(Pages : 3) **C – 3920**

Reg. No. : ....

Name : ....

Fourth Semester B.Sc. Degree Examination, July 2017
Career Related First Degree Programme under CBCSS
Group 2(a) : PHYSICS AND COMPUTER APPLICATIONS
Core Course
PC 1441 : Classical Mechanics and Theory of Relativity
(2014 Admission)

Time : 3 Hours Max. Marks : 80

SECTION – A

This Section contains very short answer questions, Answer **all** questions :

1. How the linear uniformity of space affects linear momentum ?
2. What do you mean by a conservative system ?
3. Define a central force. Give an example.
4. Write down the relation connecting radius vector, linear momentum and angular momentum.
5. Give an example of a holonomic constraint.
6. Write down the D'Alembert's principle.
7. What are the factors on which Lagrangian is dependent on ?
8. Are two events occurring at the same point simultaneous in all inertial frames.
9. Is length an absolute quantity ?
10. What are tachyons ? **(10×1=10 Marks)**

SECTION – B

This Section contains short answer questions (answer **8** questions) :

11. Write down the relation connecting torque and angular momentum and obtain the law of conservation of angular momentum.

12. Explain the homogeneity of flow of time and conservation of energy.

13. Distinguish between elastic and inelastic collisions.

14. What is meant by the term cross-section of scattering ?

15. How constraints affect the degree of freedom of a system ? Illustrate.

16. Write down the Lagrange's equation of motion. What is the physical meaning of the term Lagrangian ?

17. Write any advantage of Lagrangian formalism over Newtonian formalism.

18. Distinguish between inertial and non-inertial frames of references.

19. Discuss the effects of coriolis force as a result of earth's motion.

20. Write down the postulates of the special theory of relativity.

21. What is twin paradox in the theory of special relativity ?

22. Discuss the principle of equivalence of mass and energy. **(8×2=16 Marks)**

SECTION – C

This section contains short essay questions (answer **6** questions) :

23. Show that if the potential energy of a system does not depend on time explicitly, its mechanical energy is conserved.

24. Calculate the reduced mass of hydrogen molecule.

25. The maximum and minimum velocities of a satellite are v_{max} and v_{min}, respectively. Prove that the eccentricity of the satellite is $e = \frac{v_{max} - v_{min}}{v_{max} + v_{min}}$.

26. A bullet of mass 10 gm strikes a ballistic pendulum of mass 2kg. The centre of mass of the pendulum rises to a vertical height of 12 cm. Assuming that the bullet remains embedded in the pendulum, calculate its initial speed.

mV + M

27. Obtain the Lagrange's equation for a simple pendulum.

28. Prove that acceleration is invariant under Galilean transformations.

$T = 2\pi\sqrt{}$

29. In a laboratory, the life-time of a particle moving with speed 2.8×10^{8} m/sec is observed to be 2.5×10^{-7} sec. Determine the proper life-time of the particle.

30. Show that for a particle moving with velocity equal to that of light has zero rest mass.

31. Distinguish between space-like and time-like intervals. **(6×4=24 Marks)**

SECTION – D

This section contains long essay questions (answer **2** questions) :

32. Prove that a translational symmetry leads to conservation of linear momentum and rotational symmetry results in conservation of angular momentum.

33. State Kepler's laws of planetary motion and prove them by treating the motion of planets as one body equivalent problem.

34. Obtain Lagrange's equations for a conservative system from D'Alembert's principle.

35. Obtain Lorentz transformation equations for co-ordinates and time for two inertial frames. **(2×15=30 Marks)**

$$\frac{dE}{dt} = d(U+P)$$

$$= \frac{\partial U}{\partial x}dx + \frac{\partial U}{\partial t}dt + \frac{\partial P}{\partial x}dx + \frac{\partial P}{\partial t}dt$$

$$\frac{dE}{dt} = \frac{\partial U}{\partial x}\frac{dx}{dt} + \frac{dP}{dx}\frac{dx}{dt}$$

$$= (-F + F)\frac{dx}{dt}$$

$= (M+m)V$

$k^2 + \rho^2$

$(k^2 + l^2)$

(Pages : 3) **C – 3938**

Reg. No. : ....

