Q.P. Code – 42141

First Semester B.Sc. Degree Examination, October/November 2019

(CBCS – 2016-18 Repeaters)

Physics

MECHANICS AND SPECIAL THEORY OF RELATIVITY

Time : 3 Hours] *[Max. Marks : 90*

Instructions to Candidates : Answers should be written in English only.

PART – A

Answer any **FIVE** of the following questions. Each question carries 8 marks : **(5 × 8 = 40)**

1. (a) State and explain Newton's III Law of motion.

   (b) Show that Newton's laws of motion are invariant under Galilean transformations. **(2 + 6)**

2. (a) State and explain work-energy theorem.

   (b) State and prove law of conservation of momentum. **(3 + 5)**

3. (a) Define :
   (i) Angular velocity
   (ii) Angular acceleration.

   (b) Show that angular momentum L = Iw. **(2 + 6)**

4. (a) State Kepler's law of planetary motion.

   (b) Define escape velocity of satellite and obtain expression for it. **(3 + 5)**

5. (a) Define frequency and displacement.

   (b) What are harmonic and non harmonic oscillations?

   (c) Derive a differential equation of SHM. **(2 + 2 + 4)**

6. (a) Define :
   (i) Young's modulus
   (ii) Rigidity modulus and
   (iii) Bulk modulus.

   (b) Obtain expression for work done in stretching a wire. **(3 + 5)**

7. (a) State the postulates of special theory of relativity.

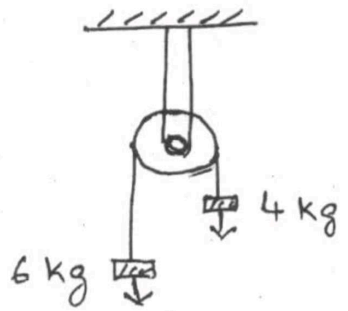
   (b) Derive Einstein's mass energy relation on the basis of special theory of relativity. **(2 + 6)**

8. Obtain expression for variation of mass with velocity. **(8)**

PART – B

Answer any **SIX** from the following : **(6 × 5 = 30)**

9. Two bodies of masses 6 kg and 4 kg connected by inextensible string over smooth pulley. Find acceleration and tension in the string as shown in diagram ($g = 10\ ms^{-2}$)



10. Two bodies of masses 5 Q and 10 Q have position vectors $(3\hat{i}+2\hat{j}-\hat{k})$ and $\hat{i}-\hat{j}+3\hat{k})$ respectively. Calculate the position vector and the distance of the centre of mass from the origin.

11. A solid cylinder of mass 20 kg rotates about its axis with angular speed 100 rad s^{-1}. The radius is 0.25 m. What is the kinetic energy associated with the rotation of the cylinder? What is the magnitude of angular momentum of the cylinder about its axis?

12. The force of attraction between two spheres of mass 40 kg and 80 kg is equal to the weight of 8.7×10^{-8} kg. If the distance beween the centres of the two spheres is 0.5 m. Calculate value of G.

13. The displacement of a particle executing SHM given by $y = 0.04\sin\left(100t + \frac{\pi}{6}\right)$, where y is in metre and t is in second. Calculate its

    (a) amplitude

    (b) frequency

    (c) period

    (d) initial phase.

14. What force is required to stretch a steel wire 2×10^{-4} sq.m in cross section to double its length $q = 20\times10^{10}\,Nm^{-2}$.

15. In Michelson-Morley experiment the effective length of each path is 11 m. If the velocity of the earth is $30\times10^{3}\,ms^{-1}$ and wavelength of light used in 550 nm. What is the fringe shift expected produced?

16. At what velocity will the mass of a body be 10 times its rest mass? (given $C = 3\times10^{8}\,ms^{-1}$)

PART – C

Answer any **TEN** of the following. Each question carries 2 marks : **(10 × 2 = 20)**

17. (a) Explain why passengers are thrown forward from their seats when a speeding bus stops suddenly.

    (b) A body is at rest. Does it mean that no external forces are acting on it.

    (c) Can kinetic energy of a body be negative? Explain.

    (d) Two satellites of equal mass are orbiting the earth at different heights. With their moment of inertia be the same or different.

    (e) Mention the weakest force in nature. Why it is important?

    (f) Why is Newton's law of gravitation is called a universal?

    (g) Can the motion of the artificial satellite around earth be taken as SHM?

    (h) Steel is more elastic than rubber. Explain.

    (i) Bridges become unsafe for use over a long time. Explain.

    (j) At what velocity relativistic increase of mass is significant? Why?

    (k) What are the two important kinematic effects which derives from the special theory of relativity?

    (l) Rest mass is least. Comment.

