



# UNIVERSITY OF THE PUNJAB

Roll No. ....

First Semester 2018  
Examination: B.S. 4 Years Programme

PAPER: Elementary Mechanics  
Course Code: PHY-101/11003

TIME ALLOWED: 30 mins.  
MAX. MARKS: 10

*Attempt this Paper on this Question Sheet only.*

## SECTION I (Tick the correct statement)

- 1) The value of  $\text{div}(\text{curl } \vec{F})$  is always
  - a)  $\vec{F}$
  - b)  $\text{curl } \vec{F}$
  - c) 0
  - d) none of these
- 2) The divergence of position vector  $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$ 
  - a) 3
  - b) zero
  - c) non-zero
  - d) none of these
- 3) A stone is thrown upward which rises to height of 300m. The relative velocity of stone with respect to earth will be maximum at
  - a) 300
  - b) the ground
  - c) the highest point
  - d) None of these
- 4) The decrease in P.E of a ball of mass, 20kg which falls from a height 50 cm is
  - a) 900J
  - b) 1980J
  - c) zero
  - d) 98 J
- 5) The maximum weight of body is
  - a) at poles
  - b) at moon
  - c) at equator
  - d) none of these
- 6) On moving from pole to equator, the weight of body
  - a) constantly decreases
  - b) constantly increases
  - c) remain same
  - d) none of these
- 7) The relation between linear and angular velocity is
  - a)  $v = \omega r$
  - b)  $v = r\omega$
  - c)  $\omega = v/r$
  - d) all of above
- 8) The ratio of angular velocity of hour hand and minute hand of a watch is
  - a) 1:12
  - b) 1:1
  - c) 720:1
  - d) none of these
- 9) Torque per unit moment of inertia is equivalent to
  - a) Radius of gyration
  - b) angular acceleration
  - c) angular velocity
  - d) inertia
- 10) The centre of mass rigid solid circular cone of height h is
  - a)  $h/2$
  - b)  $2h/3$
  - c)  $3h/4$
  - d) none of these



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First Semester 2018  
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Roll No. ....

PAPER: Elementary Mechanics  
Course Code: PHY-101/11003

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

*Attempt this Paper on Separate Answer Sheet provided.*

## Section -II

Q1: write the answers of the following questions (2 × 10 = 20)

- i) Prove work energy theorem?
- ii) Prove that curl of gradient of scalar function is always zero
- iii) Define Coriolis forces with one example?
- iv) In conical pendulum, what happens to period and speed when  $\theta = 90^\circ$
- v) What are non-conservative forces? Give examples.
- vi) Calculate the velocity of solid sphere at the bottom of inclined plane?
- vii) Define moment of inertia?
- viii) What is perfect inelastic collision. Give its physical significance?
- ix) State Gauss's divergence theorem?
- x) State Kepler's laws of period?

## Section -III

Q3

- a) State and prove Stoke's law (6, 4)
- b) A particle of mass  $m$  moves on a path

$$\vec{r} = a \cos \omega t \hat{i} + b \sin \omega t \hat{j}.$$

Calculate angular momentum and torque. Which conclusion do you draw from the result of torque?

Q4

(6, 4)

- a) Calculate rotational inertia of solid cylinder about an axis passing through its centre perpendicular to its axis of symmetry.
- b) Consider a rotor of radius  $2m$ . It is given that coefficient of friction between material of clothing and rotor wall is  $0.40$ . Find speed of object, time period and frequency of rotor?

Q5

(6, 4)

- a) What is conservative field? Prove that the force is negative gradient of P.E?
- b) Calculate centre of mass of uniform solid cylinder?



# UNIVERSITY OF THE PUNJAB

Roll No. ....

First Semester 2018  
Examination: B.S. 4 Years Programme

PAPER: Waves, Oscillations and Optics  
Course Code: PHY-102

TIME ALLOWED: 30 mins.  
MAX. MARKS: 10

*Attempt this Paper on this Question Sheet only.*

## Section- II

### Question No.2

Q.2. Write short answers of the following questions

(2x10=20)

- i. What are mechanical waves. Give three examples of mechanical waves
- ii. Establish a relation between wavelength and wave number.
- iii. A block of mass  $m$  is attached with one end of a spring. The other end of spring is attached with a fixed support. What is the change in total energy of block when it is displaced from mean position to the extreme position
- iv. Write down the condition under which a simple pendulum will have the same period as the physical pendulum
- v. In the case of damped harmonic oscillator, prove that the value of minimum life time corresponding to critical damping is reciprocal of the angular frequency..
- vi. What is the source of energy which sets waves in motion along a string. Give types of energy transported by such waves.
- vii. Write the condition under which beats between two tones can be detected by human ear.
- viii. Write at least two conditions under which Doppler effect is not observed.
- ix. What is the role of compensator in Michelson Interferometer.
- x. Write equation of diffraction grating. Why zero order image formed by grating is bright.

## Section III

### Question No. 3

- (a) Define centre of oscillation of a physical pendulum. Derive the equation of motion of physical pendulum and prove that simple pendulum is special case of physical pendulum.
- (b) A uniform disk is pivoted at its rim. Find its period for small oscillations. Also calculate the length of equivalent simple pendulum

(6+4)

### Question No. 04

- (a) What are standing waves. Drive the condition under which nodes and antinodes are formed. Also show that distance between consecutive node and anti node is  $\frac{\lambda}{4}$
- (b) Speed of a wave on a string is 172 m/s when the tension in it is 123N. To what value must the tension be increased in order to raise the wave speed to 180 m/s

(6+4)

### Question No. 05

- (a) Describe Young's double slit experiment. Determine the conditions of constructive and destructive interference. Also calculate angular separation of fringes.
- (b) A double slit experiment is performed with blue green light of wavelength 512 nm. Bright fringes are seen on a screen which is 5.4m away from the slits. If the distance between two consecutive bright fringes is  $2.30 \times 10^{-3}$  m, how far apart are the slits.

(6+4)



# UNIVERSITY OF THE PUNJAB

First Semester 2018

Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Waves, Oscillations and Optics  
Course Code: PHY-102

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

*Attempt this Paper on Separate Answer Sheet provided.*

## Section- I

Question No.1 Choose the right answer:

- (i) Equation of simple harmonic motion can be written as:  
(a)  $m \frac{d^2x}{dt^2} = -kx$  (b)  $m \frac{d^2x}{dt^2} = -k/x$  (c)  $m \frac{d^2v}{dt^2} = -kx$
- (ii) A simple harmonic oscillator starts its motion from the extreme position. Its displacement (x) at any instant of time 't' can be written as :  
(a)  $x = x_m \sin(\omega t + \phi)$  (b)  $x = x_m \cos(\omega t + \phi)$  (c)  $x = x_m \tan(\omega t + \phi)$
- (iii) Frequency of a simple pendulum can be given as:  
(a)  $f = \frac{1}{2\pi} \sqrt{gL}$  (b)  $f = \frac{1}{2\pi} \sqrt{1/gL}$  (c)  $f = \frac{1}{2\pi} \sqrt{g/L}$
- (iv) Combination of two simple harmonic motions which are at right angle to each other having identical amplitude and frequency but differing in phase by 90 will result in a:  
(a) circle (b) straight line (c) parabola
- (v) The space occupied by a rarefaction is equal to :  
(a)  $\lambda$  (b)  $\lambda/4$  (c)  $\lambda/2$
- (vi) A tuning fork of unknown frequency makes three beats per second with a standard fork of frequency 384 Hz. The beat frequency decreases when a small piece of wax is put on a prong of the first fork. The frequency of this fork will be :  
(a) 381 Hz (b) 387 Hz (c) 384 Hz
- (vii) In the case of light waves, the relation between path difference and phase difference can be written as :  
(a)  $\Delta\phi = \frac{2\pi}{\lambda} \cdot d$  (b)  $\Delta\phi = \frac{2\pi\lambda}{d}$  (c)  $\Delta\phi = 2\pi\lambda d$
- (viii) In young double slit experiment the position of bright fringes on the screen is given by the relation  $Y_m = \frac{m\lambda L}{d}$ . The position of zero order bright fringe will be at the :  
(a) Centre of the screen (b) Top end of the screen (c) Bottom end of the screen
- (ix) If velocity of light in air and in a medium other than air is given by c and v respectively, then the refractive index(n) of the medium can be written as:  
(a)  $\frac{c}{v}$  (b)  $\frac{v}{c}$  (c) cv
- (x) Light falls normally on a thin film whose thickness is close to zero( i.e  $2d < \lambda$  ). On reflection, such a thin film must appear:  
(a) Bright (b) Dark (c) None of these



# UNIVERSITY OF THE PUNJAB

First Semester 2018  
Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Physics-I (Mechanics & Optics)  
Course Code: PHY-111

TIME ALLOWED: 2 hrs. & 30 mins.  
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 divergence of a vector?
2. If  $\varphi = 3x^2y^4z^3$  then find  $\text{grad } \varphi$ .
3. What is conical pendulum? Write the formula to calculate its time period.
4. What do you mean by angular momentum?
5. At what angle of projection the range and height of a projectile becomes equal?
6. How the viscosity of the liquids and gases vary with temperature?
7. How the value of gravitational acceleration 'g' varies with latitude?
8. What is Fresnel diffraction?
9. How can you differentiate the diffraction and interference?
10. Define holography.

**(Essay-type questions)**

- Q. 3 (a) State and prove Stoke's theorem. (6)  
(b) A conical pendulum is formed by attaching a 53g pebble to a 1.4 m string. The pebble swings around on a circle of radius 25 cm. (4)
- Q. 4 (a) State parallel axis theorem. Using parallel axis theorem, find the rotational inertia of a solid cylinder about an axis passing through its center and perpendicular to its axis of symmetry. (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) Find the slit separation of a double slit experiment that will produce bright interference fringes  $2^\circ$  apart in angular separation. Assume a wavelength of light is 592 nm (4)



# UNIVERSITY OF THE PUNJAB

Roll No. ....

First Semester 2018  
Examination: B.S. 4 Years Programme

PAPER: Physics-I (Mechanics & Optics)  
Course Code: PHY-111

TIME ALLOWED: 30 mins.  
MAX. MARKS: 10

*Attempt this Paper on this Question Sheet only.*

**Q.1 Encircle the correct option**

(10x1)

- Scalar is a tensor of rank  
a) Zero                      b) one                      c) two                      d) three
- If  $v$ ,  $P$  and  $E$  denote the velocity, momentum and kinetic energy of the particle, then choose the right relation  
a)  $P = dE/dv$               b)  $P = dE/dt$               c)  $P = dv/dt$               d)  $E = dP/dt$
- If a solid sphere, disc and cylinder are allowed to roll down an inclined plane from the same height, which one among these will reach the bottom first  
a) Cylinder                  b) Disc                      c) Sphere                  d) Hoop
- The reference frames where Newton's laws can be applied are called \_\_\_\_\_ frames.  
(a) inertial                  (b) non-inertial              (c) non-accelerated          (d) both a & c
- The coefficient of kinetic friction is always \_\_\_\_\_ coefficient of static friction  
(a) less than                  (b) greater than              (c) equal to                  (d) both a & c
- The velocities of two equal masses A and B are  $13 \text{ ms}^{-1}$  and  $-14 \text{ ms}^{-1}$  respectively. What will be their respective velocities after they suffer one dimensional elastic collision?  
a)  $-14 \text{ ms}^{-1}$  and  $13 \text{ ms}^{-1}$                       b)  $14 \text{ ms}^{-1}$  and  $-13 \text{ ms}^{-1}$   
b)  $0$  and  $14 \text{ ms}^{-1}$                                   d)  $0$  and  $13 \text{ ms}^{-1}$
- A neutron moving with velocity  $v$  collides with a stationary  $\alpha$ -particle. The velocity of the neutron after collision is  
a)  $-3v/5$                       b)  $3v/5$                       c)  $-2v/5$                       d)  $2v/5$
- The velocity of light was determined accurately by  
(a) Newton                      (b) Huygen                      (c) Michelson                  (d) Young
- A ball of mass  $10 \text{ gm}$  hits a hard-vertical surface with a speed of  $5 \text{ m/s}$  and rebounds with the same speed. The ball remains in contact with the surface for  $(0.01) \text{ sec}$ . The average force exerted by the surface on the ball is  
(a)  $100 \text{ N}$                       (b)  $10 \text{ N}$                       (c)  $1 \text{ N}$                       (d)  $0.01 \text{ N}$
- The earth revolves round the sun in an elliptical orbit. Its speed is  
a) Increases continuously                      b) Greatest when it is closest to the sun  
b) c) Greatest when it is farthest from the sun              d) Constant at all points of orbits



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- The velocities of two equal masses A and B are  $13 \text{ ms}^{-1}$  and  $-14 \text{ ms}^{-1}$  respectively. What will be their respective velocities after they suffer one dimensional elastic collision?  
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First Semester 2018  
Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Physics-I (Mechanics & Optics)  
Course Code: PHY-111

TIME ALLOWED: 2 hrs. & 30 mins.  
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 divergence of a vector?
2. If  $\varphi = 3x^2y^4z^3$  then find grad  $\varphi$ .
3. What is conical pendulum? Write the formula to calculate its time period.
4. What do you mean by angular momentum?
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6. How the viscosity of the liquids and gases vary with temperature?
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**(Essay-type questions)**

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(b) Find the slit separation of a double slit experiment that will produce bright interference fringes  $2^\circ$  apart in angular separation. Assume a wavelength of light is 592 nm (4)





# UNIVERSITY OF THE PUNJAB

Roll No. ....

First Semester 2018  
Examination: B.S. 4 Years Programme

PAPER: Mechanics and Wave Motion (IT)  
Course Code: PHY-121

TIME ALLOWED: 30 mins.  
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 is not allowed.

1. The unit of force in S.I. units is  
(a) kilogram                      (b) newton                      (c) watt                      (d) joule
2. A force acting on a body may  
(a) produces acceleration                      (b) balance the other forces acting on it  
(c) change its motion                      (d) all of these
3. A force is completely defined when we specify  
(a) magnitude                      (b) direction  
(c) point of application                      (d) all of these
4. The co-efficient of friction depends upon  
(a) nature of surfaces                      (b) area of contact  
(c) shape of the surfaces                      (d) all of these.
5.  $\vec{\alpha} \times \vec{r}$  gives us  
(a) Linear acceleration                      (b) Radial acceleration  
(c) Tangential Acceleration                      (d) Angular Acceleration
6. The rate of change of linear momentum of a body is equal to  
(a) force                      (b) torque                      (c) moment of inertia                      (d) none of these
7. A construction worker holds a heavy tool box. How much work is done by the worker?  
(a)  $F_g d$                       (b) zero                      (c)  $mgh$                       (d) none of these
8. Which of the following is not a scalar quantity  
(a) time                      (b) mass                      (c) volume                      (d) acceleration.
9. The wave form of S.H.M. is  
(a) square wave                      (b) standing wave  
(c) sine wave                      (d) none
10. The distance of waves covered in unit time is called its  
(a) amplitude                      (b) frequency  
(c) wavelength                      (d) none of these



# UNIVERSITY OF THE PUNJAB

First Semester 2018

Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Mechanics and Wave Motion (IT)  
Course Code: PHY-121

TIME ALLOWED: 2 hrs. & 30 mins.  
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) State Newton's second law of motion, give examples.
- (ii) Define work and power. What is the relation between work and energy?
- (iii) A motorbike engine can develop a power of 90000 W in order to keep a constant velocity of 30 m/s. What is the pushing force?
- (iv) State the law of conservation of linear momentum.
- (v) What happens to the total energy of a moving object if all the applied forces are conserved?
- (vi) Differentiate between center of mass and center of gravity.
- (vii) It is possible to tell theoretically if a mechanical motion will be SHM through a careful analysis of the forces in the system?
- (viii) State two shell's theorems.
- (ix) What is interference of waves and explain interference of waves with the help of phase difference.
- (x) Find the amplitude for a S.H.M. given by the equation  $x = 3\sin 3A + 4\cos 3A$ .

