



**COOCH BEHAR PANCHANAN BARMA UNIVERSITY**

B.Sc. Honours 3rd Semester Examination, 2020, held in 2021

CHEMISTRY-II (PRACTICAL)**PHYSICAL CHEMISTRY****CORE-5**

Time Allotted: 1 Hour

Full Marks: 15

*The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.
All symbols are of usual significance.*

Experiment No. 1

Find out the value of partition coefficient (K_D) of a non-volatile solute between the supplied liquid and water

- State Nernst Distribution Law with its limitations: 4
- Define Partition Coefficient 2
- Derivation of working formula for determining partition coefficient 4
- Discuss the effect of temperature on partition coefficient 2
- Discuss the application of partition coefficient 3

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CHEMISTRY

PHYSICAL CHEMISTRY

CORE-5

Time Allotted: 2 Hours

Full Marks: 25

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Candidates are required to give their answers in their own words as far as practicable.
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Answer any *one* question from the following

25×1 = 25

1. (a) Explain graphically the work done during the compression and expansion of one mole of an ideal gas. 5
- (b) Prove that work done in reversible process is greater than that of Irreversible process. 4
- (c) Prove that $(ds/dT)_V = nC_{V,m}/T$. What percentage T_1 is of T_2 for a 10% efficiency of a heat engine? 3+2
- (d) Discuss the origin of colligative property by drawing chemical potential vs temperature diagram for a solvent in solid, liquid and vapour phases along with addition of a non-volatile solute to this solvent. 5
- (e) 100 ml of a solution containing 1.73 g of substance 'A', isotonic with a solution containing 1.7 g of glucose dissolved in 100 ml of its solution. Calculate the molecular weight of 'A'. 4
- (f) Elevation of boiling point is a colligative property. — Explain. 2
2. (a) Explain Joule-Thomson co-efficient, inversion temperature. Deduce the relationship, 5

$$\mu_{J,T} = -\frac{1}{C_P} \left(\frac{\partial H}{\partial P} \right)_T$$
- (b) Show that the work destroyed in the single stage compression is greater than two stage compression under same conditions of initial and final states of a system. 5
- (c) "All natural processes are irreversible." — Justify it. 2
- (d) What is osmotic pressure? Derive the expression of osmotic pressure thermodynamically. 5
- (e) Discuss thermodynamics of chemical reactions and define reaction potential. 5
- (f) Equilibrium constant for a certain reaction is doubled when the temperature is increased from 27°C to 47°C. Calculate the enthalpy change for the reaction. 3

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COOCH BEHAR PANCHANAN BARMA UNIVERSITY

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CHEMISTRY (PRACTICAL)

INORGANIC CHEMISTRY

CORE-6

Time Allotted: 1 Hour

Full Marks: 15

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Answer any *one* question from the following

1. (a) Explain the following observation: 3



$$\text{Given: } E_{\text{Cu}^{2+}/\text{Cu}^+}^0 = +0.15 \text{ V}$$

$$E_{\text{I}_2/2\text{I}^-}^0 = +0.54 \text{ V}$$

- (b) Why is sodium thiosulphate considered as 'secondary standard'? 2
- (c) Write down the basic chemical reactions (redox reaction) during the standardization of sodium thiosulphate. 4
- (d) What is available chlorine? 2
- (e) What is the role of sodium sulphite for the preparation of cuprous(I) chloride? 2
- (f) Comment on the direction of the following chemical redox reaction with explanation. 2



2. (a) How would you explain disinfectant nature of bleaching powder? 2
- (b) What is alum? Give one example of alum type compound. 2
- (c) Why is monovalent copper unstable oxidation state? Give one example of stable $2+1+2=5$ Cu(I) complex. Justify your example behind stabilisation. 2+1+2=5
- (d) Distinguish between iodometric and iodimetric titration. Why is iodine-starch complex blue in colour? 2+2 = 4
- (e) What is formal potential considered as 'conditional potential'? 2

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B.Sc. Honours 3rd Semester Examination, 2020, held in 2021

CHEMISTRY

INORGANIC CHEMISTRY-II

CORE-6

Time Allotted: 2 Hours

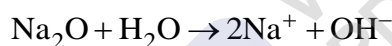
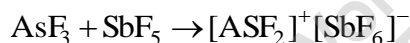
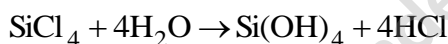
Full Marks: 25

