(3 Hours) **[Total Marks: 100]**

N.B. : (1) **All** questions are **compulsory**.

(2) **Figures** to the **right** indicate **full** marks.

(3) Draw **neat** diagrams wherever **necessary**.

(5) Symbols have usual meaning unless otherwise stated.

(5) Use of **non-programmable** calculator is allowed.

Q1. Attempt any **two:---**

(i) What is meant by a sample space? Give its types with suitable examples. **10**
Consider an experiment of tossing two dices and write a uniform sample space showing all possible events. Find the probability of each sample point. Also find probability that sum of the numbers on the dice is 5.

(ii) What is a random variable? Explain what you mean by probability function and cumulative distribution function. **10**

(iii) Explain the terms mean value, standard deviation and variance. **10**
Consider an experiment of tossing 3 coins. Write the sample space for a variable $x = number\ of\ heads$ and find mean, standard deviation and variance.

(iv) What are Bernoulli trials? Explain Binomial distribution. **10**
If n=8 and $p = q = \frac{1}{2}$ find binomial probability function for $x = 2\ and\ x = 4$.

Q2 Attempt any **two:---**

(i) Explain hyperbolic functions of complex numbers. Using the definition of hyperbolic functions find the values of **10**

(a) $\cosh^2 z - \sinh^2 z$

(b) $\frac{d(\cos h\, z)}{dz}$

(ii) An ac source is applied across a resistor, inductor and capacitor in series. Show that to calculate the total impedance of the circuit, it is much simpler if we take current $I = I_0 e^{i\omega t}$ rather than $I = I_0 \sin \omega t$. **10**

(iii) Explain the successive integration method for solving a second order nonhomogeneous equation with constant coefficients. Hence solve the differential equation: **10**

$$y'' + 3y' + 2y = e^{-x}$$

(iv) Solve the two-dimensional Laplace equation using the method of separation of variables. **10**

Q3 Attempt any **two:---**

(i) Define "weight" of a configuration. Explain how one calculates the number of microstates associated with a given configuration with an example of an oscillator. **10**

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(ii) Derive the expression of total energy E and internal energy U for canonical ensemble, **10**

$$E = NkT^2\left(\frac{d\ lnq}{dT}\right), \qquad U = -\left(\frac{\partial \ln Q}{\partial \beta}\right)_V$$

(iii) What is degeneracy? Explain with example how degeneracy influence probability of occupying a given energy level. **10**

(iv) Derive the relation between entropy S and canonical partition function Q, **10**

$$S = \frac{U}{T} + k\ lnQ$$

Q4 Attempt any **two:---**

(i) Derive Maxwell Boltzmann distribution law in terms of α and β, and evaluate $e^{-\alpha}$. **10**

(ii) Consider a large box of area A divided into k cells of area a_1, a_2 , …a_k, N identical balls are thrown in a completely random manner. Show that the most probable no. of balls in any cell is equal to the average density of ball (N/ A) multiplied by the area of cell. **10**

(iii) Apply the Bose-Einstein statistics to photons and obtain Planck's law for black body radiation. **10**

(iv) Derive Bose Einstein's distribution law. **10**

Q5. Attempt any **four:---** **20**

(i) Consider tossing of dice 5 times. Find the probability of getting exactly 3 aces. **05**

(ii) Consider two successive events A and B.Show that probability of the compound event "A and B" is the product of the probability that A will happen times the probability that B will happen if A does. **05**

(iii) Describe the motion of a particle given by $z = 1 + 3\ e^{2it}$. **05**

(iv) Show that $u = cosx\ cosat$ is a solution of the partial differential equation $\frac{\partial^2 u}{\partial t^2} = a^2\frac{\partial^2 u}{\partial x^2}$ **05**

(v) Describe what is meant by the phrase "the dominant configuration". **05**

(vi) Write a note on equipartition theorem. **05**

(vii) Calculate the temperature in which the average speed of hydrogen molecule will be same as the average speed of nitrogen molecule at 27^oC. The molecular weight of nitrogen and hydrogen is 28 and 2 respectively. **05**

(viii) Solar spectrum shows that maximum wavelength is emitted at wavelength 5500 AU. Assuming the sun as a black body, estimate its temperature. (Given Wien's constant = 2.9×10^{-3} meter-K) **05**

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Time: 03 Hours. **Marks: 100**

Please check whether you have got the right question paper.