Q.P. Code – 22140

First Semester B.Sc. Degree Examination, October/November 2019

(Non-CBCS Scheme — Repeaters)

Physics

Paper 101 — MECHANICS, OSCILLATIONS AND WAVES

Time : 3 Hours] *[Max. Marks : 60*

Instructions to Candidates : Answers should be written in English only.

PART – A

Answer any **FIVE** of the following questions. Each question carries **6** marks : **(5 × 6 = 30)**

1. Derive an expression for radial and transverse components of velocity and acceleration of a particle moving along a curve in a plane using polar coordinates. **(6)**

2. Show that Newton's second law is not valid in a frame of reference which is moving uniform acceleration with respect to the fixed frame. **(6)**

3. (a) Define the terms :

   (i) Sliding friction

   (ii) Rolling friction.

   (b) Show that the tangent of the angle of friction is equal to the coefficient of static friction. **(2 + 4)**

4. State and prove work-energy theorem for a particle subjected to a variable force. **(6)**

5. Derive an expression for the moment of inertia of a solid cylinder about an axis perpendicular to its length. **(6)**

6. (a) Define the terms moment of inertia and radius of gyration.

   (b) State and prove parallel axis theorem. **(2 + 4)**

7. (a) What is compound pendulum?

   (b) Show that the centre of oscillations and the centre of suspension of a compound pendulum are interchangeable. **(1 + 5)**

8. Derive an expression for the total energy of a particle executing simple harmonic motion. **(6)**

PART – B

Answer any **FOUR** of the following questions. Each question carries **5** marks : **(4 × 5 = 20)**

9. The displacement of a particle at any instant of time is given by $X = 8t^3 - 2t^2 + 8t + 12$. Find the velocity and acceleration at the instant of time t = 2 seconds.

10. Two bodies of masses 10 kg and 4 kgs are connected by light inextensible string passing over a light friction less pulley. Calculate the acceleration of the system and the tension in the string. (acceleration due to gravity $q = 10\,ms^{-2}$)

11. A fly wheel of mass 10 kg and radius 0.2×10^{-2} m makes 100 revolutions per minute. Calculate the moment of inertia of the flywheel.

12. Find the acceleration of the block of mass 2.4 kg which moves on a smooth surface of inclined plane at an angle of 45^0 to the horizontal.

13. Two bodies of masses 2 g and 4 g have position vectors $(2\hat{i} + 2\hat{j} + 3\hat{k})$ and $(\hat{i} - \hat{j} + 2\hat{k})$ respectively. Calculate the position vector and the distance of the centre of mass from the origin.

14. Calculate the moments of inertia of a uniform circular disc of mass 2 kg, radius 0.2 m about

   (a) the diameter of the disc

   (b) the axis through the centre of the disc and perpendicular to its plane.

PART– C

Answer any **FIVE** of the following questions. Each question carries **2** marks : **(5 × 2 = 10)**

15. (a) Can a body be said to be at rest as well as in motion at the same time? Explain.

   (b) Is earth an inertial frame? Explain.

   (c) Does the generalized coordinates have to be position coordinates only? Justify.

(d) Work done by frictional forces is always negative. Comment.

(e) A light and heavy body have equal kinetic energies. Which one has larger momentum?

(f) Can the centre of gravity of a body be outside the body? Justify.

(g) All oscillatory motions are periodic but all periodic motions are not oscillatory. Justify.

(h) Does energy of a wave depends upon the frequency of the wave? Explain.

Q.P. Code – 42148

First Semester B.Sc. Degree Examination, October/November 2019

(Revised CBCS – 2018 Onwards)

Physics

Paper 101 — MECHANICS AND SPECIAL THEORY OF RELATIVITY

Time : 3 Hours] *[Max. Marks : 90*

Instructions to Candidates : Answers should be written in English only.

PART – A

Answer any **FIVE** of the following questions. Each question carries 8 marks : **(5 × 8 = 40)**

1. (a) Define inertial and non inertial frames of reference.

   (b) Show that Newton's Second Law is not valid in a frame of reference which is moving with an uniform acceleration with respect to a fixed frame. **(2 + 6)**

2. (a) State and explain work-energy theorem.

   (b) Deduce an expression for velocity and acceleration of rocket propulsion of any instant of time. **(2 + 6)**

3. (a) State and prove theorem of parallel axis for moment of inertia.

   (b) Obtain an expression for moment of inertia of a circular disc about an axis passing through its centre and perpendicular to its plane. **(4 + 4)**

4. (a) State and prove Kepler's Second law of planetary motion.

   (b) Derive an expression for orbital velocity of a satellite. **(4 + 4)**

5. (a) Define SHM of a particle.

   (b) Obtain an expression for the instantaneous kinetic and potential energies for a particle executing SHM and hence show that their sum is a constant. **(1 + 7)**

6. (a) Define Poisson's ratio.