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Answer any one question from the following

25×1=25

1. (a) For each of the following chemical reactions, identify the acid and base, furthermore indicate whether the acid is a Brønsted-Lowry acid 4

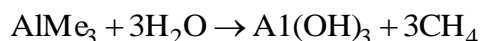


- (b) Explain the term with proper explanation along with examples: 2+2 = 4
‘Kinetically faster oxidising agent’
‘Thermodynamically faster oxidising agent’

- (c) The atomic radius of Cl is 102 pm. Explain why the ionic radius of Cl in the perchlorate ion is 41 pm, whereas the ionic radius of Cl in the chloride ion is 181 pm. Compare both values to the atomic radius. 3
- (d) Do you notice any change of polarity of the solution when solid I_2 is treated separately in (i) CCl_4 (ii) Benzene solution? — Justify your answer. 3
- (e) Give one example of paramagnetic oxide of chlorine. 1
- (f) While ‘ NO_2 ’ dimerizes but ‘ NO ’ does not — explain. 2
- (g) Explain the following data: 3

	HF	HI
ΔH_f^0 (kJ/mol):	– 271.1	26.48

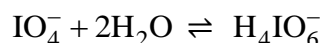
- (h) Explain the following hydrolysis reactions: 3



- (i) Why are noble gases monoatomic? 2

2. (a) What happens when iodine is added to silver nitrate solution in presence of an excess of pyridine in chloroform solution? 3

- (b) Explain the following process: 2



- (c) 'Solution of alkali metals in liquid ammonia are strongly reducing in nature' — Explain. 2

- (d) What happens when solid ammonium chloride is added to alkali metal in liquid ammonia solution? 2

- (e) What species are present in solutions of the following in anhydrous HF? 3



- (f) Why do halogens exhibit characteristic colour? 3

- (g) What is a co-solvating agent? How does it differ from a catalyst? 3

- (h) NF_3 has no donor property while PF_3 forms numerous complexes with transition metals — Explain. 2

- (i) 'Diborane behaves as a base' — Explain with an example. 2

- (j) 'Xenon is not an inert gas, it is noble' — Explain with examples. 3

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**COOCH BEHAR PANCHANAN BARMA UNIVERSITY**

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CHEMISTRY (PRACTICAL)**ORGANIC CHEMISTRY-III****CORE-7**

Time Allotted: 1 Hour

Full Marks: 15

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Answer any one question from the following

- | | |
|--|----|
| 1. (a) Report one green method for the bromination of acetanilide with proper mechanism of the reaction. | 10 |
| (b) Viva-Voce (Internal Examiner should take the examination). | 5 |
| 2. (a) Report the oxidation of benzil to benzilic acid using one green method with proper mechanism of the reaction. | 10 |
| (b) Viva-Voce (Internal Examiner should take the examination). | 5 |

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B.Sc. Honours 3rd Semester Examination, 2020, held in 2021

CHEMISTRY

ORGANIC CHEMISTRY

CORE-7

Time Allotted: 2 Hours

Full Marks: 25

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Candidates are required to give their answers in their own words as far as practicable.

All symbols are of usual significance.

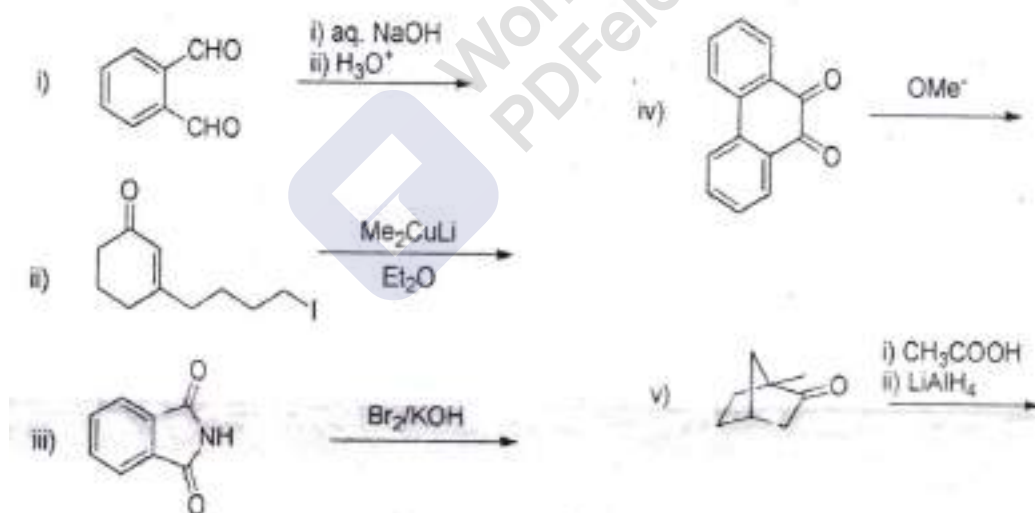
Answer any **one** question from the following

