SECTION – C

[3 X 10 = 30]

Answer Any THREE Questions.

16. State and prove Stoke's theorem.

17. Find the characteristic equation of the following matrix and verify the Cayley-Hamilton theorem. $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & -1 & 4 \\ 3 & 1 & 1 \end{bmatrix}$.

18. Obtain Fourier series for the expansion $f(x) = x \sin x$ in the interval $-\pi < x < \pi$. Hence deduce that $\frac{\pi}{2} = \frac{1}{2} + \frac{1}{1 \cdot 3} - \frac{1}{3 \cdot 5} + \dots$.

19. Obtain the series solution of Bessel differential equation
$$x^2 \frac{d^2 y}{dx^2} + x \frac{dy}{dx} + (x^2 - n^2) y = 0.$$

20. Obtain the solution of Laplace's equation in Cartesian coordinates using the method of separation of variables.

SECTION – A

[10 X 1 = 10]

Answer ALL the Questions.

Choose the Correct Answer.

1. If $\vec{V}$ is a solenoidal vector then div V is equal to _____.

   [a] zero [b] Scalar

   [c] vector [d] One

2. The gradient of a scalar function is a _____.

   [a] scalar [b] constant

   [c] vector [d] zero

3. If the vectors α and β are linearly dependent, then one of the vectors is a scalar multiple of the other.

   [a] True [b] False

   [c] Data insufficient [d] None of the above

4. For a square matrix A of order n, the characteristic polynomial is _____.

[a] $A - I$

[b] $A + \lambda I$

[c] $A \times \lambda I$

[d] $A - \lambda I$

5. Fourier integral is a _____ integral.

[a] single

[b] double

[c] triple

[d] definite

6. Fourier series for $f(x)$ converges to _____ at every value of x.

[a] $\frac{1}{2}[f(x^+) + f(x^-)]$

[b] $2[f(x^+) + f(x^-)]$

[c] $\frac{1}{2}[f(x^+) - f(x^-)]$

[d] $2[f(x^+) - f(x^-)]$

7. The Gamma function Γn is given by _____.

[a] $\int_0^\infty e^x \, x^{n-1} dx$

[b] $\int_0^\infty e^{-x} \, x^{n-1} dx$

[c] $\int_0^\infty e^{-x} \, x^{n+1} dx$

[d] $\int_0^\infty e^x \, x^{n+1} dx$

8. $P_n(-x)$ has the value _____.

[a] $P_n(x)$

[b] $-P_n(-x)$

[c] $(-1)^n P_n(x)$

[d] 0

9. $\nabla^2 \phi = \rho$ is _____.

[a] Laplace equation

[b] Poisson's equation

[c] Heat flow equation

[d] Helmholtz equation

10. Consider a non-homogeneous differential equation $Ly(x)=f(x)$; here $f(x)$ is known as _____ function.

[a] Green's

[b] unit

[c] null

[d] Source

SECTION – B

SECTION – B

[5 X 7 = 35]

Answer ALL the Questions.

11. a) Obtain an expression for grad Ψ in spherical polar coordinates.

[OR]

b) Derive an expression for equation of continuity in vector form.

12. a) Show that the following vectors are linearly independent.
(1, 2, -3), (2, 5, 1), (-1, 1, 4).

[OR]

b) Find the eigen values of the matrix $\begin{bmatrix} 3 & 1 & 4 \\ 0 & 2 & 6 \\ 0 & 0 & 5 \end{bmatrix}$.

13. a) Derive the expression for the coefficients a_0, a_n and b_n in Fourier series.

[OR]

b) State and prove the convolution theorem of Fourier transform.

14. a) Derive the relation between Beta and Gamma function.

[OR]

b) Show that $e^{2zx - z^2} = \sum_{n=0}^{\infty} \frac{H_n(x)}{n!} z^n$, where $e^{2zx - z^2}$ is the generating function of Hermite Polynomials.

15. a) Solve the three dimensional heat flow equation $\nabla^2 u = \frac{1}{h^2} \frac{\partial u}{\partial t}$.

[OR]

b) Prove that the symmetry property of green's function.

--3--

SECTION – A

Answer ALL the Questions.

Choose the Correct Answer.

