UNIVERSITY OF THE PUNJAB

First Semester 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Elementary Mechanics | **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-101/11326/11003 | **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

SECTION II

Q.1: WRITE THE ANSWERS OF THE FOLLOWING QUESTIONS **(2 x 10 = 20)**

i Prove that curl of gradient of scalar function is always zero.

ii Define pseudo forces .Give two examples.

iii In conical pendulum, what happens to the period and speed when $\theta = 0^{\circ}$

iv Find the center of mass of uniform rod.

v Define Conservative & Non-conservative forces.

vi Calculate the velocity of solid sphere at the bottom of inclined plane.

vii Define rotational inertia.

viii Define perfect inelastic collision.

ix State Gauss 's divergence theorem.

x State Kepler's law of area.

SECTION III

Q3:

(a) Define divergence of vector field. Give its physical significance. Prove that

$$\text{div}\,\vec{A} = \nabla . \vec{A}$$ (1+1+4 ,4)

(b) A100 kg object is initially moving in straight line with a speed 51.3 m/s .If it is brought to rest with a deceleration of 1.97 m/s^2, what force is required, what distance does the object travel and how much work is done by the force.

Q4:

(a)Calculate rotational inertia of a solid sphere about its diameter. (6 ,4)

(b) A solid cylinder of mass M and radius R rolls without slipping down on an inclined plane of length L and height h. Find the speed of its center of mass when the cylinder reach the bottom.

Q5:

(a) Prove that a spherical symmetric body attracts particles outside it as if its mass were concentrated at its center . (5,2,3)

(b) Prove Generalized Work- Energy theorem.

(c) A thin strip of material is bent into the shape of a semicircle of radius R. Calculate its center of mass .

UNIVERSITY OF THE PUNJAB

Roll No. .....

First Semester 2017

Examination: B.S. 4 Years Programme

PAPER: Elementary Mechanics **TIME ALLOWED: 30 mins.**

Course Code: PHY-101/11326/11003 **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

SECTION I

Tick the correct statement.

1. Gives the relation between line integral and surface integral

(a) Gauss's divergence theorem. (b) Stock's theorem.

(c) Torricelli's theorem. (d) None of these.

2. The divergence of curl of a vector is always equal to

(a) Absolutely One. (b) Zero

(c) Non-Zero. (d) None of these.

3. A stone is thrown upward which rises to a height of 100 m .The relative velocity of stone with respect to earth will be maximum at

(a) Height of 60. (b) The ground

(c) The highest point. (d) None of these.

4. In the tug of war team A is slowly being defeated by team B . Net work is being done by

(a) Team A. (b) Team B.

(c) Both a & b. (d) None of these.

5. The ratio of gravitational mass to inertial mass is

(a) 2 : 1 (b) 1 : 2

(c) 1 : 1 (d) None of these.

6. Where does a body weigh maximum

(a) At poles. (b) At moon.

(c) At equator. (d) None of these.

7. The gravitational effect of which of following causes tidal waves in the sea

(a) Moon. (b) Sun.

(c) Earth. (d) All of the these.

8. The moment of linear momentum is called

(a) Angular momentum. (b) Impulse.

(c) Torq. (d) All of the these.

9. Center of mass of uniform rod of length L lies at

(a) L / 2. (b) L / 4.

(c) 3 L / 2. (d) 2 L / 3.

10. The Solar system is an example of

(a) Conservation of energy. (b) Conservation of angular momentum.

(c) Conservation of linear momentum. (d) None of these.

UNIVERSITY OF THE PUNJAB

First Semester 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Elementary Mechanics | **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-101/11326/11003 | **MAX. MARKS: 50**

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UNIVERSITY OF THE PUNJAB

Roll No. .....

First Semester 2017

Examination: B.S. 4 Years Programme

PAPER: Waves, Oscillations and Optics **TIME ALLOWED: 30 mins.**

Course Code: PHY-102 **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

SECTION-I

Question No. 1 Choose the right answer:

i. In Spring mass system the acceleration of attached mass is zero at
   a) Mean position
   b) Extreme position
   c) Mid-way between the mean position and extreme position

ii. Relation between linear frequency and angular frequency can be written as
   a) $\omega = \frac{f}{2\pi}$
   b) $\omega = 2\pi f$
   c) $\omega = \frac{2\pi}{f}$

iii. The angular displacement of torsional oscillator is $\theta = \theta_m \cos(\omega t + \varphi)$. Its angular acceleration is
   a) $\omega^2 \theta$
   b) $-\omega^2 \theta$
   c) $\frac{\omega 2}{\theta}$

iv. The relation between rotational inertia and time period of a physical pendulum is
   a) $I = \frac{4\pi^2 d T^2}{Mg}$
   b) $I = \frac{Mgd T^2}{4\pi^2}$
   c) $I = \frac{Mg4\pi^2}{dT^2}$

v. Circular motion can be regarded as combination of two simple harmonic motions which are at right-angle to each other having identical amplitudes and frequencies, but differing in phase by
   a) Zero
   b) 45^0
   c) 90^0

vi. Wave equation of travelling wave can be written as
   a) $\frac{\partial^2 y}{\partial t^2} = v^2 \frac{\partial^2 y}{\partial x^2}$
   b) $\frac{\partial^2 y}{\partial x^2} = \frac{1}{V^2} \frac{\partial^2 y}{\partial t^2}$
   c) $\frac{\partial^2 x}{\partial y^2} = v^2 \frac{\partial^2 y}{\partial x^2}$

vii. Group velocity of a wave packet can be mathematically written as
   a) $V_g = \frac{dk}{d\omega}$
   b) $V_g = \frac{d\omega}{dk}$
   c) $V_g = d\omega.dk$

viii. The maximum intensity of light corresponding to constructive interference is
   a) $4I_0$
   b) $\frac{I_0}{4}$
   c) I_0

ix. The central spot of Newton rings is
   a) Bright
   b) Dark
   c) None of the above

x. Michelson and Morley experiment shows that
   a) Ether does not exist in space
   b) Speed of light in fee space is not constant
   c) Ether is present everywhere in space

UNIVERSITY OF THE PUNJAB

First Semester 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Waves, Oscillations and Optics **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-102 **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

SECTION-II

Question No.2 **(2× 10)**

Write short answers of the following questions

I. What are the conditions for a spring block system to execute simple harmonic motion?
II. Show by diagram the motion of two waves which have same frequency, same amplitude but differs in phase by 90°.
III. Prove that the time period of periodic motion is $\frac{2\pi}{\omega}$.
IV. The angular velocity of a torsional oscillator is $\omega = \pm\sqrt{\frac{k}{I}}\sqrt{\theta_m^2 - \theta^2}$. What is its maximum value?
V. Give conditions which are necessary to produce standing waves.
VI. Show how the apparent frequency of sound increases when listener moves towards a stationary source.
VII. Write two properties of hypothetical medium called ether.
VIII. Derive the relation between path difference and phase difference.
IX. Write down the difference between polarized and un-polarized light.
X. Why an ordinary optical diffraction grating can't be used to study diffraction of x-rays.

SECTION-III

Question No. 3 **(6+4)**

(a) What is "Damped harmonic oscillator"? Derive the equation of motion of a damped harmonic oscillator and determine its solution.

(b) A block of mass 250 g is attached to a spring of stiffness 85 N/m. The block oscillates in a resistive medium b = 0.07 kg/s. After what time the mechanical energy of this oscillator drops to one half of its initial value.

Question No. 4 **(6+4)**

(a) Derive wave equation. Calculate the energy and average power flow in a medium due to wave motion.

(b) Determine the speed of a transverse wave in a cord of length 2.0 m and mass 90 g under a tension of 450 N.

Question No.5 **(5+5)**

(a) Define resolving power. Prove that resolving power of grating spectroscope increases with increase in number of order.

(b) A grating has 45,000 rulings spread over 80 mm.

I. What is its expected dispersion D in degree / nm for sodium light (λ= 589 nm) in first order.
II. What is its resolving power in first order.

UNIVERSITY OF THE PUNJAB

Roll No. .....

First Semester 2017

Examination: B.S. 4 Years Programme

PAPER: Physics-I (Mechanics & Optics) **TIME ALLOWED: 30 mins.**

Course Code: PHY-111 /11307 **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

Q.1 Encircle the correct option **(10x1)**

1. Vector is a tensor of rank
   a) Zero b) one c) two d) three

2. Two bodies of masses m and 2m have same momentum. Their respective kinetic energies k_1 and k_2 are in the
   a) 2:1 b) 1:2 c) $1:\sqrt{2}$ d) 1:4

3. With the increase of distance from the surface of earth, the gravitational potential energy
   a) increases b) decreases c) remains constant d) varies sinusoidal

4. The reference frames where Newton's laws can be applied are called _____ frames.
   a) inertial b) non-accelerated c) non-inertial d) both a & b

5. Moment of inertia is the rotational analogue of
   a) force b) velocity c) mass d) momentum

6. A stone of mass *m* is moving in a circle of radius *r* with constant speed *v*. The work done by the force over half of the circle is
   a) $\frac{mv^2}{r} \times \pi r$ b) $\frac{mv^2}{r} \times 2\pi r$ c) $mg \times 2\pi r$ d) zero

7. A ball of mass collides with a wall with speed *v* and rebounds on the same line with the same speed. If the mass of the wall is taken as infinite, then the work done by the ball on the wall is
   a) mv^2 b) $\frac{1}{2}mv^2$ c) $2mv$ d) zero

8. The kinetic energy of a close system is always
   a) negative b) constant c) positive d) zero

9. A stationary particle is exploded into two parts of masses m_1 and m_2 which moves in opposite direction with velocities v_1 and v_2 respectively. The ratio of their kinetic energies is E_1/E_2
   a) m_2/m_1 b) m_1/m_2 c) 1 d) m_1v_2/m_2v_1

10. The resultant of two vectors of magnitudes 3 units and 4 units is $\sqrt{37}$. The angle between two vectors is
    a) 0° b) 30° c) 60° d) 90°

UNIVERSITY OF THE PUNJAB

First Semester 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Physics-I (Mechanics & Optics) **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-111 /11307 **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

Q.2 Write short answers to the following questions (10x2)

1. What is meant by curl of a vector?
2. If $\varphi = 3x^2y^4z^3$ then find grad φ.
3. What are the limitations of Newton's laws?
4. What do you mean by rotational kinetic energy?
5. At what angle of projection the range and height of a projectile becomes equal?
6. What is the relation between pressure and speed of a flowing fluid?
7. What is gravitational force between two bodies each of mass 1 kg and separated by a unit distance?
8. What are uses of diffraction grating?
9. Differentiate the terms phase difference and path difference.
10. Define holography.

(Essay-type questions)

Q. 3 a) Define divergence of a vector field. State and prove the Gauss's divergence theorem. **(6)**

b) A block is at rest on an inclined plane making an angle θ with horizontal. As angle of inclination is increased by raising its one end, it is found that slipping just started at an angle of 15°. What is the coefficient of static friction between the block and inclined plane? **(4)**

Q. 4 a) State parallel axis theorem. Using parallel axis theorem, find the rotational inertia of a solid rod of length L and mass M, about an axis which is perpendicular its length and passes through one of its end. **(6)**

b) State and give mathematical proof of work energy theorem. **(4)**

Q. 5 a) Describe Young's double slit experiment. Derive relations for the position of bright fringes and dark fringes and the fringe width. **(6)**

b) A double slit experiment is performed with blue green light of wavelength 512 nm. The slits are 1.2 mm apart and screen is 5.4 m from the slits. How far apart are the bright fringes as seen on the screen? **(4)**

UNIVERSITY OF THE PUNJAB

First Semester 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Mechanics and Wave Motion (IT) **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-121 / IT-11393 **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

Section-II (Subjective Type) (10 × 2 = 20)

Question no. 2: Write short answers of the following questions.

(i) Explain center of mass of system of particles.
(ii) Define torque and explain with the help of examples.
(iii) Define unit vector and position vector.
(iv) Define work and also prove the work-energy theorem.
(v) State the law of conservation of linear momentum.
(vi) A block slides without friction down a fixed, inclined plane. The angle of the incline is $\theta = 30^{\circ}$ from horizontal. What is the acceleration of the block?
(vii) Explain the acceleration of an object moving in a circle at constant speed.
(viii) Determine the gravitational potential energy of a system.
(ix) Explain the characteristics of transverse and longitudinal waves.
(x) Define and briefly explain damped harmonic motion.

Question No. 3: (6+4)

(a) State and prove work energy theorem.

(b) Two vectors are given by $\mathbf{A} = 4\,\mathbf{i} + 3\,\mathbf{j}$ and $\mathbf{B} = 6\,\mathbf{i} - 8\,\mathbf{j}$. Find the magnitudes and directions (with the +x-axis) of **A**, **B**, and **A** + **B**.

Question No. 4: (6+4)

(a) Calculate the Gravitation Potential Energy for many particle system.

(b) Calculate the energy possessed by a stone of mass 10kg kept at a height of 5m if 196×10^2 J of energy were used to raise a 40kg boy above the ground, how high would he be raised?

Question No. 5: (6+4)

(a) Describe the variation of energy in simple harmonic motion and find the total energy. Also show that speed is maximum at equilibrium position with the help of equation.

(b) What should be the length of a simple pendulum whose period is 1.0 second at a place where g is $9.8 m/s^2$. What is the frequency of such pendulum?

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Roll No. .....

First Semester 2017

Examination: B.S. 4 Years Programme

PAPER: Mechanics and Wave Motion (IT) **TIME ALLOWED: 30 mins.**

Course Code: PHY-121 / IT-11393 **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

Section – I (Objective Type)

Question no. 1: Choose the correct answer from the given options. Overwriting, cutting and erasing are not allowed.

1. A car stops and then starts accelerating uniformly at rate of 3 m/s^2. speed of car after 20 seconds is
   (a) 40 m/s (b) 60 m/s
   (c) 100 m/s (d) none

2. Projectile Motion is a
   (a) One dimensional motion (b) Two dimensional motion
   (c) Three dimensional motion (d) Linear motion

3. Which is scalar quantity?
   (a) Displacement. (b) Speed.
   (c) Velocity. (d) Acceleration.

4. $\vec{F} \times \vec{r}$ gives us
   (a) Torque (b) Negative of Torque
   (c) Tangential Acceleration (d) Angular Acceleration

5. A car travels a distance of 15 km with a constant force of 500 N, its work done is
   (a) 7500000 J (b) 30 J
   (c) 15500 J (d) 14500 J

6. Energy cannot be
   (a) converted or transferred (b) destroyed or transferred
   (c) created or transferred (d) created or destroyed

7. Point through which its whole weight appears to act for any orientation of object is termed as
   (a) mid-point of gravity (c) center of gravity
   (b) stable equilibrium (d) neutral equilibrium

8. During simple harmonic motion of mass-spring when block is at equilibrium position, its
   (a) P.E is Maximum (b) K.E is Maximum
   (c) P.E and K.E are equal (d) P.E and K.E both are zero

9. The time period "T" of physical pendulum is given
   (a) $2\pi\sqrt{k/I}$ (b) $2\pi\sqrt{I/k}$
   (c) $\frac{1}{2\pi}\sqrt{k/I}$ (d) $\frac{1}{2\pi}\sqrt{I/k}$

10. In a simple pendulum
    (a) The form of energy changes at every point
    (b) The total energy remains conserved
    (c) Its energy at mean position is equal to at extreme position
    (d) All of these

UNIVERSITY OF THE PUNJAB

Roll No. .....

Second Semester - 2017
Examination: B.S. 4 Years Programme

PAPER: Electricity & Magnetism | **TIME ALLOWED: 30 mins.**
Course Code: PHY-103 / PHY-12328 | **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

Section- I (Objective Type)

Q. 1. Each question has four possible answers, select the correct answer and encircle it.

Overwriting, cutting, erasing or use of lead pencil will carry zero credit. (1x10=10)

(i) A point charge –Q is at the center of a spherical conducting shell of inner radius R_1 and outer radius R_2. The charge on the inner surface of the shell is
(a) +Q
(b) Zero
(c) -Q
(d) Dependent on the total charge carried by the shell

(ii) The product of magnitude of charge and separation between them is called
(a) Charge moment
(b) Charge momentum
(c) Dipole moment
(d) Dipole momentum

(iii) The potential energy of a dipole at any position θ is given as $U(\theta) = -\vec{P}.\vec{E}$. Its potential energy will be maximum when angle between $\vec{P}$ & $\vec{E}$ is
(a) Zero
(b) 180
(c) 270
(d) None of the above

(iv) A point charge is placed at the center of a spherical Gaussian surface. If the surface is replaced by another sphere of one tenth of the volume, the flux through the surface will
(a) Decrease
(b) Increase
(c) Remain unchanged
(d) None of the above

(v) Electric potential is a scalar quantity. Its gradient is
(a) scalar quantity
(b) vector quantity
(c) Non existant
(d) None of the above

(vi) A parallel plate capacitor is connected across a source of voltage such that a potential difference V appears across its plates. If the potential difference between the plates is doubled, then its capacitance will be
(a) One half of its initial capacitance
(b) Double of its initial capacitance
(c) Unchanged
(d) None of the above

(vii) A charge q is projected into a magnetic field of strength **B** with certain velocity **V**, at an angle θ. If no force is experienced by the charge, the value of θ will be
(a) 0^0 (b) 45^0 (c) 90^0 (d) 120^0

(viii) The force **F** acting on a charge q moving in a magnetic field **B** with uniform velocity **V** is given as $\mathbf{F} = q(\mathbf{V} \times \mathbf{B})$. Which pair is at right angle to each other
(a) (q, **F**) (b) (q , **B**) (c) (**F** , **V**) (d) None of these

(ix) Current is passing through a straight conductor. The type of magnetic field produced around it is
(a) Elliptic (b) Circular (c) Straight line (d) None of these

(x) Permittivity of free space (ε_0) and permeability of free space (μ_0) are related with some constant (C) in free space as
(a) $C = \sqrt{\frac{\varepsilon_0}{\mu_0}}$ (b) $C = \sqrt{\frac{\mu_0}{\varepsilon_0}}$ (c) $C = \sqrt{\varepsilon_0 X \mu_0}$ (d) $C = \frac{1}{\sqrt{\varepsilon_0 X \mu_0}}$

UNIVERSITY OF THE PUNJAB

Second Semester - 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Electricity & Magnetism **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-103 / PHY-12328 **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

Section- II (subjective Type)

Note: Attempt all questions

Q.2. Write short answers of the following: **(2x10 = 20)**

i. An electrical dipole of dipole moment **p** is placed in a uniform electric field E. Write an expression for its potential energy. For what orientation its potential energy will be maximum.
ii. A spherical body of radius R has a surface charge density σ. What will be the total charge enclosed by the sphere.
iii. Two conductors carry similar and same amount of charge. What is potential difference between them?
iv. The value of E at a given point is zero. What will be the value of V at that point?
v. How will the capacitance of parallel plate capacitor change if the free space between its plates is replaced by a dielectric medium.
vi. A potential difference V is applied across a conducting wire of length L and diameter d, what will be effect on the drift velocity of electrons if the length of the wire is doubled.
vii. A charge is lying stationary at a certain point. Can it be set into motion if a magnetic field is applied on it. If not why?
viii. Why anti parallel current repels each other?
ix. Write integral form of Faraday's law of electromagnetic induction.
x. Why ferromagnetic materials become paramagnetic at Curie temperature?

