BPHE-101/PHE-01

ASSIGNMENT BOOKLET

Bachelor's Degree Programme (B.Sc.)

ELEMENTARY MECHANICS

Valid from January 1, 2022to December 31, 2022

It is compulsory to submit the Assignment before filling up the Term-End Examination Form.

Please Note

- **You can take electives (56 to 64 credits) from a minimum of TWO and a maximum of FOUR science disciplines, viz. Physics, Chemistry, Life Sciences and Mathematics.**
- **You can opt for elective courses worth a MINIMUM OF 8 CREDITS and a MAXIMUM OF 48 CREDITS from any of these four disciplines.**
- **At least 25% of the total credits that you register for in the elective courses from Life Sciences, Chemistry and Physics disciplines must be from the laboratory courses. For example, if you opt for a total of 64 credits of electives in these 3 disciplines, at least 16 credits should be from lab courses.**
- **You cannot appear in the Term-End Examination of any course without registering for the course. Otherwise, your result will not be declared and the onus will be on you.**

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THE PEOPLE'S UNIVERSITY

School of Sciences
Indira Gandhi National Open University
Maidan Garhi, New Delhi-110068

2022

Dear Student,

We hope you are familiar with the system of evaluation to be followed for the Bachelor's Degree Programme. At this stage you may probably like to re-read the section on assignments in the Programme Guide for Elective Courses that we sent you after your enrolment. A weightage of 30 per cent, as you are aware, has been earmarked for continuous evaluation which would consist of **one** tutor-marked assignment for this course.

Instructions for Formatting Your Assignments

Before attempting the assignment please read the following instructions carefully.

1) On top of the first page of your TMA answer sheet, please write the details exactly in the following format:

ENROLMENT NO.:……………………………………

NAME :……………………………………

ADDRESS :……………………………………

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COURSE CODE : ……………………………..

COURSE TITLE : …………………………..…….

ASSIGNMENT NO. : …………………………..…

STUDY CENTRE : ………………………..……. DATE :….……………………………...……

PLEASE FOLLOW THE ABOVE FORMAT STRICTLY TO FACILITATE EVALUATION AND TO AVOID DELAY.

2) Use only foolscap size writing paper (but not of very thin variety) for writing your answers.
3) Leave 4 cm margin on the left, top and bottom of your answer sheet.
4) Your answers should be precise.
5) While solving problems, clearly indicate the question number along with the part being solved. Be precise. Write units at each step of your calculations as done in the text because marks will be deducted for such mistakes. Take care of significant digits in your work. Recheck your work before submitting it.
6) **This assignment will remain valid from January 1, 2022 to December 31, 2022**. However, you are advised to submit it within **12 weeks** of receiving this booklet to accomplish its purpose as a teaching-tool.Answer sheets received after the due date shall not be accepted.

   We strongly feel that you should retain a copy of your assignment response to avoid any unforeseen situation and append, if possible, a photocopy of this booklet with your response.

We wish you good luck.

Tutor Marked Assignment
ELEMENTARY MECHANICS

Course Code: BPHE-101
Assignment Code: BPHE-101/PHE-01/TMA/2022
Max. Marks: 100

Note: Attempt all questions. Symbols have their usual meanings. The marks for each question are indicated against it.

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1. A massless rope is stretched horizontally between two supports that are 10.0 m apart. When an object of mass 200 kg is hung at the center of the rope, the rope is observed to sag by 100 cm. Calculate the tension in the rope. Take g=10.0 ms^{-2}. (10)

2. a) A girl having a mass 60.0 kg is driving her car at a speed of 25.0ms^{-1}. She has to apply brakes suddenly to avoid hitting a child crossing the road. If her body is brought to rest in 0.5 s by an airbag, what is the force exerted on her by the seatbelt?

   b) A rocket of mass 2000 kg is to be fired vertically upwarsds with an acceleration of 30ms^{-2}. If the relative velocity of the ejected gas is 1000ms^{-1} ,what is the mass of gas ejected per second to supply the needed thrust. Take g=10.0 ms^{-2}. (5+5)

3. A box of mass 50 kg is sliding down an inclined plane 5.0 m long from a height of 4.0 m. The coefficient of kinetic friction between the box and the plane is 0.30. What force must be applied on the box parallel to the inclined plane so that it slides at a constant speed? Take g=10.0 ms^{-2}. (10)

4. A wheel of radius 1.0 m rotates with a constant angular acceleration of 5.0 rads^{-2}.If the initial angular speed of the wheel is 4.0 rads^{-1}, what will be its angular speed after 10 s. What is the angular displacement of the wheel in this time? Also calculate the tangential speed and acceleration of a point on the rim of the wheel at 10 s. (10)

5. A block of mass 0.5 kg slides down a inclined plane from a height of 5.0 m onto a rough horizontal surface. If the speed of the block at the base of the incline is 5.0ms^{-1} and it travels a distance of 4.0 m on the horizontal surface before coming to rest, calculate:

   i) the work done by friction along the inclined plane, and

   ii) the coefficient of kinetic friction between the block and the horizontal surface.

   Take g=10.0 ms^{-2}. (5+5)

6. The position vectors of two particles of mass 1.0 kg and 2.0 kg are respectively $\vec{\mathbf{r}}_1 = 3t\,\hat{\mathbf{i}} + t\,\hat{\mathbf{j}} + 2t^2\hat{\mathbf{k}}$ and $\vec{\mathbf{r}}_2 = 3\,\hat{\mathbf{i}} + \left(t^2 - 1\right)\hat{\mathbf{j}} + 4t\,\hat{\mathbf{k}}$ where t is in seconds and the position is in metres. Determine the position vector of the centre of mass of the system, the velocity of the cm and the net force acting on the system. (10)

7. A bullet of mass 3.0 g travelling horizontally with a speed of 400 ms^{-1} hits a solid disc which is at rest and gets embedded at the edge of the disc. The mass of the disc is 2.0 kg and its radius is 1.0. If the disc can rotate about its axis, calculate the angular speed of the disc immediately after the bullet is embedded. (10)

8. A ball of mass 3.0 kg initially moving with a speed of 5.0 ms^{-1}in the positive x-direction collides elastically with a second particle of mass 2.0 kg moving in the positive$y$-direction with speed of 2.0 ms^{-1}. After collision the 3.0 kgball moves with a speed of 2.0 ms^{-1} in a direction making an angle of 30° with the positive x-direction. Determine the direction and speed of the 2.0 kg mass after the collision. (10)

9. The planet Jupiter has an elliptical orbit with e =0.05 and a semi-major axis of 7.8×10^{11} m. Determine the energy of the planet, perihelion and aphelion distances and the speed of the planet at the aphelion given that its speed at the perihelion is 3.712 kms^{-1}. Take the mass of Jupiter to be 1.9 $\times 10^{27}$ kg. (10)

10. a) How fast must a centrifuge rotate if a particle 7.0 cm from its axis of rotation is to experience an acceleration of 1000g? Take g=10.0 ms^{-2}. (5)

    b) An aeroplane flies due east along the equator with a speed of 200 ms^{-1}. Determine the magnitude and direction of the Coriolis acceleration. (5)

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