PHE-02

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

OSCILLATIONS AND WAVES

Valid from July 1, 2011 to March 31, 2012

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

(For July, 2011 Cycle)

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 :……

……

……

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 July 1, 2011 to March 31, 2012**. 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 to us on the e-mail **srjha@ignou.ac.in**.

We wish you good luck.

Tutor Marked Assignment
PHE-02: Oscillations and Waves

Course Code: PHE-02
Assignment Code: PHE-02/TMA/2011-12
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) Derive expressions for potential energy and kinetic energy of an oscillating spring-mass system. (5+5)

   b) The displacement of a simple harmonic oscillator is given by

   $$x(t) = 2\sin\left(\frac{\pi t}{2} + \frac{\pi}{4}\right)$$

   where x is measured in cm and t in second. Calculate the (i) period of oscillation (ii) maximum velocity, and (iii) maximum acceleration. (3+3+4)

2. Two collinear harmonic oscillations $x_1 = 8 \sin (100\ \pi t)$ and $x_2 = 12 \sin (96\ \pi t)$ are superposed. Calculate the (i) maximum and minimum amplitudes, and (ii) the frequency of amplitude modulation. (5+5)

3. For a damped harmonic oscillation, the equation of motion is

   $$m\frac{d^2x}{dt^2} + \gamma\frac{dx}{dt} + kx = 0,$$

   with $m = 0.25$ kg, $\gamma = 0.07$ kgs^{-1} and $k = 85$ 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. (4×5 = 20)

4. A spring is stretched 5×10^{-2} m by a force of 5×10^{-4} N. A mass of 0.01 kg is placed on the lower end of the spring. After equilibrium has been reached, the upper end of the spring is moved up and down so that the external force acting on the mass is given by $F(t) = 20 \cos \omega t$. Calculate (i) the position of the mass at any time, measured form the equilibrium position and (ii) the angular frequency for which resonance occurs. (5+5)

5. a) The displacement of an oscillator is written as

   $$y\ (t) = a \sin\ (\omega t \pm \phi)$$

   whereas the equation of a wave is written as

   $$y\ (x, t) = a \sin\ (\omega t - kx)$$

   Highlight the differences between the two. (5)

b) The equation of transverse wave on a rope is

$$y\,(x, t) = 5 \sin (4.0t - 0.02x)$$

where y and x are measured in cm and t is expressed in second. Calculate the maximum speed of a particle on the rope. (5)

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

$$y_1 = 0.2 \sin 3\pi t$$

and $$y_2 = 0.2 \sin \left(3\pi t + \frac{\pi}{8}\right)$$

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

7. Two waves, travelling along the same direction, are given by

$$y_1 = a \sin (\omega_1 t - k_1 x)$$

and $$y_2 = a \sin (\omega_2 t - k_2 x)$$

Suppose that ω_1 and k_1 are respectively slightly greater than ω_2 and k_2. (i) Derive an expression for the resultant wave obtained by their superposition, and (ii) explain the formation of wave packet. (5+5)

8. a) A stretched string is observed to vibrate with frequency 30 Hz in its fundamental mode when the supports are 60 cm apart. The amplitude at the antinode is 3 cm. The string has a mass of 30g. Calculate the speed of propagation of the wave and the tension in the string. (7)

b) State whether the variation in pressure at nodes in a stationary wave is maximum or zero. Justify your answer. (3)

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TENTATIVE SCHEDULE FOR PHYSICS PROGRAMMES BROADCAST ON GYAN DARSHAN 1
July 2011 – May 2012

This is the tentative schedule for Physics students. The students may approach their cable operator to avail this facility.

