(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS - 2021/2022 ACADEMIC YEAR

SECOND YEAR FIRST SEMESTER
MAIN EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE (PHYSICS)

COURSE CODE: SPC 213

COURSE TITLE: CLASSICAL MECHANICS I.

EXAM DURATION: 2 HOURS

DATE: 25/01/2022   TIME:8-10AM

- Answer **QUESTION ONE** (Compulsory) and any other two (2) Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.
- Symbols have their usual meaning.

QUESTION ONE (30 MARKS)

a) State three functions of dimension analysis
           (3mks)

b) Define space and matter
           (2mks)

c) Calculate the velocity of a ball just before it strikes the ground if it is dropped from rest at a height h above the earth surface.
           (3mks)

d) Discuss the branches of mechanics
           (4mks)

e) Distinguish between Gravitational field and gravitational potential at appoint
           (2mks)

f) Define inertial frames of reference
           (2mks)

g) What is a conservative force
           (2mks)

h) Briefly outline Galilean transformations and show that $U' = U - V$
           (4mks)

i) Discuss the fundamental assumptions of classical mechanics
           (4mks)

j) Two particles have position vectors given by $\vec{r}_1 = 2t\hat{i} - t^2\hat{j} + (3t^2 - 4t)\hat{k}$ and $\vec{r}_2 = (5t^2 - 12t + 4)\hat{i} + t^3\hat{j} - 3t\hat{k}$. Find (a) the relative velocity and (b) the relative acceleration
           (4mks)

QUESTION TWO (20 MARKS)

a) What is a non conservative force
           (1mk)

b) Show that the gravitational potential per unit mass at a point is given by $V(r) = \frac{-Gm}{r}$ where symbols have their usual meaning
           (7mks)

c) Define
  (i) An isopiestic process
  (ii) An isochoric process
  (iii) An isentropic process
  (iv) An adiabatic process
           (4mks)

d) An ideal fluid flows at 4.0 m/s in a horizontal circular pipe
  i. If the pipe narrows to half the original radius, determine the flow speed in the narrow section
           (4mks)

  ii. If the fluid is water and the pressure at the narrow section is $1.8 x 10^5$ Pa, what is the pressure at a wider section
           (4mks)

QUESTION THREE (20 MARKS)

a) Differentiate between elastic and inelastic collisions
           (2mks)

b) Consider a sphere rolling down an inclined plane. What would be the speed of the sphere of mass M and radius R when it reaches the bottom of an incline, if it starts from the rest at a vertical height h and rolls without slipping
           (7mks)

c) Mass $M_1=70$kg and is initially moving east at a speed $u_1=6$km/hr while the other mass $M_2=50$kg is moving initially north at a speed of $u_2=8$km/hr. What is the final velocity of the couple.(5mks)

d) State the laws of thermodynamics
           (6mks)

QUESTION FOUR (20 MARKS)

a) State the Newton's law of universal gravitation (2mks)

b) Find the moment of inertia of an annular cylinder, solid cylinder and a ring (6,3,3mks)

c) From the work energy theorem, show that the total mechanical energy of a system moving under the influence of some conservative and non conservative force is not a constant. (6mks)

QUESTION FIVE (20 MARKS)

a) Show that if the resultant force $\vec{F}_{ext}$ acting on the system of particles is zero, then $\dfrac{d\vec{P}}{dt} = 0$ (14mks)

b) What is the rise in temperature of 5kg of water if its given 8400J of heat energy(Specific heat capacity of water=4200J/kgK (3mks)

c) The heater of 800W is used to heat a 600g cast iron cooker plate. How long will it take to raise the temperature of the plate by 200^0C? Specific heat capacity of iron=500J/kgK (3mks)