

QUESTION PAPERS FOR END TERM THEORY
EXAMINATIONS
MAY-2025



B.Tech, B.Tech (Evening), B.Design,
2nd, 4th, 6th & 8th SEMESTER

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B.TECH

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B.TECH [Eve.]

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B.Sc./M.Sc.

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Roll No.

Second Semester
Int B.Sc. and M.Sc.
IMSAC108 Basic Chemistry-II

END TERM EXAMINATION

May-2025

Time: 3 Hours

Max. Marks: 50

Note: Question no. 1 is compulsory. Attempt any 9 Questions in total. Assume suitable missing data, if any

Q1. Draw the phase diagram for water system. Discuss each area, curve and triple point using Degree of freedom.

[10 Marks] [CO3]

Q2. Explain the following terms with example:

- Phase
- Component
- Degree of freedom
- Eutetic point
- metastable equilibrium

[5 Marks] [CO3]

Q3. State Gibbs phase rule. Derive equation for Gibbs phase rule.

[5 Marks] [CO3]

Q4. State and explain the three laws of crystallography.

[5 Marks] [CO1]

Q5. List and define the seven crystal system along with fourteen bravais lattice.

[5 Marks] [CO1]

Q6. a) Draw the plane for the following miller indices:

i. 100

ii. 120

[3 Marks] [CO1]

[2 Marks] [CO1]

b) Write short note on X-ray diffraction.

Q7. What is polarization in dielectrics? Name different types of polarization and discuss them in brief.

[5 Marks] [CO5]

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Q8. What is Langmuir adsorption isotherm? List the assumption of Langmuir adsorption model and derive the equation. [5 Marks][CO₁]

Q9. What are colloids? On what basis are colloids classified. Classify them on the basis of different classification criteria. [5 Marks][CO₂]

Q10. Discuss five different types of thermodynamic processes with example. [5 Marks][CO₂]

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Total No. of Printed Pages: 03

Roll No.....

IInd SEMESTER

Integrated B.Sc.-M.Sc. (Chemistry)

END TERM EXAMINATION

May 2025

Course Code: IMSAC 104

Course Title: Organic Chemistry 2

[Time: 3H]

[Max. Marks: 40]

Instructions: Attempt any 5 questions.

Q1 a) Write down the Haworth synthesis of Anthracene.

b) Account for α -isomer in nitration and halogenation of naphthalene.

[4,4][CO5][L1,3]

Q2 a) Which out of *cis* and *trans* decalin is more stable and why? Illustrate your answer drawing conformations.

b) On the basis of Baeyer's Strain theory explain why cyclobutane is less stable than cyclohexane?

[4,4][CO2][L4,5]

Q3. a) Draw the possible chair conformational structures for the following pairs of dimethylcyclohexanes: *cis* and *trans*-1,2 and *cis* and *trans*-1,3. Compare the stabilities of the more stable conformers for each pair of geometric isomers.

b) In terms of eclipsing interactions explain why the chair conformation is more stable than the boat conformation and the twist boat conformation is more stable than the boat conformation.

[4,4][CO1][L6,4,5]

Q4. a) Oxidation of 1-nitronaphthalene yields 3-nitrophthalic acid. However, if 1-nitronaphthalene is reduced to α -naphthylamine and if this amine is oxidized, the

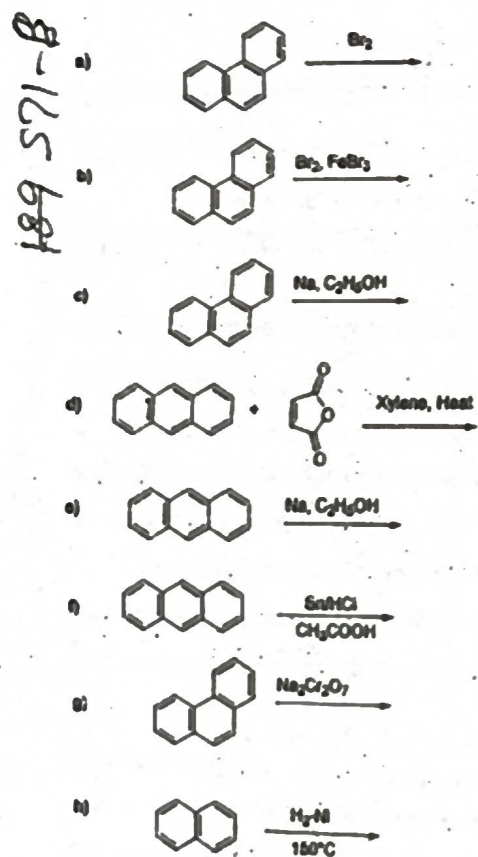
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product is phthalic acid. How do these reactions establish the gross structure of naphthalene. Write down all the reactions.

b) Describe in detail the structure of anthracene and explain its preferential position of electrophilic substitution reaction.

[4,4][CO5][L2,L1]

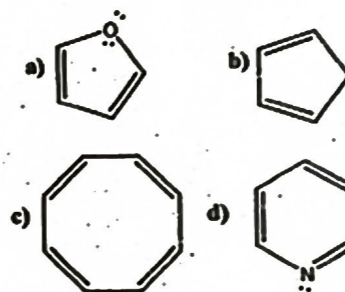
Q5. Complete the following reactions:



[1*8][CO5][L1,2]

Q6. a) Give the mechanism for nitration of benzene. Discuss the rate determining step of the reaction.

b) Classify the following compounds as aromatic, anti-aromatic and non-aromatic. Justify your answer with suitable reason.



[4,4][CO3,CO4][L1,2,3]

Q7. Write short notes on the following:

a) Friedel-Craft alkylation

b) Huckel's Rule with examples.

[4,4][CO3,CO4][L1,2]

Total No. of Pages: 03
Second Semester

Roll No.

B.Sc. and M.Sc. (Integrated)

END TERM EXAMINATION
IMSAC- 106: Physical Chemistry-II
(Gaseous and Liquid States)

May-2025

Max. Marks: 40

Time: 3 Hours

Note: Attempt six Questions in all. Question 1 is compulsory.
Assume suitable missing data, if any

Useful Physical constants: $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$; $R = 0.08206 \text{ dm}^3 \text{ atm K}^{-1} \text{ mol}^{-1}$; $1 \text{ J} = 1 \text{ kg m}^2 \text{ s}^{-2}$; $\pi = 3.14$; $N = 6.022 \times 10^{23} \text{ mol}^{-1}$; $k_b = 1.3806 \times 10^{-23} \text{ J K}^{-1}$; $g = 9.807 \text{ m s}^{-2}$.