   (b) Define the term bending moment and obtain an expression for bending moment. **(1 + 7)**

7. Describe the Michelson-Morley experiment with a neat diagram and necessary theory and discuss its negative result. **(8)**

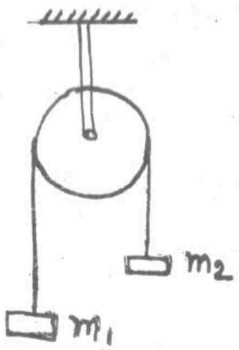
8. (a) Define proper length and proper time.

   (b) Obtain an expression for variation of mass with velocity in special theory of relativity. **(2 + 6)**

PART – B

Answer any **SIX** from the following questions. Each question carries 5 marks : **(6 × 5 = 30)**

9. Two bodies of mass m_1 = 5 kg and m_2 = 3 kg are connected by light inextensible string passing over a light smooth pulley. Find the acceleration of the system and tension in the string. $(g = 10 ms^{-2})$



10. A hunter fires a bullet of 10 g with a velocity of 500 ms^{-1} from a gun of mass 5 kg. Calculate the final momentum and kinetic energy of bullet and rifle.

11. A grinder is in the form of a circular disc of mass 10 kg and diameter 0.4 m, calculate the constant torque that has to be applied, so that the disc acquires an angular velocity of 4 revolutions/second in 5 seconds. Calculate the rate at which work is done by the torque at the end of 5 seconds.

12. A body weighs 270 kg on the surface of the earth. How much it will weighs on the surface of mars, whose mass is $\frac{1}{9}$ times and radius $\frac{1}{2}$ times that of the earth.

13. A hydrogen atom of mass 1.67×10^{-27} kg is vibrating with a frequency 10^{14} Hz. Amplitude of vibration is 10^{-9} m, calculate

   (a) force constant

   (b) maximum velocity and

   (c) average energy of hydrogen atom.

14. A load of 2 kg wt produces an extension of 0.12 mm in a wire of length 3 m and 1 mm in diameter. Calculate the Young's modulus of the wire $(g = 9.8 ms^{-2})$

15. The mean life of the μ-mesons at rest is found to be about $2.2 \times 10_s^{-6}$. The mean life time of μ-mesons in a burst of cosmic rays is found to be $1.5 \times 10_s^{-5}$. What is the speed f these cosmic ray μ-mesons.

16. An electron of rest mass 9.1×10^{-31} kg is moving with a speed of 0.9 C. What is its kinetic energy?

PART – C

Answer any **TEN** of the following. Each question carries 2 marks : **(10 × 2 = 20)**

17. (a) Why does a cricketer moves his hands backwards while holding a catch?

(b) Write any two basic forces in nature.

(c) Can kinetic energy of a body be negative? Justify.

(d) Write two examples of conservative force.

(e) Why are spokes fitted in the cycle wheel?

(f) Does the gravitational interaction depends upon intervening medium? Justify.

(g) Expand GPS. What is source of power for GPS satellite?

(h) Why is spring made of steel and not of copper?

(i) What happens to the time period of a SHM when its amplitude is doubled?

(j) What are the postulates of special theory of relativity?

(k) A moving clock runs slower than stationary one. Explain.

(l) Can a body be accelerated to the velocity of light? Justify.

22140

I Semester B.Sc. Examination, Nov./Dec. 2015
(Semester Scheme)
PHYSICS – I (101)
Mechanics, Oscillations and Waves

Time : 3 Hours Max. Marks : 60

***Instruction** : Answer should be written completely in **English**.*

PART – A

Answer **any five** of the following questions. **Each** question carries **six** marks. **(5×6=30)**

1. Assuming the expressions for radial and transverse components of acceleration.
   a) Obtain an expression for the centripetal acceleration.
   b) Show that the areal velocity of a planet is a constant. **(3+3)**

2. Show that Newton's Second law is not valid in a frame of reference which is moving with uniform acceleration with respect to a fixed frame. **6**

3. a) State the laws of limiting friction.
   b) Show that the tangent of the angle of friction is equal to the coefficient of static friction. **(3+3)**

4. a) Define Coriolis force and centrifugal force.
   b) Discuss the effect of rotation of earth on the value of acceleration due to gravity. **(2+4)**

5. a) Define moment of inertia.
   b) Obtain an expression for the moment of inertia of a solid cylinder about an axis perpendicular to its length. **(1+5)**

6. a) Define simple harmonic motion.
   b) Derive an expression for the energy of a particle executing simple harmonic motion. **(1+5)**

P.T.O.