**Question No. 3:**

(6+4)

(a) State and prove impulse-momentum theorem.

(b) A particle moves along a straight line such that distance  $x$  traversed in  $t$  seconds is given by  $x = t^2(t - 4)$ , find the acceleration of the particle at  $t=2$ sec.

**Question No. 4:**

(6+4)

(a) State and prove work energy theorem.

(b) Two blocks, with masses  $m_1 = 4.6$  kg and  $m_2 = 3.8$  kg, are connected by a light spring on a horizontal frictionless table. At a certain instant, when  $m_2$  has an acceleration  $a_2 = 2.6$  m/s<sup>2</sup>, what is the force on  $m_2$  and what is the acceleration of  $m_1$ ?

**Question No. 5:**

(6+4)

(a) Describe the energy in wave motion. Explain interference of waves with the help of phase difference.

(b) A body of mass 1 kg suspended from the free end of a spring having force constant 400 N/m is executing S.H.M. When the total energy of the system is 2 joule, find the maximum acceleration.



# UNIVERSITY OF THE PUNJAB

Roll No. ....

First Semester 2018

Examination: B.S. 4 Years Programme in  
Physical Education

**PAPER: Fundamentals of Physics**  
**Course Code: PHY-131**

**TIME ALLOWED: 30 mins.**  
**MAX. MARKS: 10**

*Attempt this Paper on this Question Sheet only.*

(Objective Type)

Attempt this paper on this sheet only.

**Q. 1:-Encircle the correct answer out of the four options given. No mark will be awarded for cutting, overwriting and for use of lead pencil or ink remover. (1 x 10 = 10)**

**(i)-** Relation between linear and angular accelerations is:

- (a)  $a = r\alpha$  (b)  $a = r\omega$   
(c)  $a = r\theta$  (d) all of above

**(ii)-** In the absence of external force, linear momentum becomes.

- (a) zero (b) constant  
(c) infinity (d) very small

**(iii)-** Number of vibrations completed in one second is called:

- (a) frequency (b) amplitude  
(c) displacement (d) time period

**(iv)-** Objects A and B are separated by small distance  $r$ . The magnitude of the force of gravity on A from B is given by  $F_{AB}$  and the magnitude of the force of the force of gravity on B from A is  $F_{BA}$ . If the mass A is doubled while that of B is unchanged, then:

- (a)- $F_{AB}$  will double while  $F_{BA}$  will remain the same (b)-  $F_{AB}$  will double while  $F_{BA}$  will remain the same  
(c)- Both  $F_{AB}$  and  $F_{BA}$  will double (d)-Both  $F_{AB}$  and  $F_{BA}$  will remain same

**(v)-** The dimensions of  $G$  are equivalent to:

- (a)-energy/momentum<sup>2</sup> (b)-velocity<sup>4</sup> /force  
(c)-distance<sup>3</sup>/force<sup>2</sup> (d)-velocity<sup>3</sup> /angular momentum

**(vi)-** The amount of heat required to raise temperature of 1 kg of a substance through 1°C is called:

- (a) heat capacity (b) temperature  
(c) heat constant (d) specific heat capacity

**(vii)-** Semiconductor materials have:

- (a) ionic bonding (b) covalent bonding  
(c) van der Waal (d) metallic bonding

**(viii)-** Nucleus contains:

- (a) protons (b) neutrons  
(c) electrons (d) both a and b

**(ix)-** In n-type semiconductors, electrons are:

- (a) majority charge carriers (b) minority charge carriers  
(c) both a and b (d) none of above

**(x)-** The thermal property of a system which remains constant during an adiabatic process when no heat enters or leaves the system is called:

- (a) enthalpy (b) entropy  
(c) temperature (d) heat



# UNIVERSITY OF THE PUNJAB

First Semester 2018

Examination: B.S. 4 Years Programme in  
Physical Education

Roll No. ....

PAPER: Fundamentals of Physics  
Course Code: PHY-131

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

*Attempt this Paper on Separate Answer Sheet provided.*

(Subjective Type)

Attempt this paper on separate sheet provided. All questions are compulsory.

Q. 2: Write short answers of following questions. (10 x 2 = 20)

(i)-Can angular momentum of an object increase without changing its linear momentum? If yes, give an example. If not prove it.

(ii)- A student holds two dumb bells with stretched arms while sitting on a turn table. He is given a push until he is rotating at certain angular velocity. The student then pulls dumb bells towards his chest, what will be effect on rate of rotation?

(iii)- System A has masses  $m$  and  $m$  separated by distance  $r$ ; system B has masses  $m$  &  $2m$  separated by distance  $2r$  and system C has masses  $2m$  and  $3m$  separated distance  $2r$ . Rank these systems in order of increasing gravitational force.

(iv)-The earth's orbit is slightly elliptical. Earth is closer to sun during the northern hemisphere winter than it is during summer. Is speed of earth during winter same as its speed during summer?

(v)- Explain why specific heat at constant pressure is greater than specific heat at constant volume.

(vi)- How could you increase the entropy of 1 mol of a metal that is at room temperature? How could you decrease its entropy?

(vii)- How is it possible that a large number of protons exist in a very small space inside the nucleus?

(viii)- Why is heat energy named as energy in transit? How is it sometimes related to thermal equilibrium?

(ix)- What are advantages of a full wave rectifier over a half wave rectifier?

(x)- Do pure semiconductors obey Ohm's law?

Q. 3: (a)-Define angular momentum and develop a relation between torque and angular momentum.

(b)- State law of conservation of angular momentum. Show that the angular momentum about any point of a single particle moving with constant velocity remains constant throughout the motion. 04 + 06

Q. 4: (a)-State Newton's law of gravitation and show that it is in accordance with Newton's third law of motion.

(b)-Equation of simple harmonic oscillator in standard form is, 05 + 05

$$\frac{d^2x}{dt^2} + \omega^2x = 0$$

Here  $\omega$  is angular frequency of oscillator and  $x$  is displacement of oscillator at any instant of time. By solving this equation, find displacement of oscillator in form,

$$x = x_m \cos(\omega t + \varphi)$$

$\varphi$  is called phase constant and  $x_m$  is called amplitude of motion.

Q. 5: (a)-Define specific heat capacities of an ideal gas at constant volume and pressure. Show that difference between specific heat at constant pressure and specific heat at constant volume is equal to ideal gas constant  $R$ .

(b)-What is meant by forward and reverse biasing of a semiconductor diode? Why a semiconductor passes current in forward direction but not in reverse direction? 05 + 05



# UNIVERSITY OF THE PUNJAB

Second Semester - 2018

Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Electricity & Magnetism

TIME ALLOWED: 15 Mints.

Course Code: PHY-103 / PHY-12328 Part - I (Compulsory)

MAX. MARKS: 10

Attempt this Paper on this Question Sheet only.

Please encircle the correct option. Each MCQ carries 1 Mark. This Paper will be collected back after expiry of time limit mentioned above.

- Q.1 Encircle the correct answer from given multiple choices in each part. (1 x 10)
- A closed spherical surface of radius  $r$  in a uniform electric field  $\vec{E}$ . What is electric flux through the surface?  
(a)  $4\pi r^2 E$  (b)  $\pi r^2 E$  (c)  $2\pi r^2 E$  (d) 0
  - What is the capacitance of a single spherical conductor of radius  $r$  surrounded by air?  
(a)  $4\pi\epsilon_0 r$  (b)  $4\pi\epsilon_0 r^2$  (c)  $2\pi\epsilon_0 r$  (d)  $4\pi\epsilon_0/r$
  - Electric charges A and B are attracted to each other. Electric charges B and C repel each other. If A and C are held close together they will  
(a) Repel (b) Attract (c) Not affect each other  
(d) More information is needed to answer
  - An electric dipole of dipole moment  $\vec{P}$  in a uniform electric field  $\vec{E}$  will experience a minimum potential energy  
(a) When  $\vec{P}$  is antiparallel  $\vec{E}$  (b) When  $\vec{P}$  is parallel to  $\vec{E}$   
(c) When  $\vec{P}$  is perpendicular to  $\vec{E}$  (d) All above are incorrect
  - The resistance  $R$  of a particular object does not depend on?  
(a) The material of which it made (b) The length  
(c) The cross sectional area (d) The applied potential difference
  - Ampere's Circuital Law and which of the following law in electrostatics are analogous  
(a) Lenz's law (b) Gauss's law (c) Biot-Savart's Law (d) Faraday's law
  - The materials in which the atoms have no permanent magnet dipole moments are  
(a) Ferromagnetic (b) Paramagnetic (c) Diamagnetic (d) Both (a) & (b)
  - Induced electric field is produced by  
(a) Changing magnetic flux (b) Changing electric charge  
(c) Changing resistance (d) Both (b) & (c)
  - A positive charge  $q$  moving with constant velocity  $v$  through magnetic field  $B$ , will experience maximum magnetic force when, the angle between  $v$  and  $B$  is  
(a)  $0^\circ$  (b)  $180^\circ$  (c)  $90^\circ$  (d) both (a) and (b)
  - The value permeability in air is  
(a)  $4\pi \times 10^{-7} B/m$  (b)  $2\pi \times 10^{-7} H/m$  (c)  $4\pi \times 10^7 H/m$  (d)  $4\pi \times 10^{-7} H/m$



# UNIVERSITY OF THE PUNJAB

Second Semester - 2018

Examination: B.S. 4 Years Programme

Roll No. ....

**PAPER: Electricity & Magnetism**

**TIME ALLOWED: 2 Hrs. & 45 Mints.**

**Course Code: PHY-103 / PHY-12328 Part – II**

**MAX. MARKS: 50**

**Attempt this Paper on Separate Answer Sheet provided.**

- Q.2** Give the short answer of each question (2 x 10 = 20)
- What does it mean to say that a physical quantity is (a) quantized (b) conserved?
  - Describe briefly the procedure for finding the force exerted by continuous charge distribution on a point charge.
  - Electric field at any point on positive y axis due to line of charge is given by  $E = \frac{\lambda L}{y\sqrt{y^2+L^2/4}}$ , compute electric field due to infinitely long line of charge.
  - State Faraday's law. What describes the negative sign in this law?
  - Electric lines of force never cross, why?
  - When I current pass through toroid windings of N turns, write the formula for magnetic field for interior path. Also describe direction of magnetic field within toroid by right-hand rule.
  - Discuss the analogies and differences between Biot-Savart law and Coulomb's law.
  - How you conclude that electric potential energy reside in the volume between the plates of the capacitor.
  - Why do not we simply define the direction of magnetic field B to be the direction of magnetic force that acts on moving charge?
  - Explain why a spherical shell exerts no electrostatic force on a charged particle placed inside it.
- Q3.** (a) What is electric dipole? Derive the expression for the magnitude of electric field at any point due to dipole. (6)
- (b) A plastic rod whose length is 220 cm and radius is 3.6 mm, carries a negative charge of magnitude  $3.8 \times 10^{-7}$  C, spread uniformly over its surface. What is the electric field near the midpoint of the rod, at a point on its surface? (4)
- Q.4** (a) By applying Biot-Savart law, calculate the magnetic field at any point, due to current passing through straight wire segment of length L. (6)
- (b) A solenoid has the length 1.23 m and an inner diameter 3.55 cm. It has five layers of winding of 850 turns each and carries a current 5.57 A. What is B at its center? (4)
- Q.5** (a) Prove that the displacement current between the plates of a parallel plate capacitor is equal to conduction current in the connecting wires. (6)
- (b) Prove that in parallel plate capacitor, the displacement current,  $i_d = C \frac{dV}{dt}$  (4)



# UNIVERSITY OF THE PUNJAB

Second Semester - 2018  
Examination: B.S. 4 Years

Roll No. ....

PAPER: Thermodynamics and Kinetic Theory  
Course Code: PHY-104, PHY-12329 Part – II

TIME ALLOWED: 2 Hrs. & 45 Min.  
MAX. MARKS: 50

Attempt this Paper on Separate Answer Sheet provided.

## Section-II

### Question no: 1

(5 X 4 = 20)

Write short answers to the given questions:

- State and relate three well-known definitions of second law of thermodynamics?
- Define the term Absolute zero. What will be happened for three different types of gases? Also define thermal equilibrium?
- A wire of length 1m and radius 1mm is heated via an electric current to produce 1kW of radiant power. Treating the wire as a perfect blackbody and ignoring any end effects, calculate the temperature of the wire.
- If the temperature difference between the source and surroundings is small then show that the Stefan's law reduces to Newton's law of cooling.
- How much heat (in eV) must be added to a system at 27° C for the number of accessible states to increase by a factor of  $10^8$ ?

## Section-III

### Question no: 1

(12)

Define the following terms:

(3x4)

- Thermal isolation.
- Seebeck effect.
- Thermistor.
- Thermo couple.

### Question no: 2

(6)

Estimate the *rms* velocity of hydrogen molecules at *NTP* and at 127°C.

### Question no: 3

(8+4=12)

- Define a brief overview of TDS equations and Clapeyron's equation?
- State the terms strictly according to the thermodynamics that what is meant by internal energy vs heat, vs temperature and vs external energy?



# UNIVERSITY OF THE PUNJAB

Second Semester - 2018  
Examination: B.S. 4 Years

Roll No. ....

PAPER: Thermodynamics and Kinetic Theory  
Course Code: PHY-104, PHY-12329 Part – I (Compulsory)

TIME ALLOWED: 15 Min.  
MAX. MARKS: 10

Attempt this Paper on this Question Sheet only.

Please encircle the correct option. Each MCQ carries 1 Mark. This Paper will be collected back after expiry of time limit mentioned above.

