UNIVERSITI TEKNOLOGI MARA

PST644: GREEN POLYMER TECHNOLOGY

Course Name (English)	GREEN POLYMER TECHNOLOGY APPROVED
Course Code	PST644
MQF Credit	3
Course Description	The word “green” implies clean and friendly environment. This course is concerned with waste management. Here waste management refers to means and ways of disposing wastes or scraps. Wastes or scraps can come from various materials and products such as metals, ceramics, papers, glasses, woods etc. However, this course is concerned with waste materials or products which are based from rubber and plastics (polymeric materials) only. The course will look into the current practice of disposing scrap tyres, rubbers and plastics, and will cover topics such as land filling, reclaiming process, recycling, energy recovery and pyrolysis. Other polymeric materials and technology which contribute to the green environment such as biodegradable plastics and recent curing technology will also be discussed.
Transferable Skills	Green technology and waste management
Teaching Methodologies	Lectures, Case Study, Tutorial, Discussion, Journal/Article Critique
CLO	CLO1 Define concepts of green chemistry and sustainability of the environment and identify and describe ways of optimising the use of thermoplastics and biodegradable polymers to minimise resource use,waste generation and post consumer ,waste rocovery problem CLO2 Describe and critically identify various methods of managing waste: recycling and reuse, reclaiming, land filling, energy recovery, polymerization and curing techniques; merits and limitation of each method in terms of technology, efficiency and costs CLO3 Recognize and select the most appropriate methods of managing waste and energy recovery under a given environmental and economic status of a community and creating green technology awareness to social and community CLO4 Describe beyond technology know-how in green technology and impacts of green polymer technology to environmental ,social and economy
Pre-Requisite Courses	No course recommendations

Topics
1. Introduction to sustainable development 1.1) 1.1 The environment and sustainable development: an integrated waste management strategy for thermoplastics 1.2) 1.2 Thermoplastics and biodegradable polymers An issue for sustainability and green environment 1.3) 1.3 Integrated resource and waste management policies for thermoplastics 1.4) 1.4 Issues and strategy on the utilisation of biodegradable polymers as environmentally safe materials
2. Recycling BIOPOL 2.1) 2.1 Composting and Material recycling 2.2) 2.2 Application and Environmental Aspects of Chitin 2.3) and Chitosan 2.4) 2.3 Use of biosynthetic, biodegradable and 2.5) thermoplastics from renewable 2.6) resources: the pros and cons 2.7) 2.4 Matter cycling in ecosystems

3. Waste streams and management of thermoplastic and biodegradable po
3.1) 3.1 Thermoplastic and biodegradable production and
3.2) global consumption of the polymers
3.3) 3.2 Waste stream categories
3.4) 3.3 Recovery and recycling of thermoplastic and
3.5) biodegradable waste in different countries
3.6) 3.4 Laws and limitation in thermoplastic waste
3.7) management

4. Future directions: towards sustainable technology from thermoplastics
4.1) 4.1 Introduction
4.2) 4.2 Designing for recyclability
4.3) 4.3 New polymer recycling technologies

5. Introduction to waste management
5.1) 5.1 Statistics of rubber wastes
5.2) 5.2 Potential problems to environment - Air and water pollution, Breeding of mosquitoes, rats, rodent and snakes
5.3) 5.3 Methods of managing rubber wastes

6. Land filling
6.1) 6.1 Introduction
6.2) 6.2 Methods of filling
6.3) 6.3 Merits and limitations

7. Whole tyre recycling and reclaim rubber
7.1) 7.1 Introduction
7.2) 7.2 Technology of tyre recycling
7.3) 7.3 Applications of tyre recycling
7.4) 7.4 Merits and limitation of the process
7.5) 7.5 Reclaim rubber

8. Energy recovery and pyrolysis
8.1) 8.1 Introduction
8.2) 8.2 Methods of energy recovery
8.3) 8.3 Merits and limitations of each method
8.4) 8.4 Method of pyrolysis
8.5) 8.5 Merits and limitations of pyrolysis

9. Introduction to Green Chemistry and Sustainability
9.1) 9.1 Definition of Green Chemistry and sustainability
9.2) 9.2 The Concept of Atom Economy
9.3) 9.3 Risk and Hazard
9.4) 9.4 Clean Technology Pool
9.5) 9.5 Design for Degradation
9.6) 9.6 Life cycle Assessments

10. Renewable polymers
10.1) 10.1 Introduction to plant polymer : Resources,
10.2) Demands and Sustainability
10.3) 10.2 Polymer, Composites and Foam from Plant Oil
10.4) 10.3 Sugars
10.5) 10.4 Starch
10.6) 10.5 Cellulose/Hemicelluloses
10.7) 10.6 Poly(lactic Acid)
10.8) 10.7 Polyhyroxyalkonates
10.9) 10.8 Proteins
10.10) 10.9 Chitin and Chitosan

11. Polymerizations and Curing Technique
11.1) 11.1 Suspension and emulsion polymerization
11.2) 11.2 Supercritical fluid in polymerization
11.3) 11.3 Emission of Monomer and Volatile Organic Compounds (VOC)
11.4) 11.4 Ultra violet and Electron Beam Curing
11.5) 11.5 Microwave Curing

Assessment Breakdown	%
Continuous Assessment	60.00%
Final Assessment	40.00%

Details of Continuous Assessment

Assessment Type	Assessment Description	% of Total Mark	CLO
Assignment	Biodegradable polymer in Automobile and Aircraft technology	20%	CLO1
Presentation	Case study- Creating awareness on waste management,policies and stratergies	20%	CLO2
Test	Test 1 From CLO 2,3 Topics 1-5	20%	CLO2

Reading List

Recommended Text

- **Adisa Azapagic,