PHY 201.1

CREDIT BASED SECOND SEMESTER B.Sc. DEGREE EXAMINATION - APRIL 2012

PHYSICS

PAPER II: MECHANICS AND THERMAL PHYSICS

Duration: 3 Hours **Max Marks: 80**

PART –A

1.A. Answer any TEN of the following. **1x10=10**

i) On what factors the radius of gyration depends upon?
ii) Write the expression for M.I. of a diatomic molecule.
iii) What is the significance of centre of mass of a system?
iv) Give one example for central force.
v) What are the uses of Kepler's Third Law?
vi) What is a conservative force field?
vii) Define isothermal process.
viii) State First Law of Thermodynamics.
ix) How does entropy and disorder in a system related?
x) What is an ideal gas?
xi) What is Joule-Thomson effect?
xii) Name the classification of liquid crystals.

1.B. Answer any FIVE of the following. **5x2=10**

i) Get expression for K.E. of rotation of a rigid body.
ii) Write a short note on Kater's Pendulum.
iii) Define areal velocity of a particle and get an expression for the same.
iv) Prove that simple harmonic motion is an example for central motion.
v) Distinguish between reversible and irreversible process.
vi) Give any four applications of liquid crystals.

PART-B

UNIT-I

Answer any TWO of the following. **2x10=20**

2. (a) State and prove the theorem of parallel and perpendicular axes of M.I.

   (b) A flat circular disc of mass 0.05 kg and diameter 0.02m rolls on its edge on a smooth horizontal table with a velocity of 0.05 m/s. Calculate its total energy.

   (6+4)

3. (a) Derive the formula for M.I. used in the experiment without neglecting the friction at bearing of the flywheel.

   (b) A uniform circular disc of radius 25 cm oscillates in a vertical plane about a horizontal axis. Find the distnace of the axis of rotation from the centre for which the period is minimum? What is value of its period? **(6+4)**

4. (a) What is a simple pendulum? Derive an expression for the time period of a simple pendulum?

   (b) A flywheel of mass 100 kg and radius 0.5 m makes 10 revolutions per second. Calculate (i) angular velocity (ii) moment of inertia (iii) the energy of the flywheel Assume that mass of the flywheel is concentrated at the rim. **(6+4)**

UNIT-II

Answer any TWO of the following. **2x10=20**

5. (a) Derive an expression for the final velocity of a rocket.

(b) A vertical spring is stretched by 0.05 m when a load of 5 kg is attached to it. What will be the period of oscillation when a load of 3Kg is attached to it ? **(6+4)**

6. (a) Show that in a conservative field, workdone is independence of the path and define potential energy of a particle.

   (b) A rocket is designed to attain a maximum speed of 4.6 km/s. Mass of the rocket without fuel is 100 kg. What should be the mass of the fuel? Given velocity of the escaping gases = 2 km/sec. **(6+4)**

7. (a) Define elastic and inelastic collisions and derive expressions for the velocities of two particles after a head on collision between them.

   (b) A sand bag of mass 10 Kg is suspended with a 3m long weightless string. A bullet of mass 0.2 Kg is fired with a speed 20ms into the bag and stays in the bag. Calculate (i) the speed acquired by the bag (ii) energy converted to heat in the collision. **(6+4)**

UNIT-III

Answer any <u>TWO</u> of the following. **2x10=20**

8. (a) Deduce Clausius – Clapeyron latent heat equation and discuss the variation of boiling and melting points of liquids and solids with pressure.

   (b) A certain mass of dry air at NTP is suddenly compressed to $\frac{1}{32}$ of its original volume. Calculate the resulting pressure and temperature of the gas. **(6+4)**

9. (a) Explain the term entropy. Explain the temperature entropy diagram and prove that its area represents available energy.

   (b) Calculate the change in the boiling point of water due to a change in pressure of 0.01 m of mercury.
   Given: Latent Heat of evaporation = 2.268×10^6J/Kg.
   Volume of 1 Kg of steam at 373K = 1.677 m^3 and
   Volume of 1 Kg of Water = $10^{-3}m^3$. **(6+4)**

10. (a) Describe Joule – Kelvin Porous Plug experiment and state the result of the experiment.