Q.3. (a) State Gauss's law. Derives both integral and differential forms of Gauss's law. Also deduce Coulombs law from Gauss's law.

(b) Distance between two protons in the nucleus of an atom is 6.0 fm. Calculate the magnitude of potential energy associated with the electric force that acts between these protons. **(6+4)**

Q.4. (a) Explain Lorentz force. Show how the concept of this force was used to determine e/m of an electron.

(b) An electron is moving in a uniform magnetic field (B) with velocity $v = (40\hat{i} + 30\hat{j})$ km/s. If the electron experience a magnetic force $F = (-4.2\hat{i} + 4.8\hat{j})$ f N where $B_x = 0$, Calculate the magnetic field. **(6+4)**

Q.5. Write the note on the following **(5+5)**

1. Magnetic field due to current through a long straight wire using Biot-Sawart Law.
2. Magnetic materials.

UNIVERSITY OF THE PUNJAB

Roll No. .....

Second Semester - 2017

Examination: B.S. 4 Years Programme

PAPER: Thermodynamics and Kinetic Theory **TIME ALLOWED: 30 mins.**

Course Code: PHY-104, PHY-12329 **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

Section – I (Objective Type)

Question no: 1 (1 X 10 = 10)

Multiple choice questions are given. Attempt every question and try to choose out more precise answer (or near to the given answers). Please write your answer separately if you think another possible approach to answer the asked MCQs. Each contains only one mark and maximum time of 1 minute. Please encircle the correct option.

1.	Absolute zero (Zero degree kelvin) is impossible	
	a) Theoretically b) Experimentally	c) Practically d) All of these
2.	The sum of energy lost and gained in any process must equal to	
	a) Maximum. b) Minimum.	c) Any value. d) Zero.
3.	A heat engine is capable of changing	
	a) Thermal energy. b) Mechanical energy.	c) Vibrational energy. d) Rotational energy.
4.	In closed system ..... may not enter or leave.	
	a) Mass. b) Velocity.	c) Pressure. d) None of these.
5.	Heat added to an open system is taken to be	
	a) +ve b) -ve	c) Zero. d) Anyone.
6.	If P/T is constant then process will be	
	a) Isochoric b) Isobaric	c) Adiabatic d) Isothermal
7.	Given that n and P are constant than V/T will be	
	a) Continuous b) Constant	c) Variable d) Zero.
8.	The change in internal energy of a closed system is due to heat.....	
	a) Added b) Leave	c) Transfer d) Information is not complete.
9.	The entropy of the system decreases if heat..... to a system	
	a) Added b) Leave	c) Transfer d) Information is not complete.
10.	Entropy can also be defined by	
	a) Uncertainty principle. b) Theory of everything.	c) Fermi Dirac statistics. d) All of these.

UNIVERSITY OF THE PUNJAB

Second Semester - 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Thermodynamics and Kinetic Theory **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-104, PHY-12329 **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

Section –II (Subjective Type)

Question no: 1 **(5 X 4 = 20)**

Write short answers to the given questions:

a. State and relate three well-known definitions of second law of thermodynamics?
b. Can you warm the kitchen in winter by leaving the oven door open? Can you cool the kitchen on a hot summer day by leaving the refrigerator door open?
c. A Carnot engine takes in 3000 calories of input heat and rejects 2000 calories as waste heat. The temperature of the waste heat is $600^{o}C$. Determine the (a) efficiency of the heat engine and (b) useful work done by the engine?
d. 100 coins are placed head up in a box. After the box is shaken vigorously, only 50 coins are found to be heads up. Determine the change in entropy of the system?
e. Define the following:
   i. Thermal Isolation.
   ii. Seebeck Effect.
   iii. Thermistor.
   iv. Thermocouple.
   v. Phase Space.

Section-III

Question no: 1 **(10)**

Taking the ideal gas as system, find the value of work done:

(i) In Thermal Equilibrium.
(ii) In Adiabatic Expansion.

Question no: 2 **(7)**

State and derive the Maxwell-Boltzmann energy distribution function.

Question no: 3 **(13)**

Define Entropy in thermodynamics? What do you know about entropy in statistical physics? Calculate the dimensions of entropy in statistical physics? Also prove the "*additive property of entropy*" and "*entropy is exact differential*"? Justify the statement that entropy in a natural system is always increasing?

UNIVERSITY OF THE PUNJAB

Roll No. .....

Second Semester - 2017

Examination: B.S. 4 Years Programme

PAPER: Physics-II (Waves & Oscillation) **TIME ALLOWED: 30 mins.**

Course Code: PHY-113 / PHY-12307 **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

Section- I (Objective Type)

Q. 1. Each question has four possible answers, select the correct answer and encircle it.

Overwriting, cutting, erasing or use of lead pencil will carry zero credit. (1x10=10)

(i) In the case of mass spring system executing simple harmonic motion if x and x_m denote the instantaneous and maximum displacements of the mass from mean position then maximum energy of mass will be

(a) $\frac{1}{2}kx^2$ (b) $\frac{1}{2}kx_0^2$ (c) $kx_0^2 + kx^2$ (d) None of these

(ii) Two simple harmonic motion which are at right angle to each other having identical amplitudes and frequencies but differing in phase by 90^0 are combined together. Their resultant motion is

(a) Circle (b) Ellipse (c) Parabola (d) None of these

(iii) The relation between wavelength (λ) and wave number (k) is given as

(a) $K=\frac{2\pi}{\lambda}$ (b) $k=\frac{1}{2\pi}\lambda$ (c) $k= 2\pi\lambda$ (d) None of these

(iv) A source of sound is moving away from an stationary observer. The wavelength of sound will appear to

(a) Increase (b) decrease (c) Remain constant (d) None of these

(v) The molecules of an ideal gas

(a) Exert force on each other (b) Do not exert force on each other

(c) Do not have kinetic energy (d) Have potential energy

(vi) An ideal gas equation can be written as

(a) $\frac{V}{N}$ = Constant (b) $\frac{V}{T}$ = Constant

(c) $\frac{PV}{nT}$ = Constant (d) Pv = Constant

(vii) Work is done on an ideal gas such that its volume changes from an initial value V_i to a final value V_f. Work done will be – ve if

(a) $V_f < V_i$ (b) $V_f > V_i$ (c) $V_f = V_i$ (d) None of these

(viii) An adiabatic process is one in which no heat

(a) Can enter but can leave the system (b) Can enter but can't leave the system

(c) Can enter or leave the system (d) None of these

(ix) A gas is compressed adiabatically. Its temperature will

(a) Increase (b) decrease (c) remain constan(d) none of these

(x) Real gases can be liquefied because

(a) They have no space between their molecules

(b) They have space between their molecules

(c) They are incompressible

(d) None of these

UNIVERSITY OF THE PUNJAB

Second Semester - 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Physics-II (Waves & Oscillation) **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-113 / PHY-12307 **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

Section- II (subjective Type)

Note: Attempt all questions

Q.2. Write short answer of the following **(2x10=20)**

i. Why the frequency of second pendulum is 0.5 Hz.
ii. A wave passes from one medium to another such that its speed of propagation changes. If equality of frequencies holds, find the relation between speeds and wavelengths in both mediums.
iii. What will be the effect on amplitude and intensity of resultant of two waves which are travelling in the same direction but out of phase by 180^0?
iv. When a body is said to be in the state of thermal equilibrium.
v. What are the macroscopic parameters of thermodynamics? Give examples.
vi. Under what condition Vander Waals equation of state reduces to an ideal gas equation.
vii. State zeroth law of thermodynamics.
viii. Establish a relation between Celsius and Fahrenheit scales.
ix. Write three properties of ideal gas.
x. Why pressure force is non conservative.

Q.3. (a) What is damped harmonic motion? Find its equation and derive its solution. Also calculate the amplitude and frequency of damped harmonic oscillator.

(b) Prove that the mean life time of damped oscillations depends upon mass of block and properties of resistive medium.

(7+3)

Q.4. (a) Derive an expression for work done on an ideal gas during isothermal process.

(b) A certain gas has a volume of 1130 cm^3 and pressure of 101 K Pa at 42 ^{0}c.The gas is then allowed to expand until its volume is 1530 cm^3 and its pressure is 106 K Pa. Find

(i) the number of molecules of gas in the system (ii) its final temperature

(6+4)

Q.5. (a) Define entropy. Explain entropy change in reversible process and irreversible process. How entropy and second law of thermodynamics are related to each other

(b) A small block of ice melts reversibly to water such that its temperature remains at 0^0c throughout the process. If the mass of the ice is 235 g, find the change in entropy for ice. The heat of fusion of ice is 333 KJ/ Kg.

(7+3)

UNIVERSITY OF THE PUNJAB

Roll No. .....

Second Semester - 2017
Examination: B.S. 4 Years Programme

PAPER: Electricity & Magnetism (IT) **TIME ALLOWED: 30 mins.**
Course Code: PHY-122 / IT-12399 **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

SECTION I
Objective Part

Question no.1: Choose the best option. **(10×1=10)**

1) What is the name of the following statement: "When two systems are in thermal equilibrium with a third system, then they are in thermal equilibrium with each other"?

(a) First Law of Thermodynamics (b) Second Law of Thermodynamics
(c) Third Law of Thermodynamics (d) None of these.

2) Which of the following is a characteristic of an adiabatic process?

a) $\Delta U = 0$ b) $Q = 0$ c) $W = 0$ d) none of these.

3) A sample of ideal gas has an internal energy U and is then compressed to one-half of its original volume while the temperature stays the same. What is the new internal energy of the ideal gas in terms of U?

a) U b) 1/2U c) 2U d) 4U e) none of these

4) The Third Law of Thermodynamics refers to a state known as "absolute zero." This is the bottom point on the _____ temperature scale.

a) Celsius b) Kelvin c) Fahrenheit d) none of these

5) The temperature of an ideal gas increases from 20 ℃ to 40 ℃ while the pressure stays the same. What happens to the volume of the gas?

a) It doubles b) It quadruples c) one-half d) none of these

6) An electric bulb draws a current of 0.35 A for 20 minutes. Calculate the amount of electric charge that flows through the circuit.

a) 420C b) 70C c) 25C d) none of these

7) If a current carrying conductor is placed in uniform magnetic field parallel to direction of field then force experienced by conductor will be

a) $ILBCos45^{o}$ b) ILB c) Zero d) none of these

8) What is true about the field lines of all electric, magnetic, and gravitational fields? They

a) form loops b) radiate from charges or masses
c) show the path that a particle will follow d) never cross

9) A magnetic field that is uniform can be found

a) around a current carrying wire b) around a current carrying loop
c) outside a current carrying solenoid d) inside a current carrying solenoid

10) When a charged particle is fired into a uniform magnetic field at an angle of 90, it moves

a) along a circular path b) along a straight path
c) along a parabolic path d) along a spiral path

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Second Semester - 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Electricity & Magnetism (IT) | **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-122 / IT-12399 | **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

SECTION II
Subjective Part

Question no.2: Write short answers of the following questions. **(10×2=20)**

1. State and briefly explain the first law of thermodynamics.
2. What is heat capacity? Differentiate between C_p and C_v.
3. An ideal heat engine operates between two temperatures 600 K and 900 K. What is the efficiency of the engine?
4. What is internal energy of an ideal gas? Explain briefly.
5. What is an electric dipole? Sketch the electric field around an electric dipole.
6. A parallel-plate air capacitor of capacitance of 100 pF has a charge of magnitude 0.1 μC on each plate. The plates are 0.5 mm apart. What is the potential difference between the plates?
7. A point charge of $+3.12 \times 10^{-6}$ C is 12.3 cm distant from a second point charge of -1.48×10^{-6} C. Calculate the magnitude of the force on each charge.
8. What is Lorentz Force? Find the expression of velocity of the moving particle at which the Lorentz force on particle is equal to zero and particle moves straight in the region of uniform electric and magnetic fields.
9. What is magnetism and electromagnetism? Explain briefly.
10. State Lenz's law of electromagnetic induction.

Question no.3: **(5+5+5=15)**

a) State Coulomb's law. Sketch torsion balance and explain how it was used to find the electrostatic forces between charged particles. Also write its vector form.

b) Find the capacitance of parallel plate capacitor in terms of area of plate 'A' and separation between plates 'd' where electric field due to infinite sheet of charges is $\sigma/2\varepsilon_o$.

c) Consider a point charge $q_1 = +2.2\mu C$ at the origin and a second point charge $q_2 = +1.2\mu C$ at a distance L along x axis, where L=15cm. At what point P along the x axis is the electric field zero?

Question no.4: **(8+7=15)**

a) Find the magnetic field due to a current carrying wire and a solenoid by using Ampere's Law.

b) Two parallel wires are 10.0 cm apart, and each carries a current of 10.0 A. If the currents are in the same direction, find the force per unit length exerted by one of the wires on the other. Are the wires attracted or repelled? Repeat the problem with the currents in opposite directions.

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Roll No. .....

Third Semester 2017

Examination: B.S. 4 Years Programme

PAPER: Concepts of Modern Physics **TIME ALLOWED: 30 mins.**

Course Code: PHY-201/21330 **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

OBJECTIVE PART

Q.1 Encircle the correct answer from given multiple choices in each part. **(1 x 10)**

A) The radiation emitted by hot body depends on

i) Temperature ii) Material of black body iii) Shape and surface

iv) All above

B) Which one of the following particles, all having the same kinetic energy, has the shortest wavelength?

i) Neutron ii) Electron iii) Proton iv) Alpha particle

C) Ballmer series of lines of hydrogen lies in the electromagnetic spectrum is in

i) Infrared region ii) Ultraviolet region

iii) Visible region iv) X-ray region

D) X-ray are produced through

i) Bremsstrahlung processes ii) K-shell emission processes

iii) Radioactive decay iv) Both Bremsstrahlung and K-shell emission

E) In the black body radiations when temperature increases

i) The wavelength of maximum spectral radiancy shift towards upper side

ii) The wavelength of maximum spectral radiancy remains same

iii) The wavelength of maximum spectral radiancy shift towards lower side

iv) None of above

F) The kinetic energy of photoelectrons depends on the

i) Angle of incident light ii) Intensity of incident light

iii) Both intensity and angle of incident light iv) Frequency of incident light

G) What is minimum possible energy of electron when trapped in infinite potential well of width L.

i) 0 ii) between 0 and $h^2/8mL^2$ iii) $h^2/8mL^2$ iv) None of above

H) In beta decay nucleon number is

i) Decreases by 1 ii) Increases by 1

iii) Increases by 2 iv) Remains unchanged

I) The force which hold the nucleons together inside the nucleus is

i) Long range Gravitational force ii) Coulomb force of attraction

iii) Short rang strong force iv) Short range weak forces

J) To make silicon to N type semiconductor you might add to it

i) Indium ii) Aluminum iii) Arsenic iv) Boron

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Third Semester 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Concepts of Modern Physics **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-201/21330 **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

SUBJECTIVE PART

Note: Attempt all questions of this section. **(2 x 10 = 20)**

Q. 2 Give the short answer of each question.

i. Briefly comment on energy-time uncertainty relationship.

ii. Describe de Broglie hypothesis.

iii. Write the Bohr Postulates to explain the hydrogen spectrum.

iv. Explain shortly, the difference between continuous and characteristic X ray spectrum.

v. What is difference between spontaneous emission and stimulated emission?

vi. Briefly mention four characteristics of Laser light.

vii. What is difference between donor and accepter impurities

viii. What is nuclear reaction? Give the difference between exothermic and endothermic reaction.

ix. Why ^{235}U is , while others isotopes are not.

x. Define controlled thermonuclear fusion. List the three problems in controlled thermo nuclear reaction.

