UPES SAP ID No.: __________________

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Sem. Examination, July 2020

Programme: B.Sc (H) Physics, Chemistry **Semester:** IV
Course Name: Numerical Methods **Max. Marks:** 100
Course Code: MATH2017
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PART- A **60 Marks**

1. PART A contains 25 questions for a total of 60 marks.
2. It contains 25 multiple-choice questions.
3. You need to answer PART A in between 02:00PM to 05:00PM.
4. The due date for the PART A is 05:00PM on 14/07/2020.
5. After the due date, PART A will not be available.

S. No		Marks	CO
Q.1. (i)	Which of the following relation is true: A. $E = 1 + \Delta$ B. $\Delta^n = (E-1)^n$ C. Both A and B D. Only A	2	CO1
(ii)	Which of the following relation is true? A. $E = \nabla^{-1}$ B. $E = (1+\nabla)^{-1}$ C. $E = (1-\nabla)^{-1}$ D. None of these	3	CO1
(iii)	Which of the following is true? A. $\mu = \frac{1}{2}\left[E^{\frac{1}{2}} + E^{-\frac{1}{2}}\right]$ B. $\mu = \frac{1}{2}\left[E^{\frac{1}{2}} - E^{-\frac{1}{2}}\right]$ C. New $\mu = \frac{1}{2}\left[E^{\frac{1}{2}}E^{-\frac{1}{2}}\right]$	2	C01

	D. None of these		
(iv)	A fixed point for a given function g is number p for which A. $g(p) = p$ B. $g(p) = 0$ C. $g(p) \neq p$ D. None of these	2	CO2
(v)	Newton-Raphson method states that. A. $f(x) = 0$, where f assumed to have a continuous derivative f', $x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$ B. $f(x) = 0$, where f assumed to have a continuous derivative f', $x_{n+1} = x_n + \frac{f(x_n)}{f'(x_n)}$ C. $(x) = 0$, where f assumed to have a continuous derivative f', $x_{n+1} = \frac{f(x_n)}{f'(x_n)}$ D. None of these	2	CO2
(vi)	The bisection method: Let f is continuous function defined on the interval $[a, b]$, with $f(a)$ and $f(b)$ of opposite sign A. By the intermediate value theorem, there exist a number p in (a, b) with $f(p)$ equals to zero. B. By the intermediate value theorem, there exist a number p in (a, b) with $f(p)$ not equals to zero. C. By the intermediate value theorem, there exist a number p in (a, b) with $f(p)$ equals to positive number. D. None of these	3	CO2
(vii)	For decreasing the number of iterations in Newton Raphson method: A. The value of $f'(x)$ must be increased B. The value of $f''(x)$) must be decreased C. The value of $f'(x)$) must be decreased D. The value of $f''(x)$ must be increased	3	CO2
(viii)	If $f(x)$ is a polynomial of degree n in x then n+1 and higher difference of this polynomial is: A. Constant B. Zero C. Variable	2	CO3

	D. None of these		
(ix)	The factorial notation form of the polynomial $f(x) = 2x^3 - 3x^2 + 3x - 10$ is A. $f(x) = 2[x]^3 + 3[x]^2 + 3[x] - 10$ B. $f(x) = 2[x]^3 + 2[x]^2 + 3[x] - 10$ C. $f(x) = 2[x]^3 + 3[x]^2 + 2[x] - 10$ D. $f(x) = 2[x]^3 + 2[x]^2 + 2[x] - 10$	3	CO3
(x)	Which of the following is true for backward difference operator? A. $\nabla^2 f(x) = f(x - 2h) - 2f(x - h) + f(x)$ B. $\nabla^2 f(x) = f(x - 2h) + 2f(x - h) + f(x)$ C. $\nabla^2 f(x) = f(x - 2h) - 2f(x - h) - f(x)$ D. None of these	3	CO3
(xi)	Shifting the origin in Gauss's backward formula one have A. Stirling Formula B. Bessel's formula C. Newton's formula D. None of these	2	CO3
(xii)	The relation between divided difference and ordinary difference is A. $\frac{\Delta y_0}{x_1} = \frac{y_0 - y_1}{x_0 - x_1} = \frac{\Delta y_0}{h}$ B. $\frac{\Delta y_0}{x_1} = \frac{y_0 - y_1}{x_0 - x_1} = \Delta y_0$ C. $\frac{\Delta y_0}{x_1} = \frac{y_0 - y_1}{x_0 - x_1} = h\Delta y_0$ D. None of these	2	CO3
(xiii)	The nth divided difference of a polynomial of the nth degree is A. Constant B. Zero C. Variable D. None of these	2	CO3
(xiv)	If $f(x)$ is a polynomial of degree n in x then nth difference of this polynomial is: A. Constant B. Zero C. Variable D. None of these	2	CO4
(xv)	Interpolation means A. To find exact value of the function $f(x)$ for an x between different x values x_0, x_1, x_2,…….. x_n at which the value of $f(x)$ is given	3	CO4