[10 X 1]

1. D'Alembert's principle may be written as
[a] $\sum_{i=1}^{N}(F_i - p_i)\delta r_i = 0$ [b] $\sum_{i=1}^{N}(F_i + p_i)\delta r_i = 0$
[c] $\sum_{i=1}^{N} F_i \delta r_i = 0$ [d] $\sum_{i=1}^{N} p_i \delta r_i = 0$

2. If a coordinate is cyclic then it does not appear in
[a] generalized momentum   [b] Lagrangian
[c] generalized force   [d] Hamiltonian

3. Central force can be represented as
[a] $\vec{F} = f(r)\dfrac{\vec{r}}{r}$ [b] $\vec{F} = f(r)$
[c] $\vec{r} = \dfrac{\vec{r}}{r}$ [d] $\dfrac{1}{r}$

---

b) Explain the section and angle variables.

[OR]

SECTION – C

Answer Any THREE Questions.   [3 X 10 = 30]

16. Derive the Hamiltons equations of motion from variation principle.
17. Deduce Rutherford scattering cross-section.
18. State and prove Lioville's theorem.
19. Obtain the normal modes of linear triatomic molecules.
20. Solve the harmonic oscillator problem using Hamilton-Jacobi method.

1. Rutherford scattering cross-section is proportional to _____.

   [a] charge on the nucleus

   [b] charge on the particle

   [c] mass of the nucleus

   [d] square of the charge on nucleus

2. If $P_i = P_i(p,q,t)$ and $Q_i = Q_i(p,q,t)$ then it is _____.

   [a] Hamilton-Jacobi variable

   [b] action and angle variable

   [c] canonical transformation

   [d] linear transformation

3. The condition for F to be a constant of motion is _____.

   [a] $[F,H] = 0$

   [b] $[F,H] \neq 0$

   [c] $[F,H] = \delta_{ij}$

   [d] $[F,H] = -[F,H]$

4. In symmetric mode of two coupled oscillators both masses have _____.

   [a] different phase

   [b] different frequency

   [c] same displacements

   [d] same amplitude and different phase

5. Relation between wavelength and frequency of a mode is known as _____.

   [a] Vanderwaal's equation

   [b] Schroedinger equation

   [c] dispersion relation

   [d] Planck's equation

9. $\int L\, dt$ is _____.

   [a] Hamilton's characteristic function

   [b] Hamilton's principal function

   [c] Planck's constant

   [d] unitary transformation

-2-

10. In Hamilton-Jacobi theory, new canonical momentum is identified as _____.

   [a] total energy of the oscillator

   [b] kinetic energy of the oscillator

   [c] potential energy of the oscillator

   [d] internal energy of the oscillator

SECTION – B

Answer ALL the Questions.

[5 X 7 = 35]

11. a) Explain the principle of D'Alembert.

   [OR]

   b) Explain the Reuthian procedure.

12. a) Explain the reduction of two body central force problem to the equivalent one body problem.

   [OR]

   b) Explain the inverse square law of force.

13. a) Show that $Q = P$ and $P = -q$ is canonical transformation.

   [OR]

   b) Deduce Poisson's bracket.

14. a) Obtain the secular equation and hence the eigen value equation of small oscillations.

   [OR]

   b) Obtain the kinetic and potential energies of two coupled oscillator in normal coordinates and hence the Lagrangian.

15. a) Explain the physical significance of the Hamilton's characteristic function.

-3-

Reg. No:

G.T.N. ARTS COLLEGE (AUTONOMOUS)

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END SEMESTER EXAMINATION - NOVEMBER 2019

Programme : M. Sc., Physics
Course Code: 18PPHC13
Course Title : Applied Electronics

Date : 18.11.2019
Time: 10.00a.m. to 1.00p.m.
Max Marks :75

SECTION – A

[10 X 1 = 10]

Answer ALL the Questions.

Choose the Correct Answer.

1. The value of V_T for P-channel standard MOSFET is typically _____ volts.

   [a] -4 V   [b] +4 V

   [c] +5 V   [d] -5V

2. The drain current is enhanced by _____ voltage in enhancement type MOS.

   [a] negative source   [b] negative drain

   [c] negative gate   [d] negative ground

3. CMRR= _____.

   [a] A_d/A_c [b] A_c/A_d

   [c] $- A_c/A_d$ [d] $- A_d/A_c$

4. Gain of an inverting op-amp is _____ :

   [a] A_d/A_c [b] A_c/A_d

   [c] $- A_c/A_d$ [d] $- A_d/A_c$

5. Barkhuasen criterion is ___

   [a] $-A\beta = -1$ [b] $(A+\beta) = -1$

   [c] $-A\beta = +1$ [d] $A\beta < 1$

6. $1/(2\pi RC\sqrt{6})$ is the frequency of ___ oscillator.

