

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

M.A./M.Sc. THIRD SEMESTER EXAMINATION, DECEMBER 2018

SECOND YEAR [BATCH 2017-19]

APPLIED CHEMISTRY

Date : 18/12/2018

Time : 11 am – 1 pm

Paper : XIII (Engineering Mathematics II)

Full Marks : 50

(Use a separate Answer Book for each unit)

UNIT-I

Answer **any two** questions:

[5 X 2]

1. Verify Gauss' divergence theorem for $\vec{F} = x^2\hat{i} + z\hat{j} + yz\hat{k}$ over the unit cube bounded by the planes $x = 0, y = 0, z = 0, x = 1, y = 1$ and $z = 1$. 5
2. Verify Stokes' theorem for $\vec{A} = (2x - y)\hat{i} - yz^2\hat{j} - y^2z\hat{k}$ about the surface S , where S is the upper half surface (with respect to $z = 0$ plane) of the sphere $x^2 + y^2 + z^2 = 1$. 5
3. Verify Green's theorem in the xy -plane for $\oint_C \{(y + \sin x)dx + \cos x dy\}$, where C is the triangle with vertices $(0, 0), \left(\frac{\pi}{2}, 0\right), \left(\frac{\pi}{2}, 2\right)$. 5

UNIT-II

Answer **any three** questions:

[5 X 3]

4. State the axiomatic definition of Probability. For any n events $A_1, A_2, \dots, A_n$ of a Random Experiment E , prove that $P(A_1 + A_2 + \dots + A_n) \leq P(A_1) + P(A_2) + \dots + P(A_n)$. 2+3
5. A man takes a step forward with probability 0.7 and backward with probability 0.3. Find the probability that at the end of 13 steps he is 3 step forward from the starting point. Also find the probability that at the end of 13 steps he is 3 step away from the starting point. 3+2
6. The probability that a product produced by a machine to be defective is 0.01. If 50 products are taken at random, find the probability that exactly 3 will be defective. Approximate it by Poisson distribution and evaluate the error of approximation. 3+1+1
7. Define mean of a distribution. Find the means for (i) Poisson (μ) distribution and (ii) Gamma (l) distribution. 1+2+2
8. Show that second order moment about any point is minimum when taken about the mean. Also show that $\sigma_{ax+b} = |a|\sigma_x$ (symbols are of usual meaning). 3+2

UNIT-III

Answer **any five** questions:

[5 X 5]

9. Solve the differential equation $\frac{dy}{dx} + \frac{y}{x} = y^2$. 5
10. Obtain the complete primitive and singular solution of $y = px + \frac{a}{p}$, where $p = \frac{dy}{dx}$ and 'a' is constant. 3+2
11. Solve the differential equation $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + 5y = 10 \sin x$. 5
12. Solve: $x^2 \frac{d^2y}{dx^2} - x \frac{dy}{dx} + y = 2 \log x$. 5
13. By Newton-Raphson method find a positive root of the equation $3x - \cos x - 1 = 0$ correct to three significant digits. 5
14. Solve, by Gauss-Seidel method, the following system of equations:
 $5x + 2y + z = 12$, $x + 4y + 2z = 15$, $x + 2y + 5z = 20$. 5
15. Using Runge-Kutta method of order 4, compute $y(0.1)$ correct to four decimal places, from the differential equation $\frac{dy}{dx} = \frac{1}{10}(x^2 + y^2)$; $y(0) = 1$ (taking $h = 0.1$). 5
16. Obtain an approximate value of $\int_0^1 \frac{dx}{1+x^2}$ upto four places of decimal by using Simpson's $\frac{1}{3}$ rule taking six equal sub-intervals and hence obtain the approximate value of π correct to four decimal places. 4+1

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