7. a) Show that the Kinetic energy of a rotating body is $\frac{1}{2}IW^2$ with usual notation.

   b) Deduce an expression for the acceleration of a sphere rolling down an inclined plane without slipping. **(2+4)**

8. a) What is a compound pendulum ?

   b) Show that the period of oscillation in a compound pendulum is same as that of the simple pendulum. **(1+5)**

PART – B

Answer **any four** of the following. **Each** carries **five** marks. **(4×5=20)**

9. Two electrons are moving parallel to each other with a common velocity $10^3 ms^{-1}$. The distance between the two electrons is 1 cm. (i) Calculate gravitational force (ii) Electrostatic force (iii) Electromagnetic force. (Mass of the electron = 9.1×10^{-31} kg. Charge on the electron = 1.6×10^{-19} Coulomb).

10. Determine the vector when added to the resultant of $\vec{A} = 2\hat{i} - 4\hat{j} - 6\hat{k}$ and $\vec{B} = 4\hat{i} + 3\hat{j} + 3\hat{k}$ gives unit vector along the z-direction.

11. A fly wheel of mass 2.5 kg and diameter 0.16 m makes 250 revolutions per minute. Calculate the moment of inertia and energy of fly wheel.

12. Find the acceleration of a block of mass 1.5 kg which moves on a smooth surface inclined at an angle of 35° to the horizontal.

13. A rocket of mass 10,000 kg is fixed vertically up from a location at the equator. The velocity of projection is 1200 ms^{-1}. Find the Coriolis force and the acceleration experienced by the rocket.

    Angular velocity of earth = 7.27×10^{-5} rad s^{-1}.

14. The equation $y = 4\sin 2\pi\left(\frac{t}{0.02} - \frac{x}{400}\right)$ represents a wave.

    i) Is the wave progressive or stationary ?

    ii) What is its amplitude ?

    iii) Linear velocity.

    iv) Angular velocity.

PART – C

Answer **any five** of the following. **Each** carries **two** marks. **(2×5=10)**

15. a) Carts with rubber tyres are easier to ply than those with iron wheels. Explain.

b) How do the resonance frequency of an organ pipe change when the temperature increases ?

c) Transverse waves cannot propagate through fluids. Give reason.

d) A person in a lift moving with an acceleration, what happens to his weight ? Explain.

e) A particle executing SHM, when will be its velocity and acceleration is maximum.

f) Why is the total mechanical energy of a SHM is constant ?

g) Interference patterns are observed only for coherent sources. True or false.

h) Can angular velocity be negative ? Explain.

22140

I Semester B.Sc. Examination, Nov./Dec. 2014
(Semester Scheme)
PHYSICS (101)
Mechanics Oscillations and Waves

Time : 3 Hours Max. Marks : 60

Instruction : *Answers should be written* ***completely*** *in* ***English.***

PART – A

Answer **any five** of the following questions. **Each** question carries **six** marks. **(5×6=30)**

1. Derive expressions for the radial and transverse components of velocity and acceleration of a particle moving along a curve in a plane using polar coordinates. **6**

2. a) What are inertial and non-inertial frames of reference ?
   b) Show that the acceleration of a particle moving in two dimensions is the same for observers in different frames of reference moving at constant velocity relative to each other. **(2+4)**

3. a) Define coefficients of static friction, kinetic friction and angle of friction.
   b) Show that the tangent of the angle of friction is equal to the coefficient of static friction. **(3+3)**

4. a) Explain the concept of variable force.
   b) State and prove work-energy theorem for a particle subjected to variable force. **(2+4)**

5. a) What is conservative force ? Give example.
   b) Show that in the case of a conservative force the workdone around a closed path is zero. **(2+4)**

6. a) Define centre of mass of a system of particles.
   b) Prove the relation $\vec{F}_{ext} = M\vec{a}_{CM}$ for a system of particles. **(1+5)**

P.T.O.

7. a) Define moment of Inertia.
   b) Obtain an expression for the moment of inertia of a solid sphere about an axis passing through its centre. **(1+5)**

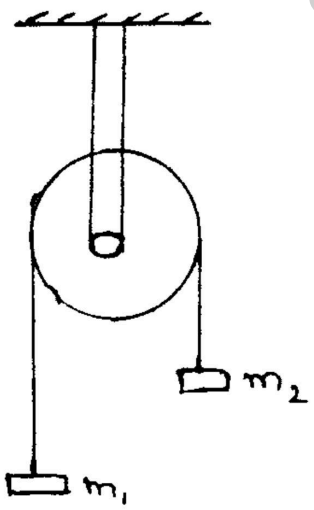
8. a) Define simple harmonic motion.
   b) Derive an expression for the energy of a particle executing simple harmonic motion. **(1+5)**

PART – B

Answer **any four** of the following questions. **Each** question carries **five** marks. **(4x5=20)**

9. A particle is moving in a straight line. Its displacement at an instant of time (t) is given by $x = 3t^3 - 4t^2 + 6t = 12$. Find the velocity and acceleration at the instant $t = 3$ seconds.

