

Total No. of Questions :10]

SEAT No. :

P3645

[5560]-601

[Total No. of Pages : 2

T.E. (Chemical)

CHEMICAL ENGINEERING MATHEMATICS - (309341)

(Semester-I) (2015 Course) (End Sem)

Time : $2\frac{1}{2}$ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer any five questions.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right side indicate full marks.

Q1) Find the root of $f(x) = (x-4)^2(x+2) = 0$, using the initial guesses of $x_L = -2.5$ and $x_U = -1.0$, Use false position method and perform up to 5 iterations. [10]

OR

Q2) State the classification of numerical methods to obtain the root of equation. [10]

Q3) The work produced by a constant temperature, pressure volume thermodynamic process can be computed as, $W = \int p \, dv$, where W is work, P is pressure, and V is volume. Using a combination of the Trapezoidal rule, Simpson's 1/3 rule, and Simpson's 3/8 rule, use the following data to compute the work in kJ (kJ=kNm.). [10]

Pressure(kPa)	336	294.4	266.4	260.8	260.5	249.6	193.6	165.6
Volume (m ³)	0.5	2	3	4	6	8	10	11

OR

Q4) Sodium borohydride is a potential fuel for fuel cell. The following over potential (η) vs. Current (i) data was obtained in a study conducted to evaluate its electrochemical kinetics. At the conditions of the study, it is known that the relationship that exists between the over potential (η) and current (i) can be expressed as $\eta = a + b \ln(i)$, where a is an electrochemical kinetics parameter of borohydride on the electrode. Use the data in following table to evaluate the values of a and b. [10]

η (V)	-0.29563	-0.24346	-0.19012	-0.18772	-0.13407	-0.0861
i(A)	13	11	8.5	8.2	7	6.2

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Q5) Solve by Euler's method $\frac{dy}{dx} = x - y^2$, for the given boundary conditions at $x = 0$, $y = 1$, find y at $x = 4$. Take step size, $h = 0.5$. [16]

OR

Q6) A ball at 1200 K is allowed to cool down in air at an ambient temperature of 300K. Assuming heat is lost only due to radiation, the differential equation for the temperature of the ball is given by $\frac{d\theta}{dt} = -2.2067 \times 10^{-12}(\theta^4 - 81 \times 10^8)$ and $\theta(0) = 1200$ K. Find the temperature at $t = 480$ seconds using Euler's method. Assume a step size of $h = 120$ seconds. [16]

Q7) A steady-state heat balance for a 10 m rod can be represented as $\frac{d^2T}{dx^2} = 0.15T$ with boundary conditions $T(0) = 240$ and $T(10) = 150$. Calculate rod temperature at 2m, 4m and 6m, from the hot end. [16]

OR

Q8) Use finite differences to solve the boundary-value ordinary differential equation $\frac{d^2u}{dx^2} + 6\frac{du}{dx} - u = 2$ with boundary conditions $u(0) = 10$ and $u(2) = 1$. Find $u(0.4), u(1.2), u(1.6)$. [16]

Q9) Consider figure below (fig). The cross-sectional area A of a canal with equal base and edge length of 3 is given by $A = 4 \sin \theta (1 + \cos \theta)$. Find the angle θ which maximizes the cross-sectional area of the gutter. Using an initial interval of $[0, \pi/2]$. Find the solution after 4 iterations. [18]

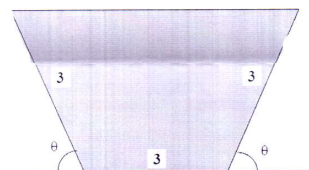


Figure. Cross section of canal

OR

Q10) Maximize function, $Z = 6X_1 + 8X_2$ using simplex method, subject to [18]

$$5X_1 + 10X_2 \leq 60$$

$$X_1 + X_2 \leq 10$$

$$X_1, X_2 \geq 0.$$
