1M2M17218 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Second Semester M.Sc Physics Degree Examination, March 2017

PHY2C08 – Computational Physics

(2016 Admission onwards)

Max. Time: 3 hours Max. Weightage : 36

Section A

Answer all questions.
Each question has weight of 1.

1. What is a *string*? How it differs from a *tuple*?
2. What do you meant by *matplotlib*?
3. List the *dictionary* methods in Python.
4. Explain the general syntax of a *while* loop in Python.
5. Differentiate the usage of *range()* and *linspace()* showing examples.
6. Write a short note on file input and output pickling.
7. Write a short note on operators in Python programming.
8. What are polar plots? Explain with an example.
9. Discuss how to plot mathematical functions using *matplotlib*.
10. What do you mean by zero of polynomials?
11. Discuss the interpolation with cubic spline and give its merits.
12. Give the principle of Monte Carlo simulation.

(12 x 1 = 12 weightage)

Section B

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

13. Explain with suitable examples the various data types in Python.
14. Explain the numpy module, array creation and its modifications using suitable examples.
15. Give the principle and program for obtaining the current-charge plot in the case of a driven LCR circuit.
16. Define DFT of a sequence *x(n)*. Explain how to calculate DFT of n sampled points and write a program.

(2 x 6 = 12 weightage)

Section C

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

17. Write a program to plot the parametric equation $x = t \sin t^2$, $y = t \cos t^2$
18. Discuss the principle and program to plot Legendre function.
19. Write Python program for evaluating the values of π by Monte- Carlo simulation.
20. Write Python code to solve the following equations using matrices.
    $2x+3y+4z = 8$, $3x+4y+5z = 10$, $4x-5y+6z = 32$.
21. Discretise second order differential equation using Relaxation method and explain the procedure to solve it.
22. Determine the cubic spline for the data points (1,-8), (2,-1), (3,18) satisfying the function y=f(x). Find the approximate value of y(2.5) and y'(2.0).

(4 x 3 = 12 weightage)

2M2M17216 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Second Semester M.Sc Physics Degree Examination, March 2017

PHY2C06 – Mathematical Physics – II

(2016 Admission onwards)

Max. Time: 3 hours Max. Weightage : 36

SECTION A

Answer **all** questions

Each question carries a weightage of 1

1. Check the analyticity of the complex function f(z) = ln z.
2. What do you mean by an essential singularity? Give example.
3. How can you determine the residue at a simple pole and at a pole of order 'm'?
4. Does $\{i, -1, -i, 1\}$ form a cyclic group?
5. State and prove Lagrange theorem of subgroups.
6. What are the features of a continuous group?
7. Integrating twice, deduce the Volterra integral equation corresponding to $y''(x) - y(x) = 0$, given $y(0) = 0$ and $y'(0) = 1$.
8. What do you mean by a separable Kernel? Give an example.
9. Explain the concept of variation.
10. Show that the shortest distance between any two points in a plane is a straight line.
11. Prove that "Green's function is symmetric".
12. Explain how Green's function is used to solve eigenvalue problems.

(12 x 1 = 12 weightage)

SECTION B

Answer any **two** questions

Each question carries a weightage of 6

13. State and prove Cauchy's integral theorem. Also, explain Cauchy's integral formula for an analytic function f(z) and obtain the expression for its derivatives.
14. Define homomorphism. Show that SU(2) and SO(3) groups are homomorphic.
15. Discuss the concept of variation for problems involving constraints. Hence, determine the critical angle at which a particle flies off while sliding on a cylindrical surface.
16. Obtain the one-dimensional Green's function of Sturm Liouville differential equation. Hence list out the properties of a 3-D Green's function.

(2 x 6 = 12 weightage)

SECTION C

Answer any **four** questions

Each question carries a weightage of 3

17. Show that div **F** = 0 and curl **F** = 0 are equivalent to Cauchy-Reimann conditions for an analytic function f(z), given $\mathbf{F} = v\,\hat{\imath} + u\,\hat{\jmath}$.
18. Evaluate by the method of residues the integral $\int_0^\infty \frac{dx}{(x^2+1)(x^2+9)} = \frac{\pi}{24}$.
19. Show that the symmetry transformations of an equilateral triangle constitute a group.
20. Using the Neumann series, solve the equation $(x) = x - \int_0^x (t-x)\,\phi(t)dt$.
21. Discuss Laplace's equation in electrostatics as a variational problem of several independent variables.
22. Find the Green's function for $Ly(x) = \frac{d^2y(x)}{dx^2} + y(x)$ if y(x) is finite for $-\infty < x < \infty$.