10. Two bodies of masses $m_1 = 5$ Kg and $m_2 = 3$ Kg are connected by light inextensible string passing over a light smooth pulley as shown in the figure given below. Find the acceleration of the system and the tension in the string ($g = 10\ ms^{-2}$).



11. A box of mass 100 Kg is pulled with uniform velocity on a horizontal floor with a force of 200 N applied at an angle of 30° to the horizontal. Calculate the coefficient of sliding friction.

12. A rocket of mass 20 Kg has 180 Kg fuel, the exhaust velocity of the fuel being 1.6 Kms^{-1}.
    a) Calculate the ultimate vertical speed gained by the rocket when the rate of consumption of fuel is 2 Kgs^{-1}.
    b) Calculate the time for which the rocket exists.

13. A fly wheel of mass 500 Kg and diameter 2 m makes 600 revolutions per minute. Calculate the moment of inertia and kinetic energy of fly wheel.

14. A particle of mass 0.01 Kg is vibrating 15 times per second with an amplitude of 0.08 m. Find the maximum velocity and kinetic energy.

PART – C

Answer **any five** of the following questions. **Each** question carries **two** marks. **(5×2=10)**

15. a) Can you add two vectors representing physical quantities having different dimension ? Give reason.
    b) Can a body remain at rest when external forces are acting on it ? Comment on it.
    c) Is the earth an inertial frame. Explain.
    d) Is the workdone by frictional forces always negative ? Give example.
    e) Can a body have momentum without having energy ? Explain.
    f) What is meant by non-conservative force ? Explain.
    g) What is the torque on a body when force is applied in the direction of the radius vector ?
    h) Does a simple pendulum execute a simple harmonic motion ? Explain.

22140

I Semester B.Sc. Examination, Nov./Dec. 2016
(Semester Scheme) (Old Batch upto 2015)
PHYSICS – I (101)
Mechanics, Oscillations and Waves

Time : 3 Hours Max. Marks : 60

Instruction : *Answer should be written* ***completely*** *in* ***English.***

PART – A

Answer **any five** of the following questions. **Each** question carries **six** marks. **(5×6=30)**

1. A particle is moving along a curve in a plane. Derive expressions for the radial and transverse components of velocity and acceleration. 6

2. State and explain Newton's laws of motion. 6

3. a) Define :
   i) Coefficient of static friction
   ii) Coefficient of sliding friction and
   iii) Angle of friction

   b) Obtain an expression for coefficient of static friction. **(3+3)**

4. State and establish the work-energy theorem in the case of a variable force. 6

5. a) What is conservative force ?

   b) Show that the loss of mechanical energy is equal to gain of internal energy in case of non-conservative forces. **(1+5)**

6. a) Distinguish between internal and external forces.

   b) Derive the law of conservation of linear momentum from Newton's law of motion. **(2+4)**

P.T.O.

7. a) Define moment of inertia and radius of gyration.

   b) Derive an expression for moment of inertia of a solid sphere along its diameter. **(2+4)**

8. Derive expressions for the instantaneous kinetic and potential energies for a particle executing simple harmonic motion and show that their sum is a constant. **6**

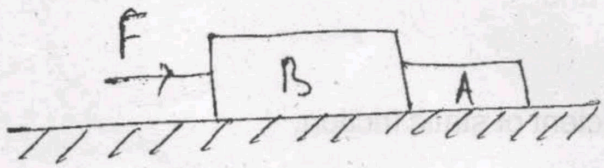
PART – B

Answer **any four** of the following questions. **Each** question carries **five** marks. **(4×5=20)**

9. One of the rectangular components of a force 40 N is 25N. Find the angle it makes with this component and the magnitude of the other component.

10. The velocity of a cycle due east is 4 ms^{-1} and that of a cart is 3 ms^{-1} due north. What is the velocity of the cart with respect to the cycle ?

11. Calculate the acceleration and the frictional force between two bodies as shown in figure when 8 N force is applied on bodies A and B of masses 3 kg and 5 kg.



12. A block is pulled at constant velocity on a horizontal surface by a force of 10N applied at angle of 30° to the horizontal. If the coefficient of friction is 0.5. Find the mass of the block.

13. Three particles of masses 1.2 kg, 2.5 kg, 3.4 kg are placed at the corners of an equilateral triangle of side 1.4 m. Locate the centre of mass of the system.

