Objectives
Project control depends on Planning and Planning depends on Estimation skills. How do we decide how much effort and how long the project should take given all the pressures, uncertainty, sources of error and bias? An alternate view is: given a deadline and fixed amount of effort, what objectives can we achieve and what functionality must be left for a later release or version? From this material, students should gain some basic ideas on approaching project estimation as a process which can be measured (for accuracy) and improved both during and after the project.

Key Points
• The purpose: the need for good estimates – even when using short time intervals (Agile).
• The basic problems of estimating. Why is estimation so difficult? Why is it so much less accurate than other forms of project estimation such as building pipelines?
• Some techniques of estimation. There are advantages in first estimating size and then converting it, via productivity calculations, into effort and then cost and finally duration.
• Clearly greater knowledge of the resources at our disposal and the problem domain will result in greater accuracy. This can be expressed in the form of confidence in our estimate.
• A brief look at the major factors impacting development time and resources.
• A classification of methods and techniques for estimating time and resources.
• We can formalise what we do instinctively – the Analogy method (for example Shepperd’s ANGEL) - compares the current task with past projects.
• A further problem involves the estimates of system size. None of the standard measures have the accuracy we would like although there are other advantages.
• Generally, when all else fails, we have to fall back on Expert Opinion. This is very pragmatic although we can improve accuracy by using a micro estimation approach with many modules, many phases, many estimates, by employing the PERT Beta function or by trying Delphi and other review methods for gaining consensus.
• Every estimate should have a confidence interval associated with it.
• Finally: it is important, given any method we choose, that the estimate is regularly reviewed.

Core reading
Bruegge & Dutoit: Section 11.3
Pressman. Chapter on "Estimation"
Sommerville. Chapter on "Software Cost Estimation"

Further reading
One of the most influential and referenced books in Software Engineering is Boehm, B.W. Software Engineering Economics, Prentice Hall, 1981.