   [a] phase shift   [b] Wien bridge

   [c] crystal   [d] Colpitts

7. Astable multivibrator is also called as ___.

   [a] sine wave generator   [b] Schmitt trigger

   [c] free running multivibrator   [d] flipflop

8. $R = 1, S = 0$ in RS flip flop is ___ state.

   [a] reset   [b] set

   [c] not allowed   [d] preset

9. Expansion of RAM is ___.

   [a] Read Accept Memory   [b] Random Access Memory

   [c] Random Address Memory   [d] Reverse Access Memory

10. Charge coupled device is a ___ detector.

   [a] photon   [b] proton

   [c] electron   [d] neutron

SECTION – B

Answer ALL the Questions.   [5 X 7 = 35]

11. a) Explain the basic structure of JFET with neat sketch.

                     [OR]

   b) How the FET will act as a voltage variable resistor? List out the applications.

12. a) List the characteristics of operational amplifier and explain it.

                     [OR]

   b) Derive the expression for the input offset voltage of an op-amp.

13. a) Derive the expression for frequency of oscillation for Wein bridge oscillator.

                     [OR]

   b) Use op-amp to explain astable multivibrator.

14. a) Explain the working of JK flip flop with truth table.

                     [OR]

   b) Describe about clocked SR flip flop.

15. a) Discuss about dynamic MOS shift registers.

                     [OR]

   b) Write a short note on RAM.

SECTION – C

Answer ANY THREE Questions.   [3 X 10 = 30]

16. Draw and explain the characteristics of E-MOSFET.

17. Describe the practical methods of measuring the important parameters of op-amp.

18. Explain the following i) FET phase shift oscillator, and ii) transistor phase shift oscillator.

19. Construct a 5-bit synchronous counter for i) series carry, and ii) parallel carry

20. Draw the structure of charge coupled device and explain it.

Reg. No:

SECTION - A

[10 X 1 = 10]

Answer ALL the Questions.

Choose the Correct Answer.

1. The simplest iterative method is _____ method.
   - [a] successive bisection
   - [b] Newton Raphson
   - [c] secant
   - [d] successive approximation

2. _____ method is not guaranteed to converge.
   - [a] Successive bisection
   - [b] Newton Raphson
   - [c] Secant
   - [d] Successive approximation

3. The algorithm for picking the largest element as the pivot and interchanging the equations is called _____ .
   - [a] pivotal condensation
   - [b] iteration
   - [c] approximation
   - [d] illustration

---

14. a) Integrate $5x^3 - 3x^2 + 2x + 1$ from $x = -1$ to $x = 1$ using Simpson's rule with $h = 1$.

    [OR]

    b) Illustrate the Trapezoidal rule.

15. a) Write a C++ program to find the mean value of given set of n numbers.

    [OR]

    b) Write a C++ program to evaluate the definite integral by Simpson's rule.

SECTION - C

[3 X 10 = 30]

Answer Any THREE Questions.

16. Find the roots of the equation $x^2 - 25 = 0$ using Newton-Raphson method.

17. Solve the following equations by Gauss-Seidal procedure. The answer should be correct to 3 significant digits.

$$9x_1 + 2x_2 + 4x_3 = 20$$
$$x_1 + 10x_2 + 4x_3 = 6$$
$$2x_1 - 4x_2 + 10x_3 = -15.$$

18. The population of a city in a census taken once in ten years is given below. Estimate the population in the years 1925, 1975 and 1984.

Year	1921	1931	1941	1951	1961	1971	1981
Population in 1000s	35	42	58	84	120	165	220

19. Solve the differential equation $dy/dx + xy = 0$, $x = 0$, $y(0) = 1$ using Heun's method.

20. Write a C++ program for linear regression.

iterative method is superior to elimination method-due to _____.

[a] $2n^3$ arithmetic operations per iteration

[b] small rounding error

[c] fast convergence of newly calculated value of iterate is stored in temporary

[d] all the above

2. _____ polynomial is a simple to program on a computer.

[a] Lagrange [b] Newton Gregory

[c] Gauss [d] Bessel

6. If $y = a_1 x + a_0$, x is the _____ variable.

[a] dependent [b] measured

[c] independent [d] none

7. _____ formula needs the evaluation of the function at only two points.

