BPHE-101/PHE-01

ASSIGNMENT BOOKLET
Bachelor's Degree Programme (B.Sc.)

ELEMENTARY MECHANICS

Valid from January 1, 2020 to December 31, 2020

It is compulsory to submit the Assignment before filling in 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.**

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

2020

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, 2020 to December 31, 2020**. 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/PHE-01
Assignment Code: BPHE-101/PHE-01/TMA/2020
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 box of mass 75 kg is placed on an inclined plane. When the angle of the plane is increased to 30º, the box begins to slide downwards. Calculate the coefficient of static friction between the plane and the box. Draw the free body diagram. Take $g = 10.0\ \text{ms}^{-2}$. (10)

2. A ball of mass 0.1kg, starting from rest, falls a height of 4.0 m and then collides with the ground. After the collision, the ball bounces up to a height of 2.0 m. The collision with the ground takes place over a time $4.0\times10^{-3}\ \text{s}$. Determine (i) the momentum of the ball immediately before the collision and immediately after the collision and (ii) the average force exerted by the ground on the ball. Take $g = 10.0\ \text{ms}^{-2}$. (10)

3. A block of mass 4.0 kg starts from rest and slides down a surface which corresponds to a quarter of a circle of 2.0 m radius. (i) If the curved surface is smooth, find the speed at the bottom. (ii) If the speed at the bottom is 2.0 ms^{-1}, calculate the energy dissipated due to friction in the descent. (iii) After the block reaches the horizontal with a speed of 2.0 ms^{-1}it slides to a stop in a distance of 1.5 m. Calculate the frictional force acting on the horizontal surface. Take $g = 10.0\ \text{ms}^{-2}$. (10)

4. A centrifuge in the shape of a uniform cylinder of radius 20 cm and mass 10 kg cylinder is spinning about its axis at a speed of 50,000 rpm. Determine the torque that must be applied in order to bring the centrifuge to a stop in 20 s. Calculate the power dissipated. (10)

5. The potential energy (in J) of a system in one dimension is given by:

$$U(x) = 12 - 2x^3 + 7x^2 - 4x$$

Which are the points of stable and unstable equilibrium for this potential function? Determine the work done in moving a particle in this potential from x = 1 m to x = 2 m. (10)

6. Three point masses of 2.0 kg each, have the following position vectors:

$$\vec{\mathbf{r}}_1(t) = (t + 4t^2)\,\text{m}\,\hat{\mathbf{i}} + t\,\text{m}\,\hat{\mathbf{k}}\ ;\ \vec{\mathbf{r}}_2(t) = 2t^2\,\text{m}\,\hat{\mathbf{j}} - 3\,\text{m}\,\hat{\mathbf{k}}\ ;\ \vec{\mathbf{r}}_3(t) = (t-1)\,\text{m}\,\hat{\mathbf{i}} + 4t^2\,\text{m}\,\hat{\mathbf{j}}$$

Determine the velocity and acceleration of the centre of mass of the system. (10)

7. A horizontal disk of rotational inertia 7.5 kg m^2 with respect to its axis of symmetry is spinning counterclockwise in its plane, about its axis of symmetry at 22.5 revolutions per second. A second disk, of rotational inertia 13.0 kg m^2 with respect to its axis of symmetry, spinning clockwise about the same axis (which is also its axis of symmetry) at 20.0 revolutions per second, is dropped on top of the first disk. The two disks stick together and rotate as one about their common axis of symmetry. Determine the new angular velocity of the system. (10)

8. A stationary ball, with a mass of 0.5 kg, is struck by an identical ball moving at $6.0\,\mathrm{ms}^{-1}$. After the collision, the second ball moves 30° to the left of its original direction. The stationary ball moves 60° to the right of the moving ball's original direction. What is the velocity of each ball after the collision? (10)

9. A comet has an aphelion distance of $6.1\times10^{11}\mathrm{m}$ and perihelion distance of $5.1\times10^{11}\mathrm{m}$. The mass of the sun is $2.0\times10^{30}\mathrm{kg}$. Calculate the speed of the comet at the perihelion and the aphelion. (10)

10. a) On Jupiter a day lasts for 9.9 earth hours and the circumference at the equator is 448600 km. If the measured value of gravitational acceleration at the equator is $24.6\,\mathrm{ms}^{-2}$, what is the true gravitational acceleration and the centrifugal acceleration. (5)

    b) A ball of mass 50g is hit due south with a speed of 70 ms^{-1} at latitude 60 ^{o}N. Calculate the magnitude and direction of the coriolis force on the ball. (5)

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