**Q.1. MCQs**

(10x1=10)

- i. If we remove the lid of a bottle containing chlorine gas then this process will be:  
a) Irreversible                                      b) Reversible  
c) Infinite    d) Both a and b
- ii. The state of highest entropy is also known as the state of:  
a) Least probable                                    b) Most probable  
c) Larger number of ways                        d) Both b and c
- iii. In  $S=k \ln(W)$ , here the W contains the number of:  
a) Macro-states                                      b) Probability  
c) Micro states                                        d) Permutations
- iv. Change in entropy is inversely proportional to the temperature at which the heat is:  
a) Lost    b) Added  
c) Constant    d) Zero
- v. The Kelvin temperature at which heat is added must remain constant for ..... Process.  
a) Reversible                                        b) Irreversible  
c) Continuous                                        d) Both b and c
- vi. In an ideal gas, reversible process is one in which the given set does not change:  
a) P and V    b) T and U  
c) P, V and U                                        d) All of these
- vii. To be reversible, a process must be done:  
a) Very slowly                                        b) Very quickly  
c) Moderately                                        d) Moderate and fast
- viii. If low temperature is 500 k and high temperature is 1000 k the efficiency will be:  
a) 0.50    b) 0.050  
c) 500%    d) 5%
- ix. If actual work done is  $2.7 \times 10^6$  joule and  $Q_H$  will be  $6.6 \times 10^6$  joule, efficiency will be:  
a) 0.41    b) 41 %  
c) Both a and b                                      d) Information not complete
- x. In refrigerators work is done to cause heat to travel ..... its normal direction.  
a) Same    b) Opposite  
c) Perpendicular                                   d) Infinity





# UNIVERSITY OF THE PUNJAB

Second Semester - 2018

Examination: B.S. 4 Years Programme

Roll No. ....

**PAPER: Physics-II (Waves & Oscillation)**  
**Course Code: PHY-113 / PHY-12307 Part – II**

**TIME ALLOWED: 2 Hrs. & 45 Mints.**  
**MAX. MARKS: 50**

**Attempt this Paper on Separate Answer Sheet provided.**

**Q.2. Write short answers of the following.**

**(2 x 10) = 20**

- i. What is the frequency of second's pendulum.
- ii. Define node and antinode in wave motion.
- iii. What is an ideal gas? Write its two properties.
- iv. State 1st law of thermodynamics. Write its mathematical form.
- v. Convert  $100^{\circ}\text{C}$  in to Kelvin (K) Scale.
- vi. What is irreversible process give its an example.
- vii. Define Zeroth Law of thermodynamics.
- viii. What is principle of superposition.
- ix. Define Damped Harmonic motion.
- x. Why sound of woman is more shrill as compared to man?

- Q.3. (a) What are beats, how these are produced and give their graphical representation. What are their applications?  
(b) Prove that Beat frequency is equal to the difference between the frequencies of the combining waves.

(7+3)

- Q.4. (a) Define and explain entropy, how entropy and 2nd law of thermodynamics are related to each other?  
(b) A small block of ice melts reversibly to water such that its temperature remains  $0^{\circ}\text{C}$  throughout the process. If mass of ice is 235 gm. Find the change in entropy of ice (Heat of fusion is 333 KJ/kg)?

(7+3)

- Q.5. (a) Define Simple Harmonic Motion (SHM). Explain relations between Simple Harmonic Motion and Uniform Circular Motion.

- (b) State and explain principle of Superposition.

(7+3)



# UNIVERSITY OF THE PUNJAB

Second Semester - 2018

Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Physics-II (Waves & Oscillation)

TIME ALLOWED: 15 Mints.

Course Code: PHY-113 / PHY-12307 Part – I (Compulsory) MAX. MARKS: 10

Attempt this Paper on this Question Sheet only.

Please encircle the correct option. Each MCO carries 1 Mark. This Paper will be collected back after expiry of time limit mentioned above.

Q.1. Attempt the all Multiple Choice Questions:

(10x1=10)

- i. Distance covered by a body during one vibration of an oscillating body in terms of  $A$  is:  
(a)  $A$  (b)  $2A$  (c)  $3A$  (d)  $4A$
- ii. In SHM, the restoring force is directly proportional to:  
(a) Velocity (b) Acceleration (c) Displacement (d) Time Period
- iii. The least distance between node and consecutive anti-node is  
(a)  $\lambda$  (b)  $2\lambda$  (c)  $\lambda/2$  (d)  $\lambda/4$
- iv. According to 1<sup>st</sup> law of thermodynamics the following quantity remain conserved:  
(a) Energy (b) Force (c) Momentum (d) Power
- v. The Equation  $\Delta U = Q - W$  is statement of law of thermodynamics:  
(a) 1<sup>st</sup> (b) Zero (c) 2<sup>nd</sup> (d) None of these
- vi. Which of the following does not have the same units:  
(a) Work (b) Heat (c) Kinetic Energy (d) Power
- vii. The temperature scale approved in S-I Units is:  
(a) Celsius Scale (b) Kelvin Scale (c) Fahrenheit Scale (d) None of these
- viii. The process for which entropy remains constant is:  
(a) Reversible Process (b) An irreversible Process (c) 2<sup>nd</sup> law of thermodynamics (d) None of these
- ix. In which cases Doppler's Effect is used:  
(a) Radar (b) Sonar (c) To find speed of Star (d) All of these
- x. Time period ( $T$ ) Wave length ( $\lambda$ ) and velocity of wave are related:  
(a)  $\lambda = T/V$  (b)  $\lambda = V/T$  (c)  $\lambda = TV$  (d) None of these



# UNIVERSITY OF THE PUNJAB

Second Semester - 2018

Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Electricity & Magnetism (IT)

TIME ALLOWED: 15 Mints.

Course Code: PHY-122 / IT-12399 Part – I (Compulsory)

MAX. MARKS: 10

Attempt this Paper on this Question Sheet only.

Please encircle the correct option. Each MCQ carries 1 Mark. This Paper will be collected back after expiry of time limit mentioned above.

Question no.1: Choose the best option.

(10×1=10)

- 1) The temperature of the system decreases in an \_\_\_\_\_.  
a) adiabatic compression                      b) isothermal expansion  
c) isothermal compression                      d) adiabatic expansion
- 2) The process of heat transfer by the movement of mass from one place to another is called  
a) Convection              b) Conduction              c) Radiation              d) None of these
- 3) The efficiency of Carnot Engine is \_\_\_\_\_%  
a) 0 %              b) 99 %              c) 100 %              d) None of these
- 4) Equal amounts of heat are absorbed by 100 g samples of various solid metals with differing specific heat values. Which of the following statements is true regarding metals and their specific heat values?  
a) The metal with the smallest specific heat will undergo the smallest change in temperature.  
b) The metal with the greatest specific heat will undergo the smallest change in temperature  
c) The metal with the greatest specific heat will resist melting to a greater degree at its melting point.  
d) none of these
- 5) Which of two temperature change are equivalent?  
a) 1 K = 1 F              b) 1 F = 1 C              c) 1 K = 1 C              d) none of these
- 6) Electric charges obey \_\_\_\_\_  
a) Newton's first law of motion                      b) Newton's second law of motion  
c) Newton's first third of motion                      d) none of these
- 7) The direction of the current density is \_\_\_\_\_ to drift velocity  
a) opposite    b) in the direction of    c) current density is a scalar    d) none of these
- 8) The direction of a magnetic field within a magnet is  
a) from front to back    b) from north to south    c) from south to north    d) none of these
- 9) Magnetic field outside a solenoid is \_\_\_\_\_  
a) exactly zero              b) strong              c) infinite              d) negligible
- 10) Bar magnet is divided in two pieces. Which of the following statements is true?  
a) The bar magnet is demagnetized.  
b) The magnetic field of each separated piece becomes stronger.  
c) The magnetic poles are separated.  
d) Two new bar magnets are created.



# UNIVERSITY OF THE PUNJAB

Second Semester - 2018

Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Electricity & Magnetism (IT)

Course Code: PHY-122 / IT-12399 Part – II

TIME ALLOWED: 2 Hrs. & 45 Mints.

MAX. MARKS: 50

**Attempt this Paper on Separate Answer Sheet provided.**

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

(10×2=20)

1. What is the significance of entropy? Describe briefly.
2. In a system undergoing adiabatic compression, what are the values of internal energy and heat if work done on the system is 500 J?
3. How many laws of thermodynamics are there? Give statements.
4. State and explain Ohm's law.
5. Sketch the electric field lines due to a uniform line of charges, uniform shell of charges and two opposite charges (dipole).
6. An electric bulb draws a current of 0.43 A for 18 minutes. Calculate the amount of electric charge that flows through the circuit.
7. In what sense are electricity and magnetism related? Explain briefly.
8. What is capacitance? Discuss the dependence of capacitance on  $q$ ,  $\Delta V$  and geometry.
9. Describe two main ways to generate electricity by electromagnetic induction.
10. State Lenz's law. Briefly explain.

Question no.3:

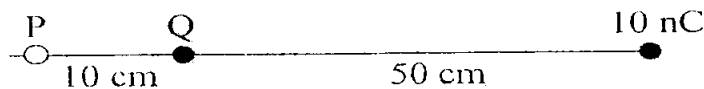
(6+6+3=15)

- a) Explain the phenomena of an insulator and a conductor in an electric field with the help of diagrams.
- b) State and explain Ampere's law. Give its any two applications (e.g. by finding the magnetic field of wire, solenoid etc).
- c) A Carnot engine has the same efficiency (i) between 200 K and 600 K and (ii) between T K and 850 K. Calculate the temperature T of the sink.

Question no.4:

(10+5=15)

- a) Find the magnetic force on a single static charge, single moving charge and a current carrying wire.
- b) The electric field at point P is zero. Find the unknown charge Q?





# UNIVERSITY OF THE PUNJAB

Third Semester 2018  
Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Concepts of Modern Physics  
Course Code: PHY-201/21330

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

*Attempt this Paper on Separate Answer Sheet provided.*

## SUBJECTIVE PART

Note: Attempt all questions of this section.

- Q.2 Give the short answer of each question (2 x 10 = 20)
- Explain thermal radiation.
  - Explain the energy of oscillator by classical physics and quantum physics
  - Briefly describe Wien's displacement law.
  - Explain briefly the Einstein's photoelectric effect equation.
  - Describe briefly, how Continuous X-ray spectrum is produced.
  - Why population inversion is necessary between two atomic levels for laser action to occur?
  - Explain semiconductors, according to band theory of solids.
  - Explain biasing rule for normal operation of NPN transistor.
  - Describe the difficulties in operation of thermonuclear fusion reactor.
  - Give the difference between exothermic and endothermic reaction.
- Q.3 (a) Define de-Broglie's hypothesis. Explain in detail, how Davisson-Germer proved de Broglie's hypothesis. (1,6)
- (b) Calculate the de-Broglie's wavelength of a particle of mass  $1.0 \times 10^{-15}$  kg moving at a speed of 2.0 m/s. (3)
- Q.4 (a) State Bohr's postulates. Using Bohr's model of hydrogen atom, derive the expression for total mechanical energy of electron orbiting about central proton. (2, 5)
- (b) Calculate the binding energy of a hydrogen atom, that is, the energy that must be added to the atom to remove the electron from its lowest energy state. The values to be used;  $h=6.63 \times 10^{-34}$  j.s,  $R=1.097 \times 10^7$  m<sup>-1</sup>,  $C=3 \times 10^8$  m/s. (3)
- Q.5 (a) What is fission chain reaction? Discuss the three problems together with their solutions in working of nuclear reactor based on fission chain reaction. (1, 6)
- (b) Consider a <sup>236</sup>U nucleus is in its ground state. How much energy is required to remove a neutron from it, leaving a <sup>235</sup>U nucleus behind? The needed atomic masses are <sup>235</sup>U= 235.043924 u; n = 1.008665 u; <sup>236</sup>U= 236.045563 u. (3)



# UNIVERSITY OF THE PUNJAB

Roll No. ....

Third Semester 2018  
Examination: B.S. 4 Years Programme

PAPER: Concepts of Modern Physics  
Course Code: PHY-201/21330

TIME ALLOWED: 30 mins.  
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) According to quantum physics, the energy of an atomic oscillator is  
i) Constant      ii) Continuous      iii) Discrete      iv) None of these
- B) What is the effect of the increasing the intensity of light in photoelectric effect  
i) The KE of photoelectrons increases      ii) The Stopping potential increases  
iii) Cutoff frequency increases      iv) Emission of photo electrons increases
- C) Series that lies in visible region of hydrogen spectrum is called  
i) Lyman series      ii) Ballmer series      iii) Bracket series      iv) Paschen series
- D) The magnitude of the minimum momentum of a particle, trapped in infinite potential well of width L will be  
i) 0      ii)  $h^2/2L$       iii)  $h^2/2L^2$       iv)  $h/2L$
- E) Space quantization in magnetic field was experimentally verified by  
i) Zeeman and Lyman      ii) Einstein and de Hass      iii) Stern and Gerlach  
iv) Pauli and Bohr
- F) X-rays are produced through  
i) Bremsstrahlung processes      ii) K-shell emission processes  
iii) Radioactive decay      iv) Both Bremsstrahlung and K-shell emission
- G) The density of charge carriers in pure silicon at room temperature is of the order of  
i)  $10^{28} \text{ m}^{-3}$       ii)  $10^{16} \text{ m}^{-3}$       iii)  $10^{22} \text{ m}^{-3}$       iv) None of these
- H) When forward biased is increased across the PN diode, the depletion region  
i) Increases      ii) Decreases      iii) Remains unchanged      iv) None of these
- I) The activity or rate of decay of a radioactive source is measured in  
i) Rad      ii) Rem      iii) Curie      iv) Roentgen
- J) The emission of a beta particle from a nucleus results in  
i) Decrease in the atomic mass number      ii) Increase in the atomic mass number  
iii) No change in the atomic mass number      iv) None of these



# UNIVERSITY OF THE PUNJAB

Third Semester 2018  
Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Physics-III (Electricity & Magnetism)  
Course Code: PHY-211/21307

TIME ALLOWED: 2 hrs. & 30 mins.  
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. Explain briefly what do you mean by quantization of charge.
- ii. What is meant by an electric field of continuous charge distribution?
- iii. Differentiate between electric and magnetic dipoles.
- iv. Define the term “motional EMF”.
- v. What is meant by the term *Joule heating* in a circuit?
- vi. Show that, the capacitance with dielectric is given by  $C' = K_c C$ .
- vii. State Faraday’s law & give reason for its negative sign.
- viii. You are given a length  $\ell$  of copper wire. How would you arrange it to obtain maximum inductance?
- ix. How do you distinguish between  $\epsilon_0$  and  $\mu_0$ ?
- x. Why a *pn* junction is sometimes called a nonlinear circuit element?

Q.3: (a) State Gauss’ law of electrostatics, and use it to find out electric field at a distance  $r$  due to an infinite line of charge.

(b) A plastic rod, whose length  $L$  is 220 cm and whose radius  $r$  is 3.6 mm, carries a negative charge  $q$  of magnitude  $3.8 \times 10^{-7} C$ , spread uniformly over its surface. What is the electric field near the midpoint of the rod, at a point on its surface?  
(5, 5)

Q.4: (a) Use Biot-Savart’s law to obtain an expression for magnetic field due to a current  $i$  in a straight wire segment of length  $L$ .

(b) Discuss the decay of charge in R-C series circuit and derive an expression for current during discharge.  
(5, 5)

Q.5: (a) Derive an expression for torque acting on a current carrying loop placed in a uniform external magnetic field  $\vec{B}$ .

(b) What are Maxwell’s equations? Write down their mathematical forms.  
(5, 5)



Attempt this Paper on this Question Sheet only.