    (b) Calculate the total inrease of entropy when 1 gm of ice at -10°C is converted into steam at 100°C.
    Specific heat of ice = 0.5 x 4200 J/kg/K. Latent heat of ice = 3.36×10^5 J/Kg.
    Latent heat of steam is 2.268×10^6 J/Kg. **(6+4)**

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PHY 201.1 **Reg No.....**

CREDIT BASED SECOND SEMESTER B.Sc. DEGREE EXAMINATION - APRIL 2013

PHYSICS

PAPER II: MECHANICS AND THERMAL PHYSICS

Duration: 3 Hours **Max Marks: 80**

PART –A

1.A. Answer any TEN of the following. **1x10=10**

xiii) What is the physical significance of moment of inertia?

xiv) Define length of equivalent simple pendulum for a compound pendulum.

xv) What is a Kater's pendulum?

xvi) Define inelastic collision.

xvii) Write any one use of Kepler's III Law.

xviii) How does internal energy change during isothermal process?

xix) What is heat death?.

xx) What is the significance of T-S diagram?

xxi) What is Joule-Thomson Effect?

xxii) What are nematic liquid crystals?

xxiii) What are quasi crystals?

xxiv) What is a conservative force field?

1.B. Answer any <u>FIVE</u> of the following. 5x2=10

vii) Derive expression for rotational energy of a diatomic molecule.

viii) Show that work done is independent of path in a conservative force field.

ix) Show that in a central motion, areal velocity is a constant.

x) What are the limitations of first law of thermodynamics?

xi) Distinguish between reversible and irreversible processes.

xii) A room cannot be cooled by keeping door of refrigerator open - explain.

PART-B

UNIT-I

Answer any <u>TWO</u> of the following. 2x10=20

2. (a) Derive expression for Moment of inertia of a circular disc about an axis perpendicular to its plane and hence derive expression for Moment of inertia of disc about an axis passing through its diatmeter.

   (b) The period of a bar pendulum is 1.53 sec. when centre of suspension is 0.3m from one end and 1.49 sec. when it is 0.2m from the same end. If the bar is 1m long, find acceleration due to gravity. **(6+4)**

3. (a) Define centre of suspension and centre of oscillation. Show that there are four points collinear with centre of gravity about which periods of compound pendulum is same.

   (b) A circular disc of mass 0.1kg and radius 0.1m rotates about its centre at 10 cycles per second. The axis of rotation is normal to the plane of the disc. Fin (i) moment of inertia and (ii) Angular momentum. **(6+4)**

4. (a) Derive expression for moment of inertia of a flywheel taking into account the loss of energy due to friction.

   (b) A circular disc of mass 2Kg rolls without slipping with a uniform velocity 0.2 m/s along a straight line on a horizontal table. Calculate its total K.E. **(6+4)**

UNIT-II

Answer any <u>TWO</u> of the following. 2x10=20

5. (a) Define elastic and head-on collisions and derive expression for velocity of 2 particles after head-on collision between them.

   (b) An empty rocket weighs 5000Kg containing 45,000Kg fuel. If the exhaust velocity of escaping gas is 2Km/Sec. Calculate maximum velocity attained. **(6+4)**

6. (a) Deduce the law of conservation of angular momentum for a particle. Show that when angular momentum is conserved (i) motion is confined to a plane and (ii) the acceleration is entirely radial for a central force field.

   (b) A 2k mass hangs from a spring. A 0.3Kg body attached below it, stretches it further by 2 cm. If 0.3 Kg is removed and mass is set into oscillations. Calculate the time period. **(6+4)**

7. (a) Define a central field. Derive an expression for period of vertical oscillation of a light loaded spring using law of conservation of energy.

   (b) A stone of mass 0.1 Kg is revolved at the end of a 0.5m long string at the rate of 2 revolutions/Sec. Find the angular momentum. If after 25 sec. it is making only one revolution/sec. Find the mean torque. **(6+4)**

UNIT-III

Answer any <u>TWO</u> of the following. **2x10=20**

8. (a) Derive an expression for work done by a gas during isothermal and adiabatic expansion.

   (b) Calculate increase in boiling point of water when pressure on it is increased by 0.1m of mercury. 1 Kg of steam occupies 1677×10^{-3} m^3 at normal pressure. Latent beat of steam = 2.268×10^6 J/Kg. Density of mercury = 13600 kg/m^3. **(6+4)**

9. (a) What are liquid crystals? By drawing necessary diagrams, explain the classification of liquid crystals.

   (b) If 10 Kg of ice at 273K is mixed with 10Kg of water at 300K. What is the change in entropy?

   Latent Heat of fusion = $3.36 \times 10^5 J/Kg^{-1}$.

   Specific heat of water = 4200 Kg^{-1} **(6+4)**

10. (a) Give the theory of Joule – Kelvin Effect and hence get expression for temperature of inversion for a real gas.