[a] Trapezoidal [b] Simpson's

[c] Gauss-Legendre [d] Euler

8. The fundamental method used in obtaining the solution of a differential equation is _____.

[a] interpolation [b] extrapolation

[c] integration [d] exponentiation

9. In C++, only the _____ can have access to the private members and private functions.

[a] data functions [b] inline functions

[c] member functions [d] member variables

--2--

10. A constructor that accepts no parameter is called the _____ constructor.

[a] default [b] parameterized

[c] implicit [d] null

SECTION – B

Answer ALL the Questions. [5 X 7 = 35]

11. a) Write down the algorithm to tabulate a given function $y = f(x)$.

[OR]

b) Compare the various iterative methods in finding the roots of the equation.

12. a) Explain the need for pivoting in triangularization of Gauss elimination procedure.

[OR]

b) Write down the algorithm for i) eliminating x_k from n equations. ii) triangularizing n equations in n unknowns.

13. a) The table of x vs f(x) is given below. Find the value of f(x) at x = 4 using Lagrange Polynomial.

x	1.5	2	3	6
f(x)	-0.25	2	20	

[OR]

b) Fit a straight line for the table of values using normal equations.

Independent variable x	1	2	4	5	6	8	9
Dependent variable y	2	5	7	10	12	15	19

--3--

SECTION – A

[10 X 1 = 10]

Answer ALL the Questions.

Choose the Correct Answer.

1. If 'r' is position vector and 'A' is a constant vector, then the value of curl $(A \times r)$ is _____ .

  [a] 0   [b] A

  [c] 2A   [d] $3(A \times r)$

2. The curl of a vector field is always _____ .

  [a] a scalar   [b] a vector

  [c] a numeric   [d] sometimes a scalar and

                          sometime a vector

3. If A and B are orthogonal matrices, the product AB is _____ .

  [a] symmetric   [b] antisymmetric

  [c] orthogonal –   [d] unitary

---

14. a) Derive Beta function.

   [OR]

  b) Show that $x P'_n = n P_n(x) + (2n-3) P_{n-2}(x) + (2n-7) P_{n-4}(x) + \ldots$

15. a) Solve the differential equation $2x \dfrac{\partial u}{\partial x} - 3y \dfrac{\partial u}{\partial y} = 0.$

   [OR]

  b) Solve, $\dfrac{\partial^2 u}{\partial x^2} + \dfrac{\partial^2 u}{\partial y^2} = 0$, subject to $u(0,y)= u(1,y) = u(x,0)=\sin \dfrac{x\pi x}{l}$

        SECTION – C   [3 X 10 = 30]

       Answer Any THREE Questions.

16. Derive an expression for equation of heat flow in solids.

17. Find that the matrix given by $A = \begin{bmatrix} 1 & 2 & 0 \\ 2 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ satisfies its own Eigen equation and hence find A^{-1}

18. Find the cosine transform of a function of x which is unity for $0 < x < a$ and zero for $x \geq a$. What is the function whose cosine transform is $\sqrt{\dfrac{2}{\pi}} \dfrac{\sin ap}{p}$

19. Show that if m and n are inters, the value of $\int_{-1}^{+1} x P_n \dfrac{dP_m}{dx} dx$ is either 0 (or) $\dfrac{2n}{2n+1}$ (or) $\dfrac{2n}{2n+1}$.

20. Determine the steady state temperature distribution of a thin rectangular plate bounded by the lines x=0, x=1, y=0, y=b assuming that edges x=0, x=1, y=0 are maintained at zero temperature and the edge y=b is maintained at steady state temperature f(x).

4. The eigen values of matrix $\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$ are _____.

   [a] ±1

   [b] 0 and +1

   [c] 0 and +2

   [d] 1 and 2

5. A Fourier series of a function $f(x)$ contains only cosine terms if functions $f(x)$ is _____.

   [a] an odd function of x

   [b] an even function of x

   [c] an exponential function containing real term only

   [d] it is not possible

6. The Fourier sine transform of function $f(x)=e^{-ax}$ is _____.

   [a] $\frac{s}{a^2+s^2}$

   [b] $\frac{a}{a^2+s^2}$

   [c] $\frac{s\sin ax}{\sqrt{a^2+s^2}}$

   [d] $\frac{a\sin ax}{\sqrt{a^2+s^2}}$

7. The value of $P_n(1)$ is _____.

   [a] 0

   [b] 1

   [c] -1

   [d] $(-1)^n$

8. If n is positive integer, then the value of $\sqrt{n}$ is _____.

   [a] $n!$

   [b] $(n-1)!$

   [c] $(n-2)!$

   [d] $\frac{(n-1)!}{2^n}$

9. The Laplace's differential equation is _____.

   [a] $\nabla^2 \emptyset=0$

   [b] $\nabla^2 \emptyset=\rho$

   [c] $\nabla^2 \emptyset=-1$

   [d] $\nabla^2 \emptyset=1$

10. Laplace's equation may be used in the study of _____.

   [a] steady state temperature in a region containing source of heat

   [b] steady state temperature in a region containing no heat source

   [c] variable state temperature in a region with no heat source

   [d] variable state temperature in a region containing heat source.

