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2B2M21424 (Pages : 2) Reg. No:.....

Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

**Second Semester Integrated M.Sc Geology Degree Examination, March/April 2021**

**BPH2C02 – Optics , Laser, Electronics & Communication**

(2020 Admission onwards)

Time: 2 hours Max. Marks : 60

**Section A**

**Answer all questions. Answer in two or three sentences. Each correct answer carries a maximum of two marks.**

1. What are coherent sources? Give an example.
2. What are Newton's rings? Give two of its uses.
3. State and explain grating law.
4. Distinguish between Fraunhofer and Fresnel's diffraction.
5. What is a half wave plate? What is its use?
6. Draw the intensity distribution curve of the single slit diffraction pattern
7. Obtain the relation between current amplification factors a and b
8. Draw the diagram of exclusive OR gate. Also draw its truth table.
9. What is negative feedback? What is its need?
10. What is stimulated emission?
11. Distinguish between **e** rays and **o** rays.
12. What is specific rotation?

**(Ceiling: 20 Marks)**

## Section B (Paragraph/Problem)

**(Answer all questions in a paragraph of about half a page to one page. Each correct carries a maximum five marks)**

13. What are constructive and destructive interferences? Give the conditions.
14. In Newton's Ring experiment the radius of curvature of the curved side of a plano lens is 100cm. Wavelength of light used is $6x10^{-5}$ cm. What will be the radius of 9$^{t}$ $10^{th}$ bright rings?
15. If the critical angle of glass air boundary is $42^0$, calculate the polarising angle for g
16. What are the conditions for brightness and darkness of normal incidence of light o plane film producing interference?
17. Write a short note on Ruby laser.
18. How will you distinguish between planes, elliptically and circularly polarised light'
19. Explain the working of a transistor oscillator.

**(Ceiling:30M**

## Section C (Essay)

**Answer anyone in about two pages .Each question carries ten marks)**

20. Give the theory of plane diffraction grating and explain how it is used to measure th wavelength of light.

21 Describe the principle and working of a full wave rectifier. Obtain the expressions f efficiency and ripple factor.

**(1x10=10 M**

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Name: .....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

**Second Semester M.Sc Degree Examination, March/April 2021**

**MPH2C05 – Quantum Mechanics – I**

(2020 Admission onwards)

Time: 3 hours Max. Weightage : 30

## Section A

*Answer all questions, each carry weightage 1*

1. Discuss the consequences of sequential Stern-Gerlach experiments.
2. Show that the incompatible observables do not have a complete set of simultaneous eigenkets.
3. Compare between Classical and Quantum Mechanical equation of motions.
4. Establish the commutation relations between angular momentum components and also with square of angular momentum.
5. Give the Schrodinger equation for four different potentials.
6. Give the algebra obeyed by Pauli spin matrices.
7. Show that the wavefunction of a system of identical particles is either totally symmetric or totally antisymmetric.
8. Distinguish between BE statistics and FD statistics.

(Total weightage $8 \times 1 = 8$)

## Section B

*Answer* any two *questions, each carry weightage 5*

9. Describe kets, bras, inner products and operators. Also discuss their algebra.
10. Solve the simple harmonic oscillator problem using the concepts of generating functions.
11. Discuss the orbital angular momentum as rotation generator. Obtain spherical harmonics as rotation matrices.

12. Solve the Schrodinger equation for central potentials and find the energy eigen values of 3-D isotropic harmonic oscillator.

(Total weightage $2 \times 5 = 10$)

## Section C

*Answer* any four *questions, each carry weightage 3*

13. Show that the expectation value of an anti-Hermitian operator is imaginary.

14. Show that the change of basis can be performed by unitary transformation.

15. The Hamiltonian for a 3-D particle is given by $H = \frac{\mathbf{p}^2}{2m} + V(\mathbf{x})$. Show that $[\mathbf{x} \cdot \mathbf{p}, H] = i\hbar\left(\frac{\mathbf{p}^2}{m} - \mathbf{x} \cdot \nabla \mathbf{V}(\mathbf{x})\right)$.

