

Enrollment No.....



Faculty of Science
End Sem (Odd) Examination Dec-2017
BC3CO04 Physics-I

Programme: B.Sc.(CS) Branch/Specialisation: Computer Science

Duration: 3 Hrs.**Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

- Q.1 i. The gradient of a scalar field ϕ is : 1
 (a) A scalar (b) A vector
 (c) Either a scalar or a vector (d) None of these
- ii. If $\vec{A} \times \vec{B} = 0$, the angle between \vec{A} and \vec{B} is: 1
 (a) 0° (b) 90° (c) 60° (d) 30°
- iii. A uniform rotating frame of reference is: 1
 (a) Inertial frame (b) Non-inertial frame
 (c) Accelerated frame (d) None of these
- iv. Gravitational potential energy is always: 1
 (a) Positive (b) Zero
 (c) Positive or negative (d) Negative
- v. The property of liquid which opposes the relative motion between its different layers is called the: 1
 (a) Viscosity (b) Elasticity
 (c) Surface tension (d) None of these
- vi. The theoretical value of Poisson's ratio lies in between 1
 (a) +1 and -0.5 (b) +0.5 and -1 (c) +0.5 and -0.5 (d) +1 and -1
- vii. At mean position of a body executing simple harmonic motion, the velocity will be: 1
 (a) Zero (b) Minimum (c) Maximum (d) Infinite
- viii. The S. I. unit of moment of inertia is: 1
 (a) Kg (b) $\text{Kg} \times \text{m}$ (c) $\text{Kg} \times \text{m}^2$ (d) m
- ix. The correct transformations relating the two inertial frames are: 1
 (a) Lorentz (b) Galilean (c) Newtonian (d) None of these

- x. The expression for the kinetic energy of a particle moving with relativistic velocity v is: 1
 (a) mc^2 (b) $\frac{1}{2}mv^2$ (c) m_0c^2 (d) $mc^2 - m_0c^2$

- Q.2 i. What do you understand by the scalar and vector quantity? 2
 ii. If $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$, then prove that \vec{A} and \vec{B} are perpendicular to each other. 3
 iii. State and prove Green's theorem. 5
 OR iv. State and prove Gauss's divergence theorem. 5

- Q.3 i. What is reduced mass? Calculate the reduced mass of hydrogen molecule (H_2). The mass of hydrogen atom is 1.7×10^{-27} Kg. 3
 ii. Deduce expressions for the gravitational potential and gravitational field due to a uniform solid sphere at a point outside the shell. 7
 OR iii. Write down the equation of motion and derive them by graphically. Also sketch acceleration-time, velocity-time and position-time graph for uniform motion. 7

- Q.4 i. What is a venturimeter? Obtain an expression for the volume of liquid flowing out per second from it. 4
 ii. Define surface tension? Describe the experiment of determination of surface tension of water by rise in capillary tube. 6
 OR iii. Establish the relation $Y = 3K(1 - 2\sigma)$. 6

- Q.5 i. Explain the moment of inertia and radius of gyration? 4
 ii. Determine the moment of inertia of a uniform solid cylinder. 6
 OR iii. What is a simple harmonic oscillator? Show that a simple harmonic oscillator executes motion as $x = a \sin(\omega t + \phi)$, where a and ϕ are constant. 6

- Q.6 i. Calculate the kinetic energy of an electron having velocity $0.8c$? 2
 ii. What is meant by length contraction at relativistic speeds? 3
 iii. Deduce transformation relations of relativistic velocity. 5
 OR iv. Derive the Einstein's energy mass relation. 5

P.T.O.

BC3CO04 Physics-I
Marking Scheme

Q.1	i.	(b) A vector	1
	ii.	(a) 0°	1
	iii.	(b) Non-inertial frame	1
	iv.	(d) Negative	1
	v.	(a) Viscosity	1
	vi.	(b) +0.5 and -1	1
	vii.	(c) Maximum	1
	viii.	(c) $\text{Kg} \times \text{m}^2$	1
	ix.	(a) Lorentz	1
	x.	(d) $mc^2 - m_0c^2$	1
Q.2	i.	Definition of Scalar and Vector 1 mark for each (1 mark * 2 = 2 marks)	2
	ii.	$ \vec{A} + \vec{B} = \vec{A} - \vec{B} $ $ \vec{A} + \vec{B} ^2 = \vec{A} - \vec{B} ^2$ (A+B) (A+B) = (A-B) (A-B) (1 mark) A.A + A. B + B.A + B.B = A.A - A. B - B.A - B.B (1 mark) $A^2 + 2 A. B + B^2 = A^2 - 2 A. B + B^2$ (1 mark) 4 A. B = 0 A.B = 0 (1 mark) Hence A and B are mutually perpendicular.	3
	iii.	State and prove Green's theorem. Statement (1 mark) Complete proof (4 marks)	5
OR	iv.	State and prove Gauss's divergence theorem. Statement (1 mark) Complete proof (4 marks)	5
Q.3	i.	Definition of reduced mass with formula (1.5 marks) Numerical $8.5 \times 10^{-28} \text{ Kg}$ (1.5 marks)	3
	ii.	Derivation upto $dV = -4\pi G\rho x^2 / r \, dx$ (3 marks) $V_{r>a} = -GM / r$ (2 marks) $I_{r>a} = -GM / r^2$ (2 marks)	7
OR	iii.	The equation of motion (4 marks) Sketch of each 1 mark (1 mark * 3 = 3 marks)	7

Q.4	i.	Definition (1 mark) Derivation (3 marks)	4
	ii.	Definition of Surface tension (2 marks) Capillary rise method (4 marks)	6
OR	iii.	Value of α, β, σ 1 mark each (1 mark * 3 = 3 marks) Value of e (1 mark) Bulk Modulus K (2 marks)	6
Q.5	i.	Definition of moment of inertia (2 marks) Definition of radius of gyration (2 marks)	4
	ii.	Solution must contain Figure (1 mark) Moment of Inertia formula For axis passing through centre (3 marks) And about geometrical axis (2 marks)	6
OR	iii.	Formation of differential equation (2 marks) Solution of second order differential equation (4 marks)	6
Q.6	i.	$K = (m-m_0)c^2$ (2 marks) $K = 5.49 \times 10^{-14} \text{ joule}$	2
	ii.	Figure (1 mark) Explanation (1 mark) Result formula (1 mark)	3
	iii.	Deduce transformation relations of relativistic velocity. (5) Inverse Lorentz transformation (1 mark) Equation of u_x, u_y, u_z 1 mark each (1 mark * 3 = 3 marks) relation with speed of light (1 mark)	5
OR	iv.	Derive the Einstein's energy mass relation. (5) $dK = c^2 \, dm$ (3 marks) $E = mc^2$ (2 marks)	5
