INDIAN MARITIME UNIVERSITY

(A Central University Government of India)

END SEMESTER EXAMINATIONS-June/July 2019

B.Tech (Marine Engineering)

Semester-III

Computational Mathematics (UG11T3301)

Date: 09-07-2019 **Maximum Marks: 100**

Duration: 3 hrs **Pass Marks: 50**

Note: i. Use of approved type of scientific calculator is permitted.
ii. The symbols have their usual meaning.

Section-A (3 × 10 = 30 Marks)

(All Questions are Compulsory)

Q.1 (a) Fit the linear equation $v = a + b\theta$ with the following values of v and θ.

$v =$	0	5	10	15
$\theta =$	1.80	1.45	1.18	1.00

(b) For a given set of (x, y) values, how would you fit the curve $y = ax^b$ using principle of least square method.

(c) Complete the truth table for the following Boolean functions :

p	q	$\bar{p}$	$\bar{q}$	$\bar{p} \vee \bar{q}$	$p \vee q$	$(\bar{p} \vee \bar{q}) \wedge (p \vee q)$
0	0					
0	1					
1	0					
1	1					

(d) Derive the Newton's forward interpolation formula using the shifting operator E.

(e) Use Regula-Falsi method to find the real root of $x^3 - 3x + 4 = 0$ upto two iterations only.

(f) Evaluate $\Delta^{10}[(1-x)(1-2x^2)(1-3x^3)(1-4x^4)]$, if the interval of differencing is 2.

(g) The two regression lines between two variables are $x = 0.7y + 5.2$ and $y = 0.3x + 2.8$. Calculate the correlation coefficient.

(h) Simplify the Boolean expression $(y \vee x) \wedge (y \vee z) \wedge (y \vee z')$.

(i) Evaluate $\int_{-3}^{3} x^2 dx$ using trapezoidal rule taking $h = 1$ and compare your result with the exact value of the integral.

(j) Draw a binary search tree to sort the random numbers 2,6,3,1,9,7,4, 10,8,5.

Section-B (5 × 14 = 70 Mark)

(Answer any 5 of the following)

Q.2 (a) In Boolean algebra show that $\{(x \vee y') \wedge (y \vee z)\} \vee \{(x \vee z) \wedge (y \vee z')\} = x \vee z$

(b) Draw the logical circuit diagram for

$$p_1 \wedge \left[\left(p_2 \vee p_4' \right) \wedge \left(p_3' \wedge \left(p_1 \vee p_4 \vee p_3' \right) \right) \right] \wedge p_2 \ .$$

(7+7)

Q.3 (a) Find the cubic polynomial which takes the following values $f(x)$

x	0	1	2	3
$f(x)$	1	2	1	10

and hence evaluate $f(4)$ from the polynomial. Also calculate $f(4)$ using the same difference table and Newton's backward interpolation formula.

(b) Use Newton's divided difference interpolation formula to compute $f(15)$ from the following table

x	4	5	7	10	11	13
$f(x)$	48	100	294	900	1210	2028

(7+7)

Q.4 (a) A rod is rotating in a plane. The following table gives the angle θ (radians) through which the rod has turned for various values of time t second.

t	0	0.2	0.4	0.6	0.8	1.0	1.2
θ	0	0.12	0.49	1.12	2.02	3.20	4.67

Calculate the angular velocity and acceleration of the rod at t =0.6 second.

(b) Evaluate the length of the arc of the curve $3y = x^3$ from $(0,0)$ to $(1,3)$ using Simpson's (1/3) rule taking 8 subintervals. (7+7)

Q.5 (a) Use Newton-Raphson method to find a root of the $x^3 - 6x + 4 = 0$ correct up to three decimal places.

(b) Draw schematically, how would you apply Merge-sort algorithm to sort the following array of numbers in increasing order.

15	5	64	8	12	11	4	33

(7+7)

Q.6 (a) Apply Runge-Kutta method to find an approximate value of y at $x = 0.2$ in steps of 0.1, if $dy/dx = x + y^2$, given that $y = 1$ at $x = 0$.

(b) Show that the correlation coefficient r_{xy} is bounded by $-1 \le r_{xy} \le 1$.

(7+7)

Q.7 (a) Use Picard's method to find the solution of $dy/dx = x^2 - y, y(0) = 1$ for $x = 0.2$

(b) Find the constants in $y = a + bx + cx^2$ using principle of least square curve fitting from the following data set:

x	0	1	2	3	4
y	-2.1	-0.4	2.1	3.6	9.9

(7+7)

Q.8 (a) Starting with the linear equation $y = a + bx$ and the corresponding normal equations. Derive the regression equation of <u>y on x</u> as $y - \bar{y} = b_{yx}(x - \bar{x})$ where $\bar{y}, \bar{x}$ are the means of the two variables and the regression coefficient $b_{yx} = \dfrac{Cov(x, y)}{\sigma_x^2}$.

(b) Using algebra of operators prove that

$$y_x = y_n - {}^{n-x}C_1 \Delta y_{n-1} + {}^{n-x}C_2 \Delta^2 y_{n-2} + \cdots\cdots + (-1)^{n-x} \Delta^{n-x} y_{n-(n-x)}$$

(7+7)