Date/Day	Time Slot	Course Code	Video Programme Title
July 2011			
10-07-11 (Sun)	9.00-9.30 pm	PHE-04	Vector Calculus Part-I
12-07-11 (Tues)	8.30-9.00 am	PHE-01	Exploring Physics: Experiment with Low cost Materials
17-07-11 (Sun)	9.00-9.30 pm	LT- 04	Physics Lab Technician: Know your job
24-07-11 (Sun)	9.00-9.30 pm	LT- 04	Bhautiki Prayogshala Technician: Aapka Kaam
26-07-11 (Tues)	8.30-9.00 am	PHE-01	The Bicycle: A Vehicle for Teaching Physics
August 2011			
09-08-11 (Tues)	8.30-9.00 am	PHE- 01	The Physics of Dance
16-08-11 (Tues)	8.30-9.00 am	PHE- 15	The Milky Way
23-08-11 (Tues)	8.30-9.00 am	PHE -04	Vector Calculus Part-II
23-08-11 (Tues)	8.30-9.00 am	PHE- 15	Stellar Spectra and Classification
September 2011			
06-09-11 (Tues)	8.30-9.00 am	PHE- 10	Digital Modulation
11-09-11 (Sun)	9.00-9.30 am	PHE -10	Amplitude Modulation
13-09-11 (Tues)	8.30-9.00 am	PHE- 06	First Law of Thermodynamics
October 2011			
09-10-11 (Sun)	9.00–9.30 pm	PHE-06	Applications of the First Law of Thermodynamics
16-10-11 (Sun)	9.00–9.30 pm	PHE-15	Stellar Structure
November 2011			
13-11-11 (Sun)	9.00–9.30 pm	PHE-10	Transistor Biasing
December 2011			
18-12-11 (Sun)	9.00–9.30 pm	PHE-06	Thermodynamics in Action
20-12-11 (Tues)	8.30-9.00 am	PHE-06	Ushmagatiki ke Anuprayog
27-12-11 (Tues)	8.30-9.00 am	PHE-10	Electronic Device

Date/Day	Time Slot	Course Code	Video Programme Title
January 2012			
08-01-12 (Sun)	9.00–9.30 pm	PHE-15	Glimpses of the Cosmos
15-01-12 (Sun)	9.00–9.30 pm	PHE-02	Simple Harmonic Motion
22-01-12 (Sun)	9.00–9.30 pm	PHE-15	Exploring the Night Sky
24-01-12 (Tues)	8.30-9.00 am	PHE-02	Dolan
February 2012			
12-02-12 (Sun)	9.00–9.30 pm	PHE-15	On the Trail of Stars
14-02-12 (Tues)	8.30-9.00 am	PHE-06	Second Law of Thermodynamics
21-02-12 (Tues)	8.30-9.00 am	PHE-02	Coupled Oscillations
March 2012			
06-03-12 (Tues)	8.30-9.00 am	PHE- 13	Introduction to Crystal Structure
13-03-12 (Tues)	8.30-9.00 am	PHE- 15	Astronomical Coordinates
18-03-12 (Sun)	9.00–9.30 pm	PHE- 10	Operational Amplifier
20-03-12 (Tues)	8.30-9.00 am	PHE- 06	Carnot Cycle
April 2012			
08-04-12 (Sun)	9-00-9.30 pm	PHE- 15	Astronomical Measurements (Measurement of Distance and Brightness)
15-04-12 (Sun)	9-00-9.30 pm	PHE- 01	Rotating Frames of Reference
May 2012			
13-05-12 (Sun)	9.00-9.30 pm	PHE -15	Astronomical Measurements (Measurement of Mass, Temperature and Time)
15-05-12 (Tues)	8.30-9.00 am	PHE -10	Logic Gates

TENTATIVE SCHEDULE FOR PHYSICS STUDENTS ON DD1 (National Network)
JULY 2011 TO MAY 2012
Time: 6.00 AM to 6.30 AM

Month/Date*	Course	Topic
July 2011 **11-07-11**	PHE-10	Operational Amplifier
August 2011 **08-08-11**	PHE-02	Coupled Oscillations
September 2011 **12-09-11**	PHE-10	Transistor Configuration
October 2011 **10-10-11**	PHE-06	Thermodynamics in Action
November 2011 **14-11-11**	PHE-15	Exploring the Night Sky
January 2012 **09-01-12**	PHE-13	Introduction to Crystal Structure
February 2012 **13-02-12**	PHE-01	Ghurni Nirdesh Tantra (Hindi)
March 2012 **12-03-12**	PHE-15	The Milky Way
April 2012 **09-04-12**	PHE-10	Semiconductor Diode
May 2012 **14-05-12**	PHE-15	On the Trail of Stars

*** Second Monday of every month**