STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.
(For candidates admitted during the academic year 2023 - 2024)

B.Sc. DEGREE EXAMINATION NOVEMBER 2023
BRANCH I - MATHEMATICS
FIRST SEMESTER

COURSE : ALLIED – CORE
PAPER : PHYSICS FOR MATHEMATICS – I
SUBJECT CODE : 23PH/AC/PM13
TIME : 3 HOURS **MAX. MARKS : 100**

Q. No.	SECTION A Answer ALL the questions (20x1=20)	CO	KL
1.	In the context of impulse, which of the following is true? A) A force applied over a short period of time. B) A constant force applied to an object. C) A force applied over a long period of time. D) A force applied to a stationary object.	CO1	K1
2.	Which of the following represents an internal force in a system? A) Friction between the object and the surface it is on B) Gravity acting on the object C) Force applied to the object from an external source D) Tension in a rope between two objects in the system	CO1	K1
3.	Which of the following represents a unit of impulse? A) Newton-second (N•s) B) Joule (J) C) Kilogram per meter (kg/m) D) Meter per second squared (m/s^2)	CO1	K1
4.	In a collision, if two objects stick together after impact and move with a common velocity, what type of collision is it? A) Perfectly elastic B) Perfectly inelastic C) Partially elastic D) Elastic	CO1	K1
5.	What does the amplitude of a simple harmonic motion represent? A) Maximum velocity B) Maximum displacement from equilibrium C) Maximum acceleration D) Maximum potential energy	CO1	K1
6.	In simple harmonic motion, the acceleration at each instant is A) proportional to the negative of the displacement at that instant. B) equal to the displacement at that instant. C) is zero at that instant D) is inversely proportional to the displacement	CO1	K1
7.	Degrees of freedom of N system of particles moving independently of each other is A) 6N B) 2N C) 3N D) zero	CO1	K1

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8.	The constraints are said to be holonomic if (A) the distance between any two points of moving body is always fixed (B) the time is changing between the events (C) the distance between the two rigid body is zero (D) the constraints are independent of time.	CO1	K1
9.	Unit of stress is (A) kg (B) m (C) cm (D) N/m^2	CO1	K1
10.	Hooke's law gives the following relation (**A**) Stress is directly proportional to strain (B) within elastic limit stress should be zero (C) stress is inversely proportional to strain (D) within elastic limit strain should be zero	CO1	K1
11.	When you apply load at free end of a beam, the filament below the neutral axis (A) get elongated (B) get compressed (C) neither elongated nor compressed (D) Extend out of the beam	CO1	K1
12.	Geometrical moment of inertia of a rectangular beam is (A) $bd^3/12$ (B) $b^3d/12$ (C) $12/bd^3$ (D) $12/b^3d$	CO1	K1
13.	Velocity of water layer at the walls of a capillary tube is (A) very high (B) equal to that of at centre (C) zero (D) both A and C	CO1	K1
14.	In turbulent flow of liquid, the velocity at every point (A) is same (B) will vary (C) is zero (D) is a dependent quantity	CO1	K1
15.	Unit of surface tension (A) N/m (B) N-m (C) N/m^2 (D) Nm^2	CO1	K1
16.	Surface tension of a drop of water is (A) inversely proportional to the radius of the drop (B) directly proportional to the radius of the drop (C) independent of the radius of the drop. (D) All the above.	CO1	K1
17.	In inertial frames of reference, which of the following statements is true? (A) Laws of physics are the same for all observers in inertial frames. (B) Observers in different inertial frames will measure different physical constants. (C) Inertial frames experience constant acceleration. (D) Observers in inertial frames perceive time differently	CO1	K1
18.	What does the Galilean Transformation describe in the context of Newtonian relativity? (A) The transformation of mass into energy. (B) The transformation of time and space coordinates between inertial frames at constant velocity. (C) The transformation of matter into antimatter. (D) The transformation of light waves in different media.	CO1	K1