SECTION – B

Answer ALL the Questions.

[5 X 7 = 35]

11. a) Show that curl $\emptyset=\emptyset$curl $A + (grad\emptyset)\times A$.

   [OR]

   b) If (q_1, q_2, q_3) are general orthogonal coordinate, then show that $\frac{\partial r}{\partial q_i}$ and ∇q_i are reciprocal system of vectors for i=1,2,3.

12. a) Find the eigen values and eigen vectors of $A=\begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$

   [OR]

   b) Check whether the following vectors are linearly dependent or independent: state which set forms a basis for $V_3(R)$?

   i) (1,2,-3), (2,5,1), (-1, 1, 4)

   ii) (1,2,3), (2,3,4), (3,4,5)

13. a) Expand as a Fourier series the function $f(x) = x^2$ in the interval –$\pi < x < \pi$ and hence show that $\frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \dots + = \frac{\pi^2}{12}$

   [OR]

   b) Find the Fourier transform of the Gaussian distribution function $f(x)=Ne^{-\alpha x^2}$ where N and α are constants.

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END SEMESTER EXAMINATION - NOVEMBER 2019

Programme : M. Sc., Physics   Date : 18.11.2019
Course Code: 19PPHC13   Time: 10.00a.m. to 1.00p.m.
Course Title : Analog Electronics   Max. Marks :75

SECTION – A

[10 X 1 = 10]

Answer ALL the Questions.

Choose the Correct Answer.

1. The field effect transistors (FET) are majority carrier operated as _____

   [a] forward bias   [b] reverse bias

   [c] voltage controlled device   [d] current controlled device

2. The Thevenin voltage in the _____

   [a] open circuit voltage   [b] short circuit voltage

   [c] open circuit and short circuit voltage   [d] node voltage

3. The open-loop voltage gain A of the op-amp is _____

   [a] 0   [b] 2

   [c] 1   [d] none

SECTION – C

Answer Any THREE Questions.

[3 X 10 = 30]

16. With neat diagram, explain in detail about field-effect transistor.

17. What is multiplier? Explain the different types of multipliers.

18. Write a note on i) Wein bridge oscillator ii) Colpitts oscillator.

19. Discuss the square wave generator using astable multivibrator.

20. Explain the chemical energy sensors in detail.

4. Which of the following statement is true negative feedback in an amplifier?

[a] Reduces gain

[b] Increase frequency and phase distortion

[c] Reduces bandwidth

[d] Increase noise

5. The Wein bride oscillator requires in to external phase shift of _____.

[a] 0^0 [b] 60^0

[c] 180^0 [d] 90^0

6. The Schmitt trigger is a very important application in the _____.

[a] integrator   [b] differentiator

[c] comparator   [d] adder

7. The condition of Barthausen criterion of oscillation is _____.

[a] $A = \beta$ [b] $A\beta = 1$

[c] $A\beta = 0$ [d] $A\beta = \infty$

8. In a LC oscillator, the frequency of oscillation is _____ L or C.

[a] proportional to square of

[b] directly proportional to

[c] independent of the value of

[d] inversely proportional to square root of

9. How many control lines are present in analog to digital converter in addition to reference voltage?

[a] Three   [b] Two

[c] One   [d] Five

10. The use of capacitive sensor is _____.

[a] time   [b] density

[c] force   [d] delay

SECTION – B   [5 X 7 = 35]

Answer ALL the Questions.

11. a) Write a note on Thevenin's theorem.

[OR]

b) Describe the construction and operation of diode.

12. a) Write and explain the characteristics of an ideal operational amplifier.

[OR]

b) Discuss the Bridge amplifier.

13. a) Write a short note on positive and negative clampers.

[OR]

b) What is the performance characteristics of analog switches.

14. a) What is pulse generator? Explain it.

[OR]

b) Discuss about short circuit protection.

15. a) Discuss the classification of sensor.

[OR]

b) Explain the pressure sensor MPX2010.

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END SEMESTER EXAMINATION - NOVEMBER 2019

SECTION – A

Answer ALL the Questions.