25×1=25

1. Answer **all** questions:

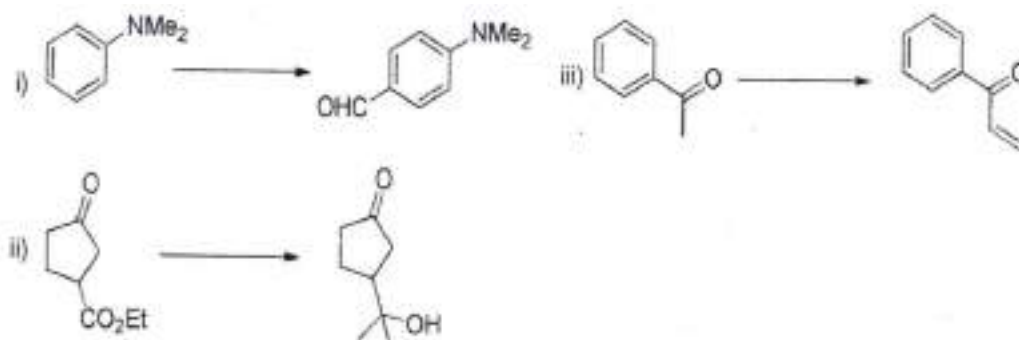
(a) Predict the products with suitable mechanism:

3×5 = 15



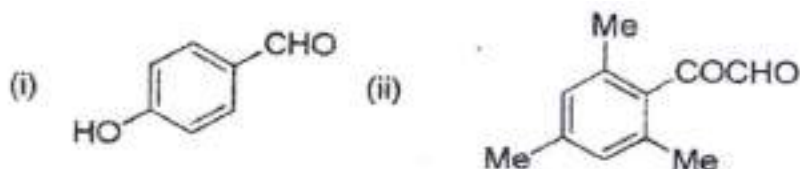
(b) How would you carry out the following transformation?

2×3 = 6



(c) Explain why the following aldehydes does not undergo Cannizzaro reaction?

2×2 = 4



2. Answer **all** questions:

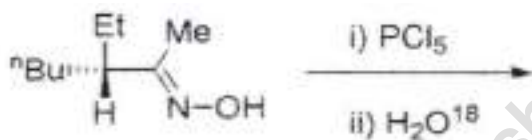
(a) Explain way:

2×4 = 8

- (i) Phenyl azide does not undergo Schmidt reaction.
- (ii) A large excess of mineral acid is used in diazotization process.
- (iii) When a solution of $\text{Ph}_3\text{C-COOH}$ in conc. H_2SO_4 is poured into methanol it yields $\text{Ph}_3\text{CO-Me}$.
- (iv) Oxime of benzaldehyde does not give normal Beckmann rearrangement.

(b) Predict the product with suitable explanation about product stereochemistry.

3



(c) What combination of carbonyl compound and ylide could you use to prepare 3-methyl-3-heptene?

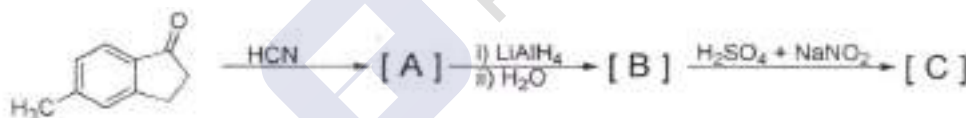
2

(d) When butamide is treated with Br_2 in aqueous sodium hydroxide solution N, N-dipropyl urea is recovered along with *n*-propyl amine. — Explain.