N.B: 1. All questions are compulsory and carry equal marks.
2. Figures to the right indicate full marks.
3. Draw neat and labelled diagrams wherever necessary.
4. Answer the questions in proper order.

Q. 1 Describe Any Two of the following: **(20)**
a) Scales in fish
b) Salt gland and Ceruminous gland
c) Feathers in birds

Q. 2 Explain Any Two of the following: **(20)**
a) Structure of Pectoral girdle
b) Skull bones
c) Structure and function of hyoid bone.

Q. 3 Give an account on Any Two of the following: **(20)**
a) Brachioradialis muscles and sartorius muscle
b) Tibialis anterior and Soleus muscles
c) Extensor digitorum muscles and Brachialis

Q. 4 Describe Any Two of the following: **(20)**
a) 33 hours of chick embryo.
b) Fate map.
c) Extra embryonic membranes.

Q. 5 Write short notes on: (Any Four) **(20)**
a) Claw
b) Coccyx
c) Femur
d) Flexors muscle.
e) Fertilization.
f) Organizer.

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[Time: 3 Hours] **[Marks: 100]**

Please check whether you have got the right question paper.

N.B: 1. All questions are compulsory and carry equal marks.
2. Figures to the right indicate full marks.
3. Draw neat and labelled diagrams wherever necessary.
4. Answer the questions in proper order.

Q. 1 Describe Any Two of the following: **(20)**
a) Transverse section of tongue
b) Transverse section of large intestine
c) Papillary and reticular layers of dermis

Q. 2 Explain Any Two of the following: **(20)**
a) Margin of safety and exposure.
b) Nephrotoxicity.
c) Nicotine

Q. 3 Give an account on Any Two of the following: **(20)**
a) Free radical mediated cell injury.
b) Types of necrosis.
c) Cloudy swelling

Q. 4 Describe Any Two of the following: **(20)**
a) Probability – multiplication rule
b) Two-tailed Z-test
c) Levels of significance and testing of hypothesis

Q. 5 Write short notes on: (Any Four) **(20)**
a) Skin receptors
b) Therapeutic Index (TI).
c) OECD guidelines for testing of chemicals
d) Z-transformation
e) Dentinal pulp
f) Wet gangrene

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[Time: 03 Hours.] **[Marks: 100]**

Please check whether you have got the right question paper.

N.B: 1. All questions are compulsory and carry equal marks.

2. Figures to the right indicate full marks.

3. Draw neat and labelled diagrams wherever necessary.

4. Answer the questions in proper order.

Q. 1 Describe Any Two of the following: **(20)**

a) Types of Anemia

b) Leucocytes: Types and functions

c) Blood volume regulation

Q. 2 Explain Any Two of the following: **(20)**

a) Introduction and scope of applied immunology

b) Microscopic examination of blood for lymphoma

c) Kidney function tests

Q. 3 Give an account on Any Two of the following: **(20)**

a) Mechanisms of innate immunity

b) Lymph node as secondary lymphoid organ

c) Endocytic pathway of antigen processing

Q. 4 Describe Any Two of the following: **(20)**

a) Characteristics and mechanism of precipitation reaction

b) Direct and indirect ELISA

c) Adjuvants used for human vaccines

Q. 5 Write short notes on: (Any Four) **(20)**

a) Plasma proteins

b) Haemophilia

c) Haptens

d) BCG vaccine

e) Haemoglobin structure

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