12M18094 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Second Semester M.Sc Physics Degree Examination, March 2018

MPHY2B05 – Quantum Mechanics – I

(2017 Admission onwards)

ax. Time: 3 hours Max. Weightage : 36

PART – A
(Answer all questions) - weightage 1

What are linearly independent vectors.

Show that Eigen vectors belonging to different Eigen values of Hermitian operators are orthogonal.

Show that the product of two Hermitian operators is Hermitian if and only if the Hermitian operators commute.

What is a symmetry transformation? Show that, symmetry transformation preserves Hermitian character.

Define differential scattering cross section $\sigma(\theta, \varphi)$ and total scattering cross section.

What are scattering length. How is it related to zero energy cross section.

Show that commutator of two Hermitian operator in Hermitian.

Discuss the Properties of bra and ket vectors.

What is Slater determinant.

Establish a relation between the position and momentum representation of the state vector $|\psi>$

Establish the retain $\mathbf{J} \times \mathbf{J} = i\hbar\mathbf{J}$

The definition of angular momentum is given by $\mathbf{L} = \mathbf{r} \times \mathbf{p}$ in not a general one. Why?

(12 x 1 = 12 weightage)

PART- B
(Answer any two) - Weightage 6

13. Solve the problem of Harmonic oscillator in operator method and find out the Eigen values.
14. Obtain the eigen values and eigen vectors of $\mathbf{J}^2$ and $\mathbf{J}_z$. Also represent matrices corresponding to $\mathbf{J}^2$ and $\mathbf{J}_2$
15. Discuss the theory of partial wave analysis in scattering by a central potential.
16. Discuss discrete and continuous symmetry operations . Show that conservation of angular momentum is a consequence of the rotational invariance of the system.

(2 x 6 = 12 weightage)

PART - C
(Answer any four) - Weightage 3

17. Write down the postulates of Quantum Mechanics
18. Show the effect of time reversal operator in the time dependant Schrödinger's equation.
19. Using Pauli's spin matrix representation reduce each of the operators
    i) S_x^2 S_y S_z^2 ii) S_x^2 S_y^2 S_z^2 iii) S_x S_y S_z^3
20. Consider the elastic scattering of 50 MeV neutrons from a nucleus. The phase shifts measured in this experiment are $\delta_0 = 95^0$, $\delta_1 = 72^0$, $\delta_2 = 60^0$, $\delta_3 = 35^0$, $\delta_4 = 18^0$, $\delta_5 = 5^0$ all other phase shifts are negligible , $\delta_l = 0$ for l greater than or equal to 6, find the total scattering cross section.
21. Show that trace of an operator does not depend on the basis in which it is expressed.
22. Obtain C.G coefficients for $J_1 = 1/2$, $J_2 = 1/2$

(4 x 3 = 12 weightage)

1M2M18095 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Second Semester M.Sc Physics Degree Examination, March 2018

MPHY2B06 – Mathematical Physics – II

(2017 Admission onwards)

Max. Time: 3 hours Max. Weightage : 3

Part A

Answer *all* questions

Each question carries 1 weightage.

1. Explain the singular Point of an analytic function.
2. What you mean by simply connected and multiply connected domain?
3. How will you find the residue at a simple pole ?
4. Prove Lagrange's theorem regarding the order of a group and that of its subgroup.
5. Discuss two Physical application of group theory.
6. Define permutation group and alternating group.
7. Give an account of SU(2) groups.
8. State two properties of delta function.
9. Explain the classes of integral equations.
10. What is Green's function , state its symmetry properties
11. Assuming the Euler's equation for $f(x,y,y_x)$, where $y_x = \frac{dy}{dx}$, evaluate $\frac{df}{dx} - \frac{d}{dx}(f - y_x \frac{\partial f}{\partial y_x})$
12. Outline the Neumann Series solution of Integral equations.

(12×1 = 12 weightage)

Part B

Answer any *two* questions.
Each question carries 6 weightage.

13. State and prove Cauchy Integral Formula
14. Explain and solve a nonhomogeneous integral equation by Hilbert-Schmidt theory usi suitable example.
15. With suitable examples explain reducible and irreducible representation of groups
16. Formulate the Greens function for Sturm-Liouvelle differential operator in one dimensi

(2× 6 = 12 weighta

Part C

Answer any *four* questions.
Each question carries 3 weightage.