16. For a 1-D simple harmonic oscillator, using the definitions of Dirac's abstract operators, evaluate $\langle m|x|n\rangle$, $\langle m|p|n\rangle$, $\langle m|x^2|n\rangle$ and $\langle m|p^2|n\rangle$

17. Find the eigenvalues and eigenvectors of $\sigma_y = \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix}$ for an electron in the spin state $\begin{pmatrix} \alpha \\ \beta \end{pmatrix}$.

18. For a spin 1 particle, find the spin matrices $S_x, S_y,$ and$S_z$ with order $3 \times 3$.

19. Evaluate the clebsch-gordon coefficients for 2 spin half particles.

(Total weightage $4 \times 3 = 12$)

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

**Second Semester M.Sc Degree Examination, March/April 2021**

**MPH2C06 – Mathematical Physics - II**

(2020 Admission onwards)

Time: 3 hours Max. Weightage : 30

## Section A
**(Answer all questions, each carry weightage 1)**

1. Define analytic function. Check whether or not the function z* is analytic.
2. Find the analytic function if the imaginery part is $e^{-y}\sin x$.
3. Show that a group of order three is always cyclic.
4. Show that the inverse of an element in a group is unique.
5. Apply Euler's equation to find the shortest distance between two points in the Euclidian xy plane.
6. Using the method of variation find the ratio of radius to height of a right-circular cylinder that will minimize its total surface area for a fixed volume.
7. Show that $u(x) = \int G(x,y)f(y)dy$ is a solution to $Lu(x) = f(x)$, where $L$ is a linear operator and $G(x,y)$ is the associated Green's function.
8. Write down the characteristics of the Green's function.

**( 8 x 1 = 8 weightage)**

## Section B
**Answer ANY TWO questions, each carry weightage 5)**

9. Obtain an expression for the derivative of a function $f(z)$ of complex variable z and hence show that if $f(z)$ is analytic, so is its derivatives.
10. What is homomorphism? Show that the group SU(2) is homomorphic to SO(3) group.
11. Find the approximate solution y(x) which satisfies the differential equation with $y'' + (\frac{\pi}{2})^2 = 0$ the boundary conditions $y(0) = 1, y(1) = 0$.
12. Construct the Green's function for the boundary value problem problem $\frac{d^2y}{dx^2} - k^2y = 0, y(\pm\infty) = 0$.

**(2 x 5 =10 weightage)**

## Section C

**Answer ANY FOUR questions, each carry weightage 3)**

13. Show that if function of a complex variable $f(z)$ is analytic so is $f^*(z^*)$.

14. Show that $\int_0^{\pi} \frac{d\theta}{(a+\cos\theta)^2} = \frac{\pi a}{(a^2-1)^{3/2}}$, where $a > 1$.

15. If every element in a group is its inverse, show that the group is abelian.

16. Apply Euler's equation to find the shape of the soap film formed between two coaxial rings of different size.

17. Find the integral equation corresponding to the boundary value problem

    $y''(x) + \lambda y(x) = 0, y(0) = y(1) = 0.$

18. Use Newman series to solve $\phi(x) = 1 - 2\int_0^x t\phi(t)$.

19. Show that the Green function is symmetric about its variables.

**(4 x 3 = 12 weightage**

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

**Second Semester M.Sc Degree Examination, March/April 2021**

**MPH2C07 – Statistical Mechanics**

(2020 Admission onwards)

Time: 3 hours Max. Weightage : 30

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

1. Distinguish between canonical, microcanonical and grand canonical ensembles.
2. Define chemical potential.
3. What is partition function?
4. Bring out the statistical origin of Third law of thermodynamics.
5. State Virial theorem.
6. What is meant by Fermi energy?
7. How is fugacity of a system related to q potential?
8. Why the electrons in a metal do not contribute to its specific heat at room temperature.

