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**
PHS 505	**Classical Mechanics**	**Semester – I**
Monday 03/06/2019	**End Semester Examination**	**Max Marks: 20**
Seat No.	**PRN No.**	**Student Sign.**
Invigilator Sign.	**Examiner Sign.**	**Marks Obtained**

(A)

Time- 30 min.
10.30 am to 11.00 am

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**	**Bloom's Level**	**CO**
i)	Differential equation for planetary motion is given as ----------. a) $\frac{d^2u}{d\theta^2} = u - \frac{m}{l^2u^2} f\left(\frac{1}{u}\right)$ b) $\frac{d^2u}{d\theta^2} = u + \frac{m}{l^2u^2} f\left(\frac{1}{u}\right)$ c) $\frac{d^2u}{d\theta^2} = -u - \frac{m}{l^2u^2} f\left(\frac{1}{u}\right)$ d) $\frac{d^2u}{d\theta^2} = -u + \frac{m}{l^2u^2} f\left(\frac{1}{u}\right)$	01	L1	505.1
ii)	For repulsive inverse square forces shape of orbit will be ----------. a) Elliptic b) parabolic c) Hyperbolic d) None of these	01	L2	505.1
iii)	The perpendicular distance between the center of force and incident velocity is called ----------. a) Scattering angle b) Differential scattering cross section c) Impact parameter d) None of these	01	L1	505.2
iv)	The desired relationship between the impact parameter and the scattering angle is ----------. a) $\frac{ZZ'e^2}{2E}\cos ec\frac{\theta}{2}$ b) $\frac{ZZ'e^2}{2E}\sin\frac{\theta}{2}$ c) $\frac{ZZ'e^2}{2E}\cot\frac{\theta}{2}$ d) $\left(\frac{ZZ'e^2}{2E}\right)^2 \cos ec^4\frac{\theta}{2}$	01	L2	505.2

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v) Relation between Hamiltonian and Lagrangian is given by

---.

a) $H = \sum_j P_j \dot{q}_j$ - L b) $H = \sum_j P_j \dot{q}_j$ + L 01 L1 505.3

c) $L = \sum_j P_j \dot{q}_j$ + H d) H = L - V

vi) First form of generating function is given by ---.

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 $p_j = \frac{-\partial F_1}{\partial Q_j}$ 01 L2 505.3

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 $P_j = \frac{-\partial F_1}{\partial q_j}$

vii) Which of the following is correct Jacobi identity?

a) $[u,[v,w]]+[v,[w,u]]+[w,[u,v]]=0$

b) $[u,[v,w]]+[v,[w,u]]+[w,[u,v]]=1$ 01 L1 505.3

c) $[u,[w,v]]+[v,[w,u]]+[w,[v,u]]=0$

d) None of these

viii) Photographs of rapidly moving distant objects will ---.

a) not show Lorentz contraction

b) show Lorentz contraction 01 L1 505.4

c) not show any change

d) none of these

ix) Lorentz transformation equations hold for ---.

a) Non relativistic velocities only

b) relativistic velocities only

c) both a and b 01 L1 505.4

d) none of these

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x)	According to special theory of relativity a particle cannot travel with the speed of light because it's ----------. a) mass will reduce to zero b) mass will be infinite c) velocity will soon be infinite d) none of these	01	L1	505.4
B)	**Fill in the blanks**			
i)	In the case of elliptic orbits, energy is proportional to ---------- ----------.	01	L1	505.1
ii)	If coordinate q_j in Lagrangian are cyclic, then $\frac{\partial H}{\partial q_j}$ is equal to ----------.	01	L1	505.2
iii)	The Lagrangian equation for conservative system is ---------- ----------.	01	L1	505.3
iv)	Amount by which measured time interval is greater than corresponding proper time interval is called ---------- ----------.	01	L1	505.4
v)	In Lagrangian mechanics, if component of total applied force vanishes, the corresponding component of ---------- --------- is conserved.	01	L1	505.3
C)	**State True or False**			
i)	Length of semi-minor axis in elliptical orbit is $b = a\sqrt{1-\varepsilon^2}$. ----------	01	L1	505.1
ii)	The distance of closest approach is small when the impact parameter 'S' is zero. ----------	01	L1	505.2
iii)	The function $\sum p_j P_j$ generates exchange transformation. ----------	01	L1	505.3
iv)	In special theory of relativity time dilation is not the consequences of Lorentz transformation. ----------	01	L1	505.4
v)	In the Minkowski space, a quantity is called four vectors if it has three components. ----------	01	L1	505.4

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F. Y. M. Sc.
PHS505
Monday
03/06/2019

School of Science
Classical Mechanics
End Semester Examination

Physics
Semester – I
Max Marks:80
Time - 2.30 hrs
11.00 am to 1.30 pm

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.

(B)

		Marks	Blooms Level	CO
Q.2	**Answer the following questions**			
a)	Discuss central force motion. Explain how to reduce two body problem into equivalent one body problem.	12	L2	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	L3	505.1
	OR			
b)	The period of moon is approximately 27.2 days. Determine the radius of moon's orbit and orbital speed of the moon.	4	L3	505.1
Q.3	**Answer the following questions**	**Marks**	**Blooms Level**	**CO**
a)	Derive the Rutherford formulae for scattering.	12	L2	505.2
b)	Prove that $r_{min} = \frac{S\cos\left(\theta/2\right)}{1-\sin\left(\theta/2\right)}$	4	L3	505.2
	OR			
b)	Find the impact parameter and distance of closest approach for α particle having energy 20 MeV being scattered at 60° from gold nuclei.	4	L3	505.2

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Q.4		Answer the following questions	Marks	Blooms Level	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)	Derive Lagrange's equations from D'Alembert's principle for conservative system.	8	L2	505.3
		OR			
	b)	Discuss Variational principle and D'Alembert's principle in Lagrangian mechanics.	8	L2	505.3
	c)	Prove the law of conservation of angular momentum in Lagrangian mechanics.	4	L3	505.3

Q.5		Answer the following questions	Marks	Blooms Level	CO
	a)	Obtain the Lorentz transformation equations from Galilean transformation equations in special theory of relativity.	12	L4	505.4
	b)	Derive the equation which gives the variation of mass with velocity.	8	L2	505.4
		OR			
	b)	Explain the addition of velocities theorem in relativistic mechanics.	8	L2	505.4
	c)	Describe length contraction phenomenon in special theory of relativity.	4	L4	505.4

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