## SECTION – I (Objective Part)

(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) A hollow conducting ball has a single positive charge  $-Q$  fixed at the center. The ball has no net charge. The charge on the inner surface of the ball will be  
(a)  $+2Q$  (b)  $+Q$  (c)  $-Q$  (d) Zero
- (ii) A conductor of resistivity  $\rho$  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)  $\frac{\rho}{\epsilon_0}$  (c)  $\frac{\vec{J}}{\rho}$  (d)  $\rho\vec{J}$
- (iii) Lenz's law deals with the  
(a) Magnetic field of EMF (b) direction of EMF  
(c) Both the direction and magnitude of EMF (d) direction of induced current
- (iv) The electric field intensity between two oppositely charged plates is  
(a)  $E = \frac{\sigma}{2\epsilon_0}$  (b)  $E = \frac{\epsilon_0}{2\sigma}$  (c)  $E = \frac{\sigma}{\epsilon_0}$  (d)  $E = \frac{\sigma\epsilon_0}{2}$
- (v) The integral involved in the expression of Ampere's law is of the form of  
(a) volume integral (b) surface integral (c) line integral (d) none as above
- (vi) Which of the following law was modified by Maxwell by introducing displacement current  
(a) Gauss's law (b) Faraday's law (c) Ampere's law (d) Biot-Savart's law
- (vii) The value of Bohr magneton is  
(a)  $\frac{e}{4\pi m}$  (b)  $\frac{eh}{2\pi m}$  (c)  $\frac{eh}{4\pi m}$  (d)  $\frac{eh}{\pi m}$
- (viii) The dimensions of  $RC$  matches with  
(a)  $LR$  (b)  $\frac{L}{R}$  (c)  $\frac{R}{L}$  (d)  $\frac{L^2}{R}$
- (ix) The product  $(\vec{P} \times \vec{E})$  is equal to  
(a) force (b) electric dipole (c) torque (d) electric potential
- (x) The magnitude of the Poynting vector is  
(a)  $\frac{P}{A}$  (b)  $\frac{\mu_0}{c} B^2$  (c)  $\frac{SA}{c}$  (d)  $\frac{1}{\mu_0} \frac{dU}{dt}$





# UNIVERSITY OF THE PUNJAB

Fourth Semester - 2018

Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Basic Electronics

TIME ALLOWED: 15 Mints.

Course Code: PHY-203 / PHY-22331 Part – I (Compulsory)

MAX. MARKS: 10

**Attempt this Paper on this Question Sheet only.**

**Please encircle the correct option. Each MCO carries 1 Mark. This Paper will be collected back after expiry of time limit mentioned above.**

Q.1

(1x10=10)

- 1) In BJT with  $\beta = 100$ ,  $\alpha$  equals
  - a) 99
  - b) 0.99
  - c) 1.0
  - d) 1.
- 2) Pinch off Voltage  $V_p$  for an FET is the drain at which
  - a) significant drain current starts flowing
  - b) drain current becomes zero
  - c) all free charges get removed from the channel
  - d) avalanche break down takes place
- 3) A transistor in common mode has:
  - a) A high input resistance and low output resistance
  - b) A medium input resistance and high output resistance
  - c) A very low input resistance and a low output resistance
  - d) A high input resistance and a high output resistance
- 4) A constant current source supplies a current of 300mA to a load of 1 K ohm. When the load is changed to 100 Ohm, load current will be
  - a) 3 Amp
  - b) 30 mA
  - c) 300 mA
  - d) 600mA
- 5) Compared to BJT, a JFET has
  - a) Lower input impedance
  - b) Higher voltage gain
  - c) Higher input impedance and high voltage gain
  - d) Higher input impedance and low voltage gain
- 6) A virtual ground means
  - a) Is a ground for voltage
  - b) Is a ground for both voltage and current
  - c) Is a ground for current
  - d) Is a ground for voltage but not for current
- 7) Which of the following is an active device
  - a) An electric blub
  - b) A diode
  - c) A transformer
  - d) A BJT
- 8) In a Full wave Rectifier without filter, the ripple factor is
  - a) 0.482
  - b) 1.21
  - c) 1.79
  - d) 2.05
- 9) A common Collector amplifier is also known as
  - a) Collector Follower
  - b) Base Follower
  - c) Emitter Follower
  - d) Source Follower
- 10) Transistor is a
  - a) Current controlled current device
  - b) Current controlled Voltage device
  - c) Voltage controlled current device
  - d) Voltage controlled Voltage device



# UNIVERSITY OF THE PUNJAB

Fourth Semester - 2018  
Examination: B.S. 4 Years

Roll No. ....

**PAPER: Physics-IV (Concepts of Modern Physics)**

**TIME ALLOWED: 15 Min.**

**Course Code: PHY-213 / PHY-22307 Part – I (Compulsory)**

**MAX. MARKS: 10**

**Attempt this Paper on this Question Sheet only.**

**Please encircle the correct option. Each MCQ carries 1 Mark. This Paper will be collected back after expiry of time limit mentioned above.**

Question no: 1

**(10x1=10)**

Attempt all MCQs and chose the best answer.

1. Frequency below which no electrons are emitted from metal surface is
  - a) minimum frequency
  - b) angular frequency
  - c) maximum frequency
  - d) threshold frequency
2. Energy absorbed by electron is used in
  - a) escaping the metal
  - b) increasing kinetic energy
  - c) both A and B
  - d) increasing frequency
3. Microwaves have wavelength of about
  - a) 10 cm
  - b) 20 cm
  - c) 30 cm
  - d) 40 cm
4. Our eyes detect light in
  - a) RGB form, Red Blue Green form
  - b) ROYGBIV, rainbow color form
  - c) The simple form of a particular color
  - d) none of these ways
5. Moon is a good example of
  - a) Luminous objects
  - b) Non-luminous objects
  - c) Transparent objects
  - d) Opaque objects
6. Temperature of a gas is increased, its kinetic energy would
  - a) increase
  - b) decrease
  - c) remain same
  - d) increase and decrease both

**(P.T.O.)**

7. Effect of diffraction is greatest if waves pass through a gap with width equal to

- a) frequency
- b) wavelength
- c) amplitude
- d) wavefront

8. Visible light has wavelength of

- a)  $5 \times 10^{-7}$  m
- b)  $3 \times 10^8$  m
- c)  $6 \times 10^3$  m
- d)  $4 \times 10^4$  m

9. Spreading of wave as it passes through a gap or around an edge is called

- a) reflection
- b) refraction
- c) diffraction
- d) superposition

10. In photoelectric effect, electrons should be removed from the

- a) inner shells
- b) surface
- c) from core
- d) the nucleus



# UNIVERSITY OF THE PUNJAB

Fourth Semester - 2018  
Examination: B.S. 4 Years

Roll No. ....

**PAPER: Physics-IV (Concepts of Modern Physics)**  
**Course Code: PHY-213 / PHY-22307 Part – II**

**TIME ALLOWED: 2 Hrs. & 45 Min.**  
**MAX. MARKS: 50**

**Attempt this Paper on Separate Answer Sheet provided.**

Question no: 2

Write short answers of the following questions.

(4 x 5 = 20)

1. Define Planks distribution law and Wien displacement law?
2. Describe the working of Nuclear Reactor?
3. Define Spectroscopy. Name three types of spectra?
4. Define azimuthal quantum number in detail?
5. State any 2 theorems associated with wave-functions in Quantum Mechanics?

Question no: 3

(10)

What do you know about Lorentz Transformation? Define Relativistic momentum in this regard?

Question no: 4

(10)

Describe the process of Controlled Thermo-Nuclear Fusion in detail?

Question no: 5

(10)

Describe the theory of Beta-Decay in detail? Also calculate its penetration depth?



*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 degree of freedom of a double pendulum is

- (a) 4
- (b) 2
- (c) 3
- (d) 1

(ii) Equation of conics  $r = \frac{h}{1+e \cos \theta}$  draws a hyperbola when

- (a)  $e = 1$
- (b)  $e > 1$
- (c)  $e < 1$
- (d)  $e = 0$

(iii) The geodesic on the surface of a sphere is a

- (a) great circle
- (b) straight line
- (c) helix
- (d) ellipse

(iv) For a system of  $N$  particles the dimension of the phase space is

- (a)  $2N$
- (b)  $3N$
- (c)  $4N$
- (d)  $6N$

P.T.O.

(v) 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)  $H = \frac{\partial L}{\partial \dot{q}_i}$

(d)  $H = \frac{1}{L}.$

(vi) A usual expression for the conserved angular momentum in a central force problem is:

(a)  $\ell = mr^2\theta.$

(b)  $\ell = mr^2\theta^2.$

(c)  $\ell = mr^2\dot{\theta}.$

(d)  $\ell = mr^2\dot{\theta}^2.$

(vii) In the central force problem, conservation of angular momentum is equivalent to saying

(a) the linear momentum is constant

(b) the total energy is constant

(c) the effective potential is constant

(d) the areal velocity is constant

(viii) If the Lagrangian is cyclic in  $\theta$ , then:

(a)  $mr^2\dot{\theta}$  is not conserved.

(b)  $mr^2\dot{\theta}$  is conserved.

(c)  $\theta$  appears in the Lagrangian

(d)  $\dot{\theta}$  does not appear in the Lagrangian

(xi) If  $A$  and  $B$  are any two constants of motion, their Poisson bracket  $\{A, B\}$

(a) is zero

(b) is invariant

(c) is a constant of motion

(d) is covariant

(x) Kepler's third law of planetary motion states that

(a)  $T^3 \propto a^3$

(b)  $T^2 \propto a^3$

(c)  $T^3 \propto a^2$

(d)  $T^2 \propto a^4$



# UNIVERSITY OF THE PUNJAB

Fifth Semester 2018  
Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Classical Mechanics  
Course Code: PHY-301

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

*Attempt this Paper on Separate Answer Sheet provided.*

## SECTION-II (20 Marks)

2. If  $L$  is a Lagrangian for a system of  $n$  degrees of freedom satisfying Lagrange equation of motion, show by direct substitution that

$$L' = L + \frac{d}{dt}F(q_1, \dots, q_n; t),$$

satisfies the Lagrange equation of motion. (5)

3. Show that the transformation

$$\begin{aligned} P &= 2(1 + \sqrt{q} \cos p)\sqrt{q} \sin p \\ Q &= \ln(1 + \sqrt{q} \cos p) \end{aligned}$$

is canonical.

(5)

4. The Lagrangian for two particles of masses  $m_1$  and  $m_2$  and coordinates  $\mathbf{x}_1$  and  $\mathbf{x}_2$ , interacting via a potential  $V(\mathbf{x}_1 - \mathbf{x}_2)$ , is

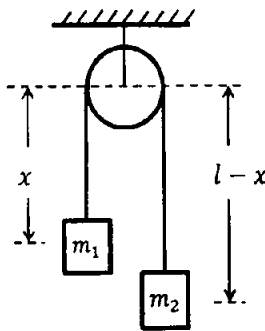
$$L = \frac{1}{2}m_1\dot{\mathbf{x}}_1^2 + \frac{1}{2}m_2\dot{\mathbf{x}}_2^2 - V(\mathbf{x}_1 - \mathbf{x}_2)$$

Rewrite the Lagrangian in terms of the center of mass coordinates

$$\mathbf{R} = \frac{m_1 \mathbf{x}_1 + m_2 \mathbf{x}_2}{m_1 + m_2}$$

and the relative coordinates  $\mathbf{x} = \mathbf{x}_1 - \mathbf{x}_2$ . Use Lagrange's equation to show that the center of mass and relative motion separate, the center of mass moving with constant velocity and relative motion being like that of a particle of reduced mass  $\mu = \frac{m_1 m_2}{m_1 + m_2}$  in a potential  $V(\mathbf{x})$ . (5)

5. Consider the Atwood machine as shown in Figure. Find the equation of motion. (5)



P.T.O.

<b>SECTION-III (30 Marks)</b>
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6. (a) State Kepler's Laws of planetary motion.  
 (b) Discuss the properties of motion in effective potential in a central force two-body problem. (5+5)
7. (a) A particle moves in an elliptical orbit in an inverse square law central force field. If the ratio of the maximum angular velocity to the minimum angular velocity of the particle in its orbit is  $n$ , then show that the eccentricity of the orbit is

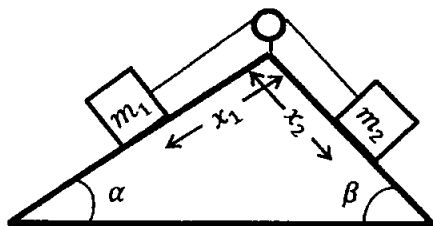
$$\epsilon = \frac{\sqrt{n} - 1}{\sqrt{n} + 1}.$$

- (b) Show that the path followed by a particle in sliding from one point to another under the action of gravity in the absence of friction and in the shortest time is a cycloid. (5+5)
8. (a) Show that, if a transformation from  $(q, p)$  to  $(Q, P)$  be canonical then the bilinear form

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

is invariant under the canonical transformation.

- (b) Consider two masses tied together on a frictionless inclined plane as shown in Figure. Find the equations of motion.



(5+5)





# UNIVERSITY OF THE PUNJAB

Roll No. ....

Fifth Semester 2018

Examination: B.S. 4 Years Programme

**PAPER: Mathematical Methods of Physics-I**  
**Course Code: PHY-302**

**TIME ALLOWED: 30 mins.**  
**MAX. MARKS: 10**

*Attempt this Paper on this Question Sheet only.*

## Section-I (Objective)

Instructions. Attempt all questions

**Marks=10**

Fill in the blank or answer true/false.

1. An arbitrary tensor of is neither symmetric nor antisymmetric but can always be written as the sum of a symmetric tensor and an antisymmetric tensor. (True/False)
2.  $\oint_C (P(x, y)dx + Q(x, y)dy) = \iint_R \left( \frac{\partial Q}{\partial y} - \frac{\partial P}{\partial x} \right) dx dy$  (True/False)
3.  $f(z) = z^2 + z$  is an analytic function. (True/False)
4. The function  $f(z) = \frac{z}{e^z - 1}$  has a removable singularity at  $z = 0$  (True/False)
5. The function  $f(z) = z(e^z - 1)$  possesses a zero of order 2 at  $z = 0$  (True/False)
6. If  $z = 10 + 8i$ , then  $\text{Re} \left( \frac{z}{z} \right) = \dots\dots\dots$
7.  $\nabla \cdot (\nabla \phi \times \nabla \psi) = \dots\dots\dots$
8. If  $e^z = 2i$ , then  $z = \dots\dots\dots$
9.  $g^{ij}e_j = \dots\dots\dots$
10. The process of contraction of an  $N$ th-order tensor produces another tensor of rank.....



# UNIVERSITY OF THE PUNJAB

Fifth Semester 2018  
Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Mathematical Methods of Physics-I  
Course Code: PHY-302

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

*Attempt this Paper on Separate Answer Sheet provided.*

## SUBJECTIVE TYPE

### Section-II (Short Questions)

Marks=20

1. Show that  $\{e_i\}$  and  $\{\epsilon_i\}$  are reciprocal systems of vectors.
2. Expand  $f(z) = e^{3/z}$  in a Laurent series valid for  $0 < |z|$ .
3. Show that  $z = 0$  is an essential singularity of  $f(z) = z^3 \sin(1/z)$ .
4. Show that  $r = \rho \hat{e}_\rho + z \hat{e}_z$ , also prove that  $\nabla \cdot r = 3$  and  $\nabla \times r = 0$ . (Note:  $x = \rho \cos \phi$ ,  $y = \rho \sin \phi$ ,  $z = z$ )
5. Using the calculus of residues, show that  $\int_0^\pi \cos^{2n} \theta d\theta = \pi \frac{(2n)!}{2^{2n} (n!)^2}$ ,  $n = 0, 1, 2, \dots$

### Section-III

Marks=30

1. Evaluate

$$\int_0^{2\pi} \frac{\cos(3\theta) d\theta}{5 - 4 \cos \theta}$$

2. Evaluate

$$\oint_{|z-2i|=4} \frac{z}{z^2 + 9} dz,$$

by using Cauchy's integral formula.