    (b) Calculate the amount of work done when 1 litre of monoatomic perfect gas at NTP is compressed adiabatically to half of its volume.

    Gas constant R = 8.4 $J.mole^{-1} k^{-1}$. **(6+4)**

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PHY 201.1 **Reg No.....**

CREDIT BASED SECOND SEMESTER B.Sc. DEGREE EXAMINATION APRIL 2014

PHYSICS

PAPER II: MECHANICS AND THERMAL PHYSICS

Duration: 3 Hours **Max Marks: 80**

PART –A

1. (A) Answer any TEN of the following. 1X10=10

(a) Write the relation between torque and angular acceleration for a rigid body.

(b) What is the measure of rotational inertia?

(c) How many collinear points are there in a compound pendulum?

(d) What will happen to the period of a pendulum transported to moon?

(e) What is the principle of rocket propulsion?

(f) Define central force.

(g) How does the period of a light loaded spring change as the mass suspended from it increases?

(h) Write the expression for torque in vector form.

(i) How does internal energy of a system vary during an adiabatic process?

(j) What is thermodynamic equilibrium?

(k) How does melting point of wax vary with pressure?

(l) What are Lyotropic liquid crystals?

(b) Answer any FIVE questions of the following. 2X5=10

i) State and prove parallel axis theorem of moment of intertia.

ii) Write a short note on Kater's pendulum.

iii) Show that for a central force field the acceleration is entirely radial.

iv) Show that Kepler's second law of planetary motion is law of conservation of angular momentum.

v) Show that the total change in entropy during a reversible cyclic change is zero.

vi) What is coefficient of performance of a refrigerator? Write the expression for it.

PART-B

UNIT-I

Answer any TWO from the following: 10x2=20

2. (a) Derive an expression for the moment of interia of a thin rod about an axis passing through its end and perpendicular to the rod and hence derive the expression for the moment of inertia of the rod about an axis passing through its centre and perpendicular to the rod.

(b) A circular disc of mass 0.5 kg and radius 10cm is making 70 revolutions per minute about an axis passing through its centre and perpendicular to its plane. Calculate its kinetic energy. **(6+4)**

3. (a) What is a compound pendulum? Derive an expression for the time period of a compound pendulum.

(b) A uniform circular disc of diameter 0.2m vibrates about a horizontal axis perpendicular to its plane and at a distance 0.05m from the centre. Calculate the period of oscillation and equivalent length of the simple pendulum. **(6+4)**

4. (a) Derive the formula for moment of inertia and rotational energy of a diatomic molecule.

(b) A uniform rectangular plate has mass 1.35 kg and length 14.5cm and breadth 10.5cm. Calculate the MI about an axis passing through

(i) its C.G. and perpendicular to its plane (ii) its one end-breadth. **(6+4)**

UNIT-II

Answer any TWO of the following. **10x2=20**

5. (a) Derive an expression for the final velocity of a rocket.

(b) A rocket motor consumes 100 kg of fuel per sec. exhausting it with a speed of

(i) What is the force exerted on the rocket?

(ii) What is the velocity of rocket when the mass is reduced to — of its initial value, if the initial velocity is zero. **(6+4)**

6. (a) Define elastic and inelastic collisions and derive the expressions for the velocities of two particles after a head-on collision between them.

(b) For a particle of mass 0.01 kg, position vector , and velocity is . Calculate the angular momentum about the origin. **(6+4)**

7. (a) Show that in a conservative field, workdone is independent of the path and define potential energy of a particle.

(b) A vertical spring is stretched by 0.05m, when a load 5kg is attached to it. What will be the period of oscillation when a load of 3 kg is attached to it? **(6+4)**

UNIT-III

Answer any TWO of the following. **10x2=20**

8. (a) Derive the relation between pressure, volume and temperature for an ideal gas undergoing adiabatic change.

(b) An ideal gas of volume 1 litre at pressure 8 Pa, at undergoes expansion until its pressure drops to 1 Pa. Calculate the final volume and also workdone if it is done

(i) slowly (ii) suddenly. Given **(6+4)**

9. (a) Deduce Claussius – Clapeyron latent heat equation and discuss the variation of boiling and melting points of liquids and solids, with pressure.

(b) Taking the normal boiling pint of ice at and normal latent heat of fusion as , Calculate the depression in the freezing point for an increase of pressure l atmosphere. 1 Kg of ice occupies of volume. **(6+4)**

10. (a) Explain the term entropy. Explain the temperature – Entropy diagram and prove that its area represents available energy.