Choose the Correct Answer.

[10 X 1 = 10]

1. One of most common solvent used for crystallization is ___
   [a] water   [b] syrup
   [c] normal saline   [d] sulphuric acid

2. Usually crystals are dried with help of ___
   [a] fan   [b] autoclave
   [c] filter paper   [d] dryer

3. Solvent should dissolve large amount of solute at ___
   [a] cold temperature   [b] room temperature
   [c] melting point   [d] boiling point

4. A ___ is a homogeneous mixture of a solute in a solvent.
   [a] solution   [b] seed
   [c] colloid   [d] nucleus

14. a) List out the advantages of CVD.

[OR]

b) Describe Double Diffusion Method with neat diagram.

15. a) Explain the features of winter fog.

[OR]

b) Explain about the artificial cloud seeding.

SECTION – C

Answer Any THREE Questions.

[3 X 10 = 30]

16. Discuss about models on surface roughness.

17. Explain Electro – Optic properties of KDP family crystals.

18. How will you produce cubic zirconia by skull melting process?

19. Describe various kinds of vapour growth processes.

20. Discuss about the factors affecting ice nucleation.

_____ is the best method to grow the bulk single crystals.

[a] Bridgmann technique   [b] Zone Melting Method
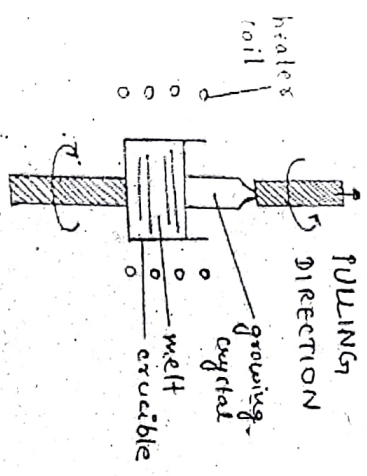
[c] Czochralski Method   [d] Verneuil Method

6. The major practical factors to be considered during the growth of crystals from melt are _____.

[a] volatility   [b] chemical reactivity

[c] melting point   [d] all the above

7. The formula for KDP is _____.

[a] KH_2PO_4 [b] KD_2PO_4

[c] $NH_4H_2PO_4$ [d] $NH_4H_2SO_4$

8. The diagram given below represents which of the given method?

heater coil

PULLING DIRECTION

growing crystal

melt

crucible

[a] Bridgman method   [b] Stockbarger method

[c] Czochralski method   [d] zone melting method

9. Which of the following statements is appropriate for Stockbarger method?

[a] Solidification is achieved by passing the melt through a concentration gradient

[b] Solidification is achieved by passing the melt through a temperature gradient.

[c] Liquefaction is achieved by passing the melt through a concentration gradient.

[d] Liquefaction is achieved by passing the melt through a temperature gradient.

10. In the zone melting method _____ of the charge is melted at any one time.

[a] large part   [b] smart part

[c] solid part   [d] anionic part

SECTION – B

Answer ALL the Questions.   [5 X 7 = 35]

11. a) Derive Gibbs Thomson equation for vapour.

[OR]

b) Classify the types of crystal growth in detail.

12. a) With neat diagram explain Constant Temperature Bath.

[OR]

b) Discuss about solubility of KDP and ADP.

13. a) Describe Bridgeman technique with neat diagram.

[OR]

b) Explain Zone Melting Technique in detail.

Reg. No:

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END SEMESTER EXAMINATION - NOVEMBER 2019

Programme : M. Sc., Physics	Date : 14.11.2019
Course Code: 18PPHC31	Time: 10.00a.m. to 1.00p.m.
Course Title : Solid State Physics - 1	Max. Marks :75

SECTION – A

Answer ALL the Questions.

Choose the Correct Answer.

[10 X 1 = 10]

1. The coordination number of NaCl Crystal is _____.

   [a] 4   [b] 6

   [c] 12   [d] 8

2. X-rays are used for diffraction studies in crystals because _____

   [a] the wavelength of radiation is of the same range as that of interatomic spacing

   [b] X-rays penetrate the crystals

   [c] crystals have atoms/molecule capable of scattering X-rays

   [d] we cannot use visible light

SECTION – C

Answer Any THREE Questions.

[3 X 10 = 30]

16. Discuss about the dimensional lattice types in two and three dimensions.

17. Show that Madelung constant for one dimensional array of ions of alternating sign with a distance between successive ions is equal to 2 ln 2.

