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B.Sc-CBCS/IS/PHS/H/C1T/17

2017

PHYSICS

[Honours]

(CBCS)

[First Semester]

PAPER –C1T

Full Marks : 40

Time : 2 hours

Answer any **five** questions from Group—A, **four** from Group—B and **one** from Group—C

The figures in the right hand margin indicate marks

GROUP—A

Answer any **five** questions : 5×2

1. Determine the value of a , so that the function $f(x)$ defined by :

(Turn Over)

(2)

$$f(x) = \begin{cases} \frac{a \cos x}{\pi - 2x} & \text{for } x \neq \frac{\pi}{2} \\ 0 & \text{for } x = \frac{\pi}{2} \end{cases}$$

be continuous.

2

2. If $f(r)$ is differentiable then calculate $\text{curl}(\vec{r} f(r))$.

2

3. Prove that $\oint_C \phi d\vec{r} = \iint_S d\vec{S} \times \vec{\nabla} \phi$.

2

4. Find the integrating factor of the differential equation

$$\cos x \frac{dy}{dx} + y \sin x = \sec^2 x.$$

2

5. Show that the area bounded by a simple closed curve C in a plane is given by

$$A = \frac{1}{2} \oint (x dy - y dx).$$

2

(3)

6. A loaded dice has the probabilities $\frac{1}{21}, \frac{2}{21}, \frac{3}{21}, \frac{4}{21}, \frac{5}{21}$ and $\frac{6}{21}$ of turning up 1, 2, 3, 4, 5 and 6 respectively. If it is thrown twice, what is probability that the sum of the numbers that turn up is even ? 2

7. Prove that $x \delta'(x) = -\delta(x)$. 2

8. The mean and the variance of a binomial variable X are 2 and 1 respectively. Find the probability that X takes values greater than 1. 2

GROUP-B

Answer any four questions: 5 x 4

then prove

11. Poisson distribution gives the probability that x events occur in unit time when the mean rate of occurrence is m .

$$P_x = \frac{e^{-m} m^x}{x!}$$

Show that

$$P_{x-1} = \frac{x}{m} P_x \text{ and } P_{x+1} = \frac{m}{x+1} P_x. \quad 5$$

12. (a) Two dices are thrown simultaneously. What is the probability of getting faces whose sum will be 6? 2

- (b) Two coordinate system have same origin but rotated coordinate axes. Unit vectors of the coordinate systems are respectively $\hat{e}_1, \hat{e}_2, \hat{e}_3$ and $\hat{e}'_1, \hat{e}'_2, \hat{e}'_3$ respectively. Show that 3

$$\hat{e}'_1 = l_{11}\hat{e}_1 + l_{12}\hat{e}_2 + l_{13}\hat{e}_3$$

$$\hat{e}'_2 = l_{21}\hat{e}_1 + l_{22}\hat{e}_2 + l_{23}\hat{e}_3$$

$$\hat{e}'_3 = l_{31}\hat{e}_1 + l_{32}\hat{e}_2 + l_{33}\hat{e}_3$$

(5)

13. If $f(x)$ is the probability density of x given by $f(x) = x e^{-x/\lambda}$ over the interval $0 < x < \infty$, find the mean and the most probable values of x . 5

14. Verify Green's theorem in the plane for

$$\int_C (x + y)dx + (x - y)dy,$$

where C is the closed curve of the region bounded by $y = x^2$ and $y^2 = 8x$. 5

GROUP-C

Answer any one questions :

10 × 1

the Gauss' divergence theorem for

16. (j) Find the unit normal vector at the point

$\left(\frac{a}{\sqrt{3}}, \frac{b}{\sqrt{3}}, \frac{c}{\sqrt{3}} \right)$ on the surface of the

ellipsoid

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1.$$

(ii) Solve: $x^2 \frac{d^2 y}{dx^2} - x \frac{dy}{dx} + y = 2 \log x.$

(iii) Evaluate

$$\left| \int_C \vec{r} \times d\vec{\theta} \right|, \text{ for a circle } C \text{ of radius } r \text{ with}$$

centre at the origin.