Q.3 (a) Explain major features of photo electric effect that cannot be explained in terms of classical wave theory of light. **(5)**

(b) Explain photoelectric effect by using the Einstein photoelectric equation. **(5)**

Q.4 (a) When an electron is trapped inside an infinitely deep potential well, show that

(i) Energy of electron is quantized **(5)**

(ii) Electron spends more time in certain parts of the well than other. **(2)**

(b) Consider an electron is confined by electrical forces to an infinite deep potential well whose length is 100 pm, which is roughly one atomic diameter. What is the energy of its lowest allowed state? **(3)**

Q.5 (a) Show that radioactive decay obeys exponential Law. Deduce relation between half life and disintegration constant. **(5, 2)**

(b) Find the energy released during the alpha decay of ^{238}U. The needed atomic masses are ^{238}U= 238.050785, ^{4}He = 4.002603 u. ^{234}Th = 234.043593 u. **(3)**

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Roll No. .....

Third Semester 2017

Examination: B.S. 4 Years Programme

PAPER: Physics-III (Electricity & Magnetism) **TIME ALLOWED: 30 mins.**

Course Code: PHY-211/21307 **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

Section –I (Objective Type) (1×10 = 10)

Q.1. Each question has four possible answers, select the correct answer and encircle it. Overwriting, cutting, erasing or use of lead pencil will carry zero credit.

(i) The correct relationship between induced charge on dielectric surface and the free charge q is

(a) $q = q'(1 - 1/k_e)$ (b) $q' = k_e q$

(c) $q' = q(1 - 1/k_e)$ (d) $q' = k_e / q$

(ii) A conductor of resistivity ρ has current density $\vec{J}$. If $\vec{E}$ is the electric field intensity applied inside then its value is equal to

(a) $\frac{\rho}{\vec{J}}$ (b) $\frac{\rho}{\varepsilon_\circ}$ (c) $\frac{\vec{J}}{\rho}$ (d) $\rho \vec{J}$

(iii) A moving charge will produce

(a) electric field (b) magnetic field (c) both (a)and(b) (d) none as above

(iv) The vector form of Biot-Savart's law for a current carrying element is

(a) $d\vec{B} = \frac{\mu_0}{4\pi} \frac{idl \sin\phi}{r^2}$ (b) $d\vec{B} = \frac{\mu_0}{4\pi} \frac{i d\vec{l} \times \hat{r}}{r^2}$

(c) $d\vec{B} = \frac{\mu_0}{4\pi} \frac{i d\vec{l} \times \hat{r}}{r^3}$ (d) $d\vec{B} = \frac{\mu_0}{4\pi} \frac{i d\vec{l} \times \vec{r}}{r^2}$

(v) The unit of $\sqrt{LC}$ is

(a) Henry (b) Farad (c) Ampere (d) Second

(vi) The temperature at which a ferromagnetic material becomes paramagnetic is

(a) Absolute temperature (b) Curie temperature

(c) Adiabatic temperature (d) Neutral temperature

(vii) Which type of substance has the largest atomic dipole moments?

(a) Paramagnetic (b) diamagnetic (c) ferromagnetic (d) all three types are same

(viii) In an electromagnetic wave the average energy density associated with magnetic field will be

(a) $\frac{1}{2} LI^2$ (b) $\frac{B^2}{2\mu_0}$ (c) $\frac{1}{2} \mu_0 B^2$ (d) $\frac{\mu_0}{2B^2}$

(ix) For an electromagnetic wave the direction of the vector $\vec{E} \times \vec{B}$ gives:

(a) the direction of the electric field (b) the direction of the magnetic field

(c) the direction of wave propagation (d) the direction of the emf induced by the wave

(x) The process of conversion of AC to DC is known as

(a) oscillation (b) amplification (c) power dissipation (d) rectification

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Third Semester 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Physics-III (Electricity & Magnetism) **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-211/21307 **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

SECTION – II (Subjective Part)

Note: Attempt all Questions

Q.2. Write short answers of the following questions: **(2×10 = 20)**

i. Why can an isolated atom not have a permanent electric dipole moment
ii. Show that, $1 Volt = \frac{1 weber}{\sec ond}$.
iii. State Gauss' law and give its integral form.
iv. What is meant by the term Bohr magneton?
v. Briefly explain the difference between diamagnetic and ferromagnetic materials.
vi. What is the effect of dielectric on the capacitance of a capacitor?
vii. What is the origin of atomic magnetization?
viii. Is there any way to set up a magnetic field other than by causing charge to move?
ix. What do you mean by Barrier Potential in a PN junction diode?
x. Write down mathematical forms of Maxwell's equations.

Q.3: (a) Consider the case of a dipole in a uniform electric field and derive expressions for
(i) Torque acting on it, and it's
(ii) Potential energy U
(b) Describe briefly the process of calculating the value of electric field from the electric potential. **(6, 4)**

Q.4: (a) Consider a parallel plate capacitor filled with a material of dielectric constant K_e. Apply Gauss' law on it to show that, $\varepsilon_\circ \oint K_e \vec{E} \bullet d\vec{A} = q$
(b) A rectangular loop of wire of width D and resistance R is dragged to the right at a constant velocity v inside a uniform external magnetic field B that is directed perpendicularly into the plane of the loop. Prove that the rate at which mechanical work will be done on the loop is $P = \frac{B^2 D^2 v^2}{R}$ **(5, 5)**

Q.5: (a) Derive an expression for magnetic force on a current-carrying wire.
(b) Describe in details the energy transport of electromagnetic waves in terms of Poynting vector $\vec{S}$.

(5, 5)

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Roll No. .....

Fourth Semester - 2017
Examination: B.S. 4 Years Programme

PAPER: Basic Electronics | **TIME ALLOWED: 30 mins.**
Course Code: PHY-203 / PHY-22331 | **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only. Max. Marks: 10

Q.1 Select the correct answer and encircle it.

Note:- Overwriting, Cutting, Erasing or use of lead pencil is not allowed and will carry zero credit.

1) The depletion region of a junction is formed
   a) During the manufacturing process
   b) When forward bias is applied to it
   c) under reverse bias
   d) when its temperature is reduced

2) When a diode is forward biased and the bias voltage is increased, the forward current will
   a) Increase
   b) Decrease
   c) not change
   d) Same

3) When forward biased a diode
   a) Block current
   b) Conducts current
   c) Has a high resistance
   d) Drop a large voltage

4) Ideally a diode can be represented by a
   a) Voltage source
   b) Resistance
   c) Switch
   d) all of these

5) If one of the diodes in a bridge rectifier is open, the output is
   a) 0V
   b) One fourth the amplitude of the input voltage
   c) A half wave rectified voltage
   d) A 120 Hz voltage

6) If you are checking a 60 Hz full-wave bridge rectifier and observe that the output has a 60 Hz ripple
   a) The circuit is working properly
   b) There is an open diode
   c) the transformer secondary is shorted
   d) the filter capacitor is leaky

7) The emitter current is always
   a) Greater than the base current
   b) Less than the collector current
   c) greater than the collector current
   d) answer a & c

8) In a transistor amplifier, if the base emitter junction is open, the collector voltage is
   a) Vcc
   b) 0V
   c) floating
   d) 0.2V

9) A JFET is always operates with
   a) The gate to source pn junction reverse biased
   b) The gate to source pn junction forward biased
   c) The drain connected to ground
   d) The gate connected to source

10) In a self biased JFET , the gate is at
   a) A positive voltage
   b) A negative voltage
   c) 0V
   d) ground

UNIVERSITY OF THE PUNJAB

Fourth Semester - 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Basic Electronics | **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-203 / PHY-22331 | **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

Q.2 Write short answer of the following questions. (2×10=20)

I. What do you mean by clipping circuits?

II. What do you mean by positive clamping circuits?

III. What are the Bias conditions to operate the transistor?

IV. Describe the conditions that produce cutoff and saturation in transistor?

V. Draw the circuit diagram of (CE) as emitter follower?

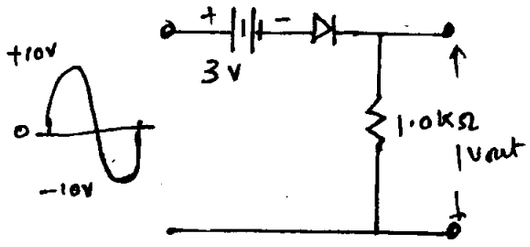
VI. Draw the circuit diagram of full wave bridge rectifier and show the current path?

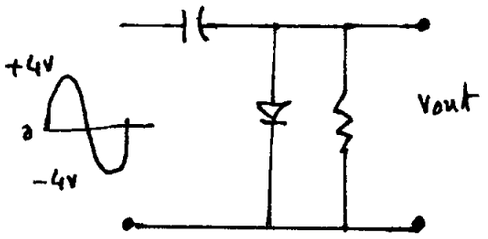
VII. What is the relation between the β and α?

VIII. What is peak reverse voltage (PRV)?

IX. Draw the circuit of voltage Tripler and show where the voltage be obtained?

X. Draw the out- put of the given circuits?





Q.3 a) How a Bridge Rectifier can operate, what are its advantages on a Full-wave Rectifier? 6

b) What is a Limiter circuit? What are its categories, where we use it, explain with examples? 4

Q.4 a)Briefly explain the working of Four resister common emitter amplifier and find its bias stabilization ratio? 7

b) Determine the β_{DC} for a transistor where I_B =50μA and I_C = 3.65mA. 3

Q.5 a) Draw and explain the function of JFET n-channel as Self- Bias circuit? 6

b) Determine the value of Rs(Source resister) required to a self bias P- channel JFET with I_{DSS} =25 mA and $V_{GS(off)}$= 15V and V_{GS} to be 5V. 4

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Roll No. .....

Fourth Semester - 2017
Examination: B.S. 4 Years Programme

PAPER: Physics-IV (Concepts of Modern Physics) **TIME ALLOWED: 30 mins.**
Course Code: PHY-213 / PHY-22307 **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

SECTION-I

Question No. 1 Choose the right answer:

1. Radiations are emitted from a hot body. If the temperature of the hot body is increased, the frequency of radiation will
   a) Decrease
   b) Increase
   c) Remain constant
   d) None of the above
2. During the study of photoelectric effect, it was observed that if the frequency of incident photon was less than the threshold frequency then number of emitted photoelectrons
   a) Increases with increase in the intensity of incident photon
   b) Decreases with increase in the intensity of incident photon
   c) Remains constant
   d) None of the above
3. The wavelength of de-Brogle waves associated with macroscopic object can not be measured because their associated wavelength is
   a) Very small
   b) Very large
   c) de – Brogle waves are not associated with massive objects
   d) None of the above
4. Using Schrodinger wave equation it can easily be shown that an electron in infinity deep well has an energy which is equal to
   a) Zero
   b) $\frac{h^2}{8mL^2}$
   c) Infinity
   d) None of the above
5. The infra-red region consists of
   a) Paschen series
   b) Balmer series
   c) Layman series
   d) None of the above
6. An electron jumps from n^{th} state to p^{th} state. The quantum frequency emitted is
   a) $\frac{C}{\lambda}$
   b) $\frac{\lambda}{C}$
   c) λC
   d) None of the above

P.T.O.

7. The excited state commonly has life time of only nanosecond before they de-excite by spontaneous emission. The longer lived state having life time of the order of 10^{-3} seconds is called
   a) Stable state
   b) Meta – stable state
   c) Long life state
   d) None of the above
8. The mass of a nuclear particle is generally measured in unified mass scale (u) such that 1u is equal to
   a) $\frac{1}{12}$ (mass of one atom of Carbon)
   b) $\frac{1}{12}$ (mass of one atom of Nitrogen)
   c) $\frac{1}{12}$ (mass of one atom of Hydrogen)
   d) None of the above
9. Mean life of a radioactive element is
   a) Greater than the half life of that radioactive element
   b) Shorter than the half life of that radioactive element
   c) Equal to the half life of that radioactive element
   d) None of the above
10. A nuclear reaction is called exothermic nuclear reaction if nuclear reaction energy Q is
   a) Negative
   b) Positive
   c) Zero
   d) None of the above

UNIVERSITY OF THE PUNJAB

Fourth Semester - 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Physics-IV (Concepts of Modern Physics) **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-213 / PHY-22307 **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

SECTION-I

Question No. 2 **Write the short answer of the following questions** (2× 10)

1. State Wein displacement law and write its mathematical form.
2. Write difference between photoelectric effect and Compton effect.
3. What is de - Broglie hypothesis.
4. Define wave function. If in a given region, the wave functions $|\psi^2| = 1$, what is the probability of finding the particle in that region.
5. Define spectroscopy. Name three different type of spectra.
6. Name four quantum numbers for hydrogen atom.
7. What is the source of k_β peak in x-rays spectrum. Also show this transition by diagram.
8. Give the difference between spontaneous emission and stimulated emission.
9. What is nuclear force? Give the source of nuclear force.
10. What is nuclear reaction? Write equation of fission of $^{235}_{92}$u.

SECTION-II

Question No. 3 (6+4)

(a) Using Schrodinger wave equation, discuss the behavior of a particle trapped in an infinity deep well and show that electron is never at rest in such a well.

(b) An electron trapped in an infinite deep well of width 253 pm is in the ground state. How much energy should it absorb to jump up to third excited state.

Question No. 4 (6+4)

(a) Define half life of a radioactive element. Derive a relation between half life and disintegration constant of radioactive element. Also prove that mean life of a radioactive element is greater than its half life.

(b) A radioactive sample decays at an absolute rate of 1600 counts per second. If there are 9.49×10^{19} atoms in that sample calculate its half life in years.

Question No. 5 (5+5)

Write notes on the following

1. He – Ne Laser
2. Nuclear Reactor

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Roll No. .....

Fifth Semester 2017

Examination: B.S. 4 Years Programme

PAPER: Classical Mechanics | **TIME ALLOWED: 30 mins.**

Course Code: PHY-301 | **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

Attempt all questions.

SECTION-I (Multiple Choice Questions) (10 Marks)

1. Select and tick one answer from the given multiple choice (10)

(i) The brachistochorone problem is the

(a) least area problem

(b) least distance problem

(c) least time problem

(d) least energy problem

(ii) If the Lagrangian does not involve a particular coordinate q_i such coordinate is called

(a) Angle coordinate.

(b) Ficticious coordinate

(c) Complete coordinate

(d) Cyclic coordinate.

(iii) The total angular momentum of a system of particles is constant if

(a) the total force is zero

(b) the total torque is zero

(c) the total energy is zero

(d) the total momentum is zero

(iv)Isotropy of space means that the system is invariant under

(a) translation in space

(b) rotation in space

(c) translation in time

P.T.O.

(d) translation in space and time

(v) Kepler's second Law of planetry motion directly follows from

(a) Conservation of linear momentum
(b) Conservation of angular momentum
(c) Homogeniety of time
(d) Homogeneity of space

(vi) Constraints that cannot be expressed as equations of coordinates and time i.e

$$f(\mathbf{r_1}, \mathbf{r_2}, \cdots, \mathbf{r_N}, t) = 0$$

are said to be

(a) holonomic
(b) Non-holonomic
(c) Simple
(d) Cruciform

(vii) Holonomic constraints are

(a) non-integrable
(b) hermitian
(c) noncyclic
(d) integrable

(viii) The shortest distance between two points on a curved surface is

(a) a straight line
(b) a tangent
(c) a geodesic
(d) a semi-circle

(xi) The value of accentricity ε for a parabola is

(a) $\varepsilon > 0$
(b) $\varepsilon = 1$
(c) $\varepsilon = 0$
(d) $0 < \varepsilon < 1$

(x) The Hamiltonian can be constructed from the Lagrangian using the formula:

(a) $H = p_i \dot{q}_i - L.$
(b) $H = \dot{p}_i \dot{q}_i - L.$
(c) $H = \dfrac{\partial L}{\partial \dot{q}_i}$
(d) $H = \dfrac{1}{L}.$

UNIVERSITY OF THE PUNJAB

Fifth Semester 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Classical Mechanics | **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-301 | **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

SECTION-II (20 Marks)

2. Show that the kinetic energy of a two-particle system is

$$\frac{1}{2}M\ \dot{R}^2 + \frac{1}{2}\mu v^2$$

where $M = m_1 + m_2$, v is the relative speed, and $\frac{1}{\mu} = \frac{1}{m_1} + \frac{1}{m_2}$(reduced mass)

(5)

3. What are constraints? Distinguish between holonomic and nonholonomic constraints by giving examples.

(5)

4. Show explicitly that

$$\frac{\partial \mathbf{x}}{\partial q_i} = \frac{\partial \dot{\mathbf{x}}}{\partial \dot{q}_i}$$

where $\mathbf{x} = \mathbf{x}(q_1, q_2, \cdots, q_n)$.(5)

5. Show that when a particle describes a circle under a central attraction directed to a point in the circumference, the law of force is the inverse fifth power of the distance.(5)

SECTION-III (30 Marks)

6. (a) Show that the equation of a curve for which surface area is minimum is a catenary

$$x = a \cosh \frac{y - b}{a}$$

where a and b are constants.

(b) Use Hamilton's principle of least action to derive Hamilton's equations of motion

$$\dot{q}_i = \frac{\partial H}{\partial p_i}, \qquad \dot{p}_i = -\frac{\partial H}{\partial q_i}$$

(5+5)

(P.T.O.)

7. (a) Use variational method to derive Euler-Lagrange equation of motion for a given functional

$$I = \int_{x_1}^{x_2} f\,[y(x), y'(x), x]dx.$$

(b) Show that the transformation

$$\begin{aligned} P &= q\cot p, \\ Q &= \log\left(\frac{\sin p}{q}\right), \end{aligned}$$

is canonical (5+5)

8. (a) Show that, if a transformation from (q,p) to (Q,P) be canonical then the bilinear form

$$\sum_i \left(\delta p_i dq_i - \delta q_i dp_i\right),$$

is invariant under the canonical transformation.

