BPHE-102/PHE-02

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

OSCILLATIONS AND WAVES

Valid from January 1, 2025 to December 31, 2025

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 that course. Otherwise, your result will not be declared and the onus will be squarely on you.

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

2025

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 consists of **one tutor-marked assignment** for this 2-credit course. **Submit your assignments at your study centre.**

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 and in your own words. Do not copy answers from study material.

5) While solving problems, clearly indicate the question number along with the part being solved. 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, 2025 to December 31, 2025**. 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. If you have any problems or queries related to the course, you can write on the e-mail **srjha@ignou.ac.in**.

We wish you good luck.

Tutor Marked Assignment
OSCILLATIONS AND WAVES

Course Code: BPHE-102/PHE-02
Assignment Code: BPHE-102/PHE-02/TMA/2025
Max. Marks: 100

Note: Attempt all questions. Symbols have their usual meanings. The marks for each question are indicated against it. Your answers to descriptive questions should be in your own words.

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1. a) A simple harmonic motion is represented by

$$x(t) = a\cos\omega t$$

Obtain expressions for velocity and acceleration of the oscillator. Also, plot the time variation of displacement, velocity and acceleration of the oscillator. (2+2+2+2+2)

b) The time period of a simple pendulum, called 'seconds pendulum', is 2 s. Calculate the length, angular frequency and frequency of the pendulum. What is the difference between a simple pendulum and a compound pendulum? (6+4)

c) Two collinear harmonic oscillations $x_1 = 8\sin(100\,\pi t)$ and $x_2 = 12\sin(96\,\pi t)$ are superposed. Calculate the values of time when the amplitude of the resultant oscillation will be (i) maximum and (ii) minimum. (5+5)

d) For a damped harmonic oscillator, the equation of motion is

$$m(d^2x/dt^2) + \gamma(dx/dt) + kx = 0$$

with $m = 0.50$ kg, $\gamma = 0.70$ kgs^{-1} and $k = 70$ Nm^{-1}. Calculate (i) the period of motion, (ii) number of oscillations in which its amplitude will become half of its initial value, (iii) the number of oscillations in which its mechanical energy will drop to half of its initial value, (iv) its relaxation time, and (v) quality factor. (4+4+4+4+4)

e) Establish the equation of motion of a weakly damped forced oscillator explaining the significance of each term. Differentiate between transient and steady state of the oscillator. (7+3)

2. a) The oscillations of two points x_1 and x_2 at $x = 0$ and $x = 1$ m respectively are modelled as follows:

$$y_1 = 0.3\sin 4\pi t$$

and $$y_2 = 0.3\sin(4\pi t + \pi/8)$$

Calculate the wavelength and speed of the associated wave. (5+5)

b) A sinusoidal wave is described by

$$y(x, t) = 3.0\sin(3.52t - 2.01x)\text{ cm}$$

where x is the position along the wave propagation. Determine the amplitude, wave number, wavelength, frequency and velocity of the wave. (2+2+2+2+2)

c) The linear density of a vibrating string is 1.3×10^{-4} kg m^{-1}. A transverse wave is propagating on the string and is described by the equation

$$y\,(x, t) = 0.021 \sin (30t - x)$$

where x and y are in metres and t is in seconds.

Calculate the tension in the string. (5)

d) A stretched string of mass 20 g vibrates with a frequency of 30 Hz in its fundamental mode and the supports are 40 cm apart. The amplitude of vibrations at the antinode is 4 cm. Calculate the velocity of propagation of the wave in the string as well as the tension in it. (4+4)

e) Consider two cylindrical pipes of equal length. One of these acts as a closed organ pipe and the other as open organ pipe. The frequency of the third harmonic in the closed pipe is 200 Hz higher than the first harmonic of the open pipe. Calculate the fundamental frequency of the closed pipe. (7)

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