

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

ASTRONOMY AND ASTROPHYSICS

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 or 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 out of those 64 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 responsibility will be yours.



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

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 for Elective Courses in the Programme Guide 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 (TMA)** for this course.

Instructions for Formatting Your Assignment:

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.
- 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.

We strongly recommend that you should retain a copy of your assignment response to avoid any unforeseen situation.

We wish you good luck.

**Tutor Marked Assignment
Astronomy and Astrophysics (PHE-15)**

Course Code: PHE-15
Assignment Code: PHE-15/TMA/2024
Max. Marks: 100

Note: Answer all questions. Marks for each question are indicated against it. Symbols have their usual meaning.

1. a) The distance of planet Jupiter from the Sun is 5 AU. Express this distance in light year and parsec. (5)

- b) Calculate the ratio of the surface temperatures of the stars A and B from the following data:

Star	Absolute magnitude	Radius (R_{\odot})
A	2	62
B	6	4

(5)

- c) Show the horizon coordinates of a star X on a celestial sphere for a location at latitude 30° N. (5)

- d) Which telescope, optical or X-ray, would have higher resolving power for the same aperture? Calculate the magnitude of the faintest object that a 15 m optical telescope can detect. (2+3)

- e) The local time at Chennai is 9 p.m. Calculate the local time at Mumbai at that time. (5)

2. a) Explain how we estimate the effective surface temperature of the Sun. A main sequence star has mass 2×10^{31} kg and radius 3×10^9 m. Obtain an estimate of the average temperature throughout the star. (5+5)

- b) Explain how sunspots survive for so long even though they are surrounded by hotter matter. (5)

- c) Derive an expression for the tidal force for the earth-moon system and show that its magnitude depends on the latitude. Explain tidal bulge on the basis of this expression. (8+2)

3. a) Derive Jeans criteria for the stability of a gas cloud. A collapsing cloud is made only of neutral hydrogen (H1). If the temperature of the cloud is 50 K and its number density is 10^5 m^{-3} , calculate its Jeans mass. (7+3)

- b) Derive the expression for the mean temperature in a star:

$$\langle T \rangle \propto M^{2/3} \langle \rho \rangle^{1/3} \quad (5)$$

- c) The mean free path of photons in stars is of the order of 0.2 cm. Show that the time taken for a photon to reach the surface of a star of radius $4 R_{\odot}$ is of the order of one million year. (5)
- d) Describe the composition of the interstellar medium. Explain how it has been possible to map the HI clouds. (2+3)
4. a) Describe Hubble's Classification scheme for galaxies. (5)
- b) With the help of a diagram, explain the unified scheme for understanding active galactic nuclei. (10)
- c) What is cosmic background radiation? Explain why it is so important to the debate between evolving and a steady-state universe. (2+3)
- d) If the temperature of the background radiation today is 3 K, at what time after the birth of the universe was the temperature 10^{15} K. Take the age of the universe as 15×10^9 years. (5)