(b)A particle of mass m glides without friction on a cycloid, given by

$$\begin{aligned} x &= a(\theta - \sin\theta) \\ y &= a(1+\cos\theta), \end{aligned} \qquad 0 \le \theta \le 2\pi$$

Find the Lagrange's equation of motion.(5+5)

UNIVERSITY OF THE PUNJAB

Roll No. .....

Fifth Semester 2017

Examination: B.S. 4 Years Programme

PAPER: Mathematical Methods of Physics-I **TIME ALLOWED: 30 mins.**

Course Code: PHY-302 **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

OBJECTIVE TYPE

Instructions. Attempt all questions

Section-I

Fill in the blank or answer true/false.

1. If f is a scalar function with continuous second partial derivatives, then $\nabla \times (\nabla f) = \text{curl}\,(\text{grad}\, f) =$ .....
2. If $\mathbf{F}$ is a vector field having continuous second partial derivatives, then $\nabla.(\nabla \times \mathbf{F}) = \text{div}\,(\text{curl}\,\mathbf{F}) =$ .....
3. Suppose that C is a piecewise-smooth simple closed curve bounding a simply connected region R. If $P, Q, \frac{\partial P}{\partial y}$ and $\frac{\partial Q}{\partial x}$ are continuous on R, then $\oint_C Pdx + Qdy =$ .....
4. $g^{ij}g_{jk} = \delta^j_k$ (True/False)
5. $\nabla\phi(r) = \frac{d\phi}{dr}\hat{\mathbf{r}}$ (True/False)
6. $\mathbf{e}^i = g^{ij}\mathbf{e}_j$ and $\mathbf{e}_i = g_{ij}\mathbf{e}^j$ (True/False)
7. The function $f(z) = e^{\frac{1}{z-1}}$ has an essential singularity at $z = 1$ (True/False)
8. If $z = 3 + 4i$, then $\text{Re}\left(\frac{z}{\bar{z}}\right) = \text{Re}\,(z/\bar{z}) =$ .....and $\text{Im}\left(\frac{z}{\bar{z}}\right) = \text{Im}(z/\bar{z}) =$ .....
9. If $f(z) = e^z$ is periodic with period .....
10. The only possible singularities of a rational function are poles (True/False)

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Fifth Semester 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Mathematical Methods of Physics-I **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-302 **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.
SUBJECTIVE TYPE

Section-II (Short Questions) Marks=20

1. If $\mathbf{B} = \nabla \times \mathbf{A}$, show that
$$\oint \mathbf{B}.d\sigma = 0,$$
for any closed surface S.

2. Expand
$$f(z) = \frac{1}{z(1-z)^2}$$
in a Laurent series valid for $0 < |z| < 1$.

3. Determine whether $z = 0$ is an isolated or non-isolated singularity of $f(z) = \tan(1/z)$.

4. A vector $\mathbf{A}$ is decomposed into a radial vector $\mathbf{A}_r$ and a tangential vector $\mathbf{A}_t$. If $\hat{\mathbf{r}}$ is a unit vector in the radial direction, show that
$$\begin{aligned} \mathbf{A}_r &= \hat{\mathbf{r}}(\mathbf{A}.\hat{\mathbf{r}}), \\ \mathbf{A}_t &= -\hat{\mathbf{r}}\times(\hat{\mathbf{r}} \times \mathbf{A}). \end{aligned}$$

5. Evaluate $\oint_C \frac{z+1}{z^4+4z^3}dz$, where C is the circle $|z| = 1$.

Section-III Marks=30

1. Show that
$$\int_0^\pi \frac{d\theta}{(a+\cos\theta)^2} = \frac{a\pi}{\left(\sqrt{a^2-1}\right)^3}, \qquad (a > 1).$$

2. Use Cauchy's residue theorem to evaluate
$$\oint_{|z|=\frac{1}{2}} \frac{\cot \pi z}{z^2}dz.$$

3. Suppose $A = [a_{ij}]$, $B = [b^{ij}]$ and that $B = A^{-1}$. By considering the determinant $a = |A_{ij}|$, show that
$$\frac{\partial a}{\partial u^k} = ab^{ji}\frac{\partial a_{ij}}{\partial u^k}.$$

4. We may define Christoffel symbols of the first kind by
$$\Gamma_{ijk} = g_{il}\Gamma^l_{jk}.$$
Show that these are given by
$$\Gamma_{kij} = \frac{1}{2}\left\{\frac{\partial g_{ik}}{\partial u^j} + \frac{\partial g_{jk}}{\partial u^i} - \frac{\partial g_{ij}}{\partial u^k}\right\}.$$

5. Prove the expression $\nabla.\mathbf{a} = \frac{1}{h_1h_2h_3}\left[\frac{\partial}{\partial u_1}(h_2h_3a_1) + \frac{\partial}{\partial u_2}(h_1h_3a_2) + \frac{\partial}{\partial u_3}(h_1h_2a_3)\right]$ in orthogonal curvilinear coordinates.

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Fifth Semester 2017

Examination: B.S. 4 Years Programme

PAPER: Solid State Physics-1 **TIME ALLOWED: 30 mins.**

Course Code: PHY-303 **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

OBJECTIVE

Q.1 Encircle the correct answer (from the given multiple choices) in each part. **(1×10 = 10)**

A) How many total number of lattice types are there in three dimensions?

i) 5 **ii)** 8 **iii)** 14 **iv)** 16

B) Which of the following combination of structures has similar packing fraction?

i) FCC and SC **ii)** BCC and SC **iii)** BCC and HCP **iv)** HCP and FCC

C) A primitive cell has lattice points per unit cell

i) One **ii)** Two **iii)** Three **iv)** Four

D) Reciprocal of FCC lattice is

i) FCC lattice **ii)** BCC lattice **iii)** SC lattice **iv)** HCP lattice **v)** None of these

E) Optical phonon branch appears in

i) monoatomic lattice **ii)** diatomic lattice **iii)** triatomic lattice **iv)** None of these

F) According to Dulong-Petit law, the phonon heat capacity C_v

i) strongly depends on temperature **ii)** independent of temperature **iii)** remains constant at all temperatures **iv)** ii) and iii) **v)** none of these

G) Van der Waals interactions in inert gas crystals are always
i) repulsive **ii)** attractive **iii)** neither attractive nor repulsive **iv)** zero **v)** none of these

H) At high temperatures, phonon heat capacity, C_v (according of Debye model) varies as:
i) T^3 **ii)** $T^{3/2}$ **iii)** T^2 **iv)** T **v)** None of these

I) In monatomic lattice, the frequency of the wave at long wavelengths varies with k as:
i) k **ii)** k^2 **iii)** k^3 **iv)** independent of wave-vector k

J) Bulk modulus (B) and compressibility (K) are related to each other as:

i) B has direct relation to K **ii)** B has inverse relation to K **iii)** B is not related to K
iv) None of these

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Fifth Semester 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Solid State Physics-1 **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-303 **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

SUBJECTIVE

Note: Attempt all questions. Write to the point answer of theoretical part of each question.

Q.2 Give to the point answer / short description of each question. **(4 × 5 = 20)**

a) Draw (211), (200), (101) and (111) crystallographic planes in cubic unit cell.

b) Describe briefly what is meant by anharmonic crystal interactions.

c) Write down the steps to find Miller indices of a plane whose intercepts are 2, 1, 2.

d) How an inert gas crystal holds together? Discuss the origin of Van der Waals interactions in crystals?

e) For hexagonal close-packed structure (HCP), show that the $c/a = 1.633a$.

Q.3

a) Derive the dispersion relation for a diatomic linear chain of atoms with masses M_1 and M_2 ($M_1 > M_2$) by taking into account nearest neighbor interactions. (7)

b) Give physical significance of the appearance of optical and acoustical branches in the dispersion relation. Why frequency gap between two modes occurs in case of diatomic lattice? (3)

Q.4

a) Derive the diffraction condition in reciprocal lattice. (7)

b) What is Madelung constant? Find its value for an infinite one dimensional array of alternative ions. (3)

Q.5

a) What are the discrepancies in the classical theory of lattice heat capacity of solids? Derive an expression for lattice heat capacity of solids on the basis of Einstein model. (3+4)

b) Discuss how Einstein model fits well with the experimental observations for low and high temperature limits. (3)

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Fifth Semester 2017

Examination: B.S. 4 Years Programme

PAPER: Electronic Devices and Circuits **TIME ALLOWED: 30 mins.**

Course Code: PHY-304 **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

Q.1 Mark the Correct one (OBJECTIVE) **10**

1. The efficiency of transformer coupled Class –A power Amplifier is

a) 25% b) 50% c) 79 % d) 100%

2. Pie (π) Filter circuit consists of _____ and two Capacitors.

a) Resistor b) Inductor c) Battery d) transistor

3. In the forward blocking region the SCR is:

a) Reverse biased b) in the off state c) in the on state d) at the point of break down

4. Which of the following is not a characteristic of the UJT?

a) intrinsic standoff ratio b) negative resistance

c) peak point voltage d) bilateral conduction

5. Flip- Flop is a circuit which can store:

a) two bit memory b) one bit memory c) both a, and b

d) non of them

6. UJT transistor use in:

a) Oscillator b) Phase control c) Amplifier d) both a and b

7. A diode that has a negative resistance characteristic is the:

a) Schottky diode b) tunnel diode c) laser diode d) Diac

8. An LED

a) emits light when reverse biased b) senses light when reverse biased

c) emits light when forward biased d) produces light with longer wavelength

9. The FET is:

a) a unipolar device b) voltage controlled device

c) current controlled device d) both a & c

10. The Miller input capacitance of an amplifier is dependent in part on

a) the input coupling capacitor b) the voltage gain

c) the bypass capacitor d) non of these

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Fifth Semester 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Electronic Devices and Circuits **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-304 **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.
SUBJECTIVE TYPE

Attempt all Questions

Q.2 Short Answer 5* 4= 20

1. What is a π Filter? Why Bridge rectifier is preferable to a two diodes full-wave rectifier?
2. What is the meaning of feedback and what is the difference of positive and negative feedback?
3. Discuss basic idea of Light Emitting Diode & LCD.
4. What is the Low frequency response in BJT?
5. What is a Miller effect?

Q.3

a) Draw the circuit of a Bi-stable Multivibrator. Explain its operation, where it use, what type of output it produce. (7)

b) Write down the Characteristics of OP Amp. (3)

Q.4

Explain and analyze of Push pull class AB amplifier? Calculate the maximum output power and its efficiency. (10)

Q.5

a) What type of feedback does a Oscillator circuit require? And what are the condition for oscillator circuits. (3)

b) Explain the function of Phase shift Oscillator. Design it and calculate its frequency. (7)

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Roll No. .....

Fifth Semester 2017

Examination: B.S. 4 Years Programme

PAPER: Quantum Mechanics-I **TIME ALLOWED: 30 mins.**

Course Code: PHY-305 **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

SECTION – I (OBJECTIVE TYPE)

Q1: Choose (encircle) the best possible answer from the given.**(1x10=10)**

1. Which of the following is a non-linear operator?

   a) Differential Operator
   b) Square Operator
   c) Momentum Operator
   d) Position Operator

2. If $[\hat{A}, \hat{B}] = 0$, then both operators can be determined:

   a) Simultaneously

   b)Precisely

   c) Both a & b

   d)Impossible to determine

3 $[\hat{L}_y, \hat{p}_y] =$

   a) $\hat{L}_y$
   b) $\hat{L}_x$
   c) $\hbar\hat{L}_z$
   d) Zero

4 The Eigen values of a Hermitian operator are always

   a) Non-imaginary
   b) Positive numbers
   c) Real
   d) All above true

P.T.O.

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Fifth Semester 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Quantum Mechanics-I
Course Code: PHY-305

TIME ALLOWED: 2 hrs. & 30 mins.
MAX. MARKS: 50

Attempt this Paper on Separate Answer Sheet provided.

SUBJECTIVE TYPE

Q.2Give short answers to the following questions.**(4x5=20)**

i. Define Hermitian operator and prove that $\hat{x}$ is hermitian.
ii. Show that the Eigen value spectrum of $\hat{L}_x$ is $m\hbar$. Where m has integer values.
iii. Describe the terms briefly,complete set of linear independent objects,degenerate Eigen values.
iv. Briefly explain the physical interpretation of ladder operator in Quantum mechanics.
v. What is a zero point energy? If a classical oscillator has energy $\frac{1}{2}\hbar\omega$, what is its amplitude?

Q.3(a) State and prove uncertainty principle in Quantum mechanics.

(b) Show that $(\Delta A)^2$ is always real number.**(6+4)**

Q.4 (a) Write down the expressions for the angular momentum operators $\hat{L}_x, \hat{L}_y, \hat{L}_z$in Cartesian coordinates and convert them into spherical polar coordinates.

(b) Also calculate eigen value spectrum of $\hat{L}_z$.**(6+4)**

Q.5 **(a)** State and prove Ehrenfest's Theorem.**(2+5,3)**

(b) Write down three canonical congugate observable.

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Sixth Semester - 2017

Examination: B.S. 4 Years Programme

PAPER: Mathematical Methods of Physics-II **TIME ALLOWED: 30 mins.**

Course Code: PHY-307 **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

Instructions. Attempt all questions

Section-I (Objective) Marks=10

Fill in the blank or answer true/false.

1. $\nabla^2 + k^2$ is a linear operator. (True/False)
2. $\Pi(z) = (z+1)!$ (True/False)
3. $\mathcal{F}\left[\frac{d^n}{dt^n} f(t)\right] = g(\omega)$. (True/False)
4. If Ψ is a solution of Laplace's equation $\nabla^2\Psi = 0$, then $\Psi_y = \frac{\partial \Psi}{\partial y}$ is also a solution. (True/False)
5. $\frac{dH_n(x)}{dx} = (2n)H_{n+1}(x)$. (True/False)
6. $H_2(x) = 4x^2 + 1$. (True/False)
7. $(\nabla^2 + k^2)\{a_1\varphi_1 + a_2\varphi_2\} =$ .....
8. $\Gamma(1/2) =$ .....
9. $\mathcal{F}\left\{e^{-ax^2}\right\} =$ .....
10. $\mathcal{L}\{t\sin kt\} =$ .....

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Sixth Semester - 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Mathematical Methods of Physics-II | **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-307 | **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

Section-II (Short Questions) Marks=20

1. Show that
$$\int_0^\infty e^{-x^4}dx = \Gamma(\frac{5}{4}).$$
2. Find the Fourier series of $f(x) = x^3$ for $0 < x \leq 2$.
3. Show that the linear operator $L = \frac{d^2}{dt^2}$ is self-adjoint, and determine the required boundary conditions for the operator to be Hermitian over the interval t_0 to $t_0 + T$.
4. Using a Rodrigues formula ($P_n(x) = \frac{1}{2^n n!}\frac{d^n}{dx^n}(x^2-1)^n$), show that the $P_n(x)$ are orthogonal and that
$$\int_{-1}^{+1} P_n(x)P_n(x)dx = \frac{2}{2n+1}.$$
5. Show that
$$\mathcal{L}\left\{\frac{\sin kt}{kt}\right\} = \frac{1}{k}\cot^{-1}\left(\frac{s}{k}\right).$$

Section-III Marks=30

1. Evaluate
$$\int_0^\infty e^{-ax}J_0(bx)dx, \quad a, b > 0.$$
2. Show that
$$G(x,t) = \begin{cases} x, & 0 \leq x < t, \\ t, & t \leq x < 1, \end{cases}$$
is the Green's function for the operator $L = -\frac{d^2}{dx^2}$ and boundary conditions $y(0) = 0,\ y'(1) = 0$.
3. Prove that
$$\left(2x - \frac{d}{dx}\right)^n 1 = H_n(x),$$
also verify that
$$\begin{aligned} a_n\Psi_n(x) &= \frac{1}{\sqrt{2}}(x + \frac{d}{dx})\Psi_n(x) = n^{1/2}\Psi_{n-1}(x), \\ a_n^\dagger\Psi_n(x) &= \frac{1}{\sqrt{2}}(x - \frac{d}{dx})\Psi_n(x) = (n+1)^{1/2}\Psi_{n+1}(x), \end{aligned}$$
where
$$\Psi_n(x) = e^{-x^2/2}\frac{H_n(x)}{(2^n n!\pi^{1/2})^{1/2}}.$$
4. Derive the recurrence relation
$$H_{n+1}(x) = 2xH_n(x) - 2nH_{n-1}(x).$$
5. Show that the Fourier sine transform of e^{-at} is
$$g_s(\omega) = \sqrt{\frac{2}{\pi}}\frac{\omega}{\omega^2 + a^2}.$$

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Sixth Semester - 2017
Examination: B.S. 4 Years Programme

PAPER: Solid State Physics-II | **TIME ALLOWED: 30 mins.**
Course Code: PHY-308 | **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

(Section I)

Question no. 1: Encircle the best answer out of the four choices given for each question

1. The number of orbitals in any energy band is

(a) N (b) 0 (c) 3N(d) 2N

2.The value of Lorentz number Lin S.I systemis

(a) 2.45×10^{-8} watt-Ω/deg^2(b) 1.3×10^{-6} watt-Ω/deg^2 (c) both (d) none

3. The Hall coefficient in S.I units is

(a) $R_H = 1$ (b) $R_H = 1/e$ (c) $R_H = -1/ne$ (d) none

4. Relaxation time for the electron is independent of

(a) Amplitude of electron(b) velocity of electron (c) both (d) incomplete statement

5.In indirect band gap materials the threshold energy is

(a)$Eg = \hbar\omega$(b) $Eg = \hbar^2 k^2/2m$(c) $Eg + \hbar\Omega = \hbar\omega$(d) none

6. Mathematical Expression of Matthiessen's rule is

(a) $\rho = \rho_L + \rho_i$ (b)$\rho = \rho_L - \rho_i$ (c)$\rho = \rho_L \rho_i$ (d) $\rho = \rho_L / \rho_i$

7. The number of orbitals per unit energy range is

(a) Fermi energy (b) orbital energy (c) density of states (d) none

8. The cyclotron frequency is

(a) $\omega_c = 2\Pi f$ (b) $\omega_c = eB/m$(c) $\omega_c = eB$ (d) none

9. Group velocity by definition is

(a) $Vg = dE/dK$(b) $Vg = S/t$ (c)$Vg = d\omega/dK$(d) none

10. The mobility of any charge carries is

(a) $\mu = Vg/E$ (b) $\mu = q/E$ (c) $\mu = Vd/E$ (d) none

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Sixth Semester - 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Solid State Physics-II **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-308 **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

(Section II)

Question no. 2: Answer the following short questions (10x2)

1) What is meant by energy gap and why energy gaps appear due to Bragg reflection at zone boundary?
2) Differentiate between metals and insulators on the basis of orbital band theory?
3) Define Bloch function and describe the significance of wave vector K used to label the Bloch function.
4) Define the terms orbital and degeneracy and how many orbitals are present in a band?
5) What are the drawbacks of classical theory in the calculation of heat capacity of electron?
6) What are significances of Hall coefficient?
7) What factors affect the resistivity of electrical materials?
8) Differentiate between direct and indirect band gap materials.
9) Plot Fermi Diracdistribution function for various temperatures.
10) What types of changes appear in band structure of semiconductor after doping with pentavalent impurity?