18. Illustrate the thermal resistivity of phonon gas with neat diagram.

19. Derive an expression for the Fermi energy of a free electron gas in 3D.

20. Discuss about the Wigner- Seitz method.

Crystals of inert gas atoms are bound by _____

[a] Madelung Constant [b] Bragg condition

[c] Van der Waals interaction. [d] Stiff constants

4. Ionic crystals are bound by the electrostatic attraction of _____ ions of opposite sign.

[a] charged [b] uncharged

[c] neutral [d] discharge

5. In Debye model ω is proportional to _____

[a] K [b] K^2

[c] $K^{1/2}$ [d] 1/K

6. The contribution of the phonons to the heat capacity of a crystal is called _____

[a] C_{latt} [b] C^2_{latt}

[c] D_{latt} [d] D^2_{latt}

7. If Hall coefficient is positive, then the material is called _____ .

[a] insulator [b] p-type semiconductor

[c] n-type semiconductor [d] conductors.

8. At T = 0 K , if E > E_F, then F(E) = _____ .

[a] 0 , [b] ½ .

[c] ¼ [d] 1

9. The scheme in which all bands are drawn in the first brillouin zones is _____ .

[a] extended zone [b] reduced zone

[c] periodic zone [d] aperiodic zone

10. Energy gap between valence band and conduction band is termed as _____ .

[a] finite energy band [b] kinetic energy band

[c] forbidden energy band [d] vibrational energy band

SECTION – B

Answer ALL the Questions.

15 X 7 = 35

11. a) Derive the Bragg conditions in terms of the reciprocal lattice vectors.

[OR]

b) Explain the structure of hcp with neat diagram.

12. a) Discuss briefly about Vander Wall- London interaction.

[OR]

b) Describe about the elastic stiffness constants of cubic crystals.

13. a) Discuss briefly about the Einstein model for density of states.

[OR]

b) What is phonon? Explain about phonon momentum in detail.

14. a) State and explain Hall effect.

[OR]

b) Deduce a mathematical expression for electrical conductivity of a material and obtain Widemann Franz law.

15. a) Derive the equation of motion of an electron in an energy band

[OR]

b) What is fermi surface? How will you construct the Fermi surface of copper? .

G.T.N. ARTS COLLEGE (AUTONOMOUS)

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(Accredited by NAAC with 'B' Grade)

END SEMESTER EXAMINATION - NOVEMBER 2019

Programme : M.Sc., Physics

Course Code: 18PPHC32

Course Title : Quantum Mechanics - I

Date : 16.11.2019

Time: 10.00a.m. to 1.00p.m.

Max. Marks :75

SECTION – A

Answer ALL the Questions.

Choose the Correct Answer.

[10 X 1 = 10]

1. Matter waves are also-called as _____.

    [a] De-Broglie waves

    [b] stationary waves

    [c] progressive waves

    [d] plane waves

2. Uncertainty principle was given by _____.

    [a] $\Delta x \, \Delta Px = h$

    [b] $\Delta x \, \Delta Px \geq E$

    [c] $\Delta x \, \Delta Px \geq h$

    [d] $\Delta x. \Delta Px = 1$

3. If $A^* = A$, then A is called as _____.

    [a] linear

    [b] Hermitian

    [c] unitary

    [d] adjoint

4. Dirac bra rotation is represented by the symbol _____

    [a] 1>

    [b] <1

    [c] unitary

    [d] =>

5. Momentum operator for a particle is given by _____.

[a] $i\hbar\nabla$

[b] $-i\hbar\nabla$

[c] $\frac{i}{\hbar}\frac{\partial}{\partial t}$

[d] $i\hbar\frac{\partial}{\partial t}$

6. In the equation of motion $E_n\psi_n = \hat{H}\psi_n$, H is called as _____.

[a] Hamiltonian

[b] Hermitian

[c] Hilbert constant

[d] Heisenberg

7. The total angular momentum is denoted by the letter _____.

[a] ω

[b] J

[c] H

[d] R

8. Commutation rules for the angular momentum is given by _____.

[a] $[H, J] = 0$

[b] $[H, J^2] = \overline{0}$

[c] $[J^2, J_z] = 0$

[d] $[H, J^2] \neq 0$

9. Splitting of lines with electron spins is given by _____.

[a] Stark effect

[b] Zeeman effect

[c] First order effect

[d] second order effect

10. The first order effect of a time dependent perturbation leads to the _____.

[a] emission of energy

[b] absorption of energy

[c] emission and absorption of energy

[d] radiation of energy

SECTION – B [5 X 7 = 35]

Answer ALL the Questions.