3

(e) Identify the products A, B, and C from the following reaction:

3



(f) Predict the products with suitable mechanism:

3×2 = 6



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PHYSICS**DIGITAL SYSTEMS AND APPLICATIONS****CORE-7**

Time Allotted: 2 Hours

Full Marks: 25

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Answer any one question from the following

25×1 = 25

1. Simplify the following logic expressions by K-Map and realize the circuits using NAND gates? 25
(i) $f_1(A, B, C, D) = \sum m(1, 3, 5, 6, 9, 13, 15)$
(ii) $f_2(A, B, C, D) = \prod M(4, 5, 6, 7, 12, 13)$
2. Discuss briefly about 4-bit asynchronous and decade counter with their proper circuits diagram. 25

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B.Sc. Honours 3rd Semester Examination, 2020, held in 2021

PHYSICS (PRACTICAL)**MATHEMATICAL PHYSICS-II LAB****CORE-5**

Time Allotted: 1 Hour

Full Marks: 15

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15×1 = 15

1. Write a Scilab program to find the roots of the quadratic equation $x^2 - 5x + 6 = 0$. 15

2. Write a Scilab program to find the solution of the following set of equations: 15

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

$$x + 2y + 3z = 5$$

$$3x - 4y - 5z = -13$$

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PHYSICS

MATHEMATICAL PHYSICS-II

CORE-5

Time Allotted: 2 Hours

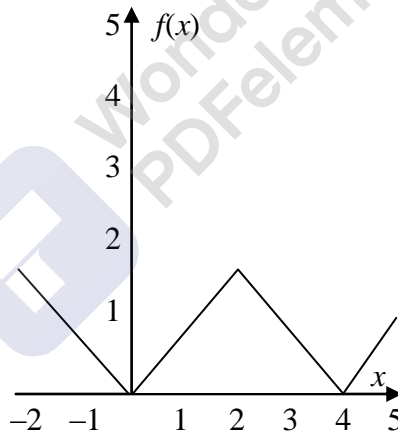
Full Marks: 25

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Answer any one question from the following

25×1 = 25

1. From the functional form in the given diagram



Find the Fourier coefficients a_0, a_n and b_n . 10

From Parseval's identity for an uniformly converging function $f(x)$ in the interval $(-L, L)$ 10

$$\frac{1}{L} \int_{-L}^L [f(x)]^2 dx = \frac{a_0^2}{2} + \sum_{n=1}^{\infty} (a_n^2 + b_n^2)$$

Arrive at the following series

$$\frac{1}{1^4} + \frac{1}{3^4} + \frac{1}{5^4} + \dots = \frac{\pi^4}{96}$$

Form the above show that

$$\frac{1}{1^4} + \frac{1}{2^4} + \frac{1}{3^4} + \dots = \frac{\pi^4}{90}$$

5



2. Gamma function is defined by

$$\Gamma(z) = \int_0^{\infty} t^{z-1} e^{-t} dt$$

where $\text{Re}(z) > 0$.

(a) For z being a real number x show that

5

$$\Gamma(x) = (x-1)\Gamma(x-1)$$

(b) For x being a real non-zero integer n , i.e., $n = 1, 2, 3, \dots$, show that

5

$$\Gamma(n) = (n-1)!$$

where $n! = n \cdot (n-1) \cdot (n-2) \cdots 1$.

(c) Prove that $\Gamma\left(\frac{1}{2}\right) = \sqrt{\pi}$

10

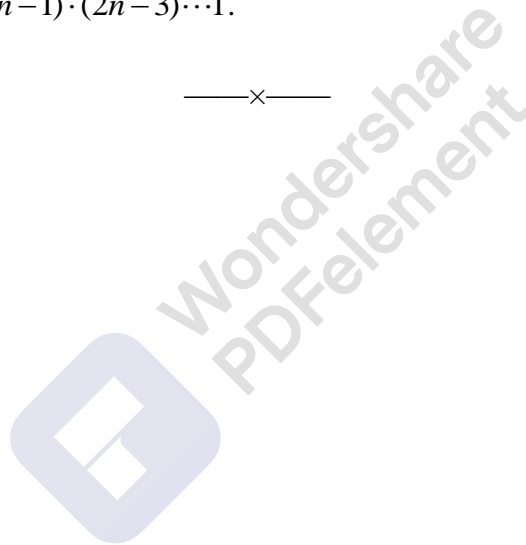
(d) Thus show the following for an integer n

5

$$\Gamma\left(n + \frac{1}{2}\right) = \frac{(2n-1)!!}{2^n} \sqrt{\pi}$$

Where $(2n-1)!! = (2n-1) \cdot (2n-3) \cdots 1$.

