Sanjay Ghodawat University, Kolhapur

Established as State Private University under Govt. of Maharashtra. Act No XL, 2017

2018-19
EXM/P/09/00

F. Y. M.Sc.	**School of Science**	**Physics**
PHS505	**Classical Mechanics**	**Semester – I**
Fri'day 30Nov18	**End Semester Examination**	**Time: 30 Min Max Marks: 20**
		10:00 to 10:30
Seat No.	**PRN No.**	**Student Sign.**
Invigilator Sign.	**Examiner Sign.**	**Marks Obtained**

Instructions: 1) All Questions are compulsory.

2) Mark √ to the correct option. Do not circle.

3) More than one options marked will not be considered for assessment.

4) Rough calculations on paper are not allowed.

5) Use non-programmable calculator is allowed.

Q.1	**A)**	**Select correct alternative**	**Marks**	**Blooms Level**	**CO**
	i)	The postulate of co-variance of physical law states that _____. a) Physical laws should have the same meaning in all inertial frames. b) Physical laws should have the same meaning in only linearly moving frames. c) Physical laws should have the same meaning in rotating frames. d) None of these.	01	L1	505.4
	ii)	In Rutherford's scattering, the differential cross section is proportional to _____. a) $\sin^4\left(\theta/2\right)$ b) $\cot^4\left(\theta/2\right)$ c) $\tan^4\left(\theta/2\right)$ d) $\operatorname{cosec}^4\left(\theta/2\right)$	01	L1	505.2
	iii)	An inertial frame is one in which _____. a) Newton's 2nd law of motion is valid b) Newton's 1st law of motion is valid c) Newton's 3rd law of motion is valid d) All of the above	01	L1	505.4

iv) Hamilton's canonical equations of motion are _____. 01 L1 505.3

a) $\dot{q}_j = \frac{\partial H}{\partial p_j}$ and $\dot{p}_j = \frac{\partial H}{\partial q_j}$

b) $\dot{Q}_j = \frac{\partial H}{\partial P_j}$ and $\dot{P}_j = \frac{-\partial H}{\partial Q_j}$

c) $\dot{P}_j = \frac{\partial H}{\partial p_j}$ and $\dot{Q}_j = \frac{\partial H}{\partial q_j}$

d) $\dot{q}_j = \frac{\partial H}{\partial p_j}$ and $\dot{p}_j = \frac{-\partial H}{\partial q_j}$

v) First form of generating function is given by _____. 01 L1 505.3

a) $p_j = \frac{\partial F_1}{\partial q_j}$ and $P_j = \frac{-\partial F_1}{\partial Q_j}$

b) $P_j = \frac{\partial F_1}{\partial q_j}$ and $p_j = \frac{-\partial F_1}{\partial Q_j}$

c) $q_j = \frac{\partial F_1}{\partial p_j}$ and $P_j = \frac{-\partial F_1}{\partial Q_j}$

d) $p_j = \frac{\partial F_1}{\partial q_j}$ and $P_j = \frac{-\partial F_1}{\partial q_j}$

vi) Transformation relations: $Q_j = \frac{\partial F}{\partial P_j}$; and $q_j = -\frac{\partial F}{\partial p_j}$ 01 L1 505.3

corresponds to which form of generating function?

a) First form b) Second form

c) Third form d) Fourth form

vii) The desired relationship between the impact parameter and the scattering angle is _____. 01 L1 505.2

a) $\frac{ZZ'e^2}{2E}\operatorname{cosec}\frac{\theta}{2}$ b) $\frac{ZZ'e^2}{2E}\sin\frac{\theta}{2}$

c) $\frac{ZZ'e^2}{2E}\cot\frac{\theta}{2}$ d) $\left(\frac{ZZ'e^2}{2E}\right)^2\operatorname{cosec}^4\frac{\theta}{2}$

viii) For repulsive inverse square forces shape of orbit will be _____. 01 L1 505.1

a) Elliptic b) parabolic c) Hyperbolic d) None of these

ix) A particle moving in a central force field located at r = 0 describes the spiral $r = e^{-\theta}$, the magnitude of force is inversely 01 L2 505.1

proportional to _____.