Q1a. Explain the deviation in the values of compressibility factor (Z) of CH_4 gas at low and high pressures as compared to the ideal gas.
[3 Marks] [CO2, CO3, L2, L3]

b. Calculate the most probable speed, the mean speed, and the root-mean-square speed of methane molecules at 0°C .
[4 Marks] [CO5, L5]

c. How does the addition of detergent(s) affect the surface tension of water? Explain. Discuss the mechanism of cleansing action of detergent(s) on the fabric.
[3 Marks] [CO2, L2]

Q2a. Derive the kinetic gas equation based on the postulates of kinetic theory of gases.
[3 Marks] [CO1, L1]

b. Calculate the relative number densities of water molecule using barometric formula at 300 K at a typical cruising altitude of 8 km, generally kept for the commercial flight. Given, molar mass of water is 18.0 g/mol. Comment on your result.
[3 Marks] [CO5, L2, L5]

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P.T.O

Q3a. Work out the average kinetic energy of ideal gas molecules using the Maxwell distribution of molecular speeds in 3-D. [3 Marks] [CO2, L2]

b. Define the critical constants (P_c , V_c and T_c) for a real gas. Work out the following expression for critical temperature (T_c) of a real gas in terms of its van der Waals constants a and b:

$$T_c = 8a / 27 Rb \quad [3 \text{ Marks}] [CO2, L2]$$

Q4a. A 5.0 L cylinder contains 8 mol of Cl_2 gas. Calculate its pressure at 27°C using: (i). ideal gas law; (ii). van der Waals gas equation. Comment on the difference in values of pressure in two cases.

Given, the van der Waals constants (a and b) for Cl_2 gas are $6.26 \text{ dm}^6 \text{ atm mol}^{-2}$ and $0.0542 \text{ dm}^3 \text{ mol}^{-1}$, respectively. [3 Marks] [CO5, L5]

b. Draw the isotherm for CO_2 qualitatively at different temperatures. In this diagram show the following: two-phase (liquid-gas) coexistence region, the supercritical fluid region and the critical isotherm. [3 Marks] [CO1, CO2, L1, L2]

Q5a. Calculate the reduced pressure (P_r), reduced volume (V_r) and reduced temperature (T_r) of one mole of methane gas confined to a volume of 5 dm^3 container under a pressure of 5 atm. Also calculate the temperature of the gas.

Given the critical constants of methane: P_c , V_c and T_c are 54.6 atm, $0.0988 \text{ dm}^3 \text{ mol}^{-1}$ and 190.2 K respectively. [3 Marks] [CO2, CO5, L2, L5]

b. In what ways the structure of liquid(s) differ to that of a solid(s) and gas(es)? Explain. [3 Marks] [CO2]

Q6a. Point out the physical significance of second and third virial coefficients in virial equation of state. [3 Marks] [CO2, L2]

P.T.O

b. Arrange the following liquids in order of increasing boiling point based on their vapour pressure and intermolecular forces: ethyl alcohol, ethylene glycol, diethyl ether and water. [3 Marks] [CO2, CO3, L2, L3]

Q7a. A capillary tube of internal diameter $0.3 \times 10^{-3} \text{ m}$ is dipped into a liquid whose density is 790 kg m^{-3} . The liquid rises in this capillary to a height of 0.9 m. Calculate the surface tension of the liquid in N m^{-1} . (Given, $g = 9.806 \text{ m s}^{-2}$). [3 Marks] [CO5, L5]

b. How would the addition of the water soluble polymer to water influence the viscosity of water? Justify your answer by taking an example. [3 Marks] [CO2, L2]

-----End-----

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Total No. of Pages: 02

Roll no.....

Integrated B.Sc.-M.Sc. I SEMESTER

END TERM EXAMINATION

May- 2025

IMSBT102 - Introduction to Computational Biology

Time: 3:00 Hours

Max. Marks: 40

Note: Attempt any 5 questions.
All questions carry equal marks.
Assume suitable missing data, if any

- 1) (a) Outline the key features of the NCBI database. How does it serve as a central resource in biological research?
(b) Describe the basic working principle of BLAST and explain how it identifies sequence similarities.
[4+4] [CO# IMSBT-102.1] [BTL#2]
- 2) (a) Discuss specific tools or features within PDB that enhance researchers' ability to analyze and interpret complex molecular data?
(b) Discuss the significance of visualization tools like PyMOL in understanding protein structures and interactions.
[4+4] [CO# IMSBT-102.1] [BTL#6]
- 3) (a) Explain the role of loops in programming for bioinformatics. How do they help in handling and analyzing biological data easily?
(b) What are arrays in programming? Explain their structure and purpose in storing data.
[4+4] [CO# IMSBT-102.3] [BTL#4]
- 4) (a) Compare the key differences between PAM and BLOSUM scoring matrices in sequence alignment.
(b) Describe the working principle of the Smith-Waterman algorithm for sequence alignment.
[4+4] [CO# IMSBT-102.4] [BTL#3]

5) (a) Describe the detailed procedure for conducting multiple sequence alignment (MSA). Outline the key steps involved, including sequence preparation, parameter selection, and result interpretation.

(b) Explain the difference between pairwise sequence alignment and multiple sequence alignment, highlighting the specific tools or algorithms used for each approach.

[4+4] [CO# IMSBT-102.5] [BTL#1]

6) (a) Explain how the Human Genome Project has contributed to advancements in genomics and personalized medicine.

(b) Describe how pathway enrichment analysis using databases like KEGG or Reactome can help identify key biological processes affected in a disease condition.

[4+4] [CO# IMSBT-102.2] [BTL#5]

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Roll No.....

II Semester
B.Sc./M.Sc. Integrated

END TERM EXAMINATION

May 2025

IMSBT-104: Genetics/Molecular Genetics

Time- 3:00 hours

Maximum marks- 40

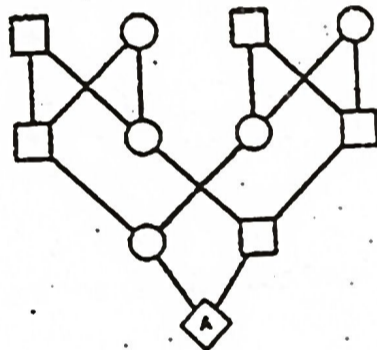
Answer SIX questions. Question No.1, 2 and 3 are compulsory

Write the characteristic features of each stage of Prophase I (Meiosis I).