Name : ....

Fourth Semester B.Sc. Degree Examination, July 2017
Career Related First Degree Programme under CBCSS
PHYSICS WITH COMPUTER APPLICATIONS
Core Course
PC 1441 : Classical Mechanics and Theory of Relativity
(2015 Admission)

Time : 3 Hours Max. Marks : 80

SECTION – A

Answer **all** questions in **one** or **two** sentences **each**. **Each** carries **1** mark.

1. What are non-inertial frames of reference ? Give an example.
2. Write down the Lorentz transformation equations.
3. Explain the ether concept.
4. Discuss time dilation in Relativity.
5. What are inverse square law forces ? Give two examples.
6. What is meant by proper length of a body ?
7. Write down the differential equation for damped harmonic motion and explain the terms.
8. State and explain Kepler's third law of planetary motion.
9. Explain generalized coordinates.
10. State D^1 Alembert's principle. **(10×1=10 Marks)**

SECTION – B

Answer **any 8** questions. **Each** carries **2** marks.

11. Explain the conditions for maximum and minimum time periods of a compound bar pendulum.
12. Discuss the variation of mass with velocity of a moving body.

P.T.O.

13. Describe the equivalence of mass and energy.
14. What is Coriolis force ? How does it vary in the two hemispheres of the earth ?
15. Explain spacelike and timelike intervals.
16. How is time dilation effect proved in the case of atmospheric mesons ?
17. Explain the Lagrange's equations for the simple pendulum.
18. Distinguish between scleronomic and rheonomic constraints, with an example each.
19. Explain the concept of centre of mass.
20. Explain the hypothesis of Galilean invariance.
21. Compare elastic and inelastic collisions.
22. Explain the terms :
    i) generalized momentum
    ii) cyclic coordinate. **(8x2=16 Marks)**

SECTION – C

Answer **any 6** questions. **Each** carries **4** marks.

23. Show that the relativistic expression for kinetic energy reduces to the classical one for $v << c$.
24. A particle moves in a potential energy field $U = U_0 - Px + Qx^2$. Find :
    a) the expression for force
    b) the force constant
    c) the time period
    d) the point where the force vanishes.
25. A particle of mass 2 g moves along the x-axis and is attracted towards the origin by a position dependent force 0.008x. If it is initially at rest at x = 10 cm, find :
    a) the differential equation of motion
    b) the position at any time
    c) the velocity of the particle at any time
    d) the amplitude and frequency of vibration.

26. Show that the average kinetic energy and average potential energy over one time period of a simple harmonic oscillator are equal.

27. The mean lifetime of mesons in their rest frame is 2×10^8 s. Consider mesons moving at a velocity of 0.73c. Find :

    a) the distance travelled during one mean lifetime

    b) the distance travelled without relativistic effects.

28. The centre of mass of a system of three particles of masses 10, 20 and 30 g is at the point (1, 1, 1). Where should a fourth particle, of mass 40 g, be placed so that the resulting centre of mass of the system of four particles is at the point (0, 0, 0) ?

29. A stone of mass 100 g is revolved at the end of a string of length 50 cm at the rate of 2 revolutions per second. Determine its angular momentum. If the stone makes only one revolution per second after 25 seconds, find the torque applied.

30. Calculate the speed of a proton of mass 1.67×10^{-27} kg for the cases when :

    a) the kinetic energy is half the total energy

    b) the kinetic energy is half the rest energy.

31. Discuss the constraints and degrees of freedom for the following systems :

    a) a simple pendulum

    b) a system of two particles moving in a plane. **(6×4=24 Marks)**

SECTION – D

Answer **any 2** questions. **Each** carries **15** marks.

32. Discuss the Michelson – Morley experiment and explain the significance of its result.

33. Solve the equations of motion for motion under an inverse square law force and describe the possible orbits.

34. Describe the theory of compound pendulum. Explain the concepts of centre of suspension and centre of oscillation and hence show that they are interchangeable.

35. Derive the expression for relativistic variation of mass with velocity.

(2×15=30 Marks)

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C – 3882

Reg. No. : ....

Name : ....