3. By considering the derivative of the second-order tensor  $\mathbf{T}$  with respect to the coordinate  $u^k$ , find an expression for the covariant derivative  $T_{ij;k}$  of its contravariant components.
4. The electric field  $\mathbf{E} = -\nabla\varphi$ ; this is derived from a scalar, the electrostatic potential  $\varphi$ , and has components  $E_i = -\frac{\partial\varphi}{\partial x_i}$ . Show that  $\mathbf{E}$  is a first order tensor.
5. Find the circular cylindrical components of the velocity and acceleration of a moving particle. (Hint:  $r(t) = \rho(t)\hat{e}_\rho(t) + z(t)\hat{e}_z$  and  $x = \rho \cos \phi$ ,  $y = \rho \sin \phi$ ,  $z = z$ )



# UNIVERSITY OF THE PUNJAB

Roll No. ....

Fifth Semester 2018  
Examination: B.S. 4 Years Programme

PAPER: Solid State Physics-1  
Course Code: PHY-303

TIME ALLOWED: 30 mins.  
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 crystal systems are there in three dimensions?  
i) 5                      ii) 7                      iii) 10                      iv) 14
- B)** Which combination of following crystal structures are closely-packed structures?  
i) FCC and SC   ii) BCC and SC   iii) BCC and HCP   iv) HCP and FCC
- C)** The space lattice of cesium chloride (CsCl) structure is:  
i) Simple cubic   ii) Body centered cubic   iii) Face-centered cubic   iv) None of these
- D)** Reciprocal of body centered cubic lattice (BCC) 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 classical model of lattice heat capacity ( $C_v$ ),  $C_v$  for all solids  
i) depends on temperature   ii) not depend on 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)** In a cubic crystal, the direction  $[hkl]$  to a plane  $(hkl)$  having the same indices is:  
i) Parallel   ii) Perpendicular   iii) neither parallel nor perpendicular   iv) none of these



# UNIVERSITY OF THE PUNJAB

Fifth Semester 2018  
Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Solid State Physics-1  
Course Code: PHY-303

TIME ALLOWED: 2 hrs. & 30 mins.  
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)

- Draw (100), (200), (101) and (110) crystallographic planes in cubic unit cell.
- What kind of anharmonic crystal interactions exist in solids. Discuss briefly.
- Discuss how diffraction of waves by crystals is analogous to diffraction of waves through grating. Is there any difference?
- What are Van der Waals interactions in crystals? Discuss their origin.
- Calculate the packing fraction of hexagonal close-packed (HCP) structure.

**Q.3**

- Derive dispersion relation for a linear monoatomic chain of atoms with mass  $m$  and separation  $a$  by taking into account nearest neighbor interactions only. (7)
- Plot a dispersion curve and discuss behavior of wave propagation at zone boundaries? (3)

**Q.4**

Define cohesive energy of a solid. Derive an expression for cohesive energy of an inert gas crystal containing  $N$  atoms at equilibrium separation  $R_0$ . (2+8)

**Q.5**

Derive an expression for lattice heat capacity of solids on the basis of Debye model. Explain graphically the discrepancies in classical and Einstein model and discuss how Debye model fits well with experimental observations. (6+4)



# UNIVERSITY OF THE PUNJAB

Roll No. ....

Fifth Semester 2018

Examination: B.S. 4 Years Programme

PAPER: Electronic Devices and Circuits

TIME ALLOWED: 30 mins.

Course Code: PHY-304-A

MAX. MARKS: 10

*Attempt this Paper on this Question Sheet only.*

## OBJECTIVE TYPE

Q.1

1. In a PNP transistor, the P region are
  - a) Base and Emitter
  - b) Base and Collector
  - c) Emitter and Collector
  - d) both a & b
2. If the output of a transistor is 5Vrms and the input is 100Vrms, the voltage gain is
  - a) 5
  - b) 500
  - c) 50
  - d) 100
3. In a transistor amplifier, if the base-emitter junction is open, the collector voltage is
  - a)  $V_{cc}$
  - b) 0V
  - c) floating
  - d) 0.2V
4. A small signal amplifier is
  - a) Use only a small portion of its load line
  - b) Always has an output signal in the mV rang
  - c) Goes into saturation once on each input cycle
  - d) Is always common Emitter Amp.
5. The input resistance of a common-base amplifier
  - a) Very low
  - b) Very high
  - c) the same as in CE
  - d) the same as in CC
6. The differential amplifier
  - a) Is used in OP-amp
  - b) Has one input and one output
  - c) has two output
  - d) a&c
7. In a certain emitter follower circuit, the current gain is 50. The power gain is approximately
  - a)  $50 A_v$
  - b) 50
  - c) 1
  - d) a& b
8. Voltage divider bias
  - a) Cannot be independent of  $\beta_{DC}$
  - b) Can be independent of  $\beta_{DC}$
  - c) Is not widely used
  - d) Require fewer components than all the others
9. The input resistance at the base of the biased transistor depends mainly on
  - a)  $\beta_{DC}$
  - b)  $R_B$
  - c)  $R_E$
  - d)  $\beta_{DC}$  &  $R_E$
10. In a Digital Multi meter (DMM) measuring an open transistor junction shows
  - a) 0V
  - b) 0.7V
  - c) OL
  - d) vcc



# UNIVERSITY OF THE PUNJAB

Fifth Semester 2018

Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Electronic Devices and Circuits  
Course Code: PHY-304-A

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

*Attempt this Paper on Separate Answer Sheet provided.*

## SUBJECTIVE TYPE

Q.2 Short Answer

5\*4= 20

1. What is  $\beta_{DC}$  and  $\alpha_{DC}$  of the transistor if  $I_c = 20.3\text{mA}$  and  $I_E = 20.5\text{mA}$ .
2. Explain the function of a Zener Diode, where we use it.
3. What is the Amplification? What are the factors to determine the Voltage gain of an Amplifier?
4. When a transistor is used as a switch, in what two states is it operated?
5. Draw the circuit of Common Collector Amplifier, how it work.

Q.3 Draw the circuit of Schmitt-trigger circuit, How it work where it used?

6

b) What is a Miller Effect?

4

Q.4 What is the meaning of negative feedback, what its importance in an Oscillator circuits? Write the function of a Phase shift Oscillator, what type of wave at the output?

10

Q.5 Draw the Class AB Amplifier, write down its function, where it used?

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- Conditions on wave function is that, it must be:

- a) Single valued
- b) Finite
- c) Continuous
- d) All above

2- Levi-civita symbol  $\epsilon_{ijk}$  for odd permutation of i, j, k is

- a) 1
- b) 0
- c) -1
- d) none of above

3-  $[\hat{L}_z, \hat{L}_+]$

- a)  $\hbar L_+$
- b)  $i \hbar L_+$
- c)  $i \hbar L_-$
- d) Zero

4- The Hamiltonian of harmonic oscillator in terms of Ladder operator:

- a)  $\hbar \omega (\hat{N} - \frac{1}{2})$
- b)  $\frac{1}{2} \hbar \omega$
- c)  $\frac{1}{2} \hbar \frac{\omega}{4}$
- d)  $\hbar \omega (\hat{N} + \frac{1}{2})$

P.T.O

5-  $\vec{L} \times \vec{L}$

- a) Zero
- b)  $\hbar L_+$
- c)  $i \hbar \vec{L}$
- d) None of above

6- If  $[\hat{A}, \hat{B}] = 0$  then both operators can be determined

- a) Simultaneously
- b) Difficult to find
- c) Both a & b
- d) none of above

7- The raising operator  $\hat{L}_+$  of angular momentum is defined as:

- a)  $\hat{L}_x + i \hat{L}_y$
- b)  $\hat{L}_x - i \hat{L}_y$
- c)  $\hat{L}_x + i \hat{L}_z$
- d)  $\hat{L}_z + i \hat{L}_y$

8- If two operators commute with each other, then operators have same set of:

- a) Eigen values
- b) Eigen spectrum
- c) Eigen functions
- d) None of above

9- Expression for Z-component of angular momentum is

- a)  $-i \hbar \frac{\partial}{\partial \theta}$
- b)  $-i \hbar \frac{\partial}{\partial \phi}$
- c)  $i \hbar \frac{\partial}{\partial \phi}$
- d)  $-i \hbar \frac{\partial}{\partial z}$

10- Applications of barrier tunneling are:

- a) Radioactive decays
- b) Semiconductor devices
- c) Both a & b
- d) None of these





# UNIVERSITY OF THE PUNJAB

Fifth Semester 2018  
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

i.

Q2: Give short answers to the following questions: (4x5 = 20)

- i. What is zero point energy, If a classical oscillator has energy  $\frac{1}{2} h \omega$ , What is its amplitude?
- ii. Define degenerate eigen values, non-degenerate eigen values, linear dependent functions and linear independent functions.
- iii. Describe Correspondence principle.
- iv. State Hilbert space and give two of its examples.
- v. Write physical significance of Uncertainty principle.

Q3: Define the term Central potential. Starting with the time independent Schrodinger's wave equation, obtain an expression of radial wave function. (10)

Q4: (a) If two operators have simultaneous eigen function, then these operators commute  
(b) Write down three postulates of Quantum Mechanics. (7+3)

Q5: (a) Find eigen value and eigen function of z-component of angular momentum.  
(b) Prove that  $[\hat{L}_z, \text{Sin}\phi] = -i\hbar\text{Cos}\phi$  (7+3)



# UNIVERSITY OF THE PUNJAB

Sixth Semester - 2018

Examination: B.S. 4 Years Programme

Roll No. ....

**PAPER: Mathematical Methods of Physics-II**  
**Course Code: PHY-307 Part - II**

**TIME ALLOWED: 2 Hrs. & 45 Mints.**  
**MAX. MARKS: 50**

**Attempt this Paper on Separate Answer Sheet provided.**

## Section-II (Short Questions)

Marks=20

(4x5)

- The functions  $u_1(x)$  and  $u_2(x)$  are eigenfunctions of the same Hermitian operator but for distinct eigenvalues  $\lambda_1$  and  $\lambda_2$ . Prove that  $u_1(x)$  and  $u_2(x)$  are linearly independent.
- A different sawtooth wave is described by

$$f(x) = \begin{cases} -\frac{1}{2}(\pi + x), & -\pi \leq x < 0 \\ \frac{1}{2}(\pi - x), & 0 < x \leq \pi. \end{cases}$$

Show that  $f(x) = \sum_{n=1}^{\infty} \frac{\sin(nx)}{n}$ .

- Show that

$$\mathcal{F} \left[ \frac{d^n}{dt^n} f(t) \right] = \left[ \frac{d^n}{dt^n} f(t) \right]^T (\omega) = (-i\omega)^n \mathcal{F} [f(t)] = (-i\omega)^n [f(t)]^T (\omega).$$

- Use mathematical induction to show that

$$J_n(x) = (-1)^n x^n \left( \frac{1}{x} \frac{d}{dx} \right)^n J_0(x).$$

- Show that

$$\int_{-\infty}^{+\infty} x^2 e^{-x^2} H_n(x) H_n(x) dx = \pi^{1/2} 2^n n! \left( n + \frac{1}{2} \right).$$

## Section-III

Marks=30

(6x5)

- Find the Green's function for

$$\frac{d^2 y}{dx^2} + k \frac{dy}{dx} = f(x),$$

subject to the initial conditions  $y(0) = y'(0) = 0$ , and solve this ODE for  $x > 0$  given  $f(x) = \exp(-x)$ .

- A function  $f(x)$  is expanded in a Legendre series  $f(x) = \sum_{n=0}^{\infty} a_n P_n(x)$ . Show that

$$\int_{-1}^{+1} [f(x)]^2 dx = \sum_{n=0}^{\infty} \frac{2a_n^2}{2n+1}.$$

- Show that

$$\int_0^{\infty} e^{-x} L_l(x) L_m(x) dx = \delta_{lm},$$

where  $L_l(x)$  and  $L_m(x)$  are Laguerre's polynomials.

- Derive the recurrence relations

$$\Gamma(z+1) = z\Gamma(z),$$

from the Euler integral

$$\Gamma(z) = \int_0^{\infty} e^{-t} t^{z-1} dt.$$

where  $z$  is a positive real number.

- Show that

$$\Gamma(k+1) \Gamma\left(\frac{1}{2} + k\right) = \frac{\sqrt{\pi}}{2^{2k}} \Gamma(2k+1),$$

where  $k$  is an integer.



# UNIVERSITY OF THE PUNJAB

Sixth Semester - 2018

Examination: B.S. 4 Years Programme

Roll No. ....

**PAPER: Mathematical Methods of Physics-II**  
**Course Code: PHY-307 Part – I (Compulsory)**

**TIME ALLOWED: 15 Mints.**  
**MAX. MARKS: 10**

**Attempt this Paper on this Question Sheet only.**

**Please encircle the correct option. Each MCQ carries 1 Mark. This Paper will be collected back after expiry of time limit mentioned above.**

## Section-I (Objective)

Marks=10

Fill in the blank or answer true/false.

1.  $\left(\frac{d}{dx}\right)^2 + k^2$  is a linear operator. (True/False)
2.  $(k+1)! = \Gamma(k-1)$  (True/False)
3.  $\mathcal{F}\left[\frac{d^n}{dt^n} f(t)\right] = g(\omega)$ . (True/False)
4. If  $\chi$  is a solution of Laplace's equation  $\nabla^2 \chi = 0$ , then  $\chi_{xy} = \frac{\partial^2 \chi}{\partial x \partial y}$  is also a solution. (True/False)
5. Hermite equation ( $y'' - 2xy' + 2ay = 0$ ) has no singularity other than an irregular singularity at  $x = \infty$ . (True/False)
6.  $\frac{\partial \psi}{\partial x} + \frac{\partial \psi}{\partial y} + (x+y)\psi = 0$  is a linear partial differential equation. (True/False)
7.  $f(x) = \sum_{n=0}^{\infty} a_n P_n(x)$ , where  $a_n = \dots$
8.  $\Gamma(1/2) = \dots$
9.  $\mathcal{F}\{f'(t)\} = \dots$
10.  $\mathcal{L}\{J_0(\alpha t)\} = \dots$



# UNIVERSITY OF THE PUNJAB

Sixth Semester - 2018

Examination: B.S. 4 Years Programme

Roll No. ....