14. The equation $y = 4 \sin 2\pi \left[\frac{t}{0.02} - \frac{x}{400}\right]$ represents a wave. Where length is expressed in 'cm' and time in second. Find :

   a) Wavelength
   b) Amplitude
   c) Frequency and
   d) Velocity of wave

PART – C

Answer **any five** of the following questions. **Each** question carries **two** marks. **(5×2=10)**

15. a) Can a body be at rest as well as in motion at the same time ? Explain.

b) How many Lagrangian equations are there for describing a system ?

c) A swinging pendulum eventually comes to rest. Is this violation of the law of conservation of energy ? Explain.

d) Is there any difference between weight of a body at poles and equator ? Explain.

e) What are elastic and inelastic collisions ?

f) Are all oscillatory motions simple harmonic ? Explain.

g) Can a body moving in a straight line have angular momentum ? Explain.

h) A spinning ballet dancer folds her outstretched arms. What happens to her angular velocity ? Explain.

42141

I Semester B.Sc. Examination, November/December 2016
(CBCS Scheme) (2016 Onwards)
PHYSICS (Paper – I)
Mechanics and Special Theory of Relativity

Time : 3 Hours Max. Marks : 90

***Instruction** : Answers should be written completely in **English**.*

PART – A

Answer **any five** of the following questions. **Each** question carries **eight** marks. **(5×8=40)**

1. a) State and explain Newton's II Law.

   b) Show that Newton's second law is not valid in a frame of reference which is moving with an uniform acceleration with respect to a fixed frame of reference. **(2+6)**

2. a) Explain law of conservation of momentum .

   b) Obtain an expression for burnt out velocity of a rocket. **(2+6)**

3. a) State and prove parallel axes theorem as applied to moment of inertia of a body.

   b) State and prove perpendicular axes theorem as applied to moment of inertia of a plane lamina. **(4+4)**

4. Obtain an expression for gravitational potential and field intensity due to a solid sphere at a point.

   a) Outside the sphere

   b) On the surface of the sphere. **(6+2)**

5. a) Obtain an expression for the period of oscillations of a compound pendulum.

   b) Show that the centre of oscillation and centre of suspension are interchangeable in a compound pendulum. **(5+3)**

P.T.O.

6. a) State and explain Hooke's law.

   b) Obtain an expression for the couple per unit twist of a cylindrical rod. **(2+6)**

7. a) What are inertial and non-inertial frames of reference ?

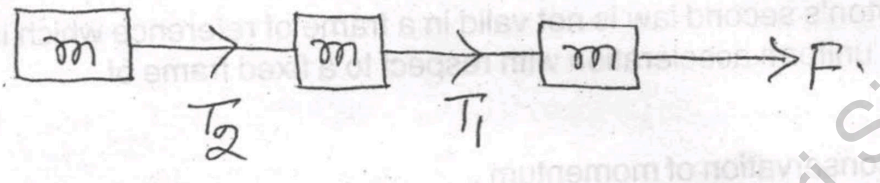
   b) Derive Lorentz transformation equations. **(2+6)**

8. Obtain an expression for variation of mass with velocity. **8**

PART – B

Answer **any six** of the following. **Each** question carries **five** marks. **(6×5=30)**

9. Three blocks each of mass 1 kg connected by ropes and are pulled by a force of 9N on a smooth horizontal surface is as shown in the figure. Determine the tensions T_1 and T_2 in the ropes.



10. A bullet of mass 50g strikes a wooden plank with a velocity of 200 m/s and emerges out with a velocity of 50 m/s. Calculate the work done by the bullet.

11. A circular disc of mass 5 kg and diameter of 0.2 m initially at rest and attains an angular velocity of 600 rpm in 10 seconds. Calculate the torque acting on it.

12. A satellite of earth revolves in a circular orbit at a height of 250 km above the earths surface. Calculate the orbital velocity and period of revolution of the satellite. Given : radius of the earth is 6400 km and acceleration due to gravity on the surface of the earth is 9.8 m/s^2.

13. A particle of mass 5g executes SHM making 25 oscillations in 11 seconds. If its maximum velocity is 0.6 m/s.Calculate the energy of vibration.

14. A disc of mass 1 kg and radius 0.1m is suspended horizontally by a vertical wire of length 0.6 m and of radius 5×10^{-4}m. If the period of oscillation is 3.9 seconds. Calculate the rigidity modulus of the material of the wire.

15. How fast would rocket have to go relative to an observer for its length to be contracted to 99% of its length at rest ?

16. An experimenter observes a radioactive atom moving with a velocity of 0.3C. The atom then emits a β-particle which has a velocity of 0.9C relative to the atom in the direction of motion. What is the velocity of the β-particle as observed by the experimenter ?

PART – C

Answer **any ten** of the following. **Each** question carries **two** marks. **(10×2=20)**

17. a) Will the action and reaction forces cancels with each other ? Why ?

b) Does the centre of mass of a solid body necessarily lie within the body ? If not give example.

c) Does kinetic energy depend on the direction of the motion involved ? Can it be negative ?

d) Explain how ballet dancer uses principle of conservation of angular momentum ?

e) Why is Newtons law of gravitation called a universal law ? Explain.

f) Under what circumstances would your weight be zero.

g) What happens to the time period of SHM when its amplitude is doubled ?

h) Usually spring is made of steel and not of copper. Comment.

i) Poisson's ratio of a material cannot be negative. Justify.

j) Can we apply the special theory of relativity to accelerated systems ? Explain.

k) A moving clock runs slower than a stationary one. Explain.

l) Why it is not correct to use the expression $\frac{1}{2}mv^2$ for the kinetic energy of a relativistic particle ?

