BPHE-101/PHE-01

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

ELEMENTARY MECHANICS

Valid from January 1, 2024 to December 31, 2024

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.**

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

2024

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, 2024 to December 31, 2024**. 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/2024
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 50 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. (10)

2. A bullet of mass 20 g, travelling at a speed of 350 ms^{-1}, strikes a steel plate at an angle of 30º with the plane of the plate. It ricochets off at the same angle, at a speed of 320 ms^{-1}. What is the magnitude of the impulse that the steel plate gives to the bullet? If the collision with the plate takes place over a time $\Delta t = 10^{-3}$ s, what is the average force exerted by the plate on the bullet? (10)

3. A truck of mass 2000 kg moving on a highway experiences an average frictional force of 800 N. If its speed increases from 25 ms^{-1} to 35 ms^{-1} over a distance of 500 m, what is the force generated by the truck. (10)

4. An automobile travelling at 80 km hr^{-1} has tyres of radius 80 cm. On applying brakes, the car is brought to a stop in 30 complete turns of the tyres. What is the magnitude of the angular acceleration of the wheels? How far does the car move while the brakes are applied? (10)

5. An insect of mass 20 g crawls from the centre to the outside edge of a rotating disc of mass 200g and radius 20 cm. The disk was initially rotating at 22.0 $rads^{-1}$. What will be its final angular velocity? What is the change in the kinetic energy of the system? (10)

6. The position vector of two particles of mass 4.0 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 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 solid cylinder of mass 3.0 kg and radius 1.0 m is rotating about its axis with a speed of 40 rad s^{-1}. Calculate the torque which must be applied to bring it to rest in 10s. What would be the power required? (10)

8. A proton undergoes a head on elastic collision with a particle of unknown mass which is initially at rest and rebounds with 16/25 of its initial kinetic energy. Calculate the ratio of the unknown mass with respect to the mass of the proton. (10)

9. A satellite going around Earth in an elliptic orbit has a speed of 10 km s^{-1} at the perigee which is at a distance of 227 km from the surface of the earth. Calculate the apogee distance and its speed at that point. (10)

10. a) A pendulum bob of mass 50 g is suspended on a string from the ceiling of an elevator which is moving downwards with an acceleration 1.5 ms^{-2}. Draw the free body diagram using the non-inertial frame of reference and determine the tension in the string. (Take g = 10 ms^{-2}) (5)

b) What should be the radius of a space station spinning with an angular speed of 2 rpm such that an astronaut inside the station experiences artificial gravity with g = 10 ms^{-2}? (5)

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