	B. To find approximate value of the function $f(x)$ for an x between different x values x_0, x_1, x_2,…….. x_n at which the value of $f(x)$ is given C. To find approximate value of the function $f(x)$ for an x outside different x values x_0, x_1, x_2,…….. x_n at which the value of $f(x)$ is given D. To find exact value of the function $f(x)$ for an x outside different x values x_0, x_1, x_2,…….. x_n at which the value of $f(x)$ is given		
(xvi)	Given y_0, y_1, y_2, y_3 corresponding to x_0, x_1, x_2, x_3 for function $y = f(x)$. Let $f(x)$ is a polynomial of degree three. Then by Simpson's three eight rule, the integral $J = \int_a^b f(x)dx$ is equivalent to A. $J = \frac{3}{8}h[y_0 + 3y_1 + 3y_2 + y_3]$ B. $J = \frac{1}{3}h[y_0 + 4y_1 + y_2]$ C. $J = \frac{3}{8}h[y_0 + 4y_1 + 3y_2 + 2y_3]$ D. None of these	2	CO4
(xvii)	In Newton-Cotes formula, if $f(x)$ is interpolated at equally spaced nodes by a polynomial of degree two then it represents A. Trapezoidal rule B. Simpson's one third rule C. Simpson's three eight rule D. None of these	3	CO4
(xviii)	The Value of the integral $I = \int_0^1 (1/(1+x))\, dx$ by dividing the interval of integration into 8 equal part and by applying the Simpson's $1/3^{rd}$ rule is: A. 0.6932 B. 1.7588 C. 2.5267 D. None of these	3	CO4
(xix)	**Match the following:** A. Newton-Raphson 1. Integration B. Runge-kutta 2. Root finding C. Gauss-seidel 3. Ordinary Differential Equations D. Simpson's Rule 4. Solution of system of Linear Equations A. A2-B3-C4-D1	3	CO5

	B. A3-B2-C1-D4 C. A1-B4-C2-D3 A4-B1-C2-D3		
(xx)	In Euler's method: Given initial value problem $\frac{dy}{dx} = f(x, y)$, with $y(x_0) = y_0$, then the approximation is given by A. $y_{n+1} = y_n + hf(x_{n-1}, y_{n-1})$ where $h = \frac{x_n - x_0}{n}$ B. $y_{n+1} = y_n + hf(x_n, y_n)$ where $h = \frac{x_n - x_0}{n}$ C. $y_{n+1} = y_n$ None of these	2	CO6
(xxi)	Given initial value problem $\frac{dy}{dx} = f(x, y)$ where $y(x_0) = y_0$. In Runge-Kutta Method A. $k_1 = hf(x_n)$ B. $k_1 = hf(x_{n,} y_n)$ C. $k_1 = hf(y_n)$ D. None of these	2	CO6
(xxii)	By Taylor's theorem, the series about a point $x = x_0$ is given by A. $y = y_0 + x_0 + (y')_0 + \frac{x_0^2}{2!}(y'')_0 + \frac{x_0^3}{3!}(y''')_0 + \ldots\ldots\ldots$ B. $y = y_0 + (x - x_0) + (y')_0 + \frac{(x-x_0)^2}{2!}(y'')_0 + \frac{(x-x_0)^3}{3!}(y''')_0 + \ldots\ldots\ldots$ C. $y = y_0 + (x + x_0) + (y')_0 + \frac{(x+x_0)^2}{2!}(y'')_0 + \frac{(x+x_0)^3}{3!}(y''')_0 + \ldots\ldots\ldots$ D. None of these	3	CO6
(xxiii)	Given initial value problem $\frac{dy}{dx} = f(x, y)$ where $y(x_0) = y_0$. In Runge-Kutta Method A. $k_3 = hf(x_n + h, y_n + k_2)$ B. $k_3 = hf(x_{n,} y_n)$ C. $k_3 = hf\left(x_n + \frac{h}{2}, y_n + \frac{k_2}{2}\right)$ D. None of these	2	CO6
(xxiv)	Given initial value problem $\frac{dy}{dx} = f(x, y)$ where $y(x_0) = y_0$. In Runge-Kutta Method A. $k_4 = hf(x_n + h, y_n + k_2)$ B. $k_4 = hf(x_{n,} y_n)$ C. $k_4 = hf\left(x_n + \frac{h}{2}, y_n + \frac{k_2}{2}\right)$ D. $k_4 = hf(x_n + h, y_n + k_3)$	2	CO6