Fourth Semester B.Sc. Degree Examination, July 2017
(Career Related First Degree Programme Under CBCSS)
Group 2(a) : Complementary Course for Physics and Computer Applications
MM 1431.6 : MATHEMATICS – IV : LINEAR TRANSFORMATIONS, VECTOR INTEGRATION AND COMPLEX ANALYSIS
(2013 Admission Onwards)

Time : 3 Hours

Max. Marks : 80

SECTION – I

All the **first 10** questions are **compulsory**. They carry 1 mark **each**.

1. Define the linear transformation reflection.
2. If T(x) = Ax is a linear transformation from R^2 to R^3, what is the order of A ?
3. Define matrix representation of a linear transformation.
4. Find the work done by the conservative field $F = \nabla(xyz)$ along a smooth curve joining the points (– 1, 3, 9) and (1, 6, – 4).
5. Define potential function.
6. Write the condition for F = Mi – Nj + Pk to be conservative.
7. Define argument of a complex number.
8. Is complex conjugate differentiable ?
9. Write Cauchy-Riemann equations for analytic functions.
10. Find $\int_{-\pi i}^{\pi i} \cos z dz$.

P.T.O.

SECTION – II

Answer **any 8** questions from among the questions **11** to **22.** These questions carry **2** marks **each**.

11. Determine whether the transformation $T : R^2 \rightarrow R^1$ defined by $T[a\ b] = ab$ is linear or not.
12. If $T : R^2 \rightarrow R^2$ is a linear transformation which satisfies $T[1\ 1] = [5\ 6]$ and $T[1\ -1] = [7\ 8]$. Find $T[a\ b]$, for any two real numbers a and b.
13. Determine whether the linear transformation $T\begin{bmatrix} a \\ b \end{bmatrix} = \begin{bmatrix} a+b \\ a-b \\ 2a+3b \end{bmatrix}$ is one-to-one.
14. Find unit normal to the surface $x^2y + 2xz = 4$ at the point $(2, -2, 3)$.
15. Find the flux of $F = (y - x)i + yj$ across the circle $x^2 + y^2 = 1$ in the xy-plane.
16. Test whether $F = (z + y)i + zj + (y + x)k$ is conservative or not.
17. Show that an analytic function is constant if its modulus is constant.
18. If $f(z) = u(x, y) + iv(x, y)$ is analytic in a domain D, then prove that u and v satisfies Laplace's equation.
19. Find all points where $w = z^2 + \frac{1}{z^2}$, is not conformal.
20. Find an upper bound for the absolute value of the integral $\int_C z^2\, dz$, where C is the straight line from 0 to $1 + i$.
21. State Cauchy's integral theorem. What is $\int_C \cos z\, dz$, where C is any closed path.
22. Evaluate $\int_C \frac{z^2 - 6}{2z - i}\, dz$, where C is any closed path.

SECTION – III

Answer **any 6** questions from among the questions **23** to **31.** These questions carry **4** marks **each.**

23. Find the both change of coordinate matrices for the bases $C = \{t + 1, t - 1\}$ and $D = \{2t + 1, 3t + 1\}$.
24. Prove that the image of a linear transformation is a subspace of the codomain.

    Determine the image of the matrix $A = \begin{bmatrix} 1 & 1 & 5 \\ 2 & -1 & 1 \end{bmatrix}$.

25. Find the area of the cap cut from the hemisphere $x^2 + y^2 + z^2 = 2$ by the cylinder $x^2 + y^2 = 1$.

26. Find the flux of $F = yzj + z^2k$ outward through the surface S cut from the cylinder $y^2 + z^2 = 1$, $z \geq 0$, by the planes $x = 0$ and $x = 1$.

27. Show that $ydx + xdy + 4dz$ is exact and evaluate the integral $\int_C (ydx + xdy + 4dz)$ from A(1, 1, 1) to B(2, 3, – 1).

28. Write a short note on logarithmic and hyperbolic functions in the complex plane.

29. Find an analytic function $f(z) = u + iv$, where $v = 2y(-1 + x)$.

30. Evaluate $\int_C \frac{e^z}{z} dz$ where C is the circle $| z | = 2$, counterclockwise.

31. Evaluate $\int_C \frac{dz}{z^2 + 1}$ where C is $|z - i| = 1$, counterclockwise.

SECTION – IV

Answer **any 2** questions from among the questions **32** to **35.** These questions carry 15 marks **each**.