3 + 4 + 3

Total Pages—7

B.Sc.-CBCS/IS/PHS/H/C2T/17

2017

PHYSICS

[Honours]

(CBCS)

PAPER – C2T

Full Marks : 40

Time : 2 hours

**Answer five questions from Group—A four from
Group—B and one from Group—C**

The figures in the right hand margin indicate marks

*Candidates are required to give their answers in their
own words as far as practicable*

Illustrate the answers wherever necessary

2. An observer sees two spaceships flying apart with speed $0.99c$. Find the speed of one spaceship as viewed by the other. 2
3. A particle moves under a potential $V = ax - bx^2$, where a and b are positive constants. Find the equilibrium position of the particle. Determine whether the equilibrium is stable or unstable or neutral. 2
4. A planet is revolving around the sun in a circular orbit. Due to some reason the speed of the planet suddenly becomes double. What is the new orbit of the planet. 2
5. A rectangular bar is suspended horizontally from its centre of mass by a straight wire of circular cross section of radius a , length l and composed of an elastic material of rigidity modulus n . The bar executes angular oscillation in horizontal place about the wire as axis and moment of inertia of the bar about this axis is I . Find the expression of time period of this oscillation. 2

6. A fluid of viscosity η and density ρ flows through a capillary tube of radius a . Obtain the expression of critical velocity in terms of η , ρ and a by the method of dimensions. 2

7. Prove that momentum of a particle of rest mass m_0 and kinetic energy k is

$$p = \frac{1}{c} \sqrt{k(k + 2m_0 c^2)}. \quad 2$$

8. Show that at resonance, velocity is in phase with the driving force. 2

GROUP – B

Answer any four questions : 5 × 4

9. (a) Find the position of centre of mass of a uniform thin hemispherical shell. 2

(b) A gun fires a bullet of mass m with horizontal velocity \vec{v} into a wooden block of mass M which is moving away from the gun with velocity \vec{V} on a horizontal frictionless table.

If the bullet becomes embedded in the wood, then determine the subsequent velocity of the system and the loss in kinetic energy. 3

10. Two particles each of rest mass m_0 move with speed v w.r.t. an inertial frame but in opposite direction. Calculate the energy of one particle in the rest frame of the other particle. 5

11. A particle of mass ' m ' is moving under potential $V(x) = ax^3 - bx^2$. Initially the particle is at rest at stable point. What minimum speed be given to the particle so that it reaches unstable point. Plot the potential versus x . 5

12. A solid sphere of mass M and radius R has non-uniform mass density which varies linearly with distance from the centre. Calculate the moment of inertia of the sphere about its diameter. 5

13. Prove that $E^2 = p^2c^2 + m_0^2c^4$ where the symbols have usual meanings. 5

14. Show that in forced vibration the total energy of the vibrating system is not constant. Also show that

$$\frac{\langle P \cdot E \rangle}{\langle k \cdot E \rangle} = \frac{\omega_0^2}{\omega^2}$$

where ω_0 is natural frequency. 5

GROUP - C

Answer any one question : 10 × 1

15. (a) A rocket moves under an external force \vec{F} . It ejects fuel at a constant velocity \vec{u} with respect to itself. If \vec{v} is the instantaneous velocity of the rocket with respect to a rest frame and m be its instantaneous mass then show that :

$$m \frac{d\vec{v}}{dt} - \vec{u} \frac{dm}{dt} = \vec{F}. \quad 3$$

- (b) Given that the instantaneous velocity of a particle executing forced vibration in steady state is :

$$v = \frac{F \cos(\omega t - \alpha)}{\sqrt{k^2 + \left(\omega m - \frac{s}{\omega}\right)^2}},$$

where the symbols used have their usual meanings.

- (i) Show that the average power over a complete cycle is given by : 2

$$P_{av} = \frac{F^2 k}{2 \left[k^2 + \left(\omega m - \frac{s}{\omega} \right)^2 \right]}.$$

- (ii) Obtain the expressions of resonant frequency and bandwidth. 2

- (e) Two stars at 16.5 light years distance explode simultaneously as measured by synchronized clocks of a frame with respect to which the stars are at rest. What will be the time gap between the explosions of the stars as measured by synchronized clocks of a frame moving at velocity $0.8c$ parallel to the line joining the stars ? 3

16. (a) A particle of mass ' M ' initially at rest breaks up into a particle of mass ' m ' and another particle of zero rest mass. Calculate the speed of the particle whose rest mass is ' m '. 5
- (b) A light source is moving along $+Y$ direction and light detector is placed at $(a, 0)$ along X axis. What is the frequency of light measured by the detector at the moment when the source is at origin. Actual frequency of light is ν_0 . 5
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2017

MATHEMATICS

[**Generic Elective**]

(CBCS)

[**First Semester**]

PAPER – GE1T

Full Marks : 60

Time : 3 hours

The figures in the right-hand margin indicate marks

UNIT – I

(*Calculus - I*)