Q.P. Code – 42141

First Semester B.Sc. Degree Examination, November 2017

(CBCS Scheme – 2016 onwards)

Physics

Paper I – MECHANICS AND SPECIAL THEORY OF RELATIVITY

Time : 3 Hours] *[Max. Marks : 90*

Instructions to Candidates : Answers should be written completely in English.

PART – A

Answer any **FIVE** of the following questions. Each question carries **8** marks. **(5 × 8 = 40)**

1. (a) Define inertial frame of reference and non-inertial frame of reference.

   (b) Define inertial mass and gravitational mass and obtain equivalence relation between them.

   (c) Define centre of mass. Write the coordinate of x and y in centre of mass. **(2 + 4 + 2)**

2. (a) State and explain work-energy theorem.

   (b) Deduce an expression for velocity and acceleration of rocket propulsion at any instant of time. **(4 + 4)**

3. (a) State and prove parallel axes theorem.

   (b) Obtain an expression for moment of inertia of disc an axis passing through its centre of mass and perpendicular to plane. **(4 + 4)**

4. (a) State and prove Kepler's second law of planetary motion.

   (b) Define orbital velocity of satellite and obtain an expression for it. **(4 + 4)**

5. (a) Derive Rigidity modulus of wire by dynamic method with theory.

   (b) Define bending moment of material and obtain an expression for it. **(4 + 4)**

6. Derive elastic constant [q, n, k and σ] of wire by Seark's method with theory. **(8)**

7. With neat diagram describe Michelson-Morley experiment with theory and discuss significance of negative result on special theory of relativity. **(8)**

8. (a) Deduce the Einstein's mass-energy relation with example of experimental evidence.

   (b) Obtain relation between momentum and energy of relativistic particle.

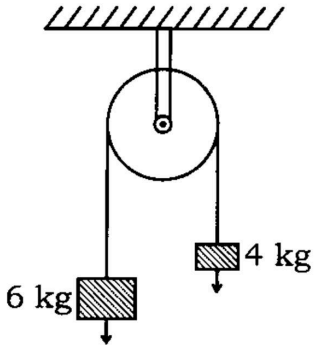
(6 + 2)

PART – B

Answer any **SIX** of the following questions. Each question carries **5** marks.

(6 × 5 = 30)

9. Two bodies of masses 6 kg and 4 kg connected by inextensible string over smooth pulley. Find acceleration and tension in the string as shown in diagram. Take $g = 10\ \text{m/s}^2$.



10. A force act on particle of mass 3 kg its position varies with time represented as $X = t^3 + 2t^2 + 3t + 4$ where 'x' in metre and 't' in seconds. Find total workdone by force in 3 seconds.

11. On the surface a body weights 99 N. What is weight on it at height equal to half the radius of earth?

12. Calculate the height above the earth at which geostationary satellite orbiting the earth. Given Radius of earth = 6400 km. Mass of earth $= 6 \times 10^{24}$ kg and $G = 6.67 \times 10^{-11}\ \text{Nm}^2\ \text{kg}^{-2}$.

13. Circular body of mass 1.5 kg and radius 0.04 m is suspended by a wire of length 0.5 m and radius 0.4 mm. If the period of oscillation is 2.56 seconds calculate the Rigidity modulus of the wire.

14. A square bar of length 1 m and breadth 2×10^{-2} m is clamped horizontally at one end and load of 2 kg is suspended at other end. Neglecting the mass of the bar, calculate the depression (a) at the load end (b) at 0.3 m from the loaded end.

15. An observer moves with metre scale with a velocity 0.5 C. What length does he measure for the metre scale? What will be new length of velocity reduces to 0.3 C?

16. A certain elementary particle called k-meson has a life time 2×10^{-6} s.

    (a) What is the mean life time when particle is travelling with speed of 0.99 C?

    (b) How far does it travel in one mean life time?

PART – C

Answer any **TEN** of the following questions. Each question carries **2** marks.

(10 × 2 = 20)

17. (a) Action and reaction are equal and opposite then do not cancel each other. Why?

    (b) What is the value of velocity in the inertial frame of reference? Explain.

    (c) Can body have negative workdone? Explain.

    (d) How Ballet dancer make to slow down the rotation?

    (e) Explain weightlessness of a man in a satellite.

    (f) What is minimum value of gravitational potential? Where?