[CO1; L1][5]

Calculate the Inbreeding coefficient (F) of individual "A". Assume common ancestors are not inbred.

[CO2; L4][5]



[CO1, CO2; L2][2+2+2]

Answer the following:

Two examples of X-linked recessive disorder.

Explain Base substitution mutations

Define mFISH

a) Explain different types of chromosomal structural variation.

[CO3; L3][4]

Describe site-specific recombination between the circular DNA of a bacteriophage and that of a bacterium, with the help of an illustration.

[CO3; L3][4]

5. a) Describe any two DNA repair mechanisms. [CO4; L3][4]
b) Explain the positive and negative regulation of Lac operon. [CO4; L3][4]
6. a) Describe different chromosome banding techniques using Giemsa stain. [CO5; L3][4]
b) Briefly explain the steps involved in Fluorescence In Situ Hybridization. [CO5; L4][4]
7. a) Calculate the recombination frequency, average number of crossovers a genetic distance between points A and B on a chromosome from following information:
i) Individuals with no crossover = 70
ii) Individuals with single crossover = 20
iii) Individuals with double crossover = 8
iv) Individuals with triple crossover = 2
- b) Differentiate between Type I and Type II transposons. [CO3; L4][3]
c) Differentiate between Dominant and Codominant markers. [CO4; L1][3]
[CO5; L5][2]

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Total no. of Pages: 02

Roll no.....

II SEMESTER

B.SC M.SC Integrated

END TERM EXAMINATION

MAY-2025

COURSE CODE IMSBT106

COURSE TITLE : Cell Biology

Time: 01:30 Hours

Max. Marks: 50

**Note : Paper is divided into 3 sections.
Assume suitable missing data, if any.**

Section A – Short Answer Questions (Any 5 out of 6) [5 × 3 = 15 Marks]

1. Define the cytoskeleton. Mention two major cytoskeletal elements and their functions. [CO1] [BTL1]
2. Differentiate between prokaryotic and eukaryotic cells with one example each. [CO1] [BTL2]
3. What are the differences between apoptosis and necrosis? [CO6][BTL2]
4. What is the role of the p53 gene in controlling the cell cycle? [CO2] [BTL2]
5. Explain the function of tight junctions in epithelial cells. [CO3][BTL2]
6. Describe the mechanism of receptor-mediated endocytosis with an example. [CO4][BTL3]

**Section B – Medium Answer Questions (Any 3 out of 5)
[3 × 5 = 15 Marks]**

8. Explain the molecular components and structural organisation of the cytoskeleton. [CO1][BTL2]

9. Discuss the mechanisms through which tumour suppressor genes like pRb prevent cancer progression. [CO5][BTL3]
10. Analyse the role of Bcl-2 family proteins and cytochrome c in apoptosis. [CO2][BTL4]
11. Describe the role of intracellular signalling proteins in transmitting signals from receptors to the nucleus. [CO3][BTL2]
12. Explain the importance of the extracellular matrix in regulating cell-cell interactions and signalling. [CO1][BTL3]

Section C - Long Answer Questions (Any 2 out of 3)
[2 × 10 = 20 Marks]

13. Describe and differentiate the major types of cell signalling (autocrine, paracrine, endocrine, and juxtacrine), including examples and biological relevance. [CO3][BTL4]
14. Discuss in detail the process of cancer progression from proto-oncogene activation to metastasis, including targeted therapies. [CO5][BTL4]
15. Design an experimental approach to study apoptosis using caspase assays and mitochondrial markers. [CO2][BTL6]

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II SEMESTER

Roll no.....

B.Sc.

END TERM EXAMINATION

May-2025

IMSPH 102 Mathematical Physics II

Time: 03:00 Hours

Max. Marks: 50.

Note: Answer all Questions.

Assume suitable missing data, if any.

- Q.1 Find the gradient and divergence of a complex function $f(z) = x^2y - xy^2$.
[5][CO2][BTL2]
- Q.2 Write the law of transformation of a covariant and contravariant tensor of order 1. Give an example of a physical quantity of each type. [5][CO2][BTL2]
- Q.3 What is the geometrical interpretation of gradient. Find the directional derivative of $f(x,y,z) = x^2yz - 4xyz^2$ at the point (1,3,1) in the direction of the vector $2i - j - 2k$. [5][CO3][BTL2]
- Q.4 Write the Green's divergence theorem and write the expression of gradient and divergence in cartesian coordinates. [5][CO2][BTL2]
- Q.5 What is an analytic function. What is a simply connected and a multiply connected region. Write cauchy-riemann equations. [6][CO3][BTL2]
- Q6 Determine the poles of the function $f(z) = z^2 / (z-1)^2 (z+2)$
the residue at each pole and hence evaluate the integral along a contour C
given by $|z|=3$ [6][CO3][BTL4]
- Q7. Write the line element for an Euclidean space and the Riemannian space. What is the metric tensor and write the transformation law for $g_{\mu\nu}$. [6][CO3][BTL3]

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Q8 Write the Laurent series theorem and derive it from first principles.

Or

Verify the Stokes theorem for the vector field $\mathbf{v} = xy \mathbf{i} + 2yz \mathbf{j} + 3xz \mathbf{k}$ using a square cross section of unit area in yz plane .

[7][CO3][BTL3]

Q9. Find all the roots of the complex equation $z^3 = 1$

[5][CO2][BTL2]

Total No. of Pages: 3

No. ..

IInd SEMESTER

Integrated B.Sc-M.Sc (Physics)

END TERM EXAMINATION

MAY 2025

COURSE CODE & TITLE IMSPH 104 THE PHYSICS OF VIBRATIONS & WAVES

Time:3.0 Hours

Max. Marks:50

Note: Q1 is compulsory. Attempt any four questions from Q2-Q6. Symbols have their usual meaning. Assume suitable missing data, if any.