1. Answer any *three* questions : 2 × 3

(a) Evaluate $\lim_{x \rightarrow 0} \left(\frac{1}{x} - \frac{1}{\sin x} \right)$. 2

(b) Find the envelope of the straight line $y = mx + \frac{a}{m}$, m being the variable parameter ($m \neq 0$). 2

(Turn Over)

(c) Find the asymptotes of the curve $y = xe^{\frac{1}{x}}$. 2

(d) Find the point(s) of inflexion on the curve $x = (y - 1)(y - 2)(y - 3)$. 2

(e) State Leibnitz's rule for successive differentiation. 2

2. Answer any *one* question : 10 × 1

(a) (i) If $y = \sin(m \sin^{-1}x)$, then prove that

$$(1 - x^2)y_{n+2} - (2n+1)y_{n+1}x - (n^2 - m^2)y_n = 0$$

and hence prove that $y_n(0) = 0$, for even n .

(ii) Find the value of p and q such that

$$\lim_{x \rightarrow 0} \frac{x(1 - p \cos x) + q \sin x}{x^3} = \frac{1}{3} \quad 10$$

(b) (i) Trace the curve $r^2 = a^2 \cos 2\theta$. 5

(ii) Find the envelope of circles whose centres lie on the rectangular hyperbola

$xy = c^2$ and which passes through its centre. 5

UNIT - II

(Calculus - II)

3. Answer any *two* questions : 2×2

(a) Show that the area of the circle $r = 2a \sin \theta$ is πa^2 . 2

(b) If $I_n = \int_0^{\pi/2} x^n \sin x dx$, n being positive integer > 1 , then show that

$$I_n + n(n-1)I_{n-2} = n \cdot \left(\frac{\pi}{2}\right)^{n-1} \quad 1 + 1$$

(c) Find the length of the circumference of a circle of radius a . 2

4. Answer any *two* questions : 5×2

(a) Find the volume of the solid generated by revolving the cardioid $r = a(1 - \cos \theta)$ about the initial line.

(b) If $I_n = \int_0^{\pi/2} \cos^{n-1} x \sin nx \, dx$, show that

$$2(n-1)I_n = 1 + (n-2)I_{n-1}$$

(c) Show that the area bounded by the parabolas

$$y^2 = 4ax \text{ and } x^2 = 4ay \text{ is } \frac{16}{3}a^2.$$

UNIT – III

(Geometry)

5. Answer any *three* questions : 3 × 2

(a) Find the equation of the right circular cylinder whose axis is z-axis and radius equals to 1.

(b) Find the values of c for which the plane $x + y + z = c$ touches the sphere

$$x^2 + y^2 + z^2 - 2x - 2y - 2z - 6 = 0$$

(c) Find the polar equation of the straight line passing through the points $(1, \frac{\pi}{2})$ and $(2, \pi)$.

- (d) Find the nature of the quadric surface given by the equation

$$2x^2 + 5y^2 + 3z^2 - 4x + 20y - 6z = 5$$

- (e) Under what condition the surface $yz + zx + xy = a^2$ may produce a parabola as a plane section by the plane $lx + my + nz = p$?

6. Answer any *one* question : 5 × 1

- (a) If a sphere touches the planes $2x + 3y - 6z + 14 = 0$ and $2x + 3y - 6z + 42 = 0$ and if its centre lies on the straight line $2x + z = 0$, $y = 0$, find the equation of the sphere.

- (b) The plane $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$ meets the coordinate axes at A, B, C . Find the equation of the cone generated by the straight lines drawn from the centre O to meet the circle ABC .

7. Answer any *one* question :

10 × 1

(a) (i) Show that the straight line $r \cos(\theta - \alpha) = p$ touches the conic $\frac{l}{r} = 1 + e \cos \theta$, if

$$(l \cos \alpha - ep)^2 = p^2 - l^2 \sin^2 \alpha.$$

(ii) Find the equations of the generating lines of the hyperboloid $\frac{x^2}{4} + \frac{y^2}{9} - \frac{z^2}{16} = 1$, which passes through the point $(2, 3, -4)$.

(b) (i) A sphere of constant radius r passes through the origin and cuts the axes at A, B, C . Prove that the locus of the foot of the perpendicular from origin to the plane ABC is given by

$$(x^2 + y^2 + z^2)^2 (x^{-2} + y^{-2} + z^{-2}) = 4r^2.$$

(ii) Find the equation of the cylinder whose generator are parallel to the straight line $\frac{x}{-1} = \frac{y}{2} = \frac{z}{3}$ and whose guiding curve is $x^2 + y^2 = 9, z = 1$.

