Duration:3Hrs

Total Marks:100

N.B.: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Symbols have their usual meanings.
4) Use of non-programmable calculator is allowed.

Q.1 **Attempt any TWO.** 20

1. Let the two dice be thrown. Find a suitable sample space and answer the following:
   i) What is the probability that the product is > 16?
   ii) What is the probability that product is divisible by 3?
   iii) What is the probability that the product is 6?
   iv) What is the probability that the product is odd?
   v) What is the probability that the product is <12?
2. State and explain the probability theorems for two successive events.
3. A bank allows one person to have only one saving account insured to Rs 100,000. However, a larger family may have accounts for everyone, and accounts in the names of any 2 people, any 3 and so on. How many accounts are possible for a family of 2? Of 3? Of 5? Of 6? Of n?
4. In the family of three children, if x denotes the number of boys, Find the probability function $P = f(x)$, and compute the average of x, variance of x and standard deviation of x.

Q.2 **Attempt any TWO.** 20

1. Solve i) $e^{(3ln2-i\pi)}$ ii) $\cos iln5$
2. Prove that i) $\cos iy = \cos hy$ ii) $\frac{d}{dz}\cos hz = \sin hz$
3. Find the value of i) $ln(-1)$ ii) $i^{(3+i)}$
4. Solve the Differential equation: $y'' + y' - 6y = 12e^{-x}$

Q.3 **Attempt any TWO.** 20

1. What is the definition of β ? Explain thermal interaction in terms of β .
2. What is a partition function? How it differs for system of distinguishable and indistinguishable particles.
3. Show that the entropy of canonical ensemble is $\frac{E}{T} + k \ln Q$, where E is energy and Q is partition function.
4. Show that the probability of occupation of n^{th} energy level is given by $P_n = \frac{e^{-\beta\epsilon_n}}{q}$ where q is a partition function.

Q.4 **Attempt any TWO.** **20**

1. Use B-E statistics to derive Planck's law for the black body radiation. Hence obtain Wien's displacement law.
2. Show that the most probable number of balls in any cell is equal to the average density of balls (N/A) multiplied by the area of the cell.
3. State and derive the statistics obeyed by identical and distinguishable particles.
4. State Rayleigh-Jean's formula for black body radiation and hence explain ultraviolet catastrophe?

Q.5 (A) **Attempt any ONE.** **5**

1. What is the probability of getting the sequence$hhhttt$ in six tosses of a coin? If you know the first three are heads, what is the probability that the last three are tails?
2. A card is selected from a shuffled deck. What is the probability that it is either a king or a club? That it is both a king and a club?

(B) **Attempt any ONE.** **5**

1. Simplify and write in polar form: $\frac{1}{1+i}$
2. Express the complex number $e^{i\frac{\pi}{3}}$ into $x + iy$ form.

(C) **Attempt any ONE.** **5**

1. What is the weight associated with the configuration corresponding to observing40 heads after flipping a coin 100 times? How does this weight compare to that of themost probable outcome?
2. What is physical meaning of Boltzmann distribution?

(D) **Attempt any ONE.** **5**

1. Using Fermi-Dirac Distribution law, explain the significance of Fermi energy.
2. A black body emits maximum energy at wavelength 6500A.U. when its temperature is 35°C. Calculate the wavelength at which the body will emit maximum energy, if its temperature is raised to 120°c.

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