**PAPER: Solid State Physics-II**  
**Course Code: PHY-308 Part – II**

**TIME ALLOWED: 2 Hrs. & 45 Mints.**  
**MAX. MARKS: 50**

**Attempt this Paper on Separate Answer Sheet provided.**

**Question No.2: Answer the following short questions.**

**(10x2=20)**

- i. What factors affect the resistivity of metals.
- ii. What is Bloch function? What does it represent physically.
- iii. Differentiate between direct and indirect band gap materials.
- iv. What is the origin of energy gaps.
- v. What type of changes appear in band structure of semiconductor after doping with pentavalent impurity.
- vi. State Wiedemann-Franz law and also write down expression for Lorentz number.
- vii. Plot the optical absorption curves for the direct gap and indirect gap materials.
- viii. Plot the distribution of probability density ' $\rho$ ' in the lattice for  $|\Psi -|^2$ ,  $|\Psi +|^2$  and for a pure travelling wave.
- ix. What are significances of Hall co-efficient?
- x. What is cyclotron resonance and how it can be measured experimentally.

### Section-III

**Question No.3: Answer the following questions.**

**(3x10=30)**

- 1 Show that the effective mass of an electron in a crystal depends on the curvature of energy band. Discuss the physical basis for the effective mass of an electron in a crystal.
- 2 Derive the energy expressions for the electron in one dimensional potential box and discuss the important conclusions from this equation.
- 3 What are intrinsic semiconductors and derive an expression for intrinsic carrier concentration in a semiconductor.



# UNIVERSITY OF THE PUNJAB

Sixth Semester - 2018

Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Solid State Physics-II

TIME ALLOWED: 15 Mints.

Course Code: PHY-308 Part – I (Compulsory)

MAX. MARKS: 10

Attempt this Paper on this Question Sheet only.

Please encircle the correct option. Each MCQ carries 1 Mark. This Paper will be collected back after expiry of time limit mentioned above.

- Q.1. Encircle the best answer for each question. (10)
- Ohm's law relates to the electric field 'E' conductivity ' $\delta$ ' and current density 'J' as
    - $J = \frac{E}{\sigma}$
    - $J = \sigma E^2$
    - $J = \frac{\sigma}{E}$
    - $J = \sigma E$
  - The cyclotron frequency is
    - $\omega_c = 2\pi f$
    - $\omega_c = eB$
    - $\omega_c = \frac{eB}{m}$
    - None
  - In an intrinsic semiconductor, the Fermi level lies almost midway in the forbidden gap.
    - True
    - False
  - Relaxation time for the electron is independent of
    - Amplitude of electron
    - Velocity
    - both
    - None of these
  - The wave vector 'k' is related to wavelength ' $\lambda$ '
    - $K = 2\pi\lambda$
    - $K = \frac{2\pi}{\lambda}$
    - $K = \frac{2\pi f}{\lambda}$
    - $K = \frac{2\pi}{\lambda f}$
  - The classical value of molar lattice specific heat is
    - $\frac{3R}{2}$
    - R
    - 3R
    - $\frac{R}{2}$
  - At lower temperatures, the lattice specific heat varies as
    - $T^3$
    - $\frac{1}{T^3}$
    - T
    - $\frac{1}{T}$
  - The highest point in the conduction band is called the conduction band edge.
    - True
    - False
  - 'P' and 'As' are added in silicon to make it
    - P-type
    - N-Type
    - Insulator
    - conductor
  - The value of effective mass is
    - $\frac{1}{\hbar} \frac{d^2 E}{dk^2}$
    - $-\frac{1}{\hbar} \frac{d^2 E}{dk^2}$
    - $\frac{1}{\hbar^2} \frac{d^2 E}{dk^2}$
    - $-\frac{1}{\hbar^2} \frac{d^2 E}{dk^2}$



# UNIVERSITY OF THE PUNJAB

Sixth Semester - 2018

Examination: B.S. 4 Years Programme

Roll No. ....

**PAPER: Quantum Mechanics-II**  
**Course Code: PHY-309 Part – II**

**TIME ALLOWED: 2 Hrs. & 45 Mints.**  
**MAX. MARKS: 50**

**Attempt this Paper on Separate Answer Sheet provided.**

## SUBJECTIVE TYPE

- Q.2 Give short answers to the following questions. (4x5=20)
- Prove that  $[\hat{H}, \hat{p}_{ij}] = 0$ , interpret your results.
  - Define later determinant? Write it for N-particle system.
  - Define 'Exchange Symmetry' and 'Exchange Degeneracy'.
  - What is the Solid angle? Write its physical interpretation in scattering reference.
  - What is boson-Einstein-condensation? Give one example.
- Q.3 Write Detail Description of Time-independent perturbation theory up to first order Correction. (10)
- Q.4 Explain the theory of scattering? write a note on potential scattering. (10)
- Q.5 Briefly describe (5+5)
- Born Approximation
  - Check validity of WKB method.



# UNIVERSITY OF THE PUNJAB

Sixth Semester - 2018

Examination: B.S. 4 Years Programme

Roll No. ....

**PAPER: Quantum Mechanics-II**  
**Course Code: PHY-309 Part – I (Compulsory)**

**TIME ALLOWED: 15 Mints.**  
**MAX. MARKS: 10**

**Attempt this Paper on this Question Sheet only.**

**Please encircle the correct option. Each MCO carries 1 Mark. This Paper will be collected back after expiry of time limit mentioned above.**

Q1: Choose (encircle) the best possible answer from the given.

(1x10=10)

- 1 The operators which connect the Hilbert space :
  - a) Creation operator
  - b) Annihilation operator
  - c) Momentum operator
  - d) Both a & b
- 2 Identify, which is an approximation method?
  - a) Time dependent perturbation theory
  - b) Time independent perturbation theory
  - c) Variational technique
  - d) All above
- 3 The diagonal matrix of operator  $\hat{S}_y$  is obtained after diagonalization 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 Spin angular momentum is quantized by \_\_\_\_ quantum numbers?
  - a) 3
  - b) 2
  - c) 4
  - d) 6
- 5 Identify fermion particle:
  - a) Photon
  - b) graviton
  - c) pi meson
  - d) Neutron
- 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



# UNIVERSITY OF THE PUNJAB

Sixth Semester - 2018

Examination: B.S. 4 Years Programme

Roll No. ....

**PAPER: Digital Electronics**  
**Course Code: PHY-310 Part – II**

**TIME ALLOWED: 2 Hrs. & 45 Mints.**  
**MAX. MARKS: 50**

**Attempt this Paper on Separate Answer Sheet provided.**

Q.2 Write short answer of each.

(2×10)=20

- I. Write the Gray equivalent of  $(78)_{10}$ .
- II. Find the hex sum of  $(93 + 9DE)_{16}$ .
- III. Explain how an D type FF can work.
- IV. What is difference between Asynchronous and Synchronous counter?
- V. What is a D/A converter?
- VI. What is digital computer?
- VII. What are the semiconductor memories?
- VIII. What is the difference between the Boolean algebra & K-map in sequential circuits?
- IX. Solve  $(7 - 10)_{10}$  with 2's compliment.
- X. What are the applications of Gray and Excess Code?

Q3. Draw the diagram of JK master Slave Flip Flop, explain its function with truth table. 10

Q4. Simplify the Boolean function and solve with SOP and draw the logic diagram with NAND gates.

$$F(A,B,C,D) = \Sigma (1,3,4,5,6,7,9,12,13)$$

10

Q.5 Write short note on any two.

5,5

- a) PAL
- b) Parallel counter
- c) Digital Clock





# UNIVERSITY OF THE PUNJAB

Sixth Semester - 2018

Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Digital Electronics

TIME ALLOWED: 15 Mints.

Course Code: PHY-310 Part – I (Compulsory)

MAX. MARKS: 10

Attempt this Paper on this Question Sheet only.

Please encircle the correct option. Each MCQ carries 1 Mark. This Paper will be collected back after expiry of time limit mentioned above.

Q.1 Select the correct answer and encircle it. (10)

- How many flip flops are required to construct a ripple counter of Mod-10?  
a) 10      b) 3      c) 4      d) 2
- How many f/f required constructing a Synchronous mod-24 counter?  
a) 6      b) 4      c) 5      d) 8
- A decimal number 256 be written in BCD as:  
a) 100101110      b) 010 0101 0110      c) 10 0101 0110      d) non of them
- A XOR gate has input A and b and its output is being written as:  
a)  $A+B$       b)  $AB+A'B$       c)  $A'B+AB'$       d)  $AB+A'B'$
- The code where all successive numbers differ from their preceding number by single bit is  
a) Binary code.      b) BCD.  
c) Excess - 3.      d) Gray.
- Which of the following are known as Universal gate?  
a) NAND & NOR      b) AND & OR      c) XOR & OR      d) None
- Which of the following memories store the most number of bits?  
a) 64Kx8 memory      b) 1M x8 memory      c) 32Mx8 memory      d) 64x6 memory
- The result of adding hexadecimal number A6 to 3A is  
a) DD      b) E0      c) F0      d) EF
- The excess-3 code of decimal 7 is represented by  
a) 1100      b) 1001      c) 1011      d) 1010
- The output of SR F/F when S=1, R= 0 is  
a) 1      b) 0      c) NO change      d) High Impedance



# UNIVERSITY OF THE PUNJAB

Sixth Semester - 2018

Examination: B.S. 4 Years Programme

Roll No. ....

**PAPER: Computational Physics-I**

**TIME ALLOWED: 2 Hrs. & 45 Mints.**

**Course Code: PHY-311 Part – II**

**MAX. MARKS: 50**

**Attempt this Paper on Separate Answer Sheet provided.**

Q.2.	<p>Write short answers of the following Questions:</p> <p>i. Explain with example the following terms in C++: a) data type (b) user-function (c) /* and */ (d) getch()</p> <p>ii. Write syntax with example the following in C++: (a) for ( ) loop (b) switch()</p> <p>iii. Discuss arithmetic logical operators in C++?</p> <p>iv. Write C++ program code segment for the following: (a) to calculate and print equivalent of two capacitors connected in series, read capacitances from the user (b) to print x, y against f(x,y) for the equation <math>f(x, y) = x^2 + 77xy - y^2</math> read x and y from user (c) to calculate and display minimum of f(x,y) in above</p>	4 4 4 8
Q.3.	<p>Write C++ program to evaluate the <math>\int_1^5 (x^2 + 4\sqrt{x} + 7)dx</math> by Trapezoidal's rule or by Simpson's (1/3) rule due to options 1 or 2 respectively (use n=6). Report error message for any other option pressed by the user.</p>	10
Q.4.	<p>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) <math>C = \frac{11A \bullet 4B}{44}</math>, (ii) <math>D = A - B' + 3</math> and (iii) to print off diagonal elements of C. (iv) maximum of the elements of matrix A. (v) square of the elements of matrix B</p>	2+4+4
Q.5.	<p>(a) Write C++ program for the simple harmonic motion (S.H.M) of a mass attached with a spring using Euler's method under the following conditions: (<math>g=9.8 \text{ m/s}^2</math>, initial position zero and velocity 15 m/s, time step 0.1 sec. and maximum time 15 sec., <math>k = 1 \text{ N/m}</math>, <math>m=1\text{kg}</math>). Calculate and print values for time, position and velocity. Give comment that how you can change the same program for forced H.M.</p> <p>(b) Write a function circle () which reads in radius values and print out area and circumference values of the circle. Execute the program iteratively for 5 values.</p>	6+4



# UNIVERSITY OF THE PUNJAB

Sixth Semester - 2018

Examination: B.S. 4 Years Programme

Roll No. ....

**PAPER: Computational Physics-I**  
**Course Code: PHY-311 Part – I (Compulsory)**

**TIME ALLOWED: 15 Mints.**  
**MAX. MARKS: 10**

**Attempt this Paper on this Question Sheet only.**

**Please encircle the correct option. Each MCQ carries 1 Mark. This Paper will be collected back after expiry of time limit mentioned above.**

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

1 x 10 = 10

- i. C++ program statement that is not included in code compilation:  
a) "welcome"      (b) cout<<"welcome";      (c) /\*      (d) void
- ii. In C++ what is not a repetition structure:  
a) if-else-if      (b) while      (c) for      (d) do-while
- iii. C++ language, HEADER TYPE that provides user read from keyboard is called:  
(a) iostream.h      (b) conio.h      (c) math.h      (d) both (a) & (b)
- iv. Which of the following is not a comparison operation in C++?  
(a) X>Y      (b) X<=Y      (c) X==Y      (d) X=Y
- v. The number of bytes reserved for long int data type in C++ is:  
(a) 4      (b) 8      (c) 12      (d) 16
- vi. main() is a :  
(a) Operator      (b) user defined function      (c) built in function      (d) None
- vii. In C++, the process of sending an argument to a function is called:  
(a) sending      (b) email      (c) delivering      (d) passing
- 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 = 3. In C++ the expression a = 3\*k-3 is evaluated to:  
(a) 6      (b) 9      (c) -6      (d) 1
- x. Function declaration consists of :  
(a) function name      (b) return type      (c) parameter      (d) All



*Attempt this Paper on this Question Sheet only.*

*NOTE: Try to be focused and give only precise answers, of the asked questions.*

**Section-I**

Q.No.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. Which of the following space is used in statistical mechanics?  
(a) configuration space (b) phase space (c) Gamma space (d) both b and c
2. Which is not conserved in NVT ensemble?  
(a) energy (b) temperature (c) number of particles (d) None of these
3. The spin of He-4 is  
(a) 2 (b) 0 (c) 1/2 (d) 1
4. An ensemble in which system can exchange both energy and particles with a reservoir is known as  
(a) Micro Canonical (b) Grand canonical (c) Canonical (d) both b and c
5. Free electrons in metals obey  
(a) Bose-Einstein statistics  
(b) Fermi-Dirac statistics  
(c) Gibbs statistics  
(d) Maxwell-Boltzmann statistics
6. Photons are described by  
(a) Maxwell-Boltzmann statistics  
(b) Bose-Einstein statistics  
(c) Fermi-Dirac statistics  
(d) All of these
7. Which can be determined from canonical Partition function?  
(a) Free energy (b) Average energy (c) entropy (d) All of these
8. For indistinguishable particles  
(a) wave functions overlap (b) no wave functions (c) Pauli exclusion always hold (d) both a and c
9. No two electrons can exist in same quantum state. This is known as  
(a) Heisenberg Principle (b) Pauli exclusion Principle (c) Bohr principle (d) None of these
10. The entropy of a system in a single pure quantum state is zero. This is known as  
(a) first law of thermodynamics (b) third law of thermodynamics (c) second law of thermodynamics  
(d) zeroth law of thermodynamics



# UNIVERSITY OF THE PUNJAB

Seventh Semester 2018  
Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Statistical Mechanics  
Course Code: PHY-401

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

*Attempt this Paper on Separate Answer Sheet provided.*

*NOTE: Try to be focused and give only precise answers, of the asked questions.*

## Section-II

Q.No.2

Answer the following short questions. Each question carries equal marks (20)

- (i) What are limitations of Debye's model?
- (ii) Define (a) NVT ensemble (b) chemical potential
- (iii) What is meant by degenerate Fermi gas? Which statistics is involved in it?
- (iv) Define Gibbs free energy and enthalpy.
- (v) What are draw backs of Einstein model?