UNIT – IV

(Differential Equation)

8. Answer any *two* questions :

2 × 2

(a) By which condition the ODE

$$M(x, y) dx + N(x, y) dy = 0 \text{ will be exact ?}$$

Is this condition necessary ?

(b) Determine the integrating factor of

$$(x^4 y^2 - y) dx + (x^2 y^4 - x) dy = 0$$

(c) The bacteria in a certain culture increase according to $dN/dt = 0.25 N$. If originally $N = 200$, find N when $t = 8$.

9. Answer any *one* question :

5 × 1

(a) Solve

$$(x^2 y^2 + xy + 1) y dx - (x^2 y^2 - xy + 1) x dy = 0$$

(b) Find the singular solution of the differential equation

$$y = px + \sqrt{a^2 p^2 + b^2}, \quad p = \frac{dy}{dx}.$$

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B.Sc.-CBCS/IS/ENG/AECC/17

2017

ENGLISH COMMUNICATION

(CBCS)

[First Semester]

PAPER—AECC

Full Marks : 40

Time : 2 hours

Answer all the questions

The figures in the right hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

Illustrate the answers wherever necessary

GROUP – A

1. Attempt any five questions : 2 × 5

- ✓ (a) Mention the major theories of Communication.
- ✓ (b) Define body-language. Refer to some of the gestures we use to communicate.

(Turn Over)

- (c) What are the different barriers in our communication ?
- (d) What are the essential differences between animal communication and human communication ?
- (e) Refer to some advantages and disadvantages of written form of communication.
- (f) Enumerate the forms of electronic and online communication.
- (g) What are the principal media of mass communication ? How are they different from inter-personal communication ?
- (h) Define miscommunication.

GROUP – B

2. Attempt any *four* questions : 5 × 4

- (a) Discuss different reading strategies with special reference to 'scanning' and 'skimming'.

- (b) As the cultural secretary of your club, write a notice inviting the club members to the observation of the Republic Day.
- (c) Write a note to the co-ordinator of your AECC (English Communication) course about the problems you have faced in the AECC class-rooms and offer suggestions for improvement.
- (d) Write a paragraph on the Under-17 World Cup Football.
- (e) Read the following passage, and then answer the questions :

We often complain of the miserable quality of handwriting of some (not all) 'educated' people. Sometimes their stuff is too bad to read and decipher any sense, despite the hardest of our efforts. More than anybody else, the scribblers themselves are aware of the amount of irritation their creation leads

to. Yet they are bent on making it even worse at the earliest opportunity to outdo their previous performances. The rigidity and persistence with which the practice is carried on finally drag the 'helpless' readers to the secret – the scheme is actually a well-designed ploy to conceal behind illegibility all their shortcomings, like wrong spellings, grammatical lapses, poor knowledge of the language or even intellectual barrenness.

(i) Whose bad handwriting is intentional ?
How is it so ?

(ii) What are the complaints and final realization of the readers ?

(Answer with close reference to the given passage)

(f) Analyse and amplify the idea :

'Mother tongue is like the breast milk, English the solid diet.'

GROUP – C

3. Attempt any one question :

10 × 1

(a) Write an application to the Principal of your college requesting him to organize a workshop on 'Reading and Writing Skills' in the next semester.

(b) Translate the following passage into English :

कथं भाषा एकटि प्राकृतिक सृष्टि । आगे भाषा, तारपर आसे व्याकरण । भाषा शिक्षार जन्य व्याकरण जाना आवश्यक नय । नईले एकटि शिशु तार मातृभाषा बले किभावे ? आसले से भाषा शेखे शोनार मध्ये दिये । किन्तु द्वितीय भाषा शेखाटा अन्यारकमभावे हते पारे ।

Or

बोलनेवाली भाषा एक प्राकृतिक सृजन है । भाषा पहले, व्याकरण बाद मे आता है । भाषा शिक्षा के लिए व्याकरण को जानने की आवश्यकता नहीं है । अन्यथा एक बच्चा अपनी मातृभाषा कैसे बोलता है ? दरअसल वह शुन शुन कर भाषा सीखता है । लेकिन दूसरी भाषा सीखना अलग तरीके से हो सकता है ।

(c) Write a note on the alarming state in your locality caused by the rampant spreading of Dengue.