32. Find the matrix representation for the linear transformation $T\begin{bmatrix} a \\ b \end{bmatrix} = \begin{bmatrix} 11a + 3b \\ -5a - 5b \end{bmatrix}$.

33. a) Use divergence theorem to find the outward flux of the vector field $F(x, y, z) = zk$ across the sphere $x^2 + y^2 + z^2 = a^2$.

    b) Verify divergence theorem for the field $F = xi + yj + zk$ over the sphere of radius a.

34. Discuss the analyticity of exponential and trignometric functions.

35. Integrate $g(z) = \frac{1}{z^2 - 1} \tan z$, counterclockwise around the circle $|z| = \frac{3}{2}$.

25. Find the area of the cap cut from the hemisphere $x^2 + y^2 + z^2 = 2$ by the cylinder $x^2 + y^2 = 1$.

26. Find the flux of $F = yzj + z^2k$ outward through the surface S cut from the cylinder $y^2 + z^2 = 1$, $z \geq 0$, by the planes $x = 0$ and $x = 1$.

27. Show that $ydx + xdy + 4dz$ is exact and evaluate the integral $\int_C (ydx + xdy + 4dz)$ from A(1, 1, 1) to B(2, 3, – 1).

28. Write a short note on logarithmic and hyperbolic functions in the complex plane.

29. Find an analytic function $f(z) = u + iv$, where $v = 2y(-1 + x)$.

30. Evaluate $\int_C \frac{e^z}{z} dz$ where C is the circle $|z| = 2$, counterclockwise.

31. Evaluate $\int_C \frac{dz}{z^2 + 1}$ where C is $|z - i| = 1$, counterclockwise.

SECTION – IV

Answer **any 2** questions from among the questions **32** to **35.** These questions carry **15** marks **each**.

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33. a) Use divergence theorem to find the outward flux of the vector field $F(x, y, z) = zk$ across the sphere $x^2 + y^2 + z^2 = a^2$.

    b) Verify divergence theorem for the field $F = xi + yj + zk$ over the sphere of radius a.

34. Discuss the analyticity of exponential and trignometric functions.

35. Integrate $g(z) = \frac{1}{z^2 - 1} \tan z$, counterclockwise around the circle $|z| = \frac{3}{2}$.

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C – 3923

Reg. No. : ....

Name : ....

Fourth Semester B.Sc. Degree Examination, July 2017
Career Related FDP under CBCSS
Group 2(a) : Physics and Computer Applications
Vocational Course – PC 1472
OBJECT ORIENTED PROGRAMMING
(2014 Admission)

Time : 3 Hours Total Marks : 80

SECTION – A

Very short answer type. Answer **all** question : **(10×1=10 Marks)**

1. Define a class.
2. Define encapsulation.
3. Write an single operand operator.
4. What is a heap ?
5. What is C++ operator for dynamic memory allocation ?
6. What are exceptions ?
7. What is the extraction operator in C++ ?
8. What is data abstraction ?
9. What do you mean by dynamic binding ?
10. Which C++ data type is used to represent true or false ?

SECTION – B

Answer **any 8** questions. **Each** question carries **2** marks : **(8×2=16 Marks)**

11. How to define a class in C++ ? Write with example.
12. Write any 4 advantages of object oriented programming.
13. How type conversions can be done in C++ ?
14. What is the use of this pointer ?
15. Write syntax of try .... catch statement.

P.T.O.

16. What do you mean by structured programming ?
17. Explain '*cin*' statement with example.
18. What are the access specifiers in C++ ?
19. What are the specialities of static data members ?
20. What are the features of constructor ?
21. Differentiate early binding and late binding.
22. Write syntax to define a sub class.