(Section III)

Question no.3

(a) Discuss the motion of free electron in magnetic field. **(5+5)**

(b) Define thermal effective mass of electron and why it is different from free electron mass? Explain

Question no.4 **(8+5+7).**

(a) Derive wave equation for electron under periodic potential & find the solution of this equation for a wave vector exactly at zone boundary.
(b) Why hole is considered as positive charge in an electric and magnetic field?
(c) Distinguish between intrinsic and extrinsic semiconductors and show that intrinsic carrier concentration depends on temperature and energy gap.

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Sixth Semester - 2017

Examination: B.S. 4 Years Programme

PAPER: Quantum Mechanics-II | **TIME ALLOWED: 30 mins.**

Course Code: PHY-309 | **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

SECTION-1 (OBJECTIVE TYPE)

Q1: Choose (encircle) the best possible answer from the given. **(1x10=10)**

1 The direct sum of Hilbert space is

a) 2-D space
b) 3-D space
c) Fock space
d) All above

2 The variational Principal provides us

a) Upper band energy of the system
b) Lower band energy of the system
c) Make a guess to trial wave function
d) Both a & c

3 The diagonal matrix of operator $\hat{S}_x$ is obtained after diagonaliztion is

a) $\frac{\hbar}{2}\begin{pmatrix}0 & 1\\ 1 & 0\end{pmatrix}$
b) $\frac{\hbar}{2}\begin{pmatrix}0 & i\\ -i & 0\end{pmatrix}$
c) $\frac{\hbar}{2}\begin{pmatrix}1 & 0\\ 0 & -1\end{pmatrix}$
d) $\frac{\hbar}{2}\begin{pmatrix}1 & 0\\ -1 & 0\end{pmatrix}$

4 If $[\hat{H}, \hat{P}ij]=0$, then which will be true

a) Both can be determined simultaneously
b) The exchange operator $\hat{P}_{ij}$ will be constant of motion
c) This relation is called commutation relation
d) All of above true

(P.T.O.)

5 Which is the boson particle:

a) Proton
b) Electron
c) α particles
d) None

6 The particles composed of two or more identical elementary particles are:

a) Quarks
b) Composite particles
c) Photons
d) Gravitons

7 For anti-symmetric wave function the value of permutation operator is:

a) -1
b) +1
c) a or b
d) Zero

8 Condition for the validity of WKB approximation is:

a) $d\lambda \ll dx$
b) $\frac{d\lambda}{dx} \ll 1$
c) None of above
d) Both a & b

9 The total no of collisions over the duration of scattering experiment is proportional to

a) No of particles in incident beam
b) No of target particles per unit area
c) Both a & b
d) All of above

10 The 'Frame' in which both colliding particles has equal and opposite velocity is called

a) Centre of mass Frame
b) Inertial Frame
c) Lab Frame
d) Non-inertial Frame

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Sixth Semester - 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Quantum Mechanics-II | **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-309 | **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

SECTION- II (SHORT QUESTION)

Q.2 Give short answers to the following questions. **(4x5=20)**

i. Show that the exchange operator for a four particle state is $\hat{P}ij = \pm 1$

ii. Define variational principle; briefly describe its physical significance in quantum mechanics.

iii. How we can define Fock space in terms of Hilbert space? Describe differences and similarities of both spaces briefly.

iv. What is the Solid angle? Write its physical interpretation in scattering reference.

v. Show that

$$\hat{S}_y = \frac{\hbar}{2}\sigma_y$$ where σ_y is Pauli matrix.

SECTION-III (QUESTION WITH BRIEF ANSWER)

Q.3 Write Detail Description of Time-dependent perturbation theory. **(10)**

Q.4 Construct the symmetric and anti-symmetric wave function for the system of four Non-interacting particles. **(10)**

Q.5 Briefly describe

a) Variational Method.

b) check validity of WKB method. **(5+5)**

UNIVERSITY OF THE PUNJAB

Sixth Semester - 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Digital Electronics | **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-310 | **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

Note: Attempt all questions:

SECTION –II (Subjective Type)

Q.2 write short answers: (20)

a. Find the hex sum of $(93)_{16}$ +$(DE)_{16}$.
b. What is the Gray equivalent of $(25)_{10}$.
c. Simplify the Boolean expression, Y=(A+B)($\overline{A}$+C)(B+C)
d. Add 20-15 using 2's complement.
e. Convert the 430 to excess 3-code
f. Write the Boolean expression F=A+BC in SOP and draw the logic diagram with NAND gate.
g. Draw the Positive Edge logic diagram, truth table and logic symbol of T-Flip Flop.
h. Explain how an S-R F/F can be converted into a JK F/F.
i. What is difference between the ROM and RAM.
j. What are the PLD's.

Q.3 Draw a neat diagram of JK Flip Flop with a positive going edge trigged of clock Signal, and explain it with truth table. 10

Q.4 Simplify the Boolean expression with K-Map and draw the circuit diagram with NAND Gate's. $X = A\overline{C}D + \overline{A}B\overline{C}D + \overline{A}\overline{B}D + A\overline{B}CD$ 5+5

b) Draw a ripple Counter of MOD- 6 with D- Type.

Q.5 Write a short note on any two of the following: 5+5

a) PAL

b) Computer System

c) ALU

UNIVERSITY OF THE PUNJAB

Roll No. .....

Sixth Semester - 2017
Examination: B.S. 4 Years Programme

PAPER: Digital Electronics | **TIME ALLOWED: 30 mins.**
Course Code: PHY-310 | **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

Note: Attempt all questions on the Question sheet only:

Q.1 Encircle the correct answer, over writing and cutting will carry the zero marks:

1) The excess-3 code of decimal number 26 is

a) 0100 1001 b) 01011001

c) 1000 1001 d) 01001101

2) The octal equivalent of $(247)_{10}$ is

a) $(352)_8$ b) $(366)_8$

c) $(367)_8$ d) $(400)_8$

3) A decimal number 256 be written in BCD as:

a) 100101110 b) 0010 0101 0110 c) 10 0101 0110 d) Non of them

4) How many Flip Flop are required for Mod-16 Counter

a) 5 b) 6

c) 3 d) 4

5) The output of logic gate is 1 when all input are at logic 0. The gate is either

a) A NAND or an EX-OR c) an OR or an EX-NOR

b) An AND or an EX-OR d) a NOR or an EX-NOR

6) Data can be changed from special code temporal code by using

a) Shift register c) Counter

b) Combinational circuits d) A/ D converters

7) A ring counter consisting of Five Flip-Flops will have

a) 5 states c) 10 states

b) 32 states d) 6 states

8) If the input to a T Flip-Flop is 100 Hz signal, the final output of the 3 F/F is

a) 1000Hz c) 500 Hz

b) 333Hz d) 12.5 Hz

9) Which of the following is the fastest logic

a) ECL c) TTL

b) CMOS d) LSI

10) The NOR gate output will be low if the two inputs are

a) 00 c) 10

b) 01 d) 11

UNIVERSITY OF THE PUNJAB

Roll No. .....

Sixth Semester - 2017
Examination: B.S. 4 Years Programme

PAPER: Computational Physics-I | **TIME ALLOWED: 30 mins.**
Course Code: PHY-311 | **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

Objective

Q1: Each question has FOUR possible answers. Select the correct answer and encircle it. 1x 10 = 10

i. C++ program statement that is not included in code compilation:
a) % (b) = (c) // (d) ( )

ii. In C++ what is not a repetition structure:
a) if-else-if (b) while (c) for (d) do-while

iii. C++ language, LIBRARY TYPE that provides power function is called:
(a) pow() (b) x^2 (c) math.h (d) both (a) & (b)

iv. Which of the following is a comparison operator in C++?
(a) Compare() (b) = (c) = = (d) ++

v. The number of bytes reserved for char data type in C++ is:
(a) 1 (b) 2 (c) 4 (d) 8

vi. If there is a function factorial() then it is called:
(a) Operator (b) user defined function (c) built in function (d) None

vii. In C++, a loop with at least one must iterations is:
(a) While (b) do-while (c) for (d) None

viii. If x =2 and y= 3, then for statement " y = x" which of the following result is true
(a) x equals y (b) x is less than y (c) true (d) false

ix. If a = 2. In C++ the expression a = 2*k+1 is evaluated to:
(a) 5 (b) 5.0 (c) 1 (d) error

x. Which of the following is not an increment in C++ :
(a) a++ (b) ++a (c) a = a +1 (d) a = 2*a +1

UNIVERSITY OF THE PUNJAB

Sixth Semester - 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Computational Physics-I | **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-311 | **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

Subjective

Q.2.	Write short answers of the following Questions:	
i.	Explain with example the following terms in C++: a) double k; (b) pow ( ) (c) // (d) sqrt()	4
ii.	Write syntax with example the following in C++: (a) while ( ) loop (b) if-else-if	4
iii.	Explain logical operators in C++?	4
	Write C++ program code segment for the following: (a) to print table of a number enter by the user (b) to print x against f(x) for the equation $f(x) = 7\sqrt{3x^2 - 2x - 22}$ to calculate and display maximum and minimum of f(x) (c) to read (x,y) values from the user and calculate polar coordinates (r, θ)	8
Q.3.	Write C++ program to evaluate the $\int_1^6 \frac{(x^2+4)}{5} dx$ by Trapezoidal's rule or by Weddle's rule due to options 1 or 2 respectively (use n=6). Report error message for any other option pressed by the user.	10
Q.4.	Suppose A and B be 3x3 matrices. Write C++ program which reads in entries of A and B and prints out the entries of matrix which is (i) $C = A \bullet B$, (ii) $D = 2A' + 3B$ and (iii) to print diagonal elements of C. (iv) square of the elements of matrix D (v) square of the matrix C.	2+4+4
Q.5.	Find the roots of the equation **3x – cos x - 5** using simple iterative method using xo = 1.5. Write C++ program to implement the method correct to 2dp. Write C++ program for conversions of (i) temperature from F to C (ii) length from m to km	6+4

UNIVERSITY OF THE PUNJAB

Seventh Semester 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Statistical Mechanics | **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-401 | **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

SUBJECTIVE TYPE

Q2- Write down short answers of the following questions. Marks: **2x10=20**

1- State the equipartition of energy theorem.
2- Define ortho and para molecule.
3- Why entropy change is always greater than zero for natural processes?
4- Show that according to Dulong-Petit law $C_V=3R$?
5- Show that rotational degree of freedom is active on 10K?
6- Give physical interpretation of Livioulle's theorem?
7- Write down two properties of entropy?
8- Show that on doubling the volume entropy also doubles?
9- What is necessary condition for system to be in thermal equilibrium?
10- Write down draw backs of Einstein theory?

Q3- Derive an expression for the orbit of simple harmonic oscillator in phase space. (5)

Q4- Calculate the entropy of ideal gas by using the canonical Ensemble? (10)

Q5- Derive $C_V= 3R$ using the Debye Model? (5)

Q6- Draw the graph of Fermi-dirac distribution function and explain its behavior at low temperatures and at high temperature? (5)

Q7- Discuss the vibrational motion of a diatomic molecule and Using the partition function, Derive the formula of specific heat of vibrational energy and find its high temperature limit. (5)

UNIVERSITY OF THE PUNJAB

Roll No. .....

Seventh Semester 2017
Examination: B.S. 4 Years Programme

PAPER: Statistical Mechanics | **TIME ALLOWED: 30 mins.**
Course Code: PHY-401 | **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

OBJECTIVE TYPE

Marks: 10

Q1- Choose the correct option.

1- The canonical ensemble physically describes a
(a) Open system (b) partially open system(c) closed system(d) none of these

2- The Gibbs function in thermodynamics is defined as =H-TS. In an isothermal isobaric and reversible process G must be
(a) remains constant but not zero (b) varies linearly (c) varies nonlinearly (d) zero

3- when applied to solar radiation Planck's law reduces to Wien's displacement law in
(a) UV region (b) microwave region (c) infrared region (d) visible region

4- According to Maxwell's law of distribution the most probable velocity is
(a) Greater than V_{rms} (b) equal to V_{rms} (c) equal to mean velocity (d) greater than mean velocity

5- In a micro canonical ensemble a system A of fixed volume is in contact with large reservoir B then which statement is true
(a) A can change only energy with B (b) A can change only particles with B
(c) A can change neither energy nor particles with B (d) A can change both energy and particles with B

6- The Quantum statistics reduces to classical statistics under condition(λ is De Broglie wave length and ρ is density)
(a) $\rho\lambda^3 \approx 1$ (b) $\rho\lambda^3 >> 1$ (c) $\rho\lambda^3 << 1$ (d) $\rho=0$

7- According to Debye theory the specific heat of solid at high temperature is proportional to
(a) T (b) T^2 (c) T^3 (d) independent of T

8- Specific heat of metal can be expressed as
(a) T^3 (b) $AT+BT$ (c) AT^2+BT^3 (d) $AT+BT^3$

9- If Z be the partition function of a system of particles, the average energy is written as
(a) $E=\partial Z/\partial T$ (b) $E=-\partial Z/\partial T$ (c) $E= -\partial \ln Z/\partial T$ (d) none of these

10- The function $-\partial f(E)/\partial E$, where f(E) is the Fermi Dirac distribution Function and E is the enegy, then at finite low temperature, behaves as
(a) Dirac Delta fn. (b)Sine fn. (c) exponential fn. (d) none

UNIVERSITY OF THE PUNJAB

Seventh Semester 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Classical Electrodynamics-I | **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-402 | **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

Note: Attempt all questions:

SUBJECTIVE TYPE

Q.2. Give answers to the following short questions: **20 Marks**

1. What is magnetic vector potential? 4
2. What is magnetization current I_m ? 4
3. What is Lorentz gauge? 4
4. What is method of electrostatic images? 4
5. Derive wave equation for field vector ***H***. 4

Q.3. Find the expression for magnetic field of a distant circuit. 10

Q.4. Find the expressions for force and torque on current carrying conductors. 10

Q.5. For magnetic problems, discuss boundary conditions for the field vectors ***B*** and ***H*** for an interface between two media. 10

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Seventh Semester 2017

Examination: B.S. 4 Years Programme

PAPER: Classical Electrodynamics-I **TIME ALLOWED: 30 mins.**

Course Code: PHY-402 **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

Note: Attempt all questions:

OBJECTIVE

Q.1 Choice the correct answer.

1. Which of the following justify the non-existence of magnetic monopole
   (i) $\nabla \times B = 0$ (ii) $\nabla \times E = 0$ (iii) $\nabla . E = 0$ (iv) none of these

2. Magnetic susceptibility is negative for
   (i) Paramagnetic materials (ii) Ferromagnetic materials (iii) Both (i) and (ii) (iv) none of these

3. For n=1, Legendre Polynomial $P_n(\theta)$ is
   (i) 0 (ii) 1 (iii) $\cos\theta$ (iv) $\cos\theta/2$

4. The resistance R of a straight conductor of uniform cross section A is (g = conductivity, *l* =length)
   (i) $R = l/gA$ (ii) $R = lg/A$ (iii) $R = A/gl$ (iv) none of these

5. The ---------- measures the magnetic dipole moment per unit volume
   (i) **P** (ii) **H** (iii) **M** (iv) **B**

6. Ampere circuital law is in many ways parallel to
   (i) Gauss's Law in electrostatics (ii) Biot and Savart Law (iii) Faraday's Law (iv)none of these

7. Ability of a material to remain magnetized after removal of the magnetizing force is known as
   (i) Permeability (ii) Hysteresis (iii) Retentivity (iv) Reluctance

8. The basic source of magnetism is
   (i) Magnetic domains (ii) Magnetic dipoles (iii) Movement of charged particles (iv) none of these

9. Permeability of vacuum is
   (i) 0 (ii) 1 (iii) $4\pi \times 10^{-7}$ H/m (iv) 1 H/m

10. Which of the following equation can not be a boundary condition of the field vectors
    (i) $E_{1t} = E_{2t}$ (ii) $H_{1t} = H_{2t}$ (iii) $E_{1n} - E_{2n} = \varepsilon$ (iv) $D_{1n} - D_{2n} = \sigma$

UNIVERSITY OF THE PUNJAB

Seventh Semester 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Nuclear Physics-I | **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-403 | **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

(Subjective)

(Section I)

2×10=20

Q 2 **Write down short answers of the following:**

i. Draw a schematic diagram of mass spectrograph clearly showing each part.

ii. Write down the assumptions of 'Collective Model'.

iii. Write down the two postulates of 'Neutrino hypotheses.

iv. Define nuclear spin.

v. Write any two achievements of 'Liquid drop model'.

vi. Define magnetic dipole moment.

vii. Write at least two evidences of shell structure in nuclei.

viii. Why solid state detector is more suitable for the detection of low energy particles?

ix. Why does energy of α-particles emitted in a decay process have line spectrum and energy of β-particles have continuous distribution?

x. What is the Q value for the radioactive disintegration?

$$^{226}_{88}Ra \rightarrow {}^{222}_{86}Ra + {}^{4}_{2}He$$

Section-II

Q 3 **a)** Explain the concept of nuclear electric quadrupole moment. **(7)**

b) Write in detail the principle, construction and working of bubble chamber. **(5)**

Q 4 **a)** By using semi empirical mass formula, find an expression for the atomic number of the stable nuclei after β-decay. **(5)**

b) Which nucleus is more stable $^{7}_{3}Li$ or $^{8}_{3}Li$? . Give m_p = 1.007825 amu, m_n = 1.008665 amu, m_{Li_7} = 7.016003 amu and m_{Li_8} = 8.022486 amu. **(3)**

Q 5 **a)** Briefly describe the theory of spontaneous alpha emission. **(6)**

b) Discuss multipolarities of γ-rays. **(4)**

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Roll No. .....

