

Class Test (PH 1101)
Section A (Civil Engineering)

Answer all questions.

Duration: One hour

1. Two headlights of a distant truck are 1.4 m apart. If the diameter of the pupil of the eye is $a = 3$ mm and $\lambda = 5 \times 10^{-7}$ m for the headlight, what is the maximum distance at which two headlights can be resolved by eye? 4
- ✓ 2. Motion of a spring-mass system is given by a differential equation of the form $\frac{1}{4}\ddot{x} + \dot{x} + x = 0$. Show, whether the system is weakly-damped, over-damped or critically damped? Write the possible general solution. 4
3. Which among A and B represents a solution to one-dimensional wave equation, where $A(x,t) = Ce^{-\alpha(x-vt)^2}$ and $B(x,t) = Ce^{-(\alpha x^2 - vt)}$ and how? 4
- ✓ 4. Suppose a 35-kW radio station emits EM waves uniformly in all directions. What is the rms magnitude of the electric field at 1.0 km away from the station, assuming the station is operating at full power? 4
- ✓ 5. Find the directional derivative of $\phi = 4xz^3 - 3x^2y^2z$ at $(2, -1, 2)$ along the direction of $2i - 3j + 6k$. How much it differs from the maximum value of the directional derivative of ϕ , at that point? 4

- ✓ 6. Using Newton's forward interpolation formula, find the value of $f(4.8)$, if

x	2	4	6	8	10	12
$f(x)$	1	2	4	9	14	18

(6)

- ✓ 7. Using Newton-Raphson method, find a root of the equation $x^4 + x^3 - 7x^2 - x + 5 = 0$ correct to the three decimal places which is near to $x_0 = 2$. (6)

- ✓ 8. Apply Runge-Kutta fourth order method, to find an approximate value of $\frac{du}{dx}$ at $x^2 = x^2$.

National Institute of Technology, Silchar
Mid-Semester (UG) Examination, February '2015

Subject Code: MA-1102, Subject: Mathematics-II

Semester: 2nd, Branch: B.Tech. (All)

Duration: One Hour, Total Marks: 30

Figure in the right hand margin indicates full marks for the question.

1. Find the inverse of $A = \begin{pmatrix} 7 & 2 & -2 \\ -6 & -1 & 2 \\ 6 & 2 & -1 \end{pmatrix}$ by using Cayley-Hamilton's theorem. (6)

2. Solve the following system of equations by using Gauss Elimination Method:

$$2x + 2y - z = 6$$

$$4x + y - 3z = 7$$

$$2x + y - 2z = 3$$

(6)

3. Evaluate the integral $\int_C [(3x - 8y^2)dx + (4y - 6xy)dy]$ by using Green's theorem, where C is the boundary of the region bounded by $x = 0$, $y = 0$, and $x + y = 1$. (6)

4. Evaluate the integral $\iiint 24x dx dy dz$ over the volume in the first octant bounded by $y = 1 - x^2$ and $z = y$. (6)

5. Verify Stoke's theorem for $F = -yi + xj + zk$ over the upper half surface of $x^2 + y^2 + z^2 = 1$ bounded by its projection on the xy -plane. (6)

6. Using Newton's forward interpolation formula, find the value of $f(4.8)$, if

x	2	4	6	8	10	12
$f(x)$	1	2	4	9	14	18

(6)

7. Using Newton-Raphson method, find a root of the equation $x^4 + x^3 - 7x^2 - x + 5 = 0$ correct to the three decimal places which is near to $x_0 = 2$. (6)

National Institute of Technology, Silchar
End-Semester (UG) Examination, April-May '2015
Subject Code: MA-1102, Subject: Mathematics-II
Semester: 2nd, Branch: B.Tech. (All)
Duration: Two Hours, Total Marks: 50

Figure in the right hand margin indicates full marks for the question.

1. Find the eigenvalues and eigenvectors of the matrix $A = \begin{pmatrix} 3 & 0 & 0 \\ 2 & 1 & 0 \\ 1 & 3 & 2 \end{pmatrix}$. Hence, find the eigenvalues and eigenvectors of the matrix $\tilde{A} = P^{-1}AP$, where $P = \begin{pmatrix} 2 & 0 & 3 \\ 0 & 1 & 0 \\ 3 & 0 & 5 \end{pmatrix}$. (6)

2. Evaluate the integral $\iiint 2y dx dy dz$ over the volume bounded by xz -plane and the surfaces $x^2 + z^2 = 1$, $x^2 + z^2 = y^2$. (6)

3. Determine a, b such that the function $u(x, y) = ax^3 + by^3 + x^2 - y^2 + y$ is harmonic, and then find its harmonic conjugate. (6)

4. Evaluate $\oint_C \left(\frac{z^2 - 2z + 2}{z^3 - 4z^2 + 5z - 2} + z^2 e^{\pi/z} \right) dz$, where C is the circle $|z| = 3$. (7)

5. Evaluate $\int_0^{2\pi} \frac{\cos \theta}{13 - 12 \cos 2\theta} d\theta$ (7)

6. Using Newton's forward interpolation formula, find the value of $f(4.8)$, if (6)

x	2	4	6	8	10	12
$f(x)$	1	2	4	9	14	18

7. Using Newton-Raphson method, find a root of the equation $x^4 + x^3 - 7x^2 - x + 5 = 0$ correct to the three decimal places which is near to $x_0 = 2$. (6)

8. Apply Runge-Kutta fourth order method, to find an approximate value of y when $x = 0.2$ given that $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$ and $y(0) = 1$. (6)

National Institute of Technology, Silchar
End Semester UG examination, May-2015
Subject: Chemistry
Subject Code: CH-1101
Semester: 2nd

1. (a) What is cement? Write the chemical composition of Portland cement 3
- (b) What are the reasons for the decaying of cement? How is it prevented? 3
- (c) Define setting of cement? What are the reactions involved in initial setting of cement? 4
2. (a) How do we classify polymers on the basis of their structure? Give examples of each type. 3
- (b) Which type of polymer cannot be reprocessed? Give reasons. 1
- (c) Define "number average molecular weight" of polymer with its expression 2
- (d) Mention the methods of preparation of the given polymers: 4
 - i. HDPE
 - ii. PTFE
3. (a) What is air pollution? Give basic chemical reactions leading to formation of carbon monoxide pollutant. 3
- (b) Write the chemical reaction involved in photochemical dissociation of NO₂ in the atmosphere. 3
- (c) What are the consequences of green house effect? 3
- (d) Describe the chemical reactions involved in the formation of peroxyacyl nitrate (PAN) from aldehyde. 2
- (e) Write the principle and working of electrostatic precipitator with the help of a neat diagram 4
4. (a) Calculate the quantity of lime and soda required for softening of 10,000 liters of water containing the following salts per liter
 $\text{Ca}(\text{HCO}_3)_2 = 16.1 \text{ mg}$; $\text{Mg}(\text{HCO}_3)_2 = 15 \text{ mg}$; $\text{CaSO}_4 = 27.2 \text{ mg}$; $\text{MgSO}_4 = 24 \text{ mg}$;
 $\text{MgCl}_2 = 4 \text{ mg}$ and $\text{NaCl} = 9.4 \text{ mg}$
 Calculate total lime and soda requirement for above data. 7
- (b) What is physical and chemical adsorption? Derive an expression for Langmuir's Theory of adsorption. 5
- (c) What is Break point chlorination? 3