Q.No.3

- (a) Discuss concentration fluctuation for grand canonical ensemble. (6)
- (b) What is Gibbs paradox? How can we resolve it? (4)

Q.No.4

- (a) Define Photon gas. Derive Bose-Einstein distribution function. (6)
- (b) What is Bose-Einstein condensate? Under what conditions it is formed? Give examples of this state of matter. (4)

Q.No.5

- (a) Define density operator. Is it linear? What is its significance? (4)
- (b) Write down properties of density matrix. Also define mixed state and pure state. (6)



# UNIVERSITY OF THE PUNJAB

Roll No. ....

Seventh Semester 2018  
Examination: B.S. 4 Years Programme

**PAPER: Classical Electrodynamics-I**  
**Course Code: PHY-402**

**TIME ALLOWED: 30 mins.**  
**MAX. MARKS: 10**

*Attempt this Paper on this Question Sheet only.*

NOTE: Attempt all questions.

## OBJECTIVE

Q1- Choice the correct answer.

- The unit of resistivity in SI system of units is  
a. ohm-meter      b. amp-meter      c. volt/amp      d. volt-meter
- The force on moving charge is Lorentz force if  
a. electric field is present only      b. magnetic field is present  
c. gravitational force is present      d. both a and b
- Conventional current is flow of  
a. positive charge      b. negative charge      c. neutrons      d. both a & b
- Biot-Savart law in magnetism is analogous to which law in electricity?  
a. Gauss's law      b. Faraday's law      c. Coulomb's law      d. Ampere's law
- Which of the following cannot be computed using Biot-Savart law?  
a. magnetic field intensity      b. magnetic flux density      c. electric field intensity  
d. permeability
- In Maxwell's equation  $\nabla \times H = J + \partial D / \partial t$ ,  $D$  is  
a. electric displacement      b. magnetic flux density      c. surface current density  
d. none of these
- In SI units, the current density  $J$  is  
a. A/m      b. A/m<sup>2</sup>      c. m/A      d. A/m<sup>3</sup>
- The continuity equation is based on the principle of  
a. conservation of charge      b. conservation of momentum  
c. conservation of angular momentum      d. none of these
- The magnetic moment is given by  $m = IA$ , where  $A$  is  
a. a magnetic vector potential      b. an area (vector)      c. a scalar potential  
d. a surface density
- In metals, current is carried entirely by  
a. ions      b. electrons      c. neutrons      d. none of these



# UNIVERSITY OF THE PUNJAB

Seventh Semester 2018

Examination: B.S. 4 Years Programme

Roll No. ....

**PAPER: Classical Electrodynamics-I**

**Course Code: PHY-402**

**TIME ALLOWED: 2 hrs. & 30 mins.**

**MAX. MARKS: 50**

*Attempt this Paper on Separate Answer Sheet provided.*

## SUBJECTIVE TYPE

**NOTE: Attempt all questions.**

**Q.2. Give short answers to the following: (20 marks)**

- |  |   |
|--|---|
| (i) Write Laplace equation in cylindrical coordinates.                 | 2 |
| (ii) What is magnetic moment?  | 3 |
| (iii) Discuss briefly the Hysteresis loop in a ferromagnetic material. | 5 |
| (iv) What is Biot-Savart Law?  | 3 |
| (v) Discuss briefly Lorentz gauge.                                     | 4 |
| (vi) What is Poynting vector?  | 3 |

Q.3. What is a plane wave solution? Find the wave equation for  $E$  in a linear and charge free medium. 3,7

Q.4. Describe briefly the magnetic field intensity  $H$ . Discuss how the field vectors  $B$  and  $H$  change in passing an interface between two media. 3,7

Q.5. What are electrostatic images? By using the method of electrostatic images, find potential due to a point charge  $q$  in the vicinity of a conducting sphere. 3,7



# UNIVERSITY OF THE PUNJAB

Roll No. ....

Seventh Semester 2018  
Examination: B.S. 4 Years Programme

PAPER: Nuclear Physics-I  
Course Code: PHY-403

TIME ALLOWED: 30 mins.  
MAX. MARKS: 10

*Attempt this Paper on this Question Sheet only.*

(Objective Type)

Attempt this paper on this sheet only.

**Q. 1:-** Encircle the correct answer out of the four options given. No mark will be awarded for cutting, overwriting and for use of lead pencil or ink remover. (1 x 10 = 10)

- (i)- The ionization energy of an atom as compared to binding energy of its nucleus is:  
(a) greater (b) same  
(c) less (d) none of above
- (ii)- Beta decay is also called ----- transformation.  
(a) isobaric (b) isotopic  
(c) isotonic (d) none of above
- (iii)- If electric dipole field has odd parity then magnetic dipole field will have ---- parity.  
(a) even (b) odd  
(c) mixed (d) zero
- (iv)- According to shell model, even-even nuclei have spin:  
(a) zero (b) one  
(c) half (d) all of these
- (v)- In scintillation counter, electrons are accelerated by:  
(a) electric field (b) magnetic field  
(c) oscillating field (d) both a and b
- (vi)- Number of protons in a nucleus is called its:  
(a) mass number (b) atomic number  
(c) quantum number (d) none of above
- (vii)- For spherically symmetric charge distribution, electric quadrupole moment is:  
(a) positive (b) negative  
(c) zero (d) not predicted yet
- (viii)- Nuclear forces are:  
(a) charge independent (b) spin dependent  
(c) short range (d) all of above
- (ix)- Each nucleon moves independently inside the nucleus in a fixed orbit. This is assumption of:  
(a) liquid drop model (b) shell model  
(c) collective model (d) all of above
- (x)- In cyclotron, the frequency of rotation of charged particle decreases as the velocity:  
(a) increases (b) decreases  
(c) remains constant (d) none of above





# UNIVERSITY OF THE PUNJAB

Seventh Semester 2018  
Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Nuclear Physics-I  
Course Code: PHY-403

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

*Attempt this Paper on Separate Answer Sheet provided.*

(Subjective Type)

Attempt this paper on separate sheet provided.

Q. 2: Write short answers of following questions. (10 x 2 = 20)

(i)-Can we accelerate a neutron by cyclotron?

(ii)-Explain in few lines the concept that the working of a betatron is like that of a transformer.

(iii)-Give two properties of nuclear radiation used in detection instruments.

(iv)-Give differences between ionization chamber and proportional counter.

(v)-Give at least two reasons for acceptance of proton-neutron hypothesis for the constitution of nucleus.

(vi)-Why neutron number tends to exceed proton number in stable nuclei?

(vii)-The nucleons constantly emit and absorb pions. Why the neutrons and protons are never found with other than their usual masses?

(viii)-State similarities between nucleus and liquid drop model. (at least four).

(ix)-What is meant by range of alpha particles? On what factors it depend upon?

(x)-The law of conservation of energy and momentum are not obeyed in beta decay. How neutrino hypothesis explain this discrepancy?

Q. 3: (a)-What is principle of van de Graaff accelerator? Explain its construction and working. 01+ 05 + 01  
Also give its uses.

(b)-What is meant by magnetic dipole moment? By giving an example show that magnetic moments are not additive. 01 + 02

Q. 4: (a)-How limitations of nuclear shell model were rectified by collective nuclear model. Also give achievements of collective nuclear model. 06

(b)- How charge particles passes through matter? Explain. 04

Q. 5: (a)-Explain theory of gamma decay in detail by explaining multi-polarity of gamma rays. 07

(b)- State basic properties of nuclear forces. 03



# UNIVERSITY OF THE PUNJAB

Roll No. ....

Seventh Semester 2018  
Examination: B.S. 4 Years Programme

PAPER: Relativity and Cosmology  
Course Code: PHY-404

TIME ALLOWED: 30 mins.  
MAX. MARKS: 10

*Attempt this Paper on this Question Sheet only.*

Note: Attempt all questions.

Q1. Choose the correct option.

- i. Special theory of relativity treats problems involving
  - (a) inertial frame of reference
  - (b) non-inertial frame of reference
  - (c) non-accelerated frame of reference
  - (d) accelerated frame of reference
- ii. Two twins A and B, A is at rest and B is moving with velocity  $v = 2.5 \times 10^5$  m/s, then after 5 years
  - (a) Age of B will be more than A
  - (b) Age of A will be more than B
  - (c) Age of A&B are same
  - (d) None of the above
- iii. Lorentz transformation equations hold for
  - (a) Non-relativistic velocities only
  - (b) Relativistic velocities only
  - (c) All velocities: relativistic & non-relativistic
  - (d) Photons only
- iv. Symmetric part of electromagnetic field tensor  $F_{\mu\nu}$  is
  - (a)  $\frac{\partial A_\nu}{\partial x_\mu}$
  - (b)  $\frac{\partial A_\nu}{\partial x_\mu} + \frac{\partial A_\mu}{\partial x_\nu}$
  - (c)  $\frac{\partial A_\mu}{\partial x_\nu}$
  - (d) 0
- v. Gravitational red shift corresponds to
  - (a) Longer wavelength
  - (b) Smaller frequency
  - (c) Observer in weaker gravitational field
  - (d) All of the above
- vi. Theory which states that black hole is formed when sufficient compact mass can deform space time is known as
  - (a) general theory of relativity
  - (b) theory of electromagnetic fields
  - (c) theory of gravitational fields
  - (d) theory of particle radiation
- vii. What is the lower limit for the mass of a black hole?
  - (a) 10 solar masses
  - (b) 2 solar masses
  - (c) 3 solar masses
  - (d) 30 solar masses
- viii. Simultaneity is
  - (a) dilated
  - (b) absolute
  - (c) invariant
  - (d) relative
- ix. Which one has zero divergence
  - (a) Four current density
  - (b) Electromagnetic field tensor
  - (c) Four vector potential
  - (d) All of these
  - (e) None of these
- x. Which of the following is closest to Einstein's first postulate:
  - (a) Light always travel at  $3 \times 10^8$  m/s.
  - (b) there is no way to tell how fast you are going unless you can see what is around you.
  - (c) velocities can only be measured relative to something else.
  - (d) absolute velocity is that measured with respect to the Sun.



# UNIVERSITY OF THE PUNJAB

Seventh Semester 2018  
Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Relativity and Cosmology  
Course Code: PHY-404

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

*Attempt this Paper on Separate Answer Sheet provided.*

Note: Attempt all questions.

Q2. Write down short answers to the following questions.

2x10=20

- I. Show that  $c^2 = V^\mu V_\mu$ .
- II. How fast can you drive towards a red traffic light for the light to appear green? The approximate wavelengths of red and green light signals are given as:  
 $\lambda_{red} \approx 7 \times 10^{-5} cm$        $\lambda_{green} \approx 5 \times 10^{-5} cm$
- III. Explain the relativity in simultaneity with the help of space-time diagram.
- IV. Consider a two-dimensional line element  $ds^2 = dx^2 + dy^2$ , write down the  $g^{ab}$  and  $g_{ab}$ .
- V. Explain the terms (a) Vacuum density (b) Critical density.
- VI. Prove that  $E^2 = mc^2$  in relativistic mechanics.
- VII. Let the events  $E_1$  and  $E_2$  are observed to occur at space-time coordinates  $(x, t)$  of  $(2, 3/c)$ ,  $(6, 5/c)$  respectively, in some frame  $S$ . Check the causal connections between the two events.
- VIII. What is Hubble time? Write Hubble's model about Universe.
- IX. Define frame of reference, what are inertial and non-inertial frames of reference?
- X. What is Cosmic Microwave Background (CMB)?

Q3. Give detail answers of the following questions.

- I. Derive and discuss the Einstein Field Equations. Also reduce these equations for the vacuum. [8]
- II. If  $\nu_0$  and  $E_0$ , are respectively frequency and energy of photon in source frame and  $\nu$  and  $E$  are frequency and energy of photon in the frame of observer then for any pair of inertial observers, show that [7]

$$\frac{E_0}{\nu_0} = \frac{E}{\nu}$$

- III. What is geodesic? Derive the equation of geodesic on manifold. [8]
- IV. Show that for curvature tensor  $R_{\rho\mu\nu\lambda} = -R_{\lambda\nu\rho\mu} = -R_{\lambda\nu\mu\rho} = R_{\lambda\mu\rho\nu}$  [7]



# UNIVERSITY OF THE PUNJAB

Seventh Semester 2018  
Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Particle Physics-I  
Course Code: PHY-407

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

*Attempt this Paper on Separate Answer Sheet provided.*

## Section - II (Subjective Type)

Note: Attempt all questions.

Question 2:

(2 × 10 = 20)

Write short answers of the following questions.

- (i) What are fundamental particles? How do they interact?
- (ii) What are lepton and baryon conservation laws?
- (iii) What is the relationship between the hypercharge, the strangeness and the baryon number of a particle? What is the value of the hypercharge for a strange quark?
- (iv) Draw the Feynman diagram showing the mechanism of  $\mu^-$  decay.
- (v) Define parity operation. What are the eigenvalues of the corresponding operator?
- (vi) Assign the isospin quantum numbers to the nucleonic doublet and pionic triplet.
- (vii) Draw the meson octet.
- (viii) Write down the four Maxwell equations.
- (ix) Name a force which acts between an up quark (u) and an electron ( $e^-$ ). Explain with reference to an exchange particle, how this force operates?
- (x) Prove that  $[\frac{\sigma_2}{2}, \frac{\sigma_3}{2}] = i\frac{\sigma_1}{2}$ , where  $\sigma$ 's are the pauli-spin matrices.

Question 3:

(10)

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

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

where  $\square^2$  is d'Alembertian 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 4:

(10)

What is charge conjugation operation and what are the eigen values of the corresponding operator? Show that a proton-antiproton system in a state of definite orbital angular momentum,  $l$ , and spin,  $s$ , is an eigen state of the charge conjugation operator with eigen value  $(-1)^{l+s}$ .

Question 5:

(10)

Show that the translational symmetry in Quantum Mechanics implies the law of conservation of linear momentum.



# UNIVERSITY OF THE PUNJAB

Roll No. ....

Seventh Semester 2018  
Examination: B.S. 4 Years Programme

PAPER: Particle Physics-I  
Course Code: PHY-407

TIME ALLOWED: 30 mins.  
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 × 10 = 10)

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

- (i) The adjoint of a unitary operator  $U$ , is
- (a)  $U$  (b)  $1$   
(c)  $U^{-1}$  (d)  $0$
- (ii) The beta particle decay is the best known example of
- (a) Strong interaction (b) Weak interaction  
(c) Electromagnetic interaction (d) Gravitational interaction
- (iii) Using Lorentz gauge, the Maxwell equations can be written in the following 4-vector form
- (a)  $\square A^\mu = j^\mu$  (b)  $\square A^\mu = \rho^\mu$   
(c)  $\square A^\mu = 0$  (d)  $\square A^\mu = -j^\mu$
- (iv) If a system is invariant under rotation in space, the corresponding conserved quantity is
- (a) Linear momentum (b) Angular momentum  
(c) Energy (d) Charge
- (v) 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
- (vi) 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
- (vii) Isospin state for  $\Sigma^+$  is
- (a)  $|1, 1\rangle$  (b)  $|1, -1\rangle$   
(c)  $|1, 0\rangle$  (d)  $|0, 0\rangle$
- (viii) The top quark (t) carries a charge of
- (a)  $+2/3$  (b)  $+1/3$   
(c)  $-1/3$  (d)  $-2/3$
- (ix) The fundamental  $\beta^-$ -decay process is
- (a)  $p \rightarrow n + e^- + \bar{\nu}_e$  (b)  $p \rightarrow n + e^+ + \nu_e$   
(c)  $p \rightarrow n + e^- + \nu_e$  (d)  $p \rightarrow n + e^+ + \bar{\nu}_e$
- (x) Which of the following forces have infinite range?
- (a) Electromagnetic and Gravitational forces  
(b) Electromagnetic and Weak forces  
(c) Strong and Gravitational forces  
(d) Weak and Gravitational forces



# UNIVERSITY OF THE PUNJAB

Seventh Semester 2018  
Examination: B.S. 4 Years Programme

Roll No. ....