11. a) Explain how a wave function can be normalized? Give the physical interpretation of it.

[OR]

b) Derive the time-dependent Schrödinger equation.

12. a) Explain the types of matrices with examples.

[OR]

b) Give the matrix theory of harmonic oscillator.

13. a) Explain the linear and Hermitian operators.

[OR]

b) State the postulates of quantum mechanics.

14. a) Obtain the Clebsch-Gorden coefficients for angular momenta.

[OR]

b) Explain the construction procedure for $j_1 = 1/2$ and $j_2 = 1/2$.

15. a) Explain the evaluation of first order energy.

[OR]

b) Explain how the variation method is applied for the ground state of Helium atom.

SECTION – C [3 X 10 = 30]

Answer Any THREE Questions.

16. Solve the one-dimensional potential using Schrödinger's equation.

17. Give the Schrodinger picture for the equation of motion.

18. Explain about eigen functions and eigen values.

19. Explain how the eigen value of the total angular momentum is obtained.

20. What is perturbation? Give the stationary perturbation for non-degenerate case.

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Reg. No:

G.T.N. ARTS COLLEGE (AUTONOMOUS)

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END SEMESTER EXAMINATION - NOVEMBER 2019

Programme : M. Sc., Physics

Course Code: 18PPHC33

Course Title : Molecular Spectroscopy

Date : 19.11.2019

Time: 10.00a.m to 1.00p.m.

Max. Marks :75

SECTION – A

Answer ALL the Questions.

Choose the Correct Answer.

[10 × 1 = 10]

1. The number of independent operations in a group is called the _____ of the group.

   [a] order   [b] symmetry

   [c] identity   [d] multiplication

2. A molecule has no symmetry element present in following group _____

   [a] C_{nh} [b] C_s

   [c] C_i [d] C_1

3. In spherical tops, all the principal moments of inertia of a molecule are

   [a] non-zero   [b] distinct

   [c] equal   [d] inequal

---

15. a) State and explain the Frank-Condon principle.

[OR]

b) How would you understand the vibrational coarse structure?

SECTION – C

Answer Any THREE Questions.

[3 X 10 = 30]

16. Give the matrix representation of symmetry operations.

17. Enumerate the allowed rotational energies of a diatomic molecule.

18. Explain the basic components of IR spectrometer with neat schematic diagram.

19. Discuss the concept of polarizability of molecule.

20. Describe the vibrational analysis of band system.

4. Which of the following one show a rotational spectrum?

[a] CO_2

[b] HF

[c] CS_2

[d] H_2

5. The vibrational stretching frequencies of diatomic molecule depends on

_____

[a] magnetic field

[b] atomic population

[c] temperature

[d] force constant

6. Since the nuclei in a polyatomic molecule do not always vibrate in a simple harmonic manner, which of the following situation arises there?

[a] Harmonicity

[b] Anharmonicity

[c] Fundamental frequency

[d] Infrared

7. The transition zone for Raman spectra is _____.

[a] between vibrational and rotational levels

[b] between electronic levels

[c] between magnetic levels of nuclei

[d] between magnetic levels of unpaired electrons

8. In vibrational Raman spectra, $\Delta J = +2$ transitions are associated with _____

[a] P-branches

[b] Q- branches

[c] R- branches

[d] S -branches

9. The band head occurs in the P-branch with negative p values, if _____.

[a] $B' > B''$

[b] $B' < B''$

[c] $B' \geq B''$

[d] $B' \leq B''$

10. The resolving power of photo electron spectrometer decreases as the line width of the source

[a] decreases

[b] increase

[c] equal

[d] zero

11. a) Write a note on symmetry elements.

[OR]

b) Outline the Mulliken's nomenclature for the symmetry species of point groups.

12. a) Explain the allowed energy levels and rotational spectrum of symmetric top molecule.

[OR]

b) Demonstrate the microwave spectrometer with the help of a neat diagram.

13. a) The normal modes of vibration of CO_2 molecule are $\bar{v}_1 = 1330$ cm^{-1}, $\bar{v}_2 = 667$ cm^{-1}, $\bar{v}_3 = 2349$ cm^{-1}. Evaluate the zero point energy of CO_2 molecule.

[OR]

b) Explain the formation of hydrogen bond.

14. a) Give an account of polarization of Raman scattered light.

[OR]

b) How will you determine the structure of XY_2 type molecule?

--3--

[c] Residue function