# Unit 3
# Astrophysics

## A1 Observing stars

| Unit | Topic | Content |
|---|---|---|
| | Recording star images. | • Photographic emulsions and charge coupled devices (CCDs).<br>• Grain and pixel size; relative efficiencies; linearity of response. |
| | Benefits of observing from above the Earth's atmosphere. | • The importance of different wavelengths of radiation as a means of discovering information about distant objects.<br>• Use of satellites such as Hubble telescope, IRAS and COBE. |
| | The total power emitted; luminosity *L*. | • The Planck distribution of energy.<br>• Stefan-Boltzmann law:<br>$L = \sigma T^4 \times \textit{surface area}$<br>and for a sphere<br>$L = 4\pi r^2 \sigma T^4$ |
| | Surface temperature of stars | Wien's law: $\lambda_{max} T = 2.898 \times 10^{-3}$ m K<br>Appreciation that the surface temperatures of stars range from near absolute zero to $10^{7}$ K, corresponding to peak wavelengths from radio to X-rays. |
| | Measuring distance by trigonometric parallax. | Use of annual parallax to measure the distance of nearby stars, including the use of the small angle approximation.<br>The light year. (Parsecs and AU will not be required). |
| | Simple Hertzsprung-Russell diagram. | Simplified luminosity – temperature diagram showing main sequence, white dwarfs and red giants. The use of an L/T diagram to deduce L for a distant main-sequence star. |
| | Estimating distance of more distant stars. | Use of intensity = $L/4\pi D^2$ to find distance of stars of known luminosity.<br>Use of Cepheid variable stars to find distance to nearby galaxies. |

## A2 The lives of stars

| | Topic | Content |
|---|---|---|
| | Energy for stars | .Gravitational collapse and hydrogen 'burning'.<br>$c^2 \Delta m = \Delta E$. (Details of the p-p chain are not required.) |
| | Main sequence stars. | A star spends most of its life as a main sequence star. |
| | White dwarfs. | Hot, low volume, low mass stars. Origins and typical masses, (less than about 1.4 solar masses). Core remnants. |
| | Red giants. | Cool, high volume, stars. Origins and typical masses, (between 0.4 and 8 solar masses). Core remnants. |
| | Supernovae (Type II only). | Rapid implosion of stars of more than eight solar masses. Shock wave: outer layers blown away. |
| | Neutron stars. | Core remnants greater than about 1.4 solar masses. Formation from electrons and protons. Very high density. Pulsars. |
| | Black holes. | Core remnants greater than about 2.5 solar masses. The dense core traps radiation |