PHE-09

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

OPTICS

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 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

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 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 :……

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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, 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
OPTICS

Course Code: PHE-09
Assignment Code: PHE-09/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) Light waves are propagating in vacuum. Derive the wave equation for the associated magnetic field vector. On the basis of this equation, calculate the speed of light. (7+3)

   b) What kind of polarised light will you get if two plane polarised light waves of equal amplitude but having a phase difference of 90^o are superposed? Justify your answer. Explain why unpolarised light reflected by a pile of plates is linearly polarized. (6+4)

   c) For normal incidence of light from a medium of refractive index 1.42 onto a medium of refractive index 1.64, calculate the reflection and transmission co-efficients. (5)

2. a) i) Two light waves propagating in the same direction are superposed. The frequency of the two light waves is the same and there is a constant phase difference between them. Obtain an expression for the intensity of the resultant wave. (5)

      ii) Two coherent sources of light having intensity ratio 16:1 produce an interference fringe pattern. Calculate the ratio of the intensities of bright and dark fringes. (5)

   b) For obtaining Newton's rings due to reflected light, a convex lens is placed on a plane glass plate and irradiated by monochromatic light. Obtain an expression showing the relation between radii of successive dark rings related to each other? If the space between the lens and plane glass plate in the Newton's ring set up is filled with a liquid of refractive index 1.38 and the wavelength of light used is 580 nm, calculate the diameter of the 4^{th} dark ring. Take the radius of curvature of the lens to be 0.75 m. (6+4)

   c) A wedge shaped film has refractive index 1.34 and thickness of extreme sides 0 (zero) and t. If a light of wavelength 492 nm is incident normally on it and 20 fringes are obtained, determine t. (5)

3. a) Fraunhofer diffraction is a special case of Fresnel diffraction. Explain. Also discuss the concept of Fresnel half-period elements. (5+5)

   b) Discuss the dependence of image forming ability of an optical device on the phenomenon of diffraction. A diffraction grating has 2000 lines. Two sources of monochromatic lights emanating wavelengths λ_1 and λ_2 are just resolved by the grating in the first order spectrum. If the mean of λ_1 and λ_2 is 600 nm, calculate the difference between the wavelengths. (5+5)

c) A grating has 10,000 lines per cm. Calculate the maximum number of principal maxima that can be formed for light of wavelength 487 nm. (5)

4. a) What do you understand by temporal and spatial coherence of light? Is it true that observable interference fringe pattern cannot be obtained by using two incoherent sources in an interference experiment? Justify your answer. (6+4)

b) What condition(s) must be met to obtain sustained stimulated emission? Compare and contrast three level and four level pumping schemes for a laser. (3+7)

c) An extended source of light whose linear dimension is 0.3 mm is used in Young's double slit experiment. Calculate the maximum separation between the slits for which interference pattern will be observable if the wavelength of light is 580 nm and separation between the source and the slits is 0.50 m. (5)

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