Seventh Semester 2017
Examination: B.S. 4 Years Programme

PAPER: Nuclear Physics-I | **TIME ALLOWED: 30 mins.**
Course Code: PHY-403 | **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

(Objective Type)

Q 1 Encircle the correct answer out of the four options given. No mark will be given for cutting, over-writing and for use of lead pencil or ink remover.

(1 x 10)

1. The ionization energy of an atom as compared to the binding energy of its nucleus is _____.

   a) Greater b) Less

   c) Same d) None of these

2. The most widely used gas in Van de Graff accelerator is _____.

   a) N_2 b) CO_2

   c) SF_6 d) He

3. Gamow assumed that α-particle may exist as an α-particle within a _____ nucleus.

   a) Heavy b) Light

   c) Intermediate d) Any of these

4. β-decay is also called _____ transformation.

   a) Isobaric b) Isotopic

   c) Isotonic d) None of these

(P. T. O)

5. If electric dipole field has odd parity then magnetic dipole field will have _____ parity.

a) Even
b) Odd
c) Mixed
d) Zero

6. In scintillation counter, electrons are accelerated by _____.

a) Electric field
b) Magnetic field
c) Both (a) and (b)
d) Oscillating field

7. A decay process occurs if its Q-value is _____.

a) Positive
b) Negative
c) Zero
d) All of these

8. Emission of α and β-particles was predicted by _____ model.

a) Liquid drop
b) Shell
c) Collective
d) Fermi gas

9. According to Shell model, even-even nuclei have spin_____.

a) 0
b) 1
c) 1/2
d) All of these

10. According to Yukawa, the quantum exchanged between the nucleons must have _____ mass.

a) No
b) Finite
c) Infinite
d) Equal to the mass of nucleons

UNIVERSITY OF THE PUNJAB

Seventh Semester 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Relativity and Cosmology | **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-404 | **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

Q2. Write down short answers of the following questions. **2x10=20**

1. Write down importance of K-factor.
2. How light cone describes the past present and future of a particle?
3. Define orthochronus and non orthochronus Lorentz transformation.
4. Derive energy momentum relation $E^2=m_0{}^2c^4+p^2c^2$.
5. Define electromagnetic field tensor.
6. The total energy of the particle is exactly twice of its rest energy. Calculate its speed.
7. If X^ν is a first rank tensor, than show that $\partial^\mu X^\nu$ is not (1,1) tensor.
8. What is gravitational red shift?
9. Mention the limitations of Hubble's law.
10. Define the term 'scale factor' in Cosmology.

Q3. Give detail answers of the following questions.

1. Show that Lorentz transformations form a group under rotation? **(8)**
2. Show that $\nabla_a(\nabla_b X^c) - \nabla_b(\nabla_a X^c) = R^c{}_{dab} X^d$ Where, $R^c{}_{dab}$ is Riemann curvature tensor. **(8)**
3. Define space time singularity? What is black hole? Discuss formation and detection of black hole? **(8)**
4. What is Hubble's law? Derive it from Friedman-Robertson-Walker metric. **(6)**

UNIVERSITY OF THE PUNJAB

Roll No. .....

Seventh Semester 2017
Examination: B.S. 4 Years Programme

PAPER: Relativity and Cosmology **TIME ALLOWED: 30 mins.**
Course Code: PHY-404 **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

Note: Attempt all questions.

Q1- Choose the correct option. **1x10=10**

1. In physically impossible world line, time would be:
   (a) In forward direction (b) in backward direction
   (c) Always constant (d) zero

2. A curve on which tangent vector is propagated Parallelly:
   (a) Tensor field (b) Euclidean space (c) Metric space (d) Geodesic

3. The signature of Minkowski line element is
   (a) 1 (b) -1 (c) -2 (d) 4

4. Divergence of Einstein tensor is
   (a) 1 (b) 0 (c) any scalar (d) 4

5. If the events are casually connected than which of the following statement is true
   (a) $\Delta S^2 = 0$ (b) $\Delta S^2 > 0$ (c) both of these (d) none of these

6. According to 2nd Freidman model, which statement is true
   (a) Gravity can never stop expansion of universe
   (b) Contraction occurs and lead to big crunch
   (c) Expansion of universe may not be very large
   (d) None of these

7. Our galaxy has _____ shape
   (a) Spiral (b) irregular (c) spherical (d) elliptical

8. Suppose we have two tensors of rank 3, the rank of their inner product must be
   (a) Reduces (b) increases (c) remain same (d) nullify

9. Example of subluminal particle is
   (a) Electron (b) graviton (c) Tachyon (d) neutrino

10. Slope of world line gives dimensions of
    (a) Speed (b) inverse of speed (c) distance (d) inverse of distance

UNIVERSITY OF THE PUNJAB

Seventh Semester 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Particle Physics-I | **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-407 | **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

Section - II (Subjective Type)

Note: Attempt all questions.

Question 2: $(2 \times 10 = 20)$

Write short answers of the following questions.

(i) What do you know about Yukawa theory?

(ii) Briefly explain the phenomena of asymptotic freedom and quark confinement.

(iii) What is difference between c-parity and G-parity?

(iv) Prove that $[\frac{\sigma_2}{2}, \frac{\sigma_1}{2}] = i\frac{\sigma_1}{2}$, where σ's are the pauli-spin matrices.

(v) Write down the basic assumptions of quark model.

(vi) Assign the isospin quantum numbers to the nucleonic doublet and pionic triplet.

(vii) Draw the meson octet.

(viii) What are lepton and baryon conservation laws?

(ix) State CPT theorem.

(x) What are quarks? Explain quark flavors.

Question 3: (10)

Using Isospin symmetry find the ratios of the cross sections of the following processes

$$\pi^+ + p \rightarrow K^+ + \Sigma^+$$
$$\pi^- + p \rightarrow K^0 + \Sigma^0$$
$$\pi^- + p \rightarrow K^+ + \Sigma^-$$

Question 4: (10)

Maxwell equations can be written in the following 4-vector form using Lorentz gauge

$$\Box^2 A^\mu = j^\mu$$

where $\Box^2$ is d'Alembration operator and $j^\mu = (\rho, \mathbf{j})$ and $A^\mu = (\phi, \mathbf{A})$. Modify this relation for free space and show that in free space $\mathbf{E}, \mathbf{B}$ and propagation vector $\mathbf{k}$ are mutually orthogonal.

Question 5: (10)

Define G-symmetry operation and G parity. Show that G-parity of all three pions is -1.

UNIVERSITY OF THE PUNJAB

Roll No. .....

Seventh Semester 2017

Examination: B.S. 4 Years Programme

PAPER: Particle Physics-I | **TIME ALLOWED: 30 mins.**

Course Code: PHY-407 | **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

Section - I (Objective Type)

Note: Attempt all questions. Cutting or over-writing is not allowed.

Question 1: $(1 \times 10 = 10)$

Each question has four possible answers. Select the correct answer and encircle it.

(i) For scalar fields, spin must be equal to

(a) an integer (b) zero

(c) one (d) half integer

(ii) An important difference between gluon and photon is

(a) gluon is massless (b) gluon has zero electric charge

(c) gluon has spin zero (d) gluon has color charge

(iii) Isospin is symmetry of

(a) weak interaction (b) strong interaction

(c) electromagnetic interaction (d) all of these

(iv) Hadrons can exist if

(a) total electric charge is zero (b) total isospin is zero

(c) total color charge is zero (d) color spin is zero

(v) Which one of the following interactions violate the conservation of parity?

(a) gravitational (b) weak

(c) strong (d) electromagnetic

(vi) Which one of the following processes is not allowed under baryon no conservation

(a) $n \rightarrow p^+ + e^- + \bar{\nu}_e$ (b) $p^+ \rightarrow e^+ + \gamma$

(c) $K^0 \rightarrow \pi^+ + \pi^-$ (d) $\lambda \rightarrow p^+ + \pi^-$

(vii) In terms of isospin, the state vector for Σ^+ is

(a) $|1,1>$ (b) $|1,-1>$

(c) $|1,0>$ (d) $|-1,1>$

(viii) The anti-top quark ($\bar{t}$) carries a charge of

(a) +1/3 (b) +2/3

(c) -1/3 (d) -2/3

(ix) A rotation θ about an axis specified by a unit vector **n** is generated by the operator

(a) $D(\theta) = \exp(-i\theta\frac{\mathbf{n}\cdot\mathbf{P}}{\hbar})$ (b) $D(\theta) = \exp(-i\theta\frac{\mathbf{n}\cdot\sigma}{\hbar})$

(c) $D(\theta) = \exp(-i\theta\frac{\mathbf{n}\cdot\mathbf{L}}{\hbar})$ (d) $D(\theta) = \exp(-i\theta\frac{\mathbf{n}\cdot\tau}{\hbar})$

(x) The covariant form of gauge transformations is given by

(a) $A'^{\mu} = A^{\mu} - \partial^{\mu}\psi$ (b) $A'^{\mu} = A_{\mu} + \partial^{\mu}\psi$

(c) $A'^{\mu} = A^{\mu} + \partial^{\mu}\psi$ (d) $A'^{\mu} = A_{\mu} - \partial_{\mu}\psi$

UNIVERSITY OF THE PUNJAB

Seventh Semester 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Particle Physics-II | **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-408 | **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

Subjective Type

Section I

Q No. 2 Answer the following questions. (24)

i. Show that $\gamma^\mu \gamma^\nu + \gamma^\nu \gamma^\mu = 2\, g^{\mu\nu}$ (3)

ii. Why do we need relativistic wave equation? (3)

iii. Show that $\beta^2 = 1$ (3)

iv. Show that γ^o is hermitian and γ^k is anti-hermitian, where k =1,2,3 (3)

v. Show that $g^{\mu\nu}\, g_{\mu\nu} = 4$ (3)

vi. Show that c^2t^2-$\mathbf{x}^2$ remains invariant under Lorentz transformation. (3)

vii. Show that $(\boldsymbol{\sigma}.\mathbf{P})^2 = |\mathbf{P}|^2$ (3)

viii. How does Dirac theory explain the negative energy solutions? (3)

Section II

Q No. 3 Show that $\Psi^*(x)\, \sigma^{\mu\nu}\, \Psi(x)$ behave as a tensor quantity (6)

Q No. 4 Derive Klein-Gordon equation for a free particle, Is it Lorentz invariant? (10)

Q No. 5 Write down Dirac equation for spinors in two component form in Weyl representation and explain the zero-mass fermions. (10)

UNIVERSITY OF THE PUNJAB

Roll No. .....

Seventh Semester 2017

Examination: B.S. 4 Years Programme

PAPER: Particle Physics-II | **TIME ALLOWED: 30 mins.**

Course Code: PHY-408 | **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

Objective Type

Note: Attempt all questions. Cutting and removing is not allowed

Q No. 1 Choose the correct option.

1- ∂^{μ} = -------

(a) $(\partial/\partial t, \nabla)$

(b) $(\partial/\partial t, -\nabla)$

(c) $(-\partial/\partial t, \nabla)$

(d) $\Box^2$

2- **A particle with negative energy moving backward in time is equivalent to**

(a) A particle with positive energy moving backward in time

(b) A particle with negative energy moving forward in time

(c) An antiparticle with positive energy moving forward in time

(d) None of these

3- **The probability of finding the spin zero particle of relativistic energy E and momentum P is**

(a) $2P|N|^2$

(b) $E|N|^2$

(c) $2E|N|^2$

(d) $P|N|^2$

Where N is the normalization constant associated with the state representing the particle

4- **The expression for the current density J obtained from the Klein-Gordon equation of spin zero particle represented by state ϕ**

(a) $i(\phi^*\nabla\phi - \phi\nabla\phi^*)$

(b) $-i(\phi^*\nabla\phi - \phi\nabla\phi^*)$

(c) $-i(\phi\nabla\phi^* - \phi^*\nabla\phi)$

(d) none of these

5- **One example of Lorentz invariant quantity is**

(a) relativistic mass

(b) probability density

(c) length of four vector

(d) relative velocity

6- **The time dependent Schrödinger equation for a particle is**

(a) Lorentz invariant but non relativistic

(b) relativistic but non invariant

(c) non relativistic and non invariant under Lorentz transformation

(d) relativistic

7- **The energy and momentum in the diagrams of transition of state are conserved at**

(a) Each vertex at Feynman diagram

(b) the intermediate lines between every two vertices

(c) both of these

(d) none of these

8- **In Dirac equation all alphas are**

(a) Identity

(b) Traceless

(c) Non traceless

(d) Inverse of other

9- $i\gamma^0\gamma^1\gamma^2\gamma^3$=

(a) γ^4

(b) I

(c) $\delta^{0123}_{\mu\upsilon\varepsilon\sigma}$

(d) γ^5

10- $(i\gamma^{\mu}\partial_{\mu} - m)\psi = 0$ **is covariant form of**

(a) Klein Gordon equation

(b) Schrödinger equation

(c) Dirac equation

(d) Wave equation

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Seventh Semester 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Advanced Electronics-I (Theory) **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-411 **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

Q.2 Attempt five parts. 4*5=20

i) What is a Counter? How counters broadly classified? Write at least two lines on each of them.

ii) Explain the Clocked RS F/F with timing diagram.

iii) What is RAM & PROM?

iv) Write general structure of PLA.

v) Write the Logic diagram, Truth table, and Logic symbol of Positive edge triggered T type flip flop?

vi) Briefly explain the operation of 4-1 line Multiplexer using AND – OR gate.

vii) Explain the meaning of the term slew rate, input offset voltage, & input offset current.

viii) What is the difference between SRAM and DRAM?

Attempt three questions. 30

Q.3

a) Explain the working of a Emitter Coupled Differential Amplifier? 6

b) If it is desired to divided an 80 K Hz clock signal with flip flop to obtain a 5 KHz signal, how much flip flop are required? 4

Q.4

a) What are weighted and Un-weighted codes? 4

b) Design a Mod-7 Up-Synchronous Counter? 6

Q.5

a) Explain the operation of a BCD to decimal decoder? 4

P.T.O.

b) Explain the working of a semiconductor RAM? 6

Q.6

a) Develop a logic circuit that has a high output when at least two out of three of inputs A,B,and C are Low by: 6

a) Develop a truth table

b) Writing the Boolean expression

c) Minimizing the expression by using the K – Map

d) Draw the logic diagram by using the NAND gates.

b) Minimize the following Boolean expression by use of K- Map, and draw its Logic diagram by using the NAND gates.

$X = A\bar{C}D + \bar{A}B\bar{C}D + \bar{A}\bar{B}D + A\bar{B}CD$ 4

Q.7 Write a note on any two of the following. 5+5

a) CPU

b) Analog to Digital

c) Operational Amplifier Parameters

UNIVERSITY OF THE PUNJAB

Roll No. .....

Seventh Semester 2017

Examination: B.S. 4 Years Programme

PAPER: Advanced Electronics-I (Theory) **TIME ALLOWED: 30 mins.**

Course Code: PHY-411 **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

Max. Marks: 10

Q.1 Multiple Choice, Attempt all Parts.

i) The simplification of Boolean expression $\overline{(\bar{A}B\bar{C})} + \overline{(A\bar{B}C)}$Type equation here.

a) 0 c) A

b) 1 d) BC

ii) The number of control lines for a 8 to 1 Multiplexer is:

a) 2 c) 4

b) 3 d) 5

iii) EPROM contents can be erased by exposing it to:

a) Infrared rays c) Burst of Microwaves

b) Ultraviolet rays d) Intense heat radiations

iv) The speed of conversion is maximum in:

a) Successive approximation A/D converter

b) Parallel comparative A/D converter

c) Counter ramp A/D Converter

d) Dual slop A/D converter

v) The 2's complement of the number 1101101 is:

a) 0101110 c) 0110010

b) 0010011 d) 0111110

vi) If the input of a T- type Flip Flop is 100 Hz, the final output after 3rd F/F in cascade is:

a) 1000Hz c) 500 Hz

b) 12.5 Hz d) 333Hz

vii) Which of the memory is volatile memory:

a) ROM c) PROM

b) RAM d) EEPROM

viii) -8 is equal to a signed binary number:

a) 00001000 c) 10000000

b) 10001000 d) 10001001

ix) The device which changes from serial data to parallel data is:

a) Counter c) Multiplexer

b) De- Multiplexer d) Flip Flop

x) A device which convert the BCD to seven Segment is called:

a) Encoder c) Multiplexer

b) Decoder d) De- Multiplexer

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Seventh Semester 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Solid State Physics-I | **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-419 | **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

Write short answers to the following questions: **(2×10=20)**

I. What is reciprocal vectors, give it expression in 3D.
II. What is Bloch electron?
III. What are the problems in Hartee-Fock equation?
IV. Give problems in solid state physics.
V. Define Fermi velocity.
VI. What are the two aspects due to which FEG (free electron gas model) differs from ordinary gas?
VII. Using free electron model , set an equation of motion and find out its steady state solution.
VIII. What is meant by a Bloch's electron? State the result of Bloch's theorem in words.
IX. How do you define effective mass of an electron? If **ℰ-k** diagram is concave upwards, is effective mass positive or negative. Similarly, what is the answer when this diagram is convex upwards?
X. What is APW method?