(b) Calculate the change in entropy when 0.02 kg of ice at 273K melts into water at 313K. Given latent heat of fusion of ice = , specific heat of

water = . **(6+4)**

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PHY 201.2 **Reg. No.....**

CREDIT BASED SECOND SEMESTER B.Sc. DEGREE EXAMINATION APRIL 2015

PHYSICS – II

Mechanics and Thermal Physics

Duration: 3 Hours **Max Mark**

PART – A

1. A. Answer any TEN of the following: **10×**

i) Define angular momentum.
ii) Write the expression for Moment of Inertia of a diatomic molecule.
iii) Define centre of mass.
iv) Write the expression for the radius of gyration of a bar pendulum.
v) State the law of conservation of linear momentum.
vi) Define areal velocity of a particle having planar motion.
vii) Define potential energy of a particle in a conservative field.
viii) What is head-on collision?
ix) State first law of thermodynamics.
x) How does the entropy change in a reversible cyclic process?
xi) Define the coefficient of performance of a refrigerator.
xii) What is critical temperature?

B. Answer any FIVE of the following: **5×**

i) State and explain perpendicular axes theorem of Moment of Inertia.
ii) What are the advantages of a compound pendulum over a simple pendulum?
iii) Distinguish between elastic and inelastic collision.
iv) Show that in a central force field, the torque acting on a particle is zero.
v) What is an indicator diagram? What is its importance?
vi) Differentiate between type I and type II super conductors.

PART - B

UNIT - I

Answer any TWO of the following: **2×1**

2. (a) Deduce an expression for the Moment of Inertia of a circular disc about an axis perpendicular to its plane and hence derive the expression for the moment of inertia of the disc about an axis passing through its diameter.

(b) A uniform rectangular plate has mass 1.2 kg length 15 cm and breadth 10cm. Calculate Moment of Inertia about an axis passing through.
i) its centre of gravity and perpendicular to plane
ii) at one end parallel to length **(**

3. (a) Derive the formula for Moment of Inertia used in experiment without neglecting the friction at bearings of the fly wheel.

(b) A fly wheel of mass 10kg has a radius of gyration of 1m. Calculate its Kinetic Energy when it makes 60 rotations per minute. (

4. (a) Define centre of suspension and centre of oscillation. Show that there are 4 points collinear with the CG about which the periods of the compound pendulum is the same.

(b) The period of a bar pendulum is 1.55 second when centre of suspension is 0.3m from one end and 1.50 second when it is 0.2m from the same end. If the bar is 1m long find the acceleration due to gravity. (

UNIT - II

Answer any <u>TWO</u> of the following: **2×1(**

5. (a) Derive an expression for the final velocity of a rocket.

(b) A rocket is designed to attain a maximum speed of 4.6 Km/s. Mass of the rocket without fuel is 100kg. What should be the mass of the fuel?

Given: velocity of the escaping gas = 2Km/s. (

6. (a) Derive an expression for the areal velocity in terms of angular momentum and show that when angular momentum is conserved, the motion is planar and transverse acceleration is zero.

(b) If the mass of a body is 10kg and position vector is $\vec{r} = 2t^2\hat{i} + 5t\hat{j}$ at any instant t, find the magnitude and direction of the angular momentum about the origin at $t = 2$ seconds. **(6+4)**

7. (a) What is meant by conservative field? Show that the law of conservation of energy holds good in a conservative field.

(b) A 2kg mass hangs from a spring. A 0.3kg body hung below it stretches it further by 2 cm. If 0.3kg is removed and mass is set into oscillations, find the period of oscillation. (

UNIT - III

Answer any <u>TWO</u> of the following: **2×1(**

8. (a) Derive the relation between pressure, volume and temperature for an ideal gas undergoing adiabatic change.

(b) Calculate the amount of work done when 1 liter of a perfect gas at NTP is compressed adiabatically till the temperature is increased to 100°c. Gas constant is 8.314 J mol^{-1} K^{-1}. (

9. (a) Explain the term entropy. Explain the Temperature – Entropy diagram and prove its area represents available energy.

(b) Calculate the change in entropy when 10^{-3}kg of ice at 273K melts into water at 323K.
Given: latent heat of fusion of ice = 3.36×10^5J Kg^{-1}.
Specific heat of water = 4200 $JKg^{-1}K^{-1}$. (

10. (a) Give the theory of Joule-Thomson effect in terms of enthalpy and arrive at the condition for the cooling and heating effect of the gas.