(xxv)	Given initial value problem $\frac{dy}{dx} = f(x,y)$ where $y(x_0) = y_0$. In Runge-Kutta Method A. $y_{n+1} = y_n + \frac{1}{6}(k_1 + k_2 + k_3 + k_4)$ B. $y_{n+1} = y_n + \frac{1}{6}(k_1 + 4k_2 + 2k_3 + k_4)$ C. $y_{n+1} = y_n + \frac{3}{8}(k_1 + k_2 + k_3 + k_4)$ D. $y_{n+1} = y_n + \frac{1}{6}(k_1 + 2k_2 + 2k_3 + k_4)$	2	CO6

PART- B **40 Marks**

<u>Note:</u>

1. There are total of FIVE questions in this SECTION (PART B). Each Carrying **EIGHT** marks.
2. You have to submit **<u>PART B</u>** within 24 hrs from the scheduled time.
3. No submission of **<u>PART B</u>** shall be entertained after 24 Hrs.
4. **<u>PART B</u>** should be attempted after **<u>PART A</u>**
5. **<u>The PART B</u>** should be attempted in blank white sheets (hand written) with all the details like programme, semester, course name, course code, name of the student, Sapid at the top (as in the format) and signature at the bottom (right hand side bottom corner)
6. Name your PDF as ROLLNO_BRANCH_SAPID.PDF
7. SUBMIT YOUR FINAL PDF THROUGH BLACKBOARD LINK ONLY.

S.NO.		**Marks**	**CO**
Q 2	Establish the operator relation $E \equiv e^{hD}$, where E and D denote the Shifting and Differential operators respectively. (h is the step-length).	**[8]**	**CO1**
Q 3	Use Secant method to solve the equation $x^3 + 2x - 2 = 0$ in [0, 1] correct to three decimal places	**[8]**	**CO2**
Q 4	The following table gives the viscosity of oil at various temperatures. Use Lagrange's formula to find viscosity of the oil at 140 degree. CO3 <table><tr><td>Temp.</td><td>110</td><td>130</td><td>160</td><td>190</td></tr><tr><td>Viscosity</td><td>10.8</td><td>8.1</td><td>5.5</td><td>4.8</td></tr></table>	**[8]**	**CO3**
Q 5	A slider in a machine moves along a fixed straight rod. Its distance 'x' cm along the road is given blow for various value of 't' second. Find the velocity and acceleration of the slider when t=0.1 sec. CO4 <table><tr><td>t:</td><td>0</td><td>0.1</td><td>0.2</td><td>0.3</td><td>0.4</td><td>0.5</td><td>0.6</td></tr><tr><td>X:</td><td>30.13</td><td>31.62</td><td>32.87</td><td>33.64</td><td>33.95</td><td>33.81</td><td>33.24</td></tr></table>	**[8]**	**CO4**

Q 6	For the given differential equations $\frac{dy}{dx} + 2y = 1.3e^{-x}, y(0) = 5$; find y(1) using Taylor's series method by considering four terms of the series.	**[8]**	**CO6**