**PAPER: Particle Physics-II**  
**Course Code: PHY-408**

**TIME ALLOWED: 30 mins.**  
**MAX. MARKS: 10**

**Attempt this Paper on this Question Sheet only.**

Objective Type  
Section I

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

Q1- Choose the correct option.

1) Klein-Gordon equation describes the particle which is moving relativistically with spin

- (a)  $\frac{1}{2}$
- (b) Zero
- (c) 1
- (d) none of these

2) Fermi Golden rule is described by the relation

- (a)  $W_{if} = 2\pi |V_{if}|^2 \rho(E_f)$
- (b)  $W_{if} = 2\pi |V_{if}| \rho(E_f)$
- (c)  $W_{if} = 2\pi |V_{if}| \rho(E_i)$
- (d) none of these

3) Scalar product of two four vector is defined as

- (a)  $A \cdot B = A^\alpha B^\alpha - A \cdot B$
- (b)  $A \cdot B = A^\alpha B^\alpha + A \cdot B$
- (c)  $A \cdot B = A \cdot B - A^\alpha B^\alpha$
- (d) none of these

4) Free particle must satisfy the

- (a) Relativistic momentum
- (b) Relativistic energy
- (c) Both of these
- (d) None of these

5)  $i\gamma^0 \gamma^1 \gamma^2 \gamma^3 =$

- (a)  $\gamma^4$
- (b) 1
- (c)  $\gamma^5$
- (d)  $\delta^{0123}$
- (e)  $\gamma^5$

(P.T.O.)

6) In Dirac equation all alphas are

- (a) Identity
- (b) Traceless
- (c) Non traceless
- (d) Inverse of other

7) The normalization for the four spinors,  $\omega^\dagger \omega =$

- (a)  $2E$
- (b) Negative energy solutions
- (c)  $E$
- (d)  $1$

8) If one attempts to include the relativistic rest energy into the Schrodinger equation, the result is either Klein-Gordon or

- (a) Uncertainty principle
- (b) Wave function
- (c) Delta function
- (d) Dirac equation

9) The eigen values of Helicity is

- (a)  $\lambda = +1/2$
- (b)  $\lambda = -1/2$
- (c)  $\lambda = -1$
- (d)  $\lambda = +1$

10)  $\{\gamma^5, \gamma^i\} =$

- (a) 0
- (b) -1
- (c)  $I_1$
- (d)  $\delta^{0i23}$



# UNIVERSITY OF THE PUNJAB

Seventh Semester 2018  
Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Particle Physics-II  
Course Code: PHY-408

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

Attempt this Paper on Separate Answer Sheet provided.

## Subjective Type Section I

Q No. 3

- Show that  $(\sigma \cdot P)^2 = P^2$  (5)
- Assuming various properties of gamma matrices, prove that  $[\sigma^{\mu\nu}, \gamma^\lambda] = 2i(\gamma^\mu g^{\lambda\nu} - \gamma^\nu g^{\lambda\mu})$  (5)
- Prove that  $\alpha$  and  $\beta$  are hermitian traceless matrices of even dimensionality with eigen values  $\pm 1, -1$ ? (5)
- Show that Dirac equation describes the intrinsic spin 1/2 particle. (5)
- Show that  $\beta^2$  (5)
- Define Chirality and Helicity operators. Define  $U_L$  and  $U_R$  and show that these are eigen functions of chirality operator? (5)

## Section II

Q No. 4

Starting from Klein-Gordon equation, obtain corresponding equation of continuity. Why was Klein-Gordon equation rejected? (10)

Q No. 5

Explain why relativistic wave equation for electron must be linear in space and time variable. Derive Dirac equation in covariant form? (10)





# UNIVERSITY OF THE PUNJAB

Roll No. ....

Seventh Semester 2018  
Examination: B.S. 4 Years Programme

PAPER: Advanced Electronics-I (Theory)  
Course Code: PHY-411

TIME ALLOWED: 30 mins.  
MAX. MARKS: 10

*Attempt this Paper on this Question Sheet only.*

Q.1 Multiple Choice, Attempt all questions on the same sheet. 10

1. In a toggle mode a JK flip flop has  
(a)  $J=0, K=0$       (b)  $J=1, K=1$       (c)  $J=1, K=0$       (d)  $J=0, K=1$
2. How many Flip- Flop are required to build a binary counter circuit to count from 0 to 1023?  
(a) 6      (b) 10      (c) 24      (d) 12
3. In Flip Flops clock is present but in Latch clock is  
(a) Present always      (b) absent always      (c) may be present / absent      (d) none
4. Counter is a :  
(a) Combinational circuit      (b) Sequential circuit      (c) both      (d) None
5. The fast logic family is  
(a) ECL      (b) DRL      (c) TTL      (d) TRL
6. A 3 input NOR gate has eight inputs possibilities, how many of those possibilities will result a high output?  
(a) 1      (b) 2      (c) 7      (d) 8
7. How many outputs are on a BCD decoder?  
(a) 4      (b) 16      (c) 8      (d) 10
8. The storage element for a static RAM is:  
(a) Diode      (b) resistor      (c) Capacitor      (d) Flip Flop
9. An OP-Amp has very \_\_\_\_\_.  
(a) high voltage gain      (b) high input impedance      (c) Low output impedance      (d) all of them
10. Common Mode Gain of OP Amp is \_\_\_\_\_.  
a) Very high      b) Very Low      c) Always Unity      d) Unpredictable



# UNIVERSITY OF THE PUNJAB

Seventh Semester 2018  
Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Advanced Electronics-I (Theory)  
Course Code: PHY-411

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

*Attempt this Paper on Separate Answer Sheet provided.*

Q.2 Short Answer, Attempt only five parts.

20

1. What is multiplexer, and de-multiplexer?
2. What are Registers, and its types?
3. Define Decoder, explain how it works?
4. What is RAM, what are its types?
5. List the major difference between PLA and PAL.
6. What is the operation of J, K Flip-Flop?
7. What is the edge triggered flip-flop?
8. What is a CPU?

Attempt three questions.

30

Q.3 (a) Describe the construction and working of Differential Amplifier?

(6,4)

(b) Why NAND and NOR gates are called Universal gate, design AND, OR, NOT with these gates.

Q.4 (a) Design a Synchronous Counter with JK Flip-Flop which count only 001,011,101,110,111

(5)

(b) What is Gray Code, design a circuit for Binary to Gray with exclusive OR for 11011. (5)

Q.5 (a) Explain the programmable logic devices PLD,s.

(6,4)

(b) Determine the output for 5-Bit R-2R ladder network when the digital input is 10101 if 0V corresponds to logic 0 and 5V corresponds to logic 1.

Q6 (a) Design a logic circuit of Multiplexer of 4 into 1 ( $4 \times 1$ ).

(6,4)

(b) A 2 MHz clock signal is applied to a five stage binary ripple counter. What is the frequency at the output of the fifth flip-flop.

Q 7. (a) Given the expression  $X = A.B.C + A.B.C + B.C + A.C$  using only NAND gates draw the logic diagram. (5)

(b) What is ALU, how it work.

(5)



# UNIVERSITY OF THE PUNJAB

Seventh Semester 2018  
Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Solid State Physics-I  
Course Code: PHY-419

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

**Attempt this Paper on Separate Answer Sheet provided.**

*NOTE: Try to be focused and give only precise answers, of the asked questions.*

## Section-II

Write short answers to the following questions:

(2×10=20)

- I. What is Bloch wave? Write its expression.
- II. What are the failures in FEG?
- III. What are the problems in Hartee-Fock equation?
- IV. How you explain effective mass? What is effect versus energy level?
- V. Write the symmetry operations that each energy band  $E_n(k)$  satisfies.
- VI. Write the an expression for a function which oscillates rapidly inside the atomic core, but runs smoothly as plane wave in the remaining open space of WS (Wigner ceitz) cell.
- VII. What is relation of Fermi-Dirac Distribution function  $f(E)$ , at temperature other than 0 K? Also draw a diagram of  $f(E)$  versus  $E$  at  $T=0$  and  $T > 0$  K.
- VIII. What does fermi energy in semiconductors indicate? Where is it commonly located in a semiconductor? Are electrons to be found at fermi level? If not, why?
- IX. Is fermi energy exactly in the center of the band gap for an intrinsic semiconductors? If not, why does is deviate?
- X. What are the two aspects due to which FEG (free electron gas model) differs from ordinary gas?

## Long Questions

Question no 3

(10)

What do you know about Orthonormalized Plane Wave (OPW) and Augmented Plane Wave (APW)? Derive the expression for the solution of SWE in case of OPW methodology in detail! Also sketch the collective behavior of the electrons in each case?

Question no 4

(10)

Define BO-Approximation? How the assumptions in this approximation lead us to the concept of a new form of Hamiltonian for TI-SWE? How we can define a Quasi-particle and expansion parameter in BO-Approximation? In the case of BO-Approximation when we use the normalization property of the Eigen function, our result leads us to the short form result of SWE. Derive it and define each term of the final expression?

Question no 5

(10)

Discuss plane- wave solution of Hartee-Fock equation?



# UNIVERSITY OF THE PUNJAB

Roll No. ....

Seventh Semester 2018  
Examination: B.S. 4 Years Programme

**PAPER: Solid State Physics-I**  
**Course Code: PHY-419**

**TIME ALLOWED: 30 mins.**  
**MAX. MARKS: 10**

**Attempt this Paper on this Question Sheet only.**

*NOTE: Try to be focused and give only precise answers, of the asked questions.*

## Section-I

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. The particles associate with collecting oscillation of lattice is called
  - (a) photons
  - (b) phonon
  - (c) tight solids
  - (d) magnons
- II. The basic for the electron-phonon interaction is
  - (a) adiabatic approximation
  - (b) Born Oppenheimer approximation
  - (c) Only electrons close to Fermi surface participate in conduction
  - (d) Both adiabatic and Born Oppenheimer
- III. The electron-electron interaction is neglected in ----- approximation.
  - (a) one electron
  - (b) free electron
  - (c) bound electron
  - (d) group electron
- IV. Momentum of free particle (electron) is
  - (a)  $\hbar k$
  - (b)  $h k$
  - (c)  $1/2\hbar k$
  - (d)  $1/2hk$
- V. The top most filled levels at 0k (kelvin) is called ----- level
  - (a) continuous
  - (b) conduction
  - (c) valence
  - (d) fermi
- VI. The density of states of the Fermi-level is approximately equal to
  - (a)  $2/5N/E_F$
  - (b)  $NE_F$
  - (c)  $5/2NE_F$
  - (d)  $N/E_F$
- VII. The fermi-energy of free electron is
  - (a) 0.35Mev
  - (b) 0.35kev
  - (c) 0.35ev
  - (d) 0.35mev
- VIII. Application of free-electron gas (F.E.G) is/are
  - (a) electrical conductivity
  - (b) thermal conductivity
  - (c) Ohm law derivation
  - (d) all
- IX. The group velocity of electron becomes velocity of free electron when periodic potential is identically equal to
  - (a) maximum
  - (b) minimum
  - (c) zero
  - (d) medium level
- X. The condition of wave-function for the Bloch is ----- over the periodicity of the lattice.
  - (a) periodic
  - (b) continuous
  - (c) random
  - (d) partially periodic and partially random



# UNIVERSITY OF THE PUNJAB

Seventh Semester 2018

Examination: B.S. 4 Years Programme

Roll No. ....

PAPER: Solid State Physics-II  
Course Code: PHY-421

TIME ALLOWED: 2 hrs. & 30 mins.  
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. Why the electron pairs in the superconductors are called as bosons?
- II. Discuss the exciton condensations into electron-hole-drops (EHD).
- III. What are the steps used to prepare Al/Al<sub>2</sub>O<sub>3</sub>/Sn sandwich?
- IV. Elaborate leakage probability and activation barrier factor for a superconductor.
- V. Describe various ways to measure the binding energy of excitons.
- VI. Differentiate reflectivity coefficient and reflectance.
- VII. Define total polarizability. Plot the frequency dependence of its several contributions.
- VIII. Differentiate Fullerenes and Hall number?
- IX. What do you mean by the thermodynamics of the superconducting phase transition?
- X. What are the ferroelectric domains?

### Long Questions:

Q-3 Discuss Landau theory and elaborate the (i) 1<sup>st</sup> order and (ii) 2<sup>nd</sup> order phase transition. (10)

Q-4 Consider an electromagnetic wave in the vacuum with field components of the form

$$E_y = B_z(\text{inc}) = A e^{i(kx - \omega t)}$$

Let the wave be incident upon a medium of dielectric constant  $\epsilon$  and permeability  $\mu = 1$ , that fills the half-space  $x > 0$ . Show that the reflectivity coefficient  $r(\omega)$  as defined by  $E(\text{refl}) = r(\omega)E(\text{inc})$  is given by

$$r(\omega) = \frac{n + iK - 1}{n + iK + 1}$$

Where  $n + iK = \epsilon^{1/2}$ , with  $n$  and  $K$  real. Show further that the reflectance is

$$R(\omega) = \frac{(n-1)^2 + K^2}{(n+1)^2 + K^2} \quad (10)$$

Q-5 Discuss flux quantization in a superconducting ring. (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. (1×10=10)

- I. One of the most well-known crystalline ceramics is Quartz, what is its chemical formula?  
(A) NaCl (B) SiO<sub>2</sub> (C) H<sub>2</sub>SO<sub>4</sub> (D) C<sub>2</sub>H<sub>4</sub>
- II. What types of materials usually exhibit piezoelectric effect?  
(A) metals (B) polymers (C) ceramics (D) composites
- III. In the molecular crystals, ----- excitons exist.  
(A) Mott-Wannier (B) Frenkel (C) tightly bound (D) both b and c
- IV. The basic mechanism responsible for the optical properties in a dielectric is  
(A) Orientation polarization (B) Ionic polarization (C) Electronic polarization (D) None
- V. Excitonic absorption occurs ----- the absorption edge of the semiconductors.  
(A) well below (B) very close to (C) exactly at (D) above
- VI. In London Equation, the drift velocity is current density per unit -----  
(A) length (B) area (C) volume (D) mass
- VII. Inter-band absorption of a photon will occur at all the points within----- for which energy conservation is satisfied.  
(A) upper band (B) intra-band (C) B.Z (D) all are true
- VIII. In-direct transition cannot occur without involvement of  
(A) electron (B) photon (C) proton (D) phonon
- IX. According to the Nernst theorem, entropy of the body at absolute zero is -----  
(A) high (B) very high (C) low (D) zero
- X. Raman effect is made possible by the strain-dependence of the ----- polarizability.  
(A) electronic (B) ionic (C) dipolar (D) orientational