    (g) If two pendulum of different masses make the oscillation, what happen to their period of oscillation?

    (h) Bridges are declared unsafe after a long use. Why?

    (i) What is Young's modulus of a rigid body? Explain.

    (j) Moving clock runs slower than the stationary one. Explain with special theory of relativity.

    (k) A light body and heavy body have same kinetic energy. Which one has more momentum?

    (l) Why the compensatory glass plate have introduced in one of the path of light in Michelson-Morley experiment?

22140

I Semester B.Sc. Examination, Nov./Dec. 2013
(Semester Scheme)
PHYSICS – I (101)
Mechanics Oscillations and Waves

Time : 3 Hours Max. Marks : 60

***Instruction** : Answer should be written completely in **English**.*

PART – A

Answer **any five** of the following questions. **Each** carries **six** marks. **(5×6=30)**

1. a) What is terminal velocity ?
   b) Obtain an expression for velocity of a particle at any given instant, when it is falling freely through a resistive medium. **(1+5)**

2. a) What are inertial and non-inertial frames of reference.
   b) Show that the acceleration of a particle moving in two dimensions is same for observers in different frames of reference moving at uniform velocity relative to each other. **(2+4)**

3. a) Define :
      i) Rolling Friction ii) Sliding Friction iii) Angle of Friction.
   b) Show that the tangent of the angle of friction is equal to the co-efficient of static friction. **(3+3)**

4. Explain the basic types of forces in nature. **6**

5. a) What are conservative and non-conservative forces ?
   b) Obtain an expression for potential energy for elastic spring force in one dimension. **(2+4)**

6. a) Distinguish between internal and external forces.
   b) Prove the relation $\overrightarrow{F_{ext}} = M\overrightarrow{a_{cm}}$ for a system of particles. Where the symbols have their usual meanings. **(2+4)**

P.T.O.

7. a) Define moment of inertia and radius of gyration.
   b) State and prove parallel axes theorem on moment of inertia. **(2+4)**

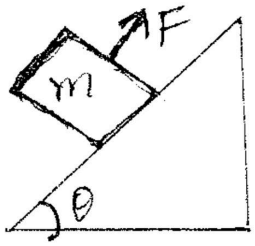
8. a) What is a compound pendulum ? Write an expression for its period of oscillations.
   b) Show that the centre of oscillations and centre of suspension of a compound pendulum are interchangeable. **(2+4)**

PART – B

Answer **any four** of the following questions. **Each** question carries **five** marks. **(4×5=20)**

9. For what value of a the two vectors $\vec{A} = 2\hat{i} + a\hat{j} + \hat{k}$ and $\vec{B} = 4\hat{i} - 2\hat{j} - 2\hat{k}$ are perpendicular to each other ?

10. A mass of 10 Kg held by a card on a frictionless plane making an inclination of 30° with the horizontal as shown in the fig. What is the tension in the card ? What force does the plane exert on the block ? ($g = 10\ ms^{-2}$)



11. A block weighing 35.6 N slides on a horizontal frictionless table with a speed of $1.22 ms^{-1}$, it is brought to rest in compressing a spring in its path. By how much is the spring compressed if its force constant is $1.35\ Nm^{-1}$.

12. The spring in a gun has a force constant $7\ Ncm^{-1}$. It is compressed by 5.1 cm from its original length and ball weighing 0.133 N is put into the barrel against it. Assuming no friction and the gun barrel is horizontal, with what speed will the ball leave the gun when released ?

13. A rocket weighs 35000 N, when fuelled up on a launching pad. It is fired vertically up and at burnt out it weighs 10000 N. Gases are exhausted at the rate of $10\ kgs^{-1}$ with a velocity of $4500\ ms^{-1}$ relative to the rocket.

    Calculate :
    a) The thrust.
    b) Net upward force at the beginning.
    c) Net upwardforce at the burnt out.

14. A solid cylinder rolls down an inclined plane without slipping. The length of the inclined plane is 1m and the inclination is 45°. With what velocity does it reach the bottom of the inclined plane ? What is its acceleration ?

PART – C

Answer **any five** of the following questions. **Each** question carries **two** marks. **(5×2=10)**

15. a) Can a body be at rest as well as in motion at the same time ? Explain.
    b) How many Lagrangian equations are there for describing a system ?
    c) Does kinetic energy depend on the direction of the motion involved ? Can it be negative ?
    d) Can a body have a energy without having momentum ? Explain.
    e) Is kinetic energy conserved in a perfectly inelastic collision ? Justify your answer.
    f) A spinning ballet dancer folds his out-stretched arms. What happens to his angular velocity ? Explain.
    g) Are all oscil'atory motions simple harmonic ? Explain.
    h) Does energy in a wave is proportional to the square of the amplitude of the wave ? Explain.