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**COOCH BEHAR PANCHANAN BARMA UNIVERSITY**

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PHYSICS (PRACTICAL)**THERMAL PHYSICS LAB****CORE-6**

Time Allotted: 1 Hour

Full Marks: 15

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15×1 = 15

1. Write down the formula to be used to determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method. Draw only the table required to record the experimental data (without data) and the graphical nature of variation of temperature with time. 15
2. Draw the circuit diagram and required formula to determine the temperature coefficient of resistance by Platinum Resistance Thermometer. Draw the tables required to tabulate the experimental data (no actual data is required). Write what type of precautions should be taken to get more accurate result. 15

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PHYSICS

THERMAL PHYSICS

CORE-6

Time Allotted: 2 Hours

Full Marks: 25

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Answer any *one* question from the following

25×1 = 25

1. (a) State and prove the Carnot's theorem and show that the efficiency of a reversible engine working between a given pair of source and sink is independent of the nature of the working substance. Find the thermal efficiency of reversible engine operating in a cycle consisting of two isotherms and two isobars, using ideal gas as working substance. Assume the specific heat C_p , C_v to be constant throughout the process. 13
- (b) Define Helmholtz free energy; prove the relation $U = -T^2 \left[\frac{\partial}{\partial T} \left(\frac{F}{T} \right) \right]_V$ symbols carry their usual meaning. Using Clausius theorem show that for any process $s_f - s_i \geq \int_i^f \frac{dQ}{T}$ Symbols carry their usual meaning. 12
2. (a) Deduce Maxwell's velocity distribution law and hence obtain an expression for the expression for the energy distribution of the gas molecules. Compare the graphical nature of the distribution function in the two cases. Prove thermodynamically $\frac{E_s}{E_T} = \frac{C_p}{C_v} = \gamma$ 15
- (b) Show that for a Vander Waal's gas $C_p - C_v = R \left\{ 1 + \frac{2a}{RTV_3} (V - b)^2 \right\}$ 10

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**COOCH BEHAR PANCHANAN BARMA UNIVERSITY**

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PHYSICS (PRACTICAL)**DIGITAL SYSTEMS AND APPLICATIONS LAB****CORE-7**

Time Allotted: 1 Hour

Full Marks: 15

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15×1 = 15

1. Discuss briefly about the theory of Half Subtractor and 4-bit binary Subtractor with their truth tables and circuit diagrams. 15
2. Discuss briefly about the theory with truth table of RS Flip-Flop, D-type Flip-Flop and JK Flip-Flop and draw the circuits diagram using NAND gates. 15

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B.Sc. Honours 3rd Semester Examination, 2020, held in 2021

MATHEMATICS

THEORY OF REAL FUNCTIONS

CORE-5

Time Allotted: 2 Hours

Full Marks: 40

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All symbols are of usual significance.

Answer any two questions

20×2 = 40

1. (a) Show that both $f(x) = x$ and $g(x) = x - 1$ are strictly increasing on $I = [0, 1]$, but that their product fg is not increasing on I . 7
- (b) Use the Maclaurin Series of $(1-x)^{-2}$ for $|x| < 1$ to find the sum $\sum_{n=0}^{\infty} \frac{n+1}{9^n}$. 6
- (c) A function $f: \mathbb{R} \rightarrow \mathbb{R}$ satisfies the condition $f(x+y) = f(x)f(y) \quad \forall x, y \in \mathbb{R}$. If f is continuous at $x = 0$, prove that f is continuous on \mathbb{R} . 7
2. (a) Using ϵ - δ definition of limit, prove $\lim_{x \rightarrow c} \frac{1}{x} = \frac{1}{c}$ if $c > 0$. 6
- (b) State and prove Rolle's theorem. 7
- (c) If $f(x) = -2 \sin x$, $-\pi \leq x \leq -\frac{\pi}{2}$ 7
 $= a \sin x + b$, $-\frac{\pi}{2} < x < \frac{\pi}{2}$
 $= \cos x$, $\frac{\pi}{2} \leq x \leq \pi$
 is continuous on $[-\pi, \pi]$, find the values of a and b .
3. (a) Prove that between any two real roots of the equation $e^x \cos x + 1 = 0$, there is at least one real root of the equation $e^x \sin x + 1 = 0$. 6
- (b) Find the points of discontinuity of the function 7

$$f(x) = \lim_{n \rightarrow \infty} \frac{\log(2+x) - x^{2n} \sin x}{1+x^{2n}}, x \in \mathbb{R}$$
- (c) If $f(x) = x^2 \sin \frac{1}{x}$, $x \neq 0$ 7
 $= 0$, $x = 0$
 and $g(x) = x$, $x \in \mathbb{R}$
 Show that $\lim_{x \rightarrow 0} \frac{f'(x)}{g'(x)}$ does not exist, but $\lim_{x \rightarrow 0} \frac{f(x)}{g(x)} = \frac{f'(0)}{g'(0)}$.