19.	What does the "Twin Paradox" in Special Relativity describe? (A) Two twins aging at different rates due to differences in gravity. (B) One twin remaining younger than the other twin due to traveling at a high velocity. (C) Two twins having the same age despite one traveling at a high velocity. (D) One twin appearing older due to differences in atmospheric pressure.	CO1	K1
20.	What does the Mass-Energy Relation signify in Einstein's theory of relativity? (A) The conversion of matter into energy. (B) The conversion of energy into mass. (C) The conservation of mass in all physical processes. (D) The conversion of time into energy.	CO1	K1
Q. No.	**SECTION B** **Answer ALL the questions (10x2=20)**	**CO**	**KL**
21.	Define impulse	CO2	K2
22.	Write down the law of conservation of energy	CO2	K2
23.	What is simple harmonic motion ? Give an example	CO2	K2
24.	What are constraints ? Give any two examples	CO2	K2
25.	Define Poisson's ratio	CO2	K2
26.	What is neutral axis?	CO2	K2
27.	Define co-efficient of viscosity.	CO2	K2
28.	Define surface tension.	CO2	K2
29.	Write down any two postulates of special theory of relativity	CO2	K2
30.	What is meson paradox ?	CO2	K2
Q. No.	**SECTION C** **Answer any TWO questions (2x20=40)**	**CO**	**KL**
31.	(a) Derive the equation for loss in kinetic energy due to direct impact of two smooth spheres (**10 marks**)	CO3	K3
	(b) Obtain an expression for energy of a simple harmonic oscillator. **(10 marks)**	CO4	K4
32.	(a) Derive the mathematical form of De Alemberts principle. **(10 marks)**	CO3	K3
	(b) Apply Lagrange's formulation to Atwood machine to find acceleration **(10 marks)**	CO4	K4
33.	(a) Drive an expression for couple per unit twist **(10 marks)**	CO3	K3
	(b) Discuss an experiment to determine the surface tension of a liquid by drop weight method. **(10 marks)**	CO4	K4
34.	(a) Explain length contraction with necessary theory. **(10 marks)**	CO3	K3
	(b) Discuss the physical significance of mass-energy equivalence. **(10 marks)**	CO4	K4

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	SECTION D **Answer any FOUR questions (4 x 5= 20)**		
35.	A particle of mass 2 kg moves along x-axis with an initial velocity of 3 $m.s^{-1}$. A force F = -6 N is applied for a period of 3s. Find the final velocity	CO5	K5
36.	A body of mass 5 kg is suspended by a spring, which stretches 0.1 m when the body is attached. It is then displaced downward an additional 0.05 m and released. Find the amplitude, time period of oscillation and frequency of resulting simple harmonic motion.	CO5	K5
37.	In an experiment to measure Young's modulus, a load of 500 kg, hanging from a steel wire of length 3m and cross-section 0.20 cm^2, was found to stretch the wire 0.4 cm above its no-load length. What were the stress, strain and the value of Young's modulus for the steel wire of which the wire was composed?	CO5	K5
38.	Water flows through a horizontal tube of length 0.2 m and internal radius 8.1 x 10^{-4} m under a constant head of liquid 0.2 m high. In 12 minutes 8.64 x 10^{-4} m^3 of liquid issues from the tube. Calculate the co-efficient of viscosity of water. (The density of water = 1000 kg m^{-3} and g = 9.8).	CO5	K5
39.	A rigid bar of length L_2 = 1.5 m is at rest to system S'. If the bar makes an angle $\theta_2 = 45°$ with respect to the x_2 axis, what is the length L1 and orientation of the bar θ_1 with relative to S when v = 0.98 c.	CO5	K5
40.	A ball of mass 8 kg moving with a velocity of 10 ms^{-1} impinges directly on another mass 24 kg moving at 2 ms^{-1} in the opposite direction. If e = 0.5, find the velocity of the balls after impact	CO5	K5

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