54

2M2M19094 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Second Semester M.Sc Physics Degree Examination, March /April 2019

MPHY2B05 – Quantum Mechanics – I

(2018 Admission onwards)

Time: 3 hours Max. Weightage : 36

PART A

(Answer all questions) - weightage 1

1. Define and explain the properties of unitary space.
2. Show that Eigen values of Hermitian operators are real
3. Show that the eigen values of unitary operators unimodular
4. Explain the effect of parity operator on the observables **r , P , L**
5. What is scattering amplitude ? Obtain the relation between scattering amplitude and scattering cross section.
6. What are partial waves ? Explain.
7. Show that $|\psi><\psi|$ is a projection operator only when $|\psi>$ is normalized.
8. Discuss the properties of bra and ket vectors.
9. Discuss the relation between spin of the particles and the statistics obeyed by it.
10. Write the position operator in momentum representation.
11. Establish $J+|jm>=\sqrt{(j-m)(j+m+1)}\,\hbar$
12. What are Clebsch-Gordan coefficients ?. Explain its significance

(12 x 1 = 12 weightage)

PART- B

(Answer any two) - Weightage 6

13. Derive the equations of motion in Schrödinger picture, Heisenberg picture and interaction Picture.
14. Define angular momentum operator. Obtain the commutation relation obeyed by angular momentum operators.
15. Explain Born approximation. Using this obtain Rutherford's scattering formula for scattering by a Coulomb potential.
16. Obtain the relation between symmetry and conservation laws. Show that time reversal operator is an anti-linear operator.

(2 x 6 = 12 weightage)

PART- C
(Answer any four) - Weightage 3

17. Derive the general uncertainty principle.

18. Show that momentum operator is the generator of the infinitesimal translation in space.

19. Obtain the normalized Eigen vectors of σ_x *and* σ_y

21. Prove optical theorem.

22. Discuss the condition for the operator $\frac{1+iA}{1-iA}$ is unitary.

23. Find the angle between angular momentum l = 4 and z axis for all possible orientations.

(4 x 3 = 12 weightage)

2M19095 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Second Semester M.Sc Physics Degree Examination, March /April 2019

MPHY2B06 – Mathematical Physics – II

(2018 Admission onwards)

ne: 3 hours Max. Weightage : 36

SECTION A

Answer all questions

Each question carries a weightage of 1

Check the analyticity of the complex function f(z) = z*, z* being the complex conjugate of z.

Find the residue of $\frac{1}{\sin z}$ at z = 0.

Find the analytic function whose real part is $x^2 - y^2$.

. Prove that every subgroup of a cyclic group is cyclic.

Illustrate isomorphism using an example.

. What are the features of an SU(2) group?

. Explain the classes of integral equations.

. Find the integral equation corresponding to $y''(x) - y(x) = 0$, given $y(0) = 1$ and $y'(0) = -1$.

. Show that the Euler equation leads to $\frac{\partial f_1}{\partial y} - \frac{\partial f_2}{\partial x} = 0$ if the integrand has the form $f(y_x, y, x) = f_1(x, y) + f_2(x, y)y_x$.

0. Explain Rayleigh-Ritz variational technique.

1. What are the advantages of using the Green's function technique for solving boundary value problems?

12. Find the Green's function for $L = -\frac{d^2y(x)}{dx^2}$, given the boundary conditions $y(0) = 0$ and $y'(1) = 0$.

(12 x 1 = 12 weightage)

SECTION B

Answer any two questions

Each question carries a weightage of 6

13. Derive the necessary and sufficient conditions for a complex function to be analytic. Also, show that the real and imaginary parts of an analytic function are harmonic functions.
14. Define conjugate elements and classes of a group. Explain these concepts for the group associated with the symmetry transformations of a square.
15. Explain the concept of variation and hence solve the soap film problem.
16. Explain the Neumann series solution technique of solving integral equations. Hence find the solution of $(x) = x + \int_0^x (t - x)\, \phi(t) dt$.