Q- Describe the concept of effective mass of an electron in solids in detail. (10)

Q-4 Discuss nearly free electron model (NFE) in detail. (10)

Q-5 Find out the expression for velocity of Bloch electron and explain in detail. Show by figure the corresponding velocity of a typical one dimensional band structure. And also show that for a whole band, the current density vanishes. (10)

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Roll No. .....

Seventh Semester 2017

Examination: B.S. 4 Years Programme

PAPER: Solid State Physics-I | **TIME ALLOWED: 30 mins.**

Course Code: PHY-419 | **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

Q-1 Four possible answers A, B, C, and D to each question are given. Encircle the correct answer. Cutting and overwriting is not allowed. 10

I. Bloch wave is a type of wave-function for a particle in a periodically-repeating environment, most commonly in a ----------medium

(a) gas medium (b) liquid medium (c) crystal medium (d) plasma medium

II. Free electron model is a simple model for the behaviour of valence electrons in a crystal structure of a metallic solid is also known as

(a) Arnold Sommerfeld (b) Classical model Drude model

(c) Fermi-Dirac Statistics (d) Drude-Sommerfeld model

III. Which is not true for electrons in a periodic boundary condition

(a) continuous k states (b) discrete k states or quasi-continuous

(c) minimum energy is zero (d) there are finite k states possible.

IV. The density of states (DOS) of a system describes the number of states per interval of energy at each energy level that are available to be

(a) excited (b) vacant (c) filled (d) occupied

V. The shape of Fermi energy surface in free electron theory for a 3-d solid is a

(a) cube (b) ellipsoid (c) plane (d) sphere

VI. Why is potential energy of electron is taken as zero in free electron theory?

(a) e is free (b) e is independent (c) neither A nor B (d) there is no e-e and e-ion interaction

VII. To describe electronic structure of materials, we use reciprocal lattice because

(a) electrons interact with lattice only in reciprocal space (b) electron energy is expressed in terms of reciprocal lattice vector (K) (c) K vectors are good vectors for Fourier analysis of electron wave (d) electrons exist only in reciprocal space

VIII. Pseudopotential is a soft potential used only for

(a) valence electron (b) ions (c) conduction electron (d) ions and electron

IX. The eigenfunctions of the wave equation for a periodic potential are the product of plane wave exp(ik.r) times a function U_k with periodicity of the crystal lattice.

(a) Bloch theorem (b) Frenkel theorem (c) Josephson theorem (d) Hall theorem

X. Momentum is decreased when effective mass is

(a) Increased (b) decreased (c) remains same (d) a little bit increased

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Seventh Semester 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Solid State Physics-II | **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-421 | **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

SUBJECTIVE TYPE

Q. 2. **Write short answers to the following questions:** **(2×10=20)**

I. Differentiate and mathematically express the electric polarization P and the dielectric susceptibility χ.

II. How would you differentiate superconducting and normal states?

III. What is critical field and critical temperatures? How the critical field does is influenced by the varying temperature?

IV. Differentiate Frenkel and Mott-Wannier excitons.

V. What are TYPE-1 and TYPE-2 superconductors?

VI. Differentiate reflectivity coefficient and the reflectance.

VII. What is Meissner effect?

VIII. How does the superconducting magnetization curve of Pb modify due to Indium content?

IX. Briefly describe thermodynamics of the superconducting phase transition?

X. What do you know about Vortex state?

Q-3 How would you estimate H_{C1} and H_{C2} for a TYPE-II superconductor? (10)

Q-4 Find an expression for the intrinsic coherence length. (10)

Q-5 Show that current across a junction oscillates with certain frequency according to the Josephson effect. (10)

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Roll No. .....

Seventh Semester 2017
Examination: B.S. 4 Years Programme

PAPER: Solid State Physics-II **TIME ALLOWED: 30 mins.**
Course Code: PHY-421 **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

OBJECTIVE TYPE

Q-1 Four possible answers A, B, C, and D to each question are given. Encircle the correct answer. Cutting and overwriting is not allowed. (10)

1. A high dielectric constant material is must for _____.
   (A) Insulation of wires (B) Generators (C) Switch bases (D) Generators

2. Example for Piezo-electric material is
   (A) Rochelle salt (B) Lead zirconate (C) Potassium niobate (D) Barium Titanium oxide

3. The Meissner effect is the ---------- of a magnetic field from a super-conductor
   (A) interaction (B) repulsion (C) attraction (D) exclusion

4. London equation relate current to the electromagnetic fields in and around
   (A) superconductor (B) insulator (C) Lead zirconate (D) quartz

5. An independent characteristic length is called
   (A) Debye length (B) Bohr length (C) Coherence length (D) Threshold length

6. It is confirmed that quantum objects forming superconducting condensate are
   (A) electrons pairs (B) isolated electrons (C) protons pairs (D) isolated protons

7. The basic mechanism responsible for optical properties in a dielectric is
   (A) Orientation polarization (B) Ionic polarization (C) Electronic polarization (D) None

8. Optical properties of a material are completely expressed by
   (A) Reflectance (B) Transmittance (C) n (D) real and imaginary dielectric constant

9. Raman effect is ---------- scattering of a photon by molecules which are excited to higher vibrational or rotational energy levels.
   (A) elastic (B) In-elastic (C) opposite (D) oblique

10. Ferroelectric materials are characterized by
    (A)Very high degree of polarization (B) A sharp dependence of polarization on temperature
    (C) Non-linear dependence of the charge Q on the applied voltage (D) All the above.

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Roll No. .....

Eighth Semester - 2017
Examination: B.S. 4 Years Programme

PAPER: Computational Physics-II | **TIME ALLOWED: 30 mins.**
Course Code: PHY-422 | **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

OBJECTIVE

Q1: Each question has FOUR possible answers. Select the correct answer and encircle it. 1x 10 = 10
MCQs.

i. Which of the following is not correct to create row vector **a** = [0 0 0 0 0]:
a) a(1:5) = 0 (b) a = zeros(1,5) (c) a =zero(1,5) (d) a = [0,0,0,0,0]

ii. In **y = sin(45)**, the angle 45 will be in :
a) degrees (b) radians (c) integers (d) numbers

iii. If **x =[6 3 2]** & **y = [3 6 2]**, which of the following is true for **z = sum(x>=y)**.
(a) **Z=3** (b) **Z=[1 0 1]** (c) **Z = 2** (d) none

iv. Which of the following is used to get input from graph curve?
a) **gtext()** (b) **input()** (c) **hold on** (d) **ginput()**

v. If **x =[4 2 0 3 6]** which of the following is true for **Z = find(~x)**.
(a) **Z=[1 2 4 5]** (b) **Z=[0 0 1 0 0]** (c) **Z = 3** (d) All of (a), (b) & (c)

vi. The command used to terminate the scope of a **for, while or if statement** is:
(a) break (b) stop (c) ; (d) end

vii. The following command performs intelligent plotting of function.
(a) plot() (b) ezplot() (c) fplot() (d) subplot()

viii. The following command can draw background lines on the graph axis:
(a) line ( ) (b) axis( ) (c) axes ( ) (d) grid on

ix Which of the following is used to plot in three dimensions (x,y,z):
(b) plot(x,y,z) (b) plotthree(x,y,z) (c) plot3(x,y,z) (d) all

x Which of the following is required to create a row vector of n equal spaced values between a and b:

a) equal(a,b) (b) linspace(a,b,n) (c) none (d) both (a) & (b)

UNIVERSITY OF THE PUNJAB

Eighth Semester - 2017
Examination: B.S. 4 Years Programme | **Roll No. .....**

PAPER: Computational Physics-II | **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-422 | **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

SUBJECTIVE

Q.2. i.	Write short answers of the following Questions: Give simple example to find index of maximum value of the array?	2
ii.	Write syntax with example for the following in MATLAB: (a) for (b) sum() (c) rand() (d) dsolve(),	8
iii.	Write MATLAB program code segment for the following: (a) to generate a matrix (8 x 6) with all 1's as entries and plot matrix (b) to give one example to calculate polynomial derivative (c) to x vs y such as y= $7x^4 - 2x^3 - x + 1$ and x = [-15 15] (d) to define two arrays and determine sum of two array values (e) to evaluate $\int_0^{\pi} \exp(x)\sin(2\sqrt{x})dx$	10
Q.3.	If y = 4 x^5 Write MATLAB symbolic operations to calculate (i) first derivative w.r.t. x (ii) perform integration of your result. If y=f(x) = x^3- 6 x^2 +9 x +2, Write program to plot x vs y using x=[-1 5]. Find and plot marks at extremes. Find maximum of y. How randomly generated points can be used to show Brownian motion? Write MATLAB program to simulate Brownian motion of a particle. Note: Plot estimate graph if any.	6+4
Q.4. (a)	A mass m is suspended by three cables with tensions T_1, T_2 and T_3, which are related by the following equations: $\mathbf{T_1/\sqrt{35} - 3T_2\sqrt{34} + T_3/\sqrt{42} = 0}$ $\mathbf{3T_1/\sqrt{35} - 4T_3/\sqrt{42} = 0}$ $\mathbf{T_1/\sqrt{35} - 3T_2\sqrt{34} + T_3/\sqrt{42} = mg}$ Write MATLAB program to solve for the tensions using three methods . Take mg=1.	4+6
(b)	Write MATLAB program to determine equivalent capacitances of n resistances connected in series (Read capacitances from the user). Using rand(), create a matrix N (5 x 7). Then i) plot N, plot 3rd row and 5th rows. ii) find maximum of column 6 and iii) sort N. Also find the maximum and mean value of N.	
Q.5. (a)	Write MATLAB program to study the damped harmonic motion (DHM) of a mass attached with a spring using Euler's method under the following conditions: (g=9.8 m/s^2, initial position zero and velocity 15 m/s, time step 0.1 sec. and maximum time 15 sec., k = 1 N/m, m=1kg, damping coefficient = 0.5 N/ms,). Print and plot values for time, position, velocity and acceleration. How you can change the same program for Simple harmonic motion?	7+3
(b)	Write a program to a 3D plot in matlab. Take three variables as x,y and z.	

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Roll No. .....

Eighth Semester - 2017
Examination: B.S. 4 Years Programme

PAPER: Classical Electrodynamics-II | **TIME ALLOWED: 30 mins.**
Course Code: PHY-423 | **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

Section-I

Q: 1. Select the correct answer. (1x10= 10)

i) Electric charge is conserved according to the equation
(a) $\nabla \cdot D = \rho$ (b) $\nabla \cdot J = -\frac{\partial \rho}{\partial t}$ (c) $\nabla \cdot B = 0$ (d) none of these

ii) Electromagnetic field energy density in a linear medium is given by
(a) $(E \cdot D + B \cdot H)/2$ (b) $E \cdot D/2$ (c) $B \cdot H/2$ (d) none of these

iii) Speed of light in vacuum is
(a) $1/\sqrt{\epsilon_o \mu_o}$ (b) $\sqrt{\epsilon_o \mu_o}$ (c) $\sqrt{\epsilon_o \mu}$ (d) $1/\sqrt{\epsilon_o \mu}$

iv) The dielectric constant K is related to the index of refraction n by
(a) $n = \sqrt{K}$ (b) $K = \sqrt{n}$ (c) $n = K^3$ (d) none of these

v) In vacuum, the dispersion relation is
(a) $k = \omega/c$ (b) $k = \sqrt{K}\ \omega/c$ (c) $k = c/\omega$ (d) $K = \sqrt{k}\ \omega/c$

vi) Snell's law is
(a) $\frac{\sin\theta_1}{\sin\theta_2} = \frac{n_2}{n_1}$ (b) $\frac{\sin\theta_1}{\sin\theta_2} = \frac{n_1}{n_2}$ (c) $\frac{\sin\theta_1}{\sin\theta_2} = \frac{\sqrt{n_2}}{\sqrt{n_1}}$ (d) none of these

vii) In plasma, orbit theory is based on charged particle motions under the force
(a) $q(E + V \times B)$ (b) $q(V \times B)$ (c) qE (d) $E + V \times B$

viii) The vectors k, E and B form a right handed orthogonal set for
(a) electrostatic waves (b) EM waves (c) acoustic waves (d) none of these

ix) No mono pole exists is physical interpretation of
(a) Gauss's law for electricity (b) Gauss's law for magnetism (c) Faraday's law (d) Ampere's law

x) Debye length depends upon
(a) density of plasma (b) electric field (c) frequency (d) all of these

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Eighth Semester - 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Classical Electrodynamics-II | **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-423 | **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

Section-II

Q: 2. Answer briefly the following questions. **(20)**

i. Describe briefly the Pinch effect. 5
ii. What is meant by a plane wave? 4
iii. What are right and left circularly polarized waves? 4
iv. What are black body radiations? 3
v. What are retarded vector and scalar potentials. 4

Section-III

Q3- Give detail answers of the following questions?

Q1- Discuss in detail the polarization of electromagnetic waves. 10

Q2- Define Debye Shielding. What is Debye sphere? Calculate radius of Debye sphere. 10

Q3- What is Ruby laser? Explain its construction and working in detail. 10

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Roll No. .....

Eighth Semester - 2017
Examination: B.S. 4 Years Programme

PAPER: Nuclear Physics-II | **TIME ALLOWED: 30 mins.**
Course Code: PHY-424 | **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

(Objective Type)

Q 1: Encircle the correct answer out of the four options given. No mark will be given for cutting, over-writing and for use of lead pencil or ink remover.

(1 x 10 = 10)

i. In D-D reaction, energy released per nucleon is equal to

a) 3 MeV b) 3.5 MeV c) 1 MeV d) 4.5 MeV

ii. The level-width has units of _____.

a) Mass b) Energy c) Time d) Speed

iii. Most of the energy released in fission reaction is in the form of _____.

a) Kinetic energy of fission fragments b) kinetic energy of neutrons

c) Gamma rays d) energy of neutrinos

iv. Which of the following is not a magic no. nucleus?

a) Sodium -23 b) Helium-4 c) Oxygen-8 d) both a and c

P.T.O.

UNIVERSITY OF THE PUNJAB

Eighth Semester - 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Nuclear Physics-II | **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-424 | **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

(Subjective)

Q 2: Write down short answers of the following: **(2x10=20)**

i) Why do the reaction with Q > 0 have neither threshold nor double valued behavior?

ii) Write down D-D reactions.

iii) What is a photo induced nuclear reaction? Write down one example.

iv) State law of conservation of parity for a nuclear reaction.

v) Write down some properties of an ideal moderator to thermalize fast neutrons.

vi) The slow neutrons are not preferable to induce fission in $^{238}_{92}U$. Why?

vii) Differentiate between thermal and fast neutrons.

viii) What are the limitations of Liquid Drop model?

ix) Define differential cross-section for a nuclear reaction.

x) A beam of deuteron is incident on $^{31}_{15}P$ target. Write down the nuclear reaction equation, when the emitted particle is:

i) An α particle

ii) A neutron

P.T.O.

UNIVERSITY OF THE PUNJAB

Roll No. .....

Eighth Semester - 2017
Examination: B.S. 4 Years Programme

PAPER: Particle Physics-III | **TIME ALLOWED: 30 mins.**
Course Code: PHY-427 | **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

Section - I (Objective Type)

Note: Attempt all questions. Cutting or over-writing is not allowed.

Question 1: $(1 \times 10 = 10)$

Each question has four possible answers. Select the correct answer and encircle it.

(i) In SU(2) group, S represents condition of
(a) $UU^{-1} = 1$ (b) $U = U^{-1}$
(c) $|U| = +1$ (d) $U = U^{\dagger}$

(ii) The plane wave solution in asymptotic region is a superposition of
(a) two spherical waves (b) four spherical waves
(c) infinite partial waves (d) none of them

(iii) In GUT, unification is possible at
(a) 1 fm (b) 10^{-29} cm
(c) 10 cm (d) 15 fm

(iv) When δ_l is positive, the potential is
(a) repulsive (b) central
(c) attractive (d) spherically symmetric

(v) The direct product of two fundamental 3-dimensional representations of SU(3) decomposes into
(a) nonent and singlet (b) octet and singlet
(c) decuplet and singlet (d) triplet and singlet

(vi) Partial wave analysis is suitable for
(a) central potential (b) low energy of incident particles
(c) potential of finite range (d) all of them

(vii) The action of I_+ produces change of
(a) $\Delta Y = 0,\ \Delta I_3 = 1$ (b) $\Delta Y = 0,\ \Delta I_3 = -1$
(c) $\Delta Y = 0,\ \Delta I_3 = +1/2$ (d) $\Delta Y = 0,\ \Delta I_3 = -1/2$

(viii) For a system of two particles having spins $s_1 = \frac{1}{2}$ and $s_2 = 1$, the total spin of the system is
(a) $s = \frac{1}{2}, -\frac{1}{2}$ (b) $s = \frac{1}{2}, \frac{3}{2}$
(c) $s = \frac{1}{2}, 1$ (d) $s = \frac{3}{2}, 1$

(ix) The generators of the SU(2) group are
(a) Unitary matrices (b) Gell-Mann matrice
(c) Special matrices (d) Pauli matrices

(x) Optical theorem relates total cross section with
(a) $f(\theta = 0)$ (b) $\mathrm{Im} f(\theta = 180)$
(c) $\mathrm{Re} f(\theta = 0)$ (d) $\mathrm{Im} f(\theta = 0)$

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Eighth Semester - 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Particle Physics-III | **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-427 | **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

Section - II (Subjective Type)

Note: Attempt all questions.