17. Find the value of the integral $\int_c \frac{e^z dz}{(z-1)(z+3)^2}$ where C is given by

    (a) $|z|$=3/2 (b) $|z| = 10$

18. Find the residues of $\frac{z^2}{z^2+a^2}$ at Z=ia

19. Obtain the integral equation corresponding to the boundary value problem $y''(x) + \lambda y(x)$ = with y(0) = y(1) = 0.
20. For a vibrating string clamped at both ends $y''(x) + \lambda y(x) = 0$. Find the solution of differential equation using Greens functions.
21. Derive Euler's equation , by applying variational principles.
22. Show that an analytic function with constant modulus is constant.

(4×3= 12 Weightage)

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M2M18096 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Second Semester M.Sc Physics Degree Examination, March 2018

MPHY2B07 – Statistical Mechanics

(2017 Admission onwards)

Max. Time: 3 hours Max. Weightage

Section A
(Answer all questions, each question carries 1 weightage)

1. Find the number of micro states available for 3 protons
2. Derive the Boltzmann relation for entropy
3. Explain intensive and extensive quantities
4. What is Gibbs paradox?
5. What are distinguishable and indistinguishable particles?
6. What are the advantages of grand canonical ensemble formalism over other formalisms
7. Differentiate quantum statistical mechanics from classical statistical mechanics
8. What is a black body? Give a typical black body.
9. Define Fermi energy
10. What is Debye's law for specific heat?
11. What are phonons?
12. Differentiate between para and diamagnetism

(12 × 1 = 12 weightag

Section B
(Answer any two. Each carries 6 weightage)

13. Obtain the thermodynamics of an ideal gas using micro canonical ensemble formalism
14. Using quantum micro canonical formalism obtain the distribution laws for bosons and fermions
15. Explain Bose Einstein condensation and obtain an expression for phase transition
16. Give the theory of Pauli paramagnetism and obtain an expression for susceptibility

(2 × 6 = 12 weightag

Section C

(Answer any four questions. Each carries 3 weightage)

7. Show that pressure exerted by a collection of classical harmonic oscillators is zero

8 Find an expression for chemical potential of an ideal gas with and without resolving Gibbs paradox

9. Using occupation number concept obtain expressions for partition functions of a Bose and a Fermi gas

20 Obtain Planck's distribution law

21 Obtain an expression for the chemical potential of a Bose gas at low temperature

22 Find an expression for adiabatic expansion of photon gas in terms of temperature and volume

(4 × 3 = 12 weightage)

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M2M18097 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Second Semester M.Sc Physics Degree Examination, March 2018

MPHY2B08 – Computational Physics

(2017 Admission onwards)

Max. Time: 3 hours Max. Weightage :

Section A

Answer all questions.

Each question has a weight of 1.

1. Explain different types of operators in Python.
2. What are functions and modules?
3. Compare lists and tuples in Python.
4. List the relevant functions for file operations in Python
5. Discuss any four set methods in Python.
6. List different dictionary methods in Python.
7. Discuss saving and restoring arrays in Python.
8. What are the methods available to solve simultaneous equations using numpy?
9. What are parametric plots? How parametric plots can be created in Python?
10. Write a Python program to plot exponential function.
11. Briefly explain interpolation with unequal intervals.
12. Find the inverse of a function $F(x) = 4x+7$.

(12 × 1 =12 weightage)

Section B

Answer any two questions.
Each question has a weight of 6.

13. Discuss with examples different conditional and looping structures in Python.
14. (a) Explain various functions used in matplotlib for visulalisation in Python
    (b)Write a Python program for plotting Bessel function.
15. With suitable examples explain the shooting and relaxation methods. What are the advantages of relaxation method over shooting method?
16. Discuss the Monte Carlo method to calculate multidimensional integrals. Explain the principle involved in calculating value of π using Monte Carlo method.

(2 × 6=12 weightage)

Section C

Answer any four questions.
Each question has a weight of 3.

17. Develop a program in Python to solve quadratic equation.
18. Write a Python program to print the cross product and dot product of two vectors by entering the coefficients as input.
19. Explain Lagrange's method of interpolation.
20. With necessary theory discuss a Python program to simulate radioactivity using Monte Carlo method and compare with standard theoretical expression.
21. Explain the characteristics of logistic map. Write a Python program to plot bifurcation diagram of logistic map function.
22. Discuss a Python program to simulate standing waves.

(4 × 3 =12 weightage)