(2 x 6 = 12 weightage)

SECTION C

Answer any four questions

Each question carries a weightage of 3

17. Find the residues of $f(z) = \frac{ze^{iz}}{z^4+a^4}$ at its poles.
18. Evaluate by the method of residues the integral $\int_0^{2\pi} \frac{d\theta}{a+b\cos\theta}$.
19. Prove that two right cosets of a subgroup of a given group are either equal or have no elements in common.
20. Find the h / r ratio of a right circular cylinder of radius r and height h that will minimize the surface area for a fixed volume by variational method.
21. Solve the equation $\varphi(x) = \lambda \int_0^{2\pi} \cos(x - t)\, \varphi(t) dt$.
22. Determine the solution of the oscillator equation $y''(x) + \lambda y(x) = 0$ with boundary conditions y(0) = y(1) = 0 using Green's function method.

(4 x 3 = 12 weightage)

56

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

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Second Semester M.Sc Physics Degree Examination, March /April 2019

MPHY2B08 – Computational Physics

(2018 Admission onwards)

hours Max. Weightage : 36

Section A

Answer all questions.

Each question has a weight of 1.

. Explain different data types in Python.

. What is meant by operator precedence? Mention different arithmetic operators in Python.

. Discuss file operations in Python.

. Explain the conditional execution in Python.

. Explain how 'infinite looping' is achieved in Python language.

. How matrix inversion is obtained in Python?

. What are the basic arithmetic operations on arrays in Python?

. Explain how to create an array from a regular Python list.

. How do you generate pi chart in Python?

0. What is sampling theorem?

1. Give the principle of Monte Carlo simulation.

2. Explain the characteristics of Logistic map.

(12 × 1 =12 weightage)

Section B

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

13. Discuss with necessary examples. the different methods to implement iteration and looping in Python.
14. Define DFT for a sequence x(n). Explain how to calculate DFT of N sampled points and write a Python program for it.
15. (a) Explain the fourth order Runge-Kutta method for solving differential equations. (b) Develop a program for solving driven LCR circuit problem using Runge-kutta method.
16. (a)Explain the function of MATPLOTLIB visualisation module in Python with suitable examples. (b) Write a Python program for plotting Gamma function.

(2 × 6=12 weightage)

Section C

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

17. With necessary theory, write a Python program for evaluating cos(x) using Taylor series expansion accurate to four decimal places.
18. Define inverse of a function. Find the inverse of f(y)= 2y-8.
19. Write a Python program to simulate the central field motion.
20. Explain the relaxation method to solve differential equations.
21. Write a Python program to calculate value of π using Monte Carlo method.
22. Write a Python program for solving and printing the solution of a set of simultaneous equations of three variables by entering the coefficients as input.

(4 × 3 =12 weightage)

57

2M19096 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Second Semester M.Sc Physics Degree Examination, March /April 2019

MPHY2B07 – Statistical Mechanics

(2018 Admission onwards)

e: 3 hours Max. Weightage : 36

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

Find the number of micro states available for 2 photons

Give examples for intensive and extensive quantities

Explain Gibbs paradox in terms of indistinguishability?

State Virial theorem

Obtain the partition function of a 1 D quantum harmonic oscillator

What is fugacity? What is chemical potential of a photon ?

What are occupation numbers for bosons and fermions

Give 3 examples for bosons and fermions. Hydrogen is a boson- True or false.

What is Stefan- Boltzmann law

What is Bose Einstein condensation

What is Fermi energy?

What is the energy of electrons in a magnetic field?

(12 × 1 = 12 weightage)

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

Obtain the partition function and thermodynamics of an ideal gas using canonical ensemble formalism

Using grand canonical ensemble obtain the equations for internal energy and pressure of a collection of N classical harmonic oscillators.

Give the theory of Pauli paramagnetism and obtain an expression for susceptibility

Derive Planck's distribution law for photons

(2 × 6 = 12 weightage)

Section C

(Answer any four questions. Each carries 3 weightage)

Obtain the phase space trajectory of a stone thrown upwards.

Using occupation number concept obtain expressions for partition function of a Bose and a Fermi gas

Find an expression for Fermi energy of a three dimensional proton gas

Show that at low temperature when fugacity becomes 1 there will a large occupancy in ground state for a Bose gas

Show that an ideal Bose gas will not obey ideal gas equation for pressure

Starting from Helmholtz free energy obtain an expression for entropy of a photon gas

(4 × 3 = 12 weightage)