a) r b) r^2 c) r^3 d) r^4

x)	Lorentz transformation equations hold for _____. a) Non relativistic velocities only b) relativistic velocities only c) both a and b d) none of these	01	L1	505.4
B)	**Fill in the blanks**			
i)	Amount by which measured time interval is greater than corresponding proper time interval is called _____.	01	L1	505.4
ii)	In _____ scattering kinetic energy before collision is not equal to kinetic energy after collision	01	L1	505.2
iii)	Canonical transformations are the transformations of _____ space.	01	L1	505.3
iv)	In the case of elliptic orbits, energy is proportional to _____.	01	L1	505.1
v)	The Lagrangian equation for conservative system is _____.	01	L1	505.3
C)	**State True or False**			
i)	In the Minkowski space, a quantity is called four vector if it has three components. _____	01	L1	505.4
ii)	Angle of scattering is defined as the angle between initial and final direction of charged particles. _____	01	L1	505.2
iii)	Photographs of rapidly moving distant objects will not show any change. _____	01	L1	505.4
iv)	In central a force field motion, for parabolic orbit $\varepsilon = 0$. _____	01	L1	505.1
v)	The function $\sum p_j P_j$ generates exchange transformation. _____	01	L1	505.3

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F. Y. M. Sc.	**School of Science**	**Physics**
PHS 505	**Classical Mechanics**	**Semester – I**
Friday 30/11/18	**End Semester Examination**	**Time: 2.5 hr. Max Marks: 80**
		10:30 to 1:00pm

Instructions:

1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Neat diagrams must be drawn wherever necessary.
4) Use of logarithmic table and calculator are allowed.

Q.2	**Answer the following questions**	**Marks**	**Blooms Level**	**CO**
a)	Describe the Kepler's problem in an inverse square law of force and explain the properties of conic section.	12	L4	505.1
b)	Show that, energy E of the orbits equally depends on the value of eccentricity ε given by, $\varepsilon = \sqrt{1+\frac{2El^2}{mk^2}}$	4	L2	505.1
	OR			
b)	A particle of mass m moves under the position of central force whose potential energy is $v(r) = kmr^3$ (k is positive). Find the energy for which the orbit will be circle of radius a. Also find the period of circular motion and angular momentum.	4	L3	505.1

Q.3	**Answer the following questions**	**Marks**		**CO**
a)	Derive the Rutherford formulae for scattering.	12	L4	505.2
b)	Explain the conservation laws in inelastic scattering	4	L3	505.2
	OR			
b)	Find the impact parameter and distance of closest approach for the α particle having energy 10 MeV being scattered at 45° from gold nuclei.	4	L3	505.2

Q.4		Answer the following questions	Marks		CO
	a)	Explain the properties of Poisson's bracket. Derive the equation of motion in terms of Poisson's bracket.	12	L3	505.3
	b)	Discuss Variational principle and D'Alembert's principle in Lagrangian mechanics.	8	L2	505.3
		OR			
	b)	Derive Lagrange's equations from D'Alembert's principle for conservative system.	8	L3	505.3
	c)	Prove the law of conservation of angular momentum in Lagrangian mechanics.	4	L2	505.3

Q.5		Answer the following questions	Marks		CO
	a)	Explain the consequences of Lorentz transformation equations in detail in relativistic mechanics.	12	L3	505.4
	b)	Derive the equation which gives the variation of mass with velocity.	8	L3	505.4
		OR			
	b)	Describe the Four vectors and four spaces in special theory of relativity.	8	L3	505.4
	c)	Obtain the Hamiltonian formulation in relativistic mechanics.	4	L3	505.4