UNIVERSITY COLLEGE LONDON

University of London

EXAMINATION FOR INTERNAL STUDENTS

For The Following Qualification:-

Coll Dip

Astronomy DP21: The Interstellar Medium and Multi-Waveband Astronomy

COURSE CODE	:	**ASTRDP21**
UNIT VALUE	:	**0.50**
DATE	:	**10-MAY-04**
TIME	:	**18.30**
TIME ALLOWED	:	**2 Hours**

04-C0096-3-50

TURN OVER

Answer THREE questions from Section A and THREE questions from Section B.

You are advised to spend no more than 10 minutes on each Section A answer, and about 30 minutes on each Section B answer.

The numbers in square brackets indicate the provisional allocation of maximum marks for sub–sections of the question.

SECTION A

1. What are the mechanical & control functions needed for a serviceable telescope? [7]

2. Sketch the optical designs of three of the following: Newtonian, Cassegrain, Schmidt and Nasmyth telescopes. [3]

   Compare the relative advantages and disadvantages of these three designs. [3]

   Why can the Schmidt telescope not be built in very large sizes. [1]

3. Describe what it means when an optical surface is described as an 'asphere'. [2]

   Why are aspheres more difficult to make than simple spherical surfaces? [4]

   Mention where aspheres are important in telescopes and instruments. [1]

4. Discuss briefly the basic properties of the four main temperature phases found in the Interstellar medium. [5]

   In which of these regimes would you expect to find dust and molecules ? [2]

5. Define what is meant by an HII region around a hot OB star, and indicate some of the basic properties of such regions (e.g. size, mass, density and temperature). [4]

   What is meant by the term a Stromgren sphere around OB stars ? [2]
   Would the radius of such a sphere be larger or smaller around an O5 star than a B0 star and why ? [1]

6. In what part of the electromagnetic spectrum are most *atomic* interstellar absorption lines observed. Explain briefly why this is the case. [4]

   Give two reasons why hot OB stars are usually used as background probes of atomic gas in the line of sight in the ISM. [3]

SECTION B

7. Why do we want to base telescopes in space, and how do they extend the range of scientific observations that an astronomer can make? [8]

   What are the engineering reasons that space-based telescopes are grossly more expensive than earth-based ones? [4]

   What disturbing influences are then in the space-environment that are absent or much reduced on Earth, and how are these handled? [8]

8. Describe why astronomers want to use adaptive optics and what benefits the technology can confer. [8]

   Describe the typical components of an adaptive optics system and how they are inter-linked. [10]

   Is adaptive optics a perfect solution ? Indicate why it is or isn't. [2]

9. Describe the different optical aberrations that can arise in an optical system, distinguishing between those that are dependent, or independent, of wavelength. [8]

   Outline why some aberrations degrade the resolution of an optical system when it is used to image a point-source, whilst others do not affect the resolution at all. What effects do these have ? [6]

   Describe briefly how computer ray-tracing methods are used to design an optical system to give the best imaging performance. [6]

10. Describe what is meant by the condition of ionisation equilibrium for a pure hydrogen HII region. [3]

Describe the physical process by which the gas in an HII region is heated. [7]

In considering the total recombination rate of hydrogen in an HII region, it is usual to use the Case B recombination rate, α_B. Explain what is meant by Case B recombination. [3]

Discuss how the emission of *Forbidden Lines* from species like O^{++} can provide the main cooling of H II region gas to yield observed values of the electron temperature of $\sim 10^4$ K. [7]

11. Discuss the observational evidence for the presence of dust in the general interstellar medium. [6]

Sketch the form of the interstellar extinction law from the near infrared through the visible to the ultraviolet regions of the spectrum. [3]

Outline briefly the heating and cooling processes for material in the diffuse interstellar medium, where the gas is mainly neutral. [5]

Outline how gas element abundances can de determined from measurements of the strengths of interstellar absorption lines. [6]

12. State what is meant by the Jeans Mass of an interstellar gas cloud, and give a rough value for this where the gas temperature is about 100 K and the density is about 1 H-atom per cc, typical for the diffuse *ISM.* [4]

Describe the main steps involved in star formation in the interstellar medium. Include in your account a sketch of a typical protostellar evolution track on the HR diagram showing the Hayashi and Henyey tracks, and an outline of the bi-polar outflows associated with protostars. [16]

ASTRDP21/2004 **END OF PAPER**