Question 2: $(2 \times 10 = 20)$

Give short answers of the following questions.

(i) What is partial wave analysis? When it can be used?

(ii) Draw weight diagram of quark-antiquark representation.

(iii) Define differential cross section in a scattering problem.

(iv) Show that differential cross section has dimensions of area.

(v) What is Standard model of Particle Physics?

(vi) Verify standard form of Lie algebra of SU(2) group by showing $[H_1, E_+] = +1E_+$.

(vii) Draw baryon resonance curve. What does its peak and full-width half-maximum represents?

(viii) What is Higgs boson?

(ix) Write down lagrangian for spin-0 particle.

(x) Show that $[I_3, V_-] = -\frac{1}{2}V_-$.

Question 3: **(10)**

How baryons can be constructed using Quark model? Explain the observed Baryon spectrum by considering the symmetry of different parts of the wave function.

Question 4: **(10)**

Explain the general process of scattering. Discuss the wave forms obtained for the incident and scattered waves. Also write down the general expression for incident and reflected wave.

Question 5: **(10)**

For an elastic scattering between spinless particles, the scattering amplitude is

$$f(\theta) = \sum_l \frac{(2l+1)}{2ik}(e^{2i\delta_l} - 1)P_l(\cos\theta)$$

Use this to calculate the differential and total cross sections. Also use the expression for total cross section to derive the Optical theorem.

UNIVERSITY OF THE PUNJAB

Roll No. .....

Eighth Semester - 2017

Examination: B.S. 4 Years Programme

PAPER: Particle Physics-IV | **TIME ALLOWED: 30 mins.**

Course Code: PHY-428 | **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

Section - I (Objective Type)

Note: Attempt all questions. Cutting or over-writing is not allowed.

Question 1: $(1 \times 10 = 10)$

Each question has four possible answers. Select the correct answer and encircle it.

(i) Which of the following is not a gauage theory?

(a) Quantum Electrodynamics (b) Weak force

(c) Quantum Chromodynamics (d) Gravitational force

(ii) For a particle at rest, relativistic energy (in natural units) is _____.

(a) zero (b) $\sqrt{p^2 + m_0^2}$

(c) m_0 (d) $2m_0$

(iii) In center-of-mass frame total momentum of initial state is =_____.

(a) total momentum of final state (b) zero

(c) Both (a) & (b) (d) None of them

(iv) Mandelstam variable "t" is defined as_____.

(a) $(P_A + P_B)^2$ (b) $(P_A - P_C)^2$

(c) $(P_A - P_D)^2$ (d) None of the above

(v) A free electron of four-momentum P^μ is described by a four-component wavefunction is

(a) $u(\underline{p})e^{ip.x}$ (b) $u(\underline{p})e^{-ip.x}$

(c) $u(p)e^{ip.x}$ (d) $u(p)e^{-ip.x}$

(vi) The unit of electromagnetic coupling constant α in MKSA system is _____.

(a) Nm^2C^2 (b) $C^2N^{-1}m^{-2}$

(c) No unit

(vii) According to Lorentz gauge _____.

(a) $\nabla.\mathbf{A} = 0$ (b) $\partial_\mu A^\mu = 0$

(c) $\Box^2 A^\mu = 0$ (d) Both (b) & (c)

(viii) In a non-relativistic limit _____. of

(a) $\underline{p} \to 0$ (b) $|\underline{p}| \to 0$

(c) $m \to 0$ (d) Both (b) & (c)

(ix) The Dirac delta $\delta^4(p_1 - p_2 + p_3 - p_4)$ along the invariant amplitude shows the conservation of four-momentum of the process_____

(a) $1 \to 2 + 3 + 4$ (b) $1 + 3 \to 2 + 4$

(c) $1 + 2 \to 3 + 4$ (d) $1 + 4 \to 2 + 3$

(x) The lowest order invariant amplitude of electron scattering by electromagnetic field has _____ vetex factor(s).

(a) zero (b) one

(c) two (d) three

UNIVERSITY OF THE PUNJAB

Eighth Semester - 2017
Examination: B.S. 4 Years Programme Roll No. .....

PAPER: Particle Physics-IV **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-428 **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

Section - II (Subjective Type)

Note: Attempt all questions.

Question 2: $(2 \times 10 = 20)$

Give short answers of the following questions.

(i) Calculate scalar product of two four-vectors $A^\mu \equiv (A^0, \mathbf{A})$ and $B^\mu \equiv (B^0, \mathbf{B})$.

(ii) Write an expression for decay rate of the process $A \to 1 + 2 + 3 + 4$.

(iii) Find $\int d^4x$ for volume V in the time interval $0 - T$.

(iv) Show that $s + t + u = m_A^2 + m_B^2 + m_C^2 + m_D^2$ for s-channel process.

(v) Show that $Tr(\gamma^5) = 0$.

(vi) $\gamma_\mu \not{a} \gamma^\mu = -2a$.

(vii) Write down the Feynman rule for a vertex factor of spin-zero particle.

(viii) Write $\overline{u}(k')\gamma^\mu u(k)$ in terms of the components of a matrix.

(ix) Draw the lowest order Feynman diagram(s) for scattering process $e^-e^- \to e^-e^-$.

(x) If $u^{(s)} = \sqrt{2m}\begin{pmatrix} \chi_0^{(s)} \end{pmatrix}$, calculate $\overline{u}^{(s)}\gamma^\mu u^{(s)}$ for $\mu = 0$.

Question 3: (10)

Use the Feynman rules to obtain the invariant amplitude for

(a)-spinless process $e^-e^+ \to e^-e^+$.

(b)-spin-1/2 process $e^-e^- \to e^-e^-$(Moller Scattering).

Question 4: (10)

(a)-A particle is described by the wave function $\phi = Ne^{-ip.x}$. Calculate its probability density by using

$$\rho = i(\phi^* \frac{\partial \phi}{\partial t} - \phi \frac{\partial \phi^*}{\partial t}).$$

(b)-Calculate the transition rate per unit volume for a scattering process $A + B \to C + D$ by using

$$T_{fi} = -iN_A N_B N_C N_D (2\pi)^4 \delta^{(4)}(p_C - p_D - p_A - p_B)\mathcal{M},$$

where $\mathcal{M}$ is invariant amplitude of the process.

Question 5: (10)

For Moller scattering, the invariant amplitude for the lowest order Feynman diagram is

$$\mathcal{M} = -\frac{e^2(\overline{u}_C\gamma^\mu u_A)(\overline{u}_D\gamma_\mu u_B)}{(p_A - p_C)^2} + \frac{e^2(\overline{u}_D\gamma^\mu u_A)(\overline{u}_C\gamma_\mu u_B)}{(p_A - p_D)^2}.$$

Show that the unpolarized differential cross-section in the non-relativistic limit is

$$\frac{d\sigma}{d\Omega}\Big|_{C.M} = \frac{m^2\alpha^2}{16p^4}\left[\frac{1}{Sin^4(\theta/2)} + \frac{1}{Cos^4(\theta/2)} - \frac{1}{Sin^2(\theta/2)Cos^2(\theta/2)}\right]$$

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Roll No. .....

Eighth Semester - 2017

Examination: B.S. 4 Years Programme

PAPER: Advanced Electronics-III (Theory) **TIME ALLOWED: 30 mins.**

Course Code: PHY-431 **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

Q.1 Note: Attempt all questions.

MCQ

Encircle the right choice:- (10)

I. Which of the following device behavior is governed by the bulk effect:

a) Tunnel Diode c) Impatt Diode

b) Gunn Diode d) PIN Diode

II. In which of these is reverse recovery time is nearly zero?

a) Tunnel Diode c) Zener Diode

b) Schottky Diode d) PIN Dide

III. In a degenerate n-type semiconductor material, the Fermi level is:

a) In valance band c) In conduction band

b) At the center in between valance and conduction band d) near valance band

IV. As frequency increases the transmission efficiency is:

a) Decreases c) Increases

b) Not effected d) either a or b

V. The major advantage of FM over AM is:

a) Reception is less noisy c) smaller bandwidth

b) Higher carrier frequency d) small frequency deviation

VI. In a TWT the amplitude of resultant wave travelling down the helix:

a) Increases linearly c) decreases exponentially

b) Increases exponentially d) is almost constant

VII. The range of audio frequency is :

a) 20-20 MHz b) 20- 20 KHz c) 20 KHz to 20 MHz d) 20 KHz to 20 GHz

VIII. The frequency at which Microwave oven operates is:

a) 50 nHz b) 2.45 GHz c) 3.3 GHz d) 4.5GHz

IX. The layer of the ionosphere mainly responsible for long distance communication is:

a) C b) D c) E d) F

X. In Klystron Amplifier, the input cavity is called:

a) Buncher

b) Pierce Gun

c) Catcher

d) Collector

UNIVERSITY OF THE PUNJAB

Eighth Semester - 2017
Examination: B.S. 4 Years Programme

Roll No. .....

PAPER: Advanced Electronics-III (Theory) **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-431 **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

Q. 2 Answer the following short questions:- (20)

a. How many junctions are in a GUNN Diode? Explain its I-V characteristics.

b. What are Surface waves and Space waves?

c. What are the properties of Microwaves?

d. What is the difference between MESFET and MOSFET?

e. Explain the construction of ESAKI DIODE?

Q.3 What is ionosphere? Explain the formation of its different layers and their variation. Also discuss its role in the spread of Radio waves. (10)

Q.4 Describe the role of each stage in AM Superhetrodyne radio receiver? (10)

Q.5 What is a microwave and its speetrum? How a magnetron tube be used in microwave, and Radar system. (10)

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Eighth Semester - 2017

Examination: B.S. 4 Years Programme

PAPER: Solid State Physics-III **TIME ALLOWED: 30 mins.**

Course Code: PHY-439 **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

Question no.1

Encircle the correct option form the given multiple choice questions. **(1 X 10 = 10)**

1. The DPPH is often used for the calibration of

   a) Magnetic field b) Electric field c) EM-filed d) Charge field

2. For transition metals the value of magnetic susceptibility is considerably

   a) High b) Low c) Intermediate d) Zero

3. The electric dipole movement per unit local electric field is described as

   a) Polariability b) Local magnet c) Polarization d) Dipolar field

4. For **k** approaches to zero, the type of waves we got were

   a) Monochromatic b) Plane c) Psuedo d) Oscillating

5. For the case of single atom the electronic states due to coulomb potential yields a spectra of type

   a) Discrete b) Continuous c) Magnons d) Mixed

6. If **Δk** approaches to zero for the case of an isolated atom then we have

   a) Discrete Energy b) Infinite resistance c) Maximum conductivity d) Normal susceptibility

7. Light scatters more efficiently at short wavelength is described in

   a) Mie theory b) Rutherford spectrum c) Faraday laws d) Huygens theory

8. Free charge carriers density in semiconductors can be increased by injecting

   a) Both b and c b) Dopants c) Pn-junction d) None of these

9. If the mass of a body is decreasing then its

   a) Both b and c b) Conductivity increases c) Fermi velocity increases d) Current density increases

10. For ferromagnets if magnetization goes to zero we have

    a) Curie point b) Reminance c) Coercitivity d) Large hysterisis

UNIVERSITY OF THE PUNJAB

Eighth Semester - 2017
Examination: B.S. 4 Years Programme Roll No. .....

PAPER: Solid State Physics-III **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-439 **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

Question no: 2 Answer the following short questions. **(2 X 10 = 20)**

1) Discuss the physical importance of collision component in Boltzmann equation?
2) Derive the equation of motion of free electron. Also calculate and plot effective mass and write the expression for the effective mass symmetrical tensor?
3) Why electrical conductivity of metal is not infinite? Briefly describe that in the process of light emission energy produces light (photon) or heat (phonon)?
4) What is the procedure for density of states filling and band movement in case of pauli-paramagnets?
5) Define De Haas Van Alphan Effect? Also define the degeneracy factor in this case?
6) What is the effect on the solid if it is placed in an external influencing field media?
7) Define the conductivity equation? What do you mean by the optical properties of semi-conductors?
8) Define landau levels? Why does free electrons exhibits diamagnetism in this regard?
9) Define exchange narrowing and zero-field splitting?
10) Define Quantum Hall Effect and write down Maxwell's equations in free space?

(Section-III)

Question no. 3

What do you know about free electron approximation in magnetic field? Show that the energy of the electron states is the sum of translational energy along the magnetic field and the quantization energy of cyclotron motion in the plane normal to field?

(10)

Question no.4

(a) Discuss the free carrier absorption function in detail.
(b) Briefly describe the absorption phenomenon for the case of semiconductors.

(5+5)

Question no. 5

(a) Discuss in detail the Landau theory of diamagnetism for the case of free electrons. Define HAGEN-RUBENS relation? Also write its expression and define each term in it?
(b) Show that $\sqrt{3}\pi/8$ of the available volume is occupied by hard spheres in contact in a body-centered cubic arrangement.

(7+3)

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Eighth Semester - 2017
Examination: B.S. 4 Years Programme

PAPER: Solid State Physics-IV **TIME ALLOWED: 30 mins.**
Course Code: PHY-440 **MAX. MARKS: 10**

Attempt this Paper on this Question Sheet only.

(OBJECTIVE PART)

Q.1 Encircle the correct answer (from the given multiple choices) in each part. **(1×10 = 10)**

A) For two parallel spins, the exchange energy is given by

i) $-JS$ ii) $-2JS$ iii) $-2JS^2$ iv) $-(1/2)JS^2$

B) Inelastic neutron scattering by a magnetic structure results in

i) creation of elastic wave ii) creation of spin wave iii) absorption of a neutron

iv) none of these

C) Ground state of a simple ferromagnet has all spins

i) parallel ii) antiparallel iii) parallel and antiparallel iv) none of these

D) How many possible orientations do spin 1/2 nuclei have when they are located in an applied magnetic field?

i) 0 ii) 1 iii) 2 iv) 3 v) none of these

E) What is the name given to the relaxation process due to an interaction between an excited nucleus and the magnetic fields caused by nuclei in molecules moving around in the sample?

i) Spin-lattice relaxation ii) Spin-spin relaxation iii) Spin-orbit relaxation
iv) None of these

F) If radiation energy is absorbed by a spin 1/2 nucleus in a magnetic field, then

i) the precessional frequency of the nucleus increases ii) the nucleus spins faster iii) the angle of precession "flips" so that the magnetic moment of nucleus opposes the applied field iv) none of these

G) For ferromagnetism to occur, exchange integral J in Heisenberg model, $U = -2JS_i.S_j$ is
i) positive ii) negative iii) infinite iv) zero v) none of these

H) According to Bloch's law, the fractional change in magnetization, $\Delta M/M(o)$ varies as:
i) T^3 ii) $T^{3/2}$ iii) T^2 iv) none of these

I) For long wavelengths, the frequency of the spin wave in antiferromagnets is proportional to
i) k ii) k^2 iii) k^3 iv) independent of wave-vector k

J) Magnons carry energy and momentum which is quantum mechanically treated as:

i) non-interacting particles ii) interacting particles iii) weakly interacting particles iv) none of these

UNIVERSITY OF THE PUNJAB

Eighth Semester - 2017
Examination: B.S. 4 Years Programme | **Roll No. .....**

PAPER: Solid State Physics-IV | **TIME ALLOWED: 2 hrs. & 30 mins.**
Course Code: PHY-440 | **MAX. MARKS: 50**

Attempt this Paper on Separate Answer Sheet provided.

(SUBJECTIVE PART)

Note: Attempt all questions. Write to the point answer of theoretical part of each question.

Q.2 Give to the point answer / short description of each question. **(4 × 5 = 20)**

a) Define the terms: i) magnetic permeability and ii) magnetic susceptibility

b) What is the origin of ferromagnetic magnetic domains? Discuss briefly.

c) What is meant by quantitation of spin waves? Explain briefly.

d) How magnetic susceptibility of diamagnetic, ferromagnetic and paramagnetic materials depends on temperature? Give graphical representation to explain how susceptibility varies with temperature in each case.

e) Describe briefly the neutron magnetic scattering.

Q.3

For a spin system, establish the Bloch equations: $dM_x/dt = \gamma(M \times B_a)_x - M_x/T_2$, $dM_y/dt = \gamma(M \times B_a)_y - M_y/T_2$ and $dM_z/dt = \gamma(M \times B_a)_z + (M_o - M_x)/T_1$, where T_1 and T_2 is the longitudinal and transverse relaxation time, respectively. Determine the frequency of free precession of a spin system in an applied static field $B_a = B_o$ along z-direction and $M_z = M_o$. **(7+3 = 10)**

Q.4

Derive magnon dispersion relation in anti-ferromagnets by taking into account the nearest neighbor interaction only and discuss its behavior for long wavelengths. **(8+2 =10)**

Q.5

a) Calculate the fractional change in magnetization for thermally excited (at temperature *T*) magnons in ferromagnets. **(6)**

b) Discuss shape effects in ferromagnetic resonance (FMR). **(4)**