(b) Find the depression in the melting point of ice for an increase in the external pressure by one atmosphere.
Specific volumes of ice at 0°C is $1.091\times10^{-3}m^3kg^{-1}$ and that of water at 0°C is $10^{-3}m^3kg^{-1}$ L=3.36×10^5J/Kg/K. 1atms.=$1.01\times10^5Nm^{-2}$. (

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PHY 201.2 Reg. No. .....

CREDIT BASED SECOND SEMESTER B.Sc. DEGREE EXAMINATION APRIL 2016
PHYSICS
PAPER – II: MECHANICS AND THERMAL PHYSICS

Time: 3 Hrs. **Max. Marks: 80**

PART – A

I. A. Answer any TEN of the following: **10×1=10**

1. Define radius of gyration.
2. What is a flywheel?
3. What are mechanical oscillators?
4. What is the moment of inertia of a body of mass 1kg situated at point whose co-ordinates are (3, 4) about the z-axis?
5. State law of conservation of linear momentum.
6. Write an expression for torque in vector form.
7. Define central force.
8. How does the period of a light loaded spring change as the mass suspended from it varies?
9. State first law of thermodynamics.
10. What is heat death?
11. What is Joule – Thomson effect?
12. What is persistant current?

B. Answer any five of the following: **5×2=10**

i) What is the difference between centre of gravity and centre of mass?
ii) Show that the oscillations of a simple pendulum are simple harmonic when the amplitude is small.
iii) What are multistage rockets and what are its advantages?
iv) State Kelper's laws.
v) Distinguish between reversible and irreversible process.
vi) Derive the expression for coefficient of performance of refrigerator.

PART – B
UNIT - I

Answer any TWO of the following: **2×10=20**

2. a) Derive an expression for the moment of inertia of a rectangular lamina
   i) about an axis at its sides and
   ii) about an axis passing through its centre and perpendicular to its plane.

   b) A flat circular disc of mass 0.05kg and diameter 0.02m rolls on its edge on a smooth horizontal table with a velocity of $0.05ms^{-1}$. Calculate it total energy. **(6+4)**

3. a) Derive the formula for moment of Inertia and rotational energy of a diatomic molecule.
   b) A flywheel of mass 500kg and radius 1m makes 500 revolutions per minute. Calculate the energy of the flywheel. **(6+4)**

4. a) What is a torsion pendulum? Derive an expression for the period of oscillation of torsion pendulum.
   b) A uniform circular disc of radius 0.8m oscillates as a compound pendulum in its plane about an axis through a point on its circumference. Calculate its time period. **(6+4)**

UNIT – II

Answer any TWO of the following: **2×10=20**

5. a) Define elastic and inelastic collisions and derive expressions for the velocities of the particles after a head on collision between them.
   b) A rocket of mass 10kg has 200kg of fuel. The exhaust velocity of fuel is 1.6 km s^{-1}. Calculate the final speed gained by the rocket when the rate of consumption of fuel is 2 kg s^{-1}. **(6+4)**

6. a) Derive an expression for the areal velocity in terms of angular momentum and show that when angular momentum is conserved, the motion of a particle is planar and transverse acceleration is zero.
   b) A vertical spring is stretched by 0.05m when a load at 5kg is attached to it. What will be period of oscillation when a load of 3kg is attached to it? **(6+4)**

7. a) Show that in a conservative field, work done is independent of the path and define potential energy of a particle.
   b) Two stages of a rocket 200kg & 10kg containing 800kg and 90kg fuel respectively. Calculate the final velocity attained with a maximum velocity of 1.5 km s^{-1} for the escaping gases. **(6+4)**

UNIT – III

Answer any TWO of the following: **2×10=20**

8. a) Derive an expression for the work done by a gas during an isothermal and adiabatic expansion.
   b) A mole of a gas at temperature 300k expands adiabatically until its volume is doubled. Calculate the temperature attained by it and also work done by the gas ($R = 8.31 Jmol^{-1}K^{-1}, \gamma = 1.4$). **(6+4)**

9. a) Arrive at an expression for the entropy of a perfect gas.
   b) Calculate the change of entropy when 1g of ice at –15°C is converted into water 0°C. Given specific heat of ice = $2090 Jkg^{-1}$, latent heat of fusion of ice is $3.34 \times 10^5 Jkg^{-1}$. **(6+4)**

10. a) Explain with neat diagrams Meissner effect and critical magnetic field.
    b) Calculate the temperature of inversion of helium gas. Given $a = 3.44 \times 10^{-3} Nm^4 mol^{-2}$, $b = 0.0237 \times 10^{-3} m^3 mol^{-1}$ and $R = 8.31 Jmol^{-1}K^{-1}$ **(6+4)**

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