- Q1 (a) Is sound wave a transverse or a longitudinal wave? Why sound waves cannot be polarized? [2] [CO: 1, 2] [BTL:2]
- (b) Define a wavefront, plane wave and a spherical wave. [1.5] [CO: 1, 2] [BTL:1]
- (c) When does a reflected pressure sound wave has the same phase or different phase with respect to an incident wave?[1.5] [CO:2] [BTL:2]
- (d) Why does the pressure variation is maximum for a sound wave when it's reflected from a rigid boundary? OR Why there is no difference between a wave velocity and a group velocity when a light travels in a vacuum? [2] [CO:5] [BTL:2]
- (e) What is the difference between an echo and reverberation for a sound wave? [1.5] [CO:2] [BTL:2]
- (f) What are the three conditions for the interference of sound waves? [1.5] [CO:3] [BTL: 2]

Attempt any four questions from Q2(a-c):

- Q2 (a) Explain Sabine's law of sound reverberation and what are the various assumptions taken for the determination of intensity of sound energy in the enclosure at any time? [2.5] [CO:5] [BTL:2]
- (b) Derive an expression for the intensity of an acoustic wave and define the specific acoustic impedance. [2.5] [CO:5] [BTL:3]

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- (c) Define the following terms (i) Logarithmic Decrement, (ii) Relaxation Time and (iii) Quality Factor and show the relation between these terms. [2.5] [CO:5] [BTL:1]
- (d) A hall has a volume of 2000 m^3 . Its total absorption is equivalent to 90 m^2 of open window. What will be the effect on the reverberation time if an audience fills the hall and thereby increases the absorption by another 90 m^2 ? [2.5] [CO:5] [BTL:3]
- (e) Calculate the displacement to amplitude ratio for a S.H.M when Kinetic Energy (KE) is 90% of total energy. [2.5] [CO:5] [BTL:3]

Attempt any four questions from Q3(a-e):

- Q3 (a) From the general solution of a forced oscillator, deduce the expression of an amplitude resonance for a very low and high driving frequency. [2.5] [CO: 1, 5] [BTL:3]
- (b) What is Newton's and Laplace correction factor for propagation of sound waves in a gas? [2.5] [CO:5] [BTL:1]
- (c) Define different types of earthquake waves. [2.5] [CO: 1, 5] [BTL:1]
- (d) Derive the differential equation of SHM of an electrical oscillator. [2.5] [CO: 1, 5] [BTL:3]
- (e) A particle is subjected to two simple harmonic motions: $x_1 = A_1 \sin \omega t$ and $x_2 = A_2 \sin(\omega t + \pi/3)$. Find (i) the displacement at $t=0$, (ii) the maximum speed of the particle and (iii) the maximum acceleration of the particle. [2.5] [CO: 1, 5] [BTL:3]

Attempt any two questions from Q4(a-c):

- Q4 (a) Derive the differential equation of motion & its general solution for a damped SHM and discuss the case for a critically damped SHM. [5.0] [CO:5] [BTL:3,4]
- (b) What are Lissajous's figures? Derive an expression for the resultant motion for two simple harmonic motions at right angles to each other with frequency ratio 1:2 and draw the Lissajous figure for two SHM's having different amplitudes, phases and frequencies in the ratio 1:2. [5.0] [CO:5] [BTL:3,4]

- (c) The equation for displacement of a point on a damped oscillator is given by $x = 5 e^{-0.25t} \sin [\pi/2]t$ metre. Find the velocity of the oscillating point at $t=T/4$ and T , where T is the time period of the oscillator. [5.0] [CO:5] [BTL:3]

Attempt any two questions from Q5(a-c):

- Q5 (a) What are the main requirements for a good acoustic auditorium? Define an acoustic transducer and name 3 acoustic transducers. [5.0] [CO:5] [BTL:1,2]
- (b) Show that for two identical stiffness coupled pendulums, the total energy is constant and transferred between the pendulums at the modulated (beat) frequency. [5.0] [CO:5] [BTL:3,4]
- (c) Define the following terms: (i) Normal Co-ordinates, (ii) normal modes of vibration and (iii) degrees of freedom. [5.0] [CO:5] [BTL:1,2]

- Q6 (a) The vibrations of a string fixed at both ends are described by the equation $y = (5.00 \text{ mm}) \sin[(1.57 \text{ cm}^{-1})x] \sin[(314 \text{ s}^{-1})t]$
- (i) What is the maximum displacement of the particle at $x = 5.66 \text{ cm}$?
- (ii) What are the wavelengths and the wave speeds of the two transverse waves that combine to give the above vibration?
- (iii) What is the velocity of the particle at $x = 5.66 \text{ cm}$ at time $t = 2\text{s}$?
- (iv) If the length of the string is 10.0 cm , locate the nodes and the antinodes. How many loops are formed in the vibration? [3.0] [CO: 1, 2] [BTL:3]

- (b) A sonometer wire has a total length of 1m between the fixed ends. Where should the two bridges be placed below the wire so that the three segments of the wire have their fundamental frequencies in the ratio 1:2:3? [2] [CO: 1, 2] [BTL:3]
- (c) Define the following terms: (i) Normal Dispersion; (ii) Non-Dispersion and (iii) Anomalous Dispersion [5.0] [CO: 1, 2] [BTL:1,2]

Total No. of Pages: 3

Roll No.

IInd SEMESTER
Integrated B.Sc-M.Sc (Physics)

END TERM EXAMINATION
COURSE CODE IMSPH 108

MAY 2025

COURSE TITLE GEC PHYSICS-2

Time:3.0 Hours

Max. Marks:40

Note: Q1 is compulsory. Attempt any four questions from Q2-Q7. Symbols have their usual meaning. Assume suitable missing data, if any.

Attempt any ten questions from Q1(a-l): [20]

- Q1 (a) What is the main difference between a solar cell and LED? [2]
[CO:1,2] [BTL:1,2]
- (b) What is the difference between a ballistic transport and a drift velocity of electrons upon application of an electric field? [2] [CO:2,3]
[BTL:1,2]
- (c) What are the two main essential conditions for a lasing action to occur? [2] [CO:1,2] [BTL:2]
- (d) What are the two essential conditions for a total Internal Reflection (TIR) at the optical fiber wall to occur? [2] [CO:1,5] [BTL:2]
- (e) What do you understand by the term "Refractive Index Profile" for an optical fiber? [2] [CO:1,2] [BTL:2]
- (f) What important conclusions can be drawn from the plot of Binding energy per nucleon as a function of mass number in nuclear physics? [2] [CO:1,5] [BTL:2]
- (g) Define the following terms: (i) Isotopes; (ii) Isobars and (iii) Isotones. [2] [CO:1,2] [BTL:1]
- (h) State four main differences between the ordinary light and laser beam. [2] [CO:1,2] [BTL:1]
- (i) Explain Mass defect formula for the stability of atomic nucleus [2]
[CO:1,5] [BTL:2]

mechanism of attenuation of signal in optical fibers. [2] [CO:5] [BTL:1,2]