SECTION – C

Answer **any 6** questions. **Each** carries **4** marks : **(6×4=24 Marks)**

23. Explain virtual functions with example.
24. Explain object and class concept with example.
25. Explain function overloading with example.
26. Explain the concept of dynamic memory allocation.
27. Explain about basic data types in C++.
28. Write a C++ program that defines a class and functions to calculate area of circle, square and rectangle.
29. Explain friend function with example.
30. Write a C++ program to illustrate operator overloading.
31. Write short note on dynamic objects.

SECTION – D

Answer **any 2** questions. **Each** carries **15** marks : **(2×15=30 Marks)**

32. Write features of object oriented programming in detail.
33. Explain types of inheritance with example.
34. Explain in detail exception handling mechanism in C++.
35. Write C++ program to add two time values using objects and classes.

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(Pages : 3)

C – 3921

Reg. No. : ....

Name : ....

Fourth Semester B.Sc. Degree Examination, July 2017
Career Related First Degree Programme under CBCSS
Group 2 (a) : Physics and Computer Applications
Core Course PC 1442 : OPTICS
(2014 Admission)

Time : 3 Hours

Total Marks : 80

SECTION – A

Answer **all** questions, **each** carries 1 mark.

1. What is the condition for destructive interference ?
2. When white light is used to produce interference fringes, fringe width for red is greater than that for blue colour ? Why ?
3. What is meant by grating element ?
4. How will you distinguish polarised light from ordinary light ?
5. What is positive uniaxial crystal ?
6. Write an example of a four level laser.
7. Why single mode optical fibre is used in long distance communication ?
8. Write any two important advantages of optical communication system.
9. Write Hartmann's equation for dispersion.
10. Write the relation between Brewster's angle and refractive index. **(10×1=10 Marks)**

P.T.O.

SECTION – B

Answer **any eight** questions, **each** carries **2** marks.

11. What are the basic conditions for laser action ?
12. Explain the overlapping of spectral lines in a grating.
13. What is the importance of refractive index of Canada balsam in Nicol prism ?
14. What will happen if wedge shaped film is placed in white light ?
15. Why is optical resonator required in laser ?
16. Why quarter wave plates are called retardation plates ?
17. Explain the Rayleigh criterion for resolving power.
18. Show that spectral lines near violet are more dispersed than red end.
19. In a Newton's ring experiment by reflected light, the refractive index of film is greater than lens but less than lower glass plate. Explain the nature of centre ring.
20. Distinguish between normal and anomalous dispersion.
21. Write a short note on fibre optic sensors.
22. Write a short note on pulse dispersion in step index fibre. **(8×2=16 Marks)**

SECTION – C

Answer **any six** questions, **each** carries **4** marks.

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23. An optical fibre immersed in oil has an acceptance angle 30° and core refractive index of 1.4. Calculate the refractive index of cladding. Refractive index of oil is 1.2.
24. At what temperature are the rates of spontaneous and stimulated emission become equal ? Wavelength of emission is 500 nm.
25. Calculate the thickness of a calcite plate which would convert plane polarised light into a circularly polarised light. Wavelength of light is 628 nm ne = 1.482 and no = 1.659.

26. Calculate the highest order spectrum which may be seen with light of wavelength 600 nm using a plane transmission grating with 5000 lines per cm.

27. Calculate the Brewster's angle for a ray of light incident from glass to water. Refractive indices of glass and water are 1.55 and 1.33 respectively.

4 28. Core and cladding refractive index of an optical fibre are 1.6 and 1.3, respectively. Calculate the acceptance cone of the fibre.

29. The movable mirror of Michelson interferometer is moved by 0.0589 mm and a shift of 200 fringe is observed. What is the wavelength of light used ?

30. Two stars which are close together are viewed through a telescope whose objective has diameter 80 cm. Calculate the smallest separation between them which may be resolved by the telescope if the mean wavelength of light used is 550 nm.

31. In Young's double slit experiment, the angular width of the fringe formed on a distant screen is 0.1°. The wavelength of light is 600 nm. What is the spacing between slits ? **(6×4=24 Marks)**

SECTION – D

Answer **any two** questions, **each** carries **15** marks.

32. Discuss the formation of interference fringes on a screen due to the monochromatic light passing through two parallel slits on an opaque screen. Also arrive at the expression for fringe width.

