

	Solids Wastes
ECTS credits	2
Year / Semester	II/2°
Specific learning outcomes	<p><i>The module considers solid wastes from industry, commerce and domestic sources. The concept of a waste management hierarchy is introduced and practical ways in which it might be implemented are discussed. These include waste minimisation, reuse, recycling and recovery as practical alternatives to disposal techniques. The technology and management strategies associated with such schemes are dealt with in detail and include: the design and operation of materials reclamation facilities; composting and anaerobic digestion; and thermal treatment processes. How the selection of these options is influenced by legislative issues is developed in a parallel manner. The module also considers planning and economic issues associated with the industry which leads on to a detailed examination of the most dominant current practice of landfill as a final disposal option. In this part of the course emphasis is placed on the design and engineering of landfill so as to maximise recovery options and negate environmental damage. The module includes a 1/2 day workshop on post closure landfill monitoring design and implementation used to familiarise students with details of the statutory monitoring required to protect ground water resources. This workshop attendance is compulsory as it is assessed to contribute 10% to the final mark. The module may include a field trip to a waste management facility if student numbers allow this; if not visual material will be used to familiarise students with details of typical plant and installations.</i></p>
Contents	<p><i>Provide students with the key legislation and policy for waste management and their implications for waste management practices</i></p> <ul style="list-style-type: none"> - Equip student to carry out waste management design or waste management technology selection including recycling, composting, anaerobic digestion, thermal technology and landfill in a specific water management context. - Offer knowledge and skills for evaluation of both resource and energy recovery from waste, and environmental impact from common waste management practices <p><i>Introduce you to the skills, techniques and processes required to effectively communicate your ideas to team members, professionals and lay persons.</i></p> <p><i>1. Driving forces in the waste management industry: Introduction to waste legislation. Quantities and types of waste for disposal; hierarchy of options. Legislative and economic factors affecting wastes management (current and forthcoming), and the structure of the industry.</i></p> <p><i>2. Waste management strategies: Waste minimisation, reuse and recycle are dealt with in the context of an ideal waste management strategy. These options are considered by means of example and by critical appraisal of the techniques and technologies that might be used. Waste segregation options and resource recovery are considered at various stages in the cycle of utility and the applicability of these to the reclamation of value added materials. Where possible these are viewed in relation to regulatory and economic drivers, as well as taking into consideration strategic planning for waste at a national, district and local level</i></p> <p><i>. 3. Waste recovery options: Organic wastes - bio-processing options are dealt with including a detailed examination of composting and anaerobic digestion processes for the production of value added products, where applicable case studies are used to highlight the advantages and disadvantages of such schemes including coprocessing (municipal and other wastes). Energy from wastes - Incineration and heat recovery processes are considered both in environmental and economic terms. Consideration is given to the types of plant used and also to the production of refuse derived fuel</i></p>

	<p><i>(RDF). New technologies for the thermal processing of waste, including pyrolysis and gasification, are briefly introduced. Hazardous wastes are dealt with in context to the management and disposal options including the concept of producer responsibility. The latter is considered in light of the various regulatory drivers such as the waste electrical and electronic equipment (WEEE) directive, and the end of life vehicles (ELV) directive.</i></p> <p><i>4. Waste disposal options: The key drivers that are influencing the types of materials that are acceptable for disposal in landfill are introduced and discussed. Landfill management and the potential to develop landfill engineering as a sustainable system for the reception of wastes are considered. This includes the concepts of landfill gas recovery, the pre-treatment of wastes through mechanical biological treatment (MBT) to reduce fugitive emissions and control leachate characteristics. These points are dealt with in the context of the Landfill Directive and other associated legislation (e.g. Groundwater Directive). Operational and management considerations for the landfilling of wastes are discussed along with the future of landfill in the context of monitoring and aftercare.</i></p>
Teaching and learning methods	Face to face, 60 hours
Teaching techniques	<p><i>Lectures, 35 hours</i> <i>Practical classes, 25 hours</i> <i>Formal lectures and website material, including lecture notes and presentations. The lecture course will introduce the various facets of this multi-disciplinary subject. Because of the specialist nature of the course additional reading material is recommended associated with both the general aspects of the course and to back up individual lectures. The course is fully supported by the web based 'Blackboard' learning resource which can help to reinforce the basic material covered in the lectures.</i></p>
Assessment methods	<p><i>Written and oral.</i> <i>A mid-term written test and a final-term written test are foreseen.</i> <i>The mid-term written test will be devoted to the assessment of the level</i></p>
Assessment criteria	<p><i>Having successfully completed this module, you will be able to demonstrate knowledge and understanding of:</i></p> <ul style="list-style-type: none"> <i>• Anaerobic digestion of waste</i> <i>• Composting of waste</i> <i>• How we quantify waste and its potential as a natural resource</i> <i>• Landfilling of waste</i> <i>• The implication of key pieces of legislation and their implications for those in the wastes management sector and industry</i> <i>• The management techniques and methods used to introduce schemes for minimisation, reuse, recycle, recovery and disposal.</i> <i>• The waste management hierarchy</i> <i>• Thermal processing of waste</i> <i>• Waste: what it is and the definitions that are associated with it</i> <p><i>Having successfully completed this module you will be able to:</i></p> <ul style="list-style-type: none"> <i>• Develop outline waste management plans</i> <i>• Consider the management of wastes in a rational manner</i> <i>• Recognise the opportunities for maximising the value in waste</i>

	<ul style="list-style-type: none"> • <i>Select and utilise in a quantitative manner information for the design of treatment and disposal processes</i> • <i>Critically analyse the limitation of waste management strategies and plans</i> • <i>Recognise waste management processes as part of our engineered infrastructure</i> • <i>Problem analysis and problem solving</i> • <i>Information handling</i> • <i>Develop time management skills</i> • <i>Develop independent learning skills</i> • <i>Interpret numerical data</i> • <i>Research for further information to develop ideas further</i>
Assessment metrics	<i>Attribution of a final grade</i>
Criteria of attribution of the final grade	<i>The final grade will be determined according to the following rules:</i> <ul style="list-style-type: none"> - <i>Mid-term written test: 30%</i> - <i>Final term written test: 70%</i>
Preparatory course units	<i>N.A.</i>
Didactic material	<i>Paul T. Williams, (2005). Waste Treatment and Disposal</i>