- (j) If the uncertainty in position of an electron is 4×10^{-10} m, calculate the uncertainty in its momentum. [2] [CO:2] [BTL:2,3]
- (k) Explain the nuclear fission and fusion process. State four main differences between the two processes. [2] [CO:3] [BTL:2]
- (l) Explain Compton Effect and Compton Shift in Nuclear Physics. [2] [CO:3,5] [BTL:2]

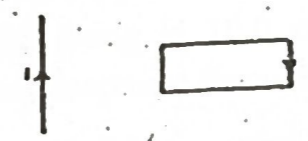
- (b) Explain the construction and the working mechanism of an optical fiber along with appropriate diagrams. OR For an optical fiber, define and derive the expressions for the following terms: (i) Acceptance angle; (ii) Acceptance cone and (iii) Numerical aperture. [3] [CO:5] [BTL:2,3]

- Q2 (a) Explain the features, advantages and limitations of either Liquid Drop Model or Nuclear Shell Model of Nuclear physics [3]. [CO:3,5] [BTL:1,2]
- (b) Calculate the binding energy of an alpha particle from the following data: Mass of $(1,1)\text{H}$ atom = 1.007825 u; mass of neutron = 1.008665 u and mass of $(4,2)\text{He}$ atom = 4.00260 u. Take $1\text{u} = 931 \text{ MeV } c^{-2}$. [2] [CO:5] [BTL:3]

- Q6 (a) What is the difference between classical mechanics and quantum mechanics? Explain Black Body radiation via Planck's quantum theory [2.5] [CO:5] [BTL:1,2]
- (b) What do you understand by de-broglie's concept of matter waves? Give its diagrammatic representation and derive de-broglie's wave equation. [2.5] [CO:5] [BTL:2,3]

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- Q3 (a) What is the effect of temperature and doping on the mobility of semiconductors and state Matthiessen's rule? OR Explain the temperature dependence of carrier concentrations in a semiconductor. [3.0] [CO:5] [BTL:2]
 - (b) Explain any two of the following terms: (i) Amphoteric Dopants; (ii) Law of Mass Action and (iii) Einstein Relationship and (iv) diffusion current and a drift current. [2.0] [CO:5] [BTL:2]

- Q7 (a) Define the following terms (i) Electric Potential; (ii) Electric Potential Energy; (iii) Dielectric Loss and (iv) Lenz's Law. [2] [CO:2,5] [BTL:1]
- (b) A conducting loop placed near a long straight wire carries a current i as shown in the fig. below. If the current increases continuously, find the direction of the induced current in the loop. [2] [CO:2,5] [BTL:3]



- Q4 (a) In the working of a laser, define the following terms (i) population inversion, (ii) Lifetime and (iii) Metastable state. OR What are the three main differences between step- and graded-index fibers? [1.5] [CO:2] [BTL:1,2]
- (b) Derive Einstein's A & B coefficients with respect to stimulated absorption, spontaneous emission and stimulated emission OR Explain the construction and the working mechanism of either Ruby laser or He-Ne laser. [3.5] [CO:5] [BTL:2,3]

- (c) A circular coil of radius 1.5 cm carries a current of 1.5 A. If the coil has 25 turns, find the magnetic field at the centre. [1] [CO:2,5] [BTL:3]

- Q5 (a) Define the parameter V-number and explain the modes of propagation of light signal via step- and graded index fibers. OR Explain the

No. of Pages: 2

Integrated B.Sc. and M.Sc. (Mathematics)

Roll No.:

END TERM EXAMINATION

II Semester

IMSMA102: CALCULUS-II

May 2025

Time: 3 Hours

Maximum Marks: 50

Note: Attempt any five questions. All questions carry equal marks.

1 (a) Verify Euler's theorem for $u = \log\left(\frac{x^2+y^2}{xy}\right)$. [5]
CO2, BTLS

1 (b) Find the maximum and the minimum distances of the point (3, 4, 12) from the sphere $x^2 + y^2 + z^2 = 1$ using Lagrange's method of multipliers. [5]
CO1, BTLS

2 (a) Evaluate the double integration $\int_0^a \int_{\sqrt{ax}}^a \left(\frac{y^2}{\sqrt{y^4 - a^2x^2}}\right) dydx$ by changing the order of integration. [5]
CO2, BTLS

2 (b) Find the volume bounded by the xy-plane, the cylinder $x^2 + y^2 = 1$ and the plane $x + y + z = 3$. [5]
CO3, BTLS

3 (a) Evaluate the volume of the ellipsoid $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$ using triple integration. [5]
CO3, BTLS

3 (b) Find the directional derivative of the function $f(x, y, z) = x^2 + xy + z^2$ at the point A(1, -1, -1) in the direction of the line AB, where B has the coordinates (3, 2, 1) [5]
CO4, BTLS

4 (a) Prove that $\nabla^2 f(r) = f''(r) + \frac{2}{r} f'(r)$. [5]
CO5, BTLS

4(b) Find a unit vector normal to the surface $y^3z^2x = 4$ at the point (-1, -1, 2). [5]
CO5, BTLS

5 (a) If $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$, prove that $\text{curl}(\vec{r}^n \vec{r}) = \vec{0}$.

[5]

COS, BTL1

5 (b) Verify Green's theorem for the function $\vec{F} = (xy + y^2)\hat{i} + x^2\hat{j}$, where the curve C is the boundary of the region bounded by the curves $y = x$ and $y = x^2$.

[5]

COS, BTL4

6 (a) A force field \vec{F} is given by $\vec{F} = (2x - y + 2z)\hat{i} + (x + y - z)\hat{j} + (3x - 2y - 5z)\hat{k}$. Find the work done by \vec{F} in moving a particle once round a circle C in xy -plane, if the circle has its centre at origin and radius 2 units.

COS, BTL3, BTL5 [5]

6 (b) Evaluate $\int \int_S ((2x + z)\hat{i} + yz\hat{j} + z^2\hat{k}) \cdot \hat{n} dS$ using Gauss divergence theorem, where S is the surface of the region enclosed by upper half of the sphere $x^2 + y^2 + z^2 = a^2$ and $z = 0$ plane.

COS, BTL1, [5]

BTL5

~End~

Total No. of Pages: 02
Second Semester
 End Term Examination

Roll No:.....

