PHE-09

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

OPTICS

Valid from January 1, 2022 to 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 that course. Otherwise, your result will not be declared and the onus will be squarely 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 consists of **one tutor-marked assignment** for this 4-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 :……………………………………………

……………………………………………

……………………………………………

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, 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
OPTICS

Course Code: PHE-09
Assignment Code: PHE-09/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. Answer any **four** parts: (5×4=20)

   a) A wave is represented by

   $$y(x,t) = 2(\sin 10\pi t - \frac{\pi x}{40} + \frac{\pi}{4})$$

   Plot the space profile at $t = \frac{T}{2}$ and time profile at $x = \frac{\lambda}{4}$.

   b) Draw *o*- and *e*- wave surfaces for calcite and quartz.

   c) Discuss the significance of population inversion for lasers.

   d) Show that a zone plate acts as a multi-foci converging lens.

   e) Discuss the concept of missing orders with particular reference to double slit diffractionpattern.

2. a) An oil (μ_0 = 1.45) film of thickness 280 nm floats on water (μ_w = 1.33). It is illuminated by white light at normal incidence. Which colour in the visible spectrum will be most strongly (i) reflected, and (ii) transmitted? (5,5)

   b) Obtain the expression for shift in fringes when a thin transparent sheet is introduced in the path of one of the waves in a double slit interference experiment. (10)

3. A vertical single slit is illuminated by a point source. State salient features of Fraunhofer diffraction pattern of the slit. Also, obtain an expression for intensity distribution in the diffraction pattern and plot it. (5,10,5)

4. a) With appropriate diagrams, discuss Rayleigh's criterion for resolving power of an optical instrument. Obtain an expression for the resolving power of a microscope. (5,5)

   b) With the help of appropriate energy level diagram, explain the working of a He-Ne laser. A He-Ne laser emits a beam of diameter 2×10^{-3}m and wavelength 630 nm. It is directedtowards an aeroplane flying at a height of 11 km. Calculate the diameter of the light patch produced on the surface of the aeroplane. (5,5)

5. a) Discuss three important practical applications of lasers. (5)

b) Calculate the ratio of stimulated emission and spontaneous emission at an operating temperature of 1100 K, if the wavelength of emitted light is 550 nm. Do these conditions correspond to a laser? (5)

c) State the characteristics of step index and gradient index optical fibres. Depict their refractive index profiles and propagation of light through them. (10)

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