitor bank captures and releases energy. During a discharge cycle, the voltage $v(t)$ is sampled at uniform intervals of $h = 0.02$ s. To ensure the motor controller operates within safety limits, **determine** the instantaneous power $P(t)$ delivered by the capacitor at $t = 0.19$ s using Newton's Backward Interpolation and Differentiation formulas.. CO-1 C(3) 8

Time, t (s)	0.10	0.12	0.14	0.16	0.18	0.20
Voltage, v (V)	12.000	11.536	11.090	10.661	10.248	9.851

Q5. A differential equation is defined by: $y_1 - x^2 + y = 0,\ y(0) = 1$ CO-1 C(3) 8

Using the second-order Runge–Kutta method with step size $h = 0.1$, **calculate** $y(0.3)$.

Q6. A water flow experiment measures the height of water in a tank over time. The recorded data are as follows: CO-1 C(3) 6+2

Time t (s)	0	1	2	3	4	5
Water Height h (cm)	2	8	14	27	41	61

i. **Identify** a second-degree polynomial to model the water height as a function of time.
ii. Using the polynomial, **compute** the water height at $t = 1.5$ s.

$y_1 = \frac{dy}{dx}$