I.M.Sc.
 May, 2025

IMSMA-104, Real Analysis-I

Time: 3 Hours

Max. Marks: 50

Note: Attempt any ten questions and assume the missing values.

- (1) State the Weierstrass M -test and with the help of M -test show that the series

$$\sum_{n=1}^{\infty} r^n \cos nx \text{ and } \sum_{n=1}^{\infty} r^n \sin nx, \quad 0 < r < 1,$$

converge uniformly on \mathbb{R} . (CO4)(L1)

- (2) Let $\{f_n\}$ be a sequence of functions, which converges uniformly to f on E . If each of the functions $f_n (n = 1, 2, 3, \dots)$ is continuous at $x_0 \in E$, then show that f is continuous at x_0 . (CO4)(L3)

- (3) Explain pointwise convergence and uniform convergence and compare them. (CO4)(L1)

- (4) Prove that a sequence of functions $\{f_n\}$ defined on E converges uniformly on a set E if and only if for every $\varepsilon > 0$, $x \in E$ there is an integer n_0 such that (CO4)(L3)

$$|f_n(x) - f_m(x)| < \varepsilon, \quad m, n \geq n_0.$$

- (5) State and prove the mean value theorem and give its geometric interpretation. (CO5)(L2)

- (6) Prove that if the series $\sum_{n=1}^{\infty} u_n$ converges, then $u_n \rightarrow 0$ as $n \rightarrow \infty$, but the converse is not necessarily true. (CO3)(L3)

- (7) Test the convergence of the series (CO3)(L2)

$$1 + \frac{2x}{2!} + \frac{3^2 x^2}{3!} + \frac{4^3 x^3}{4!} + \dots$$

(8) Test the convergence of the series

(CO3)(L3)

$$x - \frac{x^2}{2^2} + \frac{x^3}{3^2} - \frac{x^4}{4^2} + \dots$$

- (9) Show that the sequence $\{2nx/(nx+3)\}$ converges pointwise on $E = (0, 2]$ but it does not converge uniformly on E . (CO4)(L2)
- (10) Show that $\sqrt{8}$ is not a rational number. (CO1)(L1)
- (11) State and prove the Rolle's theorem and give its geometric interpretation. (CO5)(L2)
- (12) Suppose that $\{s_n\}$ and $\{t_n\}$ are two sequences of real numbers and

$$\lim_{n \rightarrow \infty} s_n = L \text{ and } \lim_{n \rightarrow \infty} t_n = L.$$

If $s_n \leq u_n \leq t_n$ ($n = 1, 2, \dots$), then show that

(CO2)(L1)

$$\lim_{n \rightarrow \infty} u_n = L.$$

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Roll No.

SECOND SEMESTER

IMSC[Mathematics]

END SEM EXAMINATION

MAY 2025

IMSMA-106 ORDINARY DIFFERENTIAL EQUATIONS

Time: 3 Hrs.

Max. Marks: 50

Note: Answer ANY FIVE questions. Assume suitable missing data, if any.

Q.1 (a) Obtain the differential equations from the solution
 $\frac{x^2}{a^2+c} + \frac{y^2}{b^2+c} = 1$, where a, b are fixed and c is arbitrary constant.

[5M][CO1][L2]

(b) Find particular member of orthogonal trajectories of $x^2 + cy^2 = 1$ passing through the point (2, 1). [5M][CO1][L2]

Q.2 (a) Solve $x^2 \frac{d^2y}{dx^2} - 3x \frac{dy}{dx} + 5y = x^2 \sin(\log x)$.

[5M] [CO4][L4]

(b) Let y_1 and y_2 be the solutions of differential equation

$$y'' + p(t)y' + q(t)y = 0, \text{ where } p \text{ and } q \text{ are continuous on}$$

$[a, b]$. Prove that the Wronskian is given by $W' + p(t)W = 0$.

[5M][CO2][L3]

Q.3 (a) Write the condition of integrability condition of total differential equation and hence solve $(x+z)^2 dy + y^2(dx+dz) = 0$.

[5M] [CO2][L1]

(b) Solve $\frac{d^2y}{dx^2} + a^2y = \tan ax$.

[5M][CO4][L2]

Q.4 (a) Find all the eigen values and eigen functions of $y'' + \lambda y = 0$, with $y(0) = y(2l)$, $y'(0) = y'(2l)$.

[5M] [CO3][L5]

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(b) Solve by method of variation of parameters

$$(D^2 + 2D + 1)y = e^{-x} \log x.$$

[5M][CO4][L2]

Q.5 (a) Find the general solution to the system $x' = Ax$, where

$$A = \begin{bmatrix} 1 & -1 \\ 1 & 3 \end{bmatrix} \text{ and } x = [x_1, x_2]^T. \quad [5M][CO5][L5]$$

(b) Find the general solution of the system $y' = Ay + h$, where

$$A = \begin{pmatrix} 1 & 1 \\ 4 & -2 \end{pmatrix}, h = \begin{pmatrix} 3t + 1 \\ 2t + 1 \end{pmatrix}, y = [y_1, y_2]^T. \quad [5M][CO5][L5]$$

Q.6 (a) Solve the following simultaneous linear differential equations.

$$\frac{dx}{dt} + 4x + 3y = t \quad \text{and} \quad \frac{dy}{dt} + 2x + 5y = e^t. \quad [5M][CO4][L4]$$

(b) Solve the following equation by changing the independent variable.

$$x \frac{d^2y}{dx^2} - \frac{dy}{dx} + 4x^3y = x^5.$$

[5M][CO2][L3]

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Total no. of Pages: 2

Roll no.....

END TERM EXAMINATION May-2025Integrated B.Sc. and M.Sc. (2nd Semester)**COURSE CODE: IMSMA108****COURSE TITLE: MATHEMATICS-II (GEC)****Time: 03:00 Hours****Max. Marks: 50****Note: All questions carry equal marks.**

Assume suitable missing data, if any.

Q.1 Find the inverse of the matrix using elementary row transformation.

$$A = \begin{bmatrix} -1 & 1 & 2 \\ 3 & -1 & 1 \\ -1 & 3 & 4 \end{bmatrix}$$

[4][CO1][BTL1,3,5]

Q.2 Determine the eigenvalues and eigenvectors of the matrix

$$A = \begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$$

[4][CO1][BTL1,5,6]

Q.3 Verify that the given function satisfies the differential equation:

$$y = \sin^{-1} x, \quad y'' = \frac{x}{(1-x^2)^{3/2}}$$

[4][CO2][BTL1,2,3,4]

Q.4 Check the equation for exactness. If it is exact, find the solution:

$$(3x^2 + 2e^y)dx + (2xe^y + 3y^2)dy = 0$$

[4][CO2][BTL1,2,3]

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Total no. of Pages: 2

Roll no.