33. Explain the structure of different types of optical fibres. What is meant by numerical aperture ? Also obtain its expression.

34. What is a zone plate ? Give the theory of zone plate and show that it has multiple foci.

35. What is a quarter wave plate ? Explain its construction. How will you use it to produce beams of elliptically and circularly polarized light ? **(2×15=30 Marks)**

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(Pages : 3)

C – 3938

Reg. No. : ....

Name : ....

Fourth Semester B.Sc. Degree Examination, July 2017
Career Related First Degree Programme under CBCSS
PHYSICS WITH COMPUTER APPLICATIONS
Core Course
PC 1441 : Classical Mechanics and Theory of Relativity
(2015 Admission)

Time : 3 Hours Max. Marks : 80

SECTION – A

Answer **all** questions in **one** or **two** sentences **each**. **Each** carries **1** mark.

1. What are non-inertial frames of reference ? Give an example.
2. Write down the Lorentz transformation equations.
3. Explain the ether concept.
4. Discuss time dilation in Relativity.
5. What are inverse square law forces ? Give two examples.
6. What is meant by proper length of a body ?
7. Write down the differential equation for damped harmonic motion and explain the terms.
8. State and explain Kepler's third law of planetary motion.
9. Explain generalized coordinates.
10. State D^1 Alembert's principle. **(10×1=10 Marks)**

SECTION – B

Answer **any 8** questions. **Each** carries **2** marks.

11. Explain the conditions for maximum and minimum time periods of a compound bar pendulum.
12. Discuss the variation of mass with velocity of a moving body.

P.T.O.

13. Describe the equivalence of mass and energy.
14. What is Coriolis force ? How does it vary in the two hemispheres of the earth ?
15. Explain spacelike and timelike intervals.
16. How is time dilation effect proved in the case of atmospheric mesons ?
17. Explain the Lagrange's equations for the simple pendulum.
18. Distinguish between scleronomic and rheonomic constraints, with an example each.
19. Explain the concept of centre of mass.
20. Explain the hypothesis of Galilean invariance.
21. Compare elastic and inelastic collisions.
22. Explain the terms :
    i) generalized momentum
    ii) cyclic coordinate. **(8×2=16 Marks)**

SECTION – C

Answer **any 6** questions. **Each** carries **4** marks.

23. Show that the relativistic expression for kinetic energy reduces to the classical one for $v << c$.
24. A particle moves in a potential energy field $U = U_0 - Px + Qx^2$. Find :
    a) the expression for force
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    a) the differential equation of motion
    b) the position at any time
    c) the velocity of the particle at any time
    d) the amplitude and frequency of vibration.

26. Show that the average kinetic energy and average potential energy over one time period of a simple harmonic oscillator are equal.

27. The mean lifetime of mesons in their rest frame is 2×10^8 s. Consider mesons moving at a velocity of 0.73c. Find :

    a) the distance travelled during one mean lifetime

    b) the distance travelled without relativistic effects.

28. The centre of mass of a system of three particles of masses 10, 20 and 30 g is at the point (1, 1, 1). Where should a fourth particle, of mass 40 g, be placed so that the resulting centre of mass of the system of four particles is at the point (0, 0, 0) ?

29. A stone of mass 100 g is revolved at the end of a string of length 50 cm at the rate of 2 revolutions per second. Determine its angular momentum. If the stone makes only one revolution per second after 25 seconds, find the torque applied.

30. Calculate the speed of a proton of mass 1.67×10^{-27} kg for the cases when :

    a) the kinetic energy is half the total energy

    b) the kinetic energy is half the rest energy.

31. Discuss the constraints and degrees of freedom for the following systems :

    a) a simple pendulum

    b) a system of two particles moving in a plane. **(6×4=24 Marks)**

SECTION – D

Answer **any 2** questions. **Each** carries **15** marks.

32. Discuss the Michelson – Morley experiment and explain the significance of its result.

33. Solve the equations of motion for motion under an inverse square law force and describe the possible orbits.

34. Describe the theory of compound pendulum. Explain the concepts of centre of suspension and centre of oscillation and hence show that they are interchangeable.

35. Derive the expression for relativistic variation of mass with velocity.

(2×15=30 Marks)