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COOCH BEHAR PANCHANAN BARMA UNIVERSITY

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MATHEMATICS

GROUP THEORY

CORE-6

Time Allotted: 2 Hours

Full Marks: 40

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Answer any two questions from the following

20×2 = 40

1. (a) Show that every group of order 49 contains a subgroup of order 7. 6
- (b) Let G be a group of order 15. A and B be two subgroups of order 5 and 3 respectively. Then show that $G = AB$. 8
- (c) Let H and K be two subgroups of a finite group G such that $|H| > \sqrt{|G|}$ and $|K| > \sqrt{|G|}$. Show that $|H \cap K| > 1$. 6
2. (a) Prove that there are exactly $\frac{n!}{2}$ even permutations and exactly $\frac{n!}{2}$ odd permutations in S_n ($n > 1$). 8
- (b) Let $\beta = (1\ 3\ 5\ 7\ 9\ 8\ 6)(2\ 4\ 10)$ in S_{10} . What is the smallest positive integer n such that $\beta^n = \beta^{-5}$? 6
- (c) Let A and B be two subgroups of G . If $|A| = p$, a prime number, then show that either $A \cap B = \{e\}$ or $A \subseteq B$. 6
3. (a) Define, $C(G)$, the center of a group G . Show that $C(G)$ is a subgroup of G and is also abelian. 8
- (b) Let (G, \circ) be a group and $a, b \in G$. Suppose that $a^2 = e$ and $aba = b^7$. Prove that $b^{48} = e$. 5
- (c) Let G be an abelian group containing six elements with one element 'a' of order 3. First show that there is an element b of order 2 in G . Next show that $a \cdot b$ is a generator of G and hence G is cyclic. 7

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**COOCH BEHAR PANCHANAN BARMA UNIVERSITY**

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MATHEMATICS (PRACTICAL)**PARTIAL DIFFERENTIAL EQUATION****CORE-7**

Time Allotted: 1 Hour

Full Marks: 15

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Answer any one question from the following

15×1=15

1. Find analytically the characteristics of the equation $pq = z$ and determine the integral surface which passes through the parabola $x = 0, y^2 = z$. Then, write a code using any software to plot the integral surface for $x, y \in [-3, 3]$. 8+7 = 15
2. Solve the Cauchy's problem analytically for $z = \frac{1}{2}(p^2 + q^2) + (p - x)(q - y)$ which passes through the x -axis. Hence, write a code using any software to plot the integral surface when $x, y \in [-1, 1]$. 8+7 = 15

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MATHEMATICS

PARTIAL DIFFERENTIAL EQUATIONS

CORE-7

Time Allotted: 2 Hours

Full Marks: 25

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Answer any one question from the following

25×1 = 25

1. (a) Solve: $(x^2 - yz)p + (y^2 - zx)q = z^2 - xy$ 10
- (b) Find the integral surface of the partial differential equation $(x - y)y^2p + (y - x)x^2q = (x^2 + y^2)z$ passing through the curve $xz = a^3, y = 0$. 10
- (c) Form a partial differential equation by eliminating the arbitrary function ϕ from $\phi(x^2 + y^2 + z^2, z^2 - 2xy) = 0$. 5
2. (a) Find by the method of characteristics, the integral surface of $pq = xy$ which passes through the line $z = x, y = 0$. 10
- (b) By using the method of separation of variables solve $3\frac{\partial z}{\partial x} + 2\frac{\partial z}{\partial y} = 0$ with $z(x, 0) = 4e^{-x}$. 5
- (c) Find the solution of the Cauchy problem for the first order PDE $x\frac{\partial z}{\partial x} + y\frac{\partial z}{\partial y} = z$, 10
on $D = \{(x, y, z) \mid x^2 + y^2 \neq 0, z > 0\}$, with the initial condition $x^2 + y^2 = 1, z = 1$.

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