Q.5 Solve the initial value problem:

$$(3xy + y^2)dx + (x^2 + xy)dy = 0, \quad y(0) = 1 \quad [6][CO3][BTL2,3,4,5]$$

Q.6 Find the solution of the Bernoulli differential equation:

$$3y^2y' + xy^3 = x \quad [6][CO3][BTL2,3,4,5]$$

Q.7 Write the convolution theorem statement and prove the statement.

[6][CO4][BTL1,4,5]

Q.8 Use Laplace transform to solve the initial value problem:

$$y'' + 6y' + 9y = 8te^{2t}, \quad y(0) = 0, \quad y'(0) = -1 \quad [6][CO4][BTL1,2,3,4,5]$$

Q.9 Define the gradient of a scalar field. Find the normal vector and the equation of the tangent plane to the surface: [5][CO5][BTL1,3,4,5]

$$z = \sqrt{x^2 + y^2} \quad \text{at } (3, 4, 5)$$

Q.10 Write the statement of Green's Theorem. Verify Green's Theorem in the plane for [5][CO5][BTL1,3,5]

$$\oint_C (3x^2 - 8y^2)dx + (4y - 6xy)dy$$

where C is the boundary of the region defined by:

$$y = \sqrt{x}, \quad y = x^2$$

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Roll No. _____

II Semester
B.Sc.-M.Sc. Integrated

END TERM EXAMINATION

May, 2025

COURSE CODE: IMSHU102

COURSE TITLE: INTRODUCTORY MACROECONOMIC

TIME: 3:00 HRS.

MAX. MARKS: 50

NOTE: Attempt any five questions from the following.

1. a) Explain the circular flow of income and expenditure in a two-sector economy. Illustrate your answer with a neat diagram.
(5Marks)(CO1)(BLT1)
b) Given the following information, calculate the Nominal GDP and Real GDP. Assume 2020 as the base year.

Year	Price (₹)	Quantity
2020	50	1000
2021	60	1000

(5Marks)(CO1)(BLT5)

2. a) Define money. Discuss the four major functions of money in an economy. Why is money considered better than the barter system?
(5Marks)(CO2)(BLT4)
b) If the money supply (M) is ₹4000 crores and the velocity of money (V) is 5, calculate the Nominal GDP using the Quantity Theory of Money (Fisher's Equation). (5Marks)(CO2)(BLT3)
3. a) What is inflation? Explain the social and economic costs of inflation. Also, differentiate between inflation and hyperinflation with examples.
(5Marks)(CO3)(BLT4)
b) The following information relates to the consumption pattern of an average household for six commonly used items:

Commodity	Quantity (base year)	Price (Base Year) (₹)	Price (Current Year) (₹)
Wheat (kg)	20	25	30
Sugar (kg)	40	40	50
Tea (kg)	200	200	250
Electricity(unit)	6	6	8
Cooking oil(litres)	90	90	110
Soap(pieces)	20	20	25

Calculate the Consumer Price Index (CPI) and the percentage increase in the cost living. (5Marks)(CO3)(BLT5)

4. a) Explain the simple Keynesian model of income determination in a closed economy. How does effective demand influence the level of output and employment? (5Marks)(CO4)(BLT4)
- b) In a closed economy, the marginal propensity to consume (MPC) is 0.75. Calculate the value of the multiplier. If government spending increases by ₹200 crores, what will be the total increase in income? (5Marks)(CO4)(BLT5)
5. a) What is inflation? Explain the causes of inflation and discuss its impact on different sections of society such as fixed-income earners, businessmen, and borrowers. (5Marks)(CO3)(BLT2)
- b) If the price index was 200 last year and it rises to 230 this year, calculate the inflation rate. (5Marks)(CO3)(BLT3)
6. a) Explain the IS-LM model for a closed economy. How do the goods market (IS curve) and money market (LM curve) interact to determine equilibrium income and interest rate? (5Marks)(CO4)(BLT6)
- b) In a simple Keynesian model, if the marginal propensity to save (MPS) is 0.2, calculate the value of the multiplier. If government expenditure increases by ₹500 crores, calculate the total increase in income. (5Marks)(CO4)(BLT5)

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Total no. of Pages: 2

Roll no.....

SECOND SEMESTER

Integrated M.Sc. Economics

END TERM EXAMINATION

May-2025

COURSE CODE: IMSHU104

COURSE TITLE: Mathematical Methods for Economics II

Time: 03:00 Hours

Max. Marks: 50

Note : All questions carry equal marks.
Assume suitable missing data, if any.

Q.1. Consider the following non-linear programming problem (NLPP):

$$\text{Maximize cost } C = 5x_1^2 - 80x_1 + x_2^2 - 32x_2$$

$$\text{Subject to } x_1 + x_2 \geq 30,$$

(a) Write the Kuhn-tucker conditions for the above NLPP.

[4][CO1][BTL1]

(b) Using the conditions obtained in part (a), solve the given NLPP.

[6][CO1][BTL2]

Q.2 (a) Prove that any function $x = x(t)$ that satisfies the equation $(t - a)^2 + x^2 = a^2$ is a solution of the following differential equation:

$$2tx \frac{dx}{dt} + t^2 - x^2 = 0$$

[6][CO2][BTL4]

(b) Find the area of region bounded by $y = x^3$, the x-axis and the line $x = 4$ for $x > 0$.

[4][CO2][BTL3]

Q.3. (a) Show that dual of the dual is primal.

(b) Use duality to solve the given problem. Also find the solution of its primal

$$\text{Minimize } Z = 3x_1 + x_2$$

$$\text{Subject to } x_1 + x_2 \geq 1;$$

$$2x_1 + 3x_2 \geq 2$$

$$x_1, x_2 \geq 0$$

[6][CO3][BTL3]

Q.4. The Cobb-Douglas Production function: $50K^{0.3}L^{0.7} = Q$, where Q is a given level of output, K is the amount of capital, and L is the amount of labor. The isoquant associated with this function reflects the levels of capital and labor that yield a constant level of output.

(a) Use the Implicit Function Theorem to derive an equation for the slope of an isoquant associated with this production function.