**(8x1=8weightage)**

## Section B
**(Answer ANY TWO questions, each carries weightage 5)**

9. Derive Liouville's theorem and explain its consequences.
10. Using grand partition function derive the general form of 'q' potential for M.B, B.E and F.D statistics.
11. Obtain the equation of state of an ideal Fermi gas at 1) High temperature and low density 2)Low temperature and high density.
12. Derive Bose-Einstein distribution law. How would it be used to obtain Plack's formula for black body radiation?

**(2x5=10 weightage)**

## Section C

**( Answer ANY FOUR questions, each carries weightage 3)**

13. Show that the pressure of a non-relativistic gas is $^2/_3$of its energy density.
14. Explain Gibb's paradox. How it is resolved?
15. Show that a system of phonons obeys $T^3$ law at low temperature.
16. Using density matrix in canonical ensemble find the expression for $< \sigma_z >$ for an electron in a magnetic field.
17. Obtain the relation $< H \geq {}^1/_2 \, fkT$ and explain its physical significance.
18. Express the average energy of a quantum harmonic oscillator as a hyperbolic function.
19. Obtain an expression for Chemical potential of a Bose gas at very low temperature

**(4x3=12 weightage)**

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FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Second Semester M.Sc Degree Examination, March/April 2021

**MPH2C08 – Computational Physics**

(2020 Admission onwards)

Time: 3 hours Max. Weightage : 30

## Section A
**(Answer all questions. Each carries one weightage)**

1. Give a single statement in Python for the following operations.
   a) finding average of ten integers stored in a list 'l'.
   b) to reverse a string stored in object 's'.
   c) to print the contents of two float objects 'x' and 'y' correct to three decimal places and their product correct to two decimal places.
   d) to return 'x' in degrees given the value of sin(x).
2. Explain how an array object is created, saved and restored.
3. Explain with suitable examples how polar plots and pie charts are created.
4. Discuss the technique of linear spline interpolation.
5. Write short note on any one numerical technique used for solving differential equations stated as a boundary value problem.
6. Discuss the factors which determines the accuracy and stability of results obtained by implementing numerical techniques using computers.
7. Sketch the following plots describing the motion of ideal and damped simple harmonic oscillator. a) velocity vs time; b) velocity vs displacement.
8. According to logistic map function representing population growth, what happens when control parameter value is between a) 0 and 1; b) 1 and 2; c) 2 and 3.

**( 8 x 1 = 8 weightage)**

## Section B
**(Answer any two questions. Each carries five weightage)**

9. Define gamma function. State the recursive property and Euler's reflection formula. Explain a method for evaluating the function numerically.
10. What is meant by interpolation? Derive Newton's forward difference interpolation formula.
11. Explain with necessary details fourth order Runge-Kutta method.
12. Discuss the numerical solution of a body falling in a viscous medium. Write a Python program to plot the velocity-time graph of the body.

**(2 x 5 = 10 weightage)**

## Section C

**(Answer any four questions. Each carries three weightage)**

13. Write a Python program to sort 'n' numbers in descending order.
14. Find the Fourier series of the function defined by;

    $f(t) = -1$ when $-\pi < t < 0$; $f(t) = 0$ when $t = 0$ and $f(t) = 1$ when $0 < t < \pi$.
15. Evaluate $\int_1^2 \frac{1}{x^2} dx$ using Trapezoidal rule.
16. Calculate the cube root of 30 correct to three decimal places using regula-falsi method.
17. Using Euler's method, find $y(0.5)$, given that $dy/dx = x + y$ and $y(0) = 1$.
18. Derive the Numerov algorithm for the differential equation of the form

    $d^2y/dx^2 + k^2(x).y(x) = 0$.
19. Explain Monte-Carlo algorithm for finding the value of $\pi$. Write a Python program to simulate the logic.

**(4 x 3 = 12 weightage)**