(4 x 3 = 12 weightage)

2M2M17215 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Second Semester M.Sc Physics Degree Examination, March 2017

PHY2C05 – Quantum Mechanics – I

(2016 Admission onwards)

Max. Time: 3 hours Max. Weightage : 36

Part A

Answer ALL questions. Each question carries 1 weightage

1. What is Hilbert space? How a state function is represented in Hilbert space?
2. Distinguish between a linear operator and an anti-linear operator. Give examples for both.
3. What is momentum representation? Write down the position operator in momentum representation.
4. Outline bra and ket notation in quantum mechanics.
5. Show that for the linear momentum of a system to be conserved, the system should be free from external forces.
6. What are the commutation relations that define angular momentum operator in quantum mechanics?
7. Discuss the symmetries associated with the different conservation laws in physics.
8. What are identical particles?
9. What is Slater determinant?
10. What is the relation between spin of a particle and statistics obeyed by it?
11. Define scattering cross section and scattering amplitude.
12. What is phase shift? Explain the nature of phase of a wave subjected to attractive and repulsive potentials.

(12 x 1 = 12 Weightage)

Part B

Answer any TWO questions. Each question carries 6 weightage

13. State the fundamental postulates of quantum mechanics, explaining their significance.
14. Derive expressions for the energy levels and eigen functions of a harmonic oscillator using the Schrodinger picture.
15. Starting from the angular momentum commutation relations, determine the eigen values of J and J_z operators.
16. Discuss the scattering of a beam of particles from a spherically symmetric square well potential using the method of partial waves.

(2 x 6 = 12 Weightage)

Part C

Answer any FOUR questions. Each question carries 3 weightage

17. Prove the uncertainty relation for energy and time from position-momentum uncertainty relation.
18. Define a Hermitian operator. Show that the eigenvalues of a Hermitian operator are real.
19. Prove that the conservation of angular momentum of a physical system is a consequence of the rotational invariance of Hamiltonian of the system.
20. Show that J_+ and J_- are ladder operators.
21. Construct the ground state wave function of a pair of electrons. Hence deduce the Pauli's exclusion principle.
22. The differential cross-section in the laboratory frame of reference for a given scattering process is $d\sigma/d\omega = a + b\,\mathrm{Cos}\theta$, where a and b are constants and θ the scattering angle. Calculate the total cross-section.

(4 x 3 = 12 Weightage)

1M2M17217 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Second Semester M.Sc Physics Degree Examination, March 2017

PHY2C07 – Statistical Mechanics

(2016 Admission onwards)

Max. Time: 3 hours Max. Weightage : 36

Section A

(Answer all questions, each question carries 1 weightage)

1. Give the Boltzmann relation for entropy and explain the terms
2. What is phase space?
3. What is partition function?
4. What is Gibbs paradox?
5. State Virial theorem
6. What is density matrix?
7. What is Bose Einstein Condensation?
8. What is a blackbody? Give an example.
9. Define Fermi energy
10. Distinguish between para and diamagnetism?
11. What are phonons?
12. Write the expression for specific heat of a metallic solid and explain the terms

(12 × 1 = 12 weightage)

Section B

(Answer any four questions. Each carries 3 weightage)

13. Obtain an expression for chemical potential of an ideal gas treating the system as indistinguishable
14. Obtain the phase space trajectory of a freely falling particle.
15. 2 particles and 3 energy levels are given. Compute the number of possible states if the particles are distinguishable and indistinguishable.
16. Find an expression for critical temperature of a Bose gas below which BEC occur
17. Show that entropy of photon gas is proportional to T^3
18. If the number density of electrons in a system is 10^{36} electrons/m^3 compute the Fermi energy and Fermi temperature

(4 × 3 = 12 weightage)

Section C

(Answer any two. Each carries 6 weightage)

19. State and prove Liouvillie's theorem

20. Obtain the partition function for a collection of classical, one dimensional harmonic oscillators using canonical ensemble. Hence find pressure, internal energy and chemical potential

21. Show that for large N, micro canonical, canonical and grand canonical ensembles are equivalent.

22. Obtain an expression for the specific heat of a solid at high and low temperatures

(2 × 6 = 12 weightage)