[4][CO4][BTL3]

(b) When $K = 6$ and $L = 2$, what is the slope of a line tangent to this isoquant? What is the slope of the line when $K = 3$ and $L = 14$?

[4][CO4][BTL1]

(c) The marginal rate of technical substitution (MRTS) is the rate at which the two production inputs can be substituted if output is held constant. Find the MRTS for both examples in part (b).

[2][CO4][BTL1]

Q.5 Let the function g be given by

$$g(x, y) = x^3 + 3xy^2 - 15x^2 - 15y^2 + 72x$$

Determine the stationary points of g and examine the nature of the extreme values.

[10][CO5][BTL5]

Total no. of pages: 2
 2nd SEMESTER
 END SEMESTER
 EXAMINATION

Roll No. _____

I.M.Sc. (ECO)
 MAY 2025

IMSHU - 106 Statistics for Economics II

Time: 180 minutes

Max. Marks: 50

Note: Attempt any Five questions. All are of equal marks. Assume missing data, if any.

1. Explain the following terms. (any five) [2 × 5]
 - a) Simple random sampling [CO.1,2,3]
 - b) Delphi technique BTL2,
 - c) Statistic and Parameter L3,L6]
 - d) Central Limit Theorem
 - e) Null Hypothesis and Alternate Hypothesis
 - f) Type I and Type II errors

2. a) Show that the sample mean is an unbiased estimator of the population mean but sample variance is a biased estimate of the population variance. What is the unbiased estimate of the population variance. [5+5]
 b) Consider a study designed to estimate the mean credit card debt for the population of households. A sample of $n = 70$ households provided the credit card balances with sample mean $\bar{x} = ₹9312$ and the sample standard deviation $s = ₹4007$. Compute an interval estimate of the population mean credit card balance. [CO.2, BTL2, L3,L4]

3. a) During testing in a sample of 300 chips, 10 have been found to be defective. Can the manufacturer's claim that 2% of the chips are defective may be accepted? [5+5]
 b) The daily collection of milk at a plant has averaged 850 kilolitres for the last several years. An observer wants to know whether the average has changed in recent months. He randomly selects 40 days from the database and finds the average collection as $\bar{x} = 840$ kilolitres with S.D. $s = 18$ kilolitres. Test the alternate hypothesis at $\alpha = 0.05$. [CO.3, BTL2, 3,4,5]

4. a) The mean heights in two large samples of 1000 and 2000 men are 67.5 inches and 68.0 inches, respectively. Can the two samples be regarded as drawn from the same population of S.D. 2.5 inches?

[5+5]
[CO.3,4,
BTL3,
[4,5]

- b) Obtain the equation of the line of regression of y on x for the following data. Also estimate y when $x=32$.

x	23	27	28	28	29	30	31	33	35	36
y	18	20	22	27	21	29	27	29	28	29

5. a) Following data give the 11 measurements of the same object on the same instrument.

2.5	2.3	2.4	2.3	2.5	2.7	2.5	2.6	2.6	2.7	2.5
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At 1% level, test the hypothesis that the variance of the instrument is no more than 0.16.

[5+5]
[CO.3,
BTL3,
4,5]

- b) There are two different choices to stimulate a certain chemical process. To test whether the variance of the yield is the same no matter which catalyst is used, a sample of 10 batches is produced using the first catalyst, and of 12 using the second catalyst. If the resulting data is $S_1^2 = 0.14$ and $S_2^2 = 0.28$, test the hypothesis of equal variance at 2% level.

6. a) Explain the method of least squares to obtain the line of best fit.

- b) Find the line of best fit relating y to x for the following data, plot the line and the data points.

x	2	3	4	5	6	7
y	3	5	5.5	6	8	9.5

[5+5]
[CO.4,
BTL1,
2,3]

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Roll no.....

II SEMESTER
BSc-MSc Integrated

END-TERM EXAMINATION

May 2025

COURSE CODE: IMSHU-108

Basics of
COURSE TITLE: Financial Accounting

Time: 3:00 Hours

Max. Marks: 50

Note: Attempt any five questions.
Assume suitable missing data, if any.

Q.1 Why is trial balance prepared? Write its main features & limitations.
[2+4+4=10 Marks] [CO1] [BTL4]

Q.2 Define:

- a) Shareholders' equity
- b) Current liabilities
- c) Current assets

[4+3+3=10 Marks] [CO 4] [BTL4]

Q.3 Define the term depreciation. Why is it important to charge depreciation on the assets of a company? What are its causes? [2+3+5=10 Marks] [CO 3] [BTL4]

Q.4 Briefly define share capital. Also mention various types of share capital.
[10 Marks] [CO 1] [BTL3]

Q.5 Elaborate on the objectives and benefits of doing ratio analysis as a part of analysing a company's financial health. [10 Marks] [CO 5] [BTL4]

Q.6 Define Inventory valuation. Why is it important and what are its various types? [10 Marks] [CO 2] [BTL2]

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Roll No.....

II SEMESTER
Integrated B.Sc.-M.Sc. (Chemistry)

EXAMINATION

May 2025

IMSAC102 INORGANIC CHEMISTRY-2

[Time: 3H]

[Max. Marks: 40]

Instructions: Attempt any 5 questions.

Ques1. A) What are essential and non-essential metal ions in the biological system? Draw the Dose-response curve for essential elements and toxic metal ions in a human body.

B) Why does a minute concentration of vanadate inhibit the operation of the ATPase in sodium-potassium pump? (6+2) [CO1, CO2][L2]

Ques2. Define:

(2 X 4) [CO1, CO2][L1]

A) Bohr's effect

B) Active transport

C) Cooperativity in haemoglobin

D) Metalloenzymes

Ques3. A) Describe the Perutz mechanism of oxygenation of haemoglobin.

B) Explain the role of ferritin in human body. (4+4) [CO3][L4]

Ques4. A) The Heme group in Haemoglobin cannot function as an oxygen carrier in the absence of the globin chain. Explain.

B) Discuss the biological importance of calcium. How is it different from magnesium? (4+4) [CO3][L1,3]

Ques5. A) Draw the oxygenation saturation curves for myoglobin and haemoglobin and justify that myoglobin has greater affinity for oxygen than haemoglobin.

B) How is iron transported in human body? (4+4) [CO4][L2,3]

Ques6. A) Write the name and symptom of disease caused by the toxic effects of Hg and Cd.

B) Write the reasons for the toxicity of Pb(II). How can it be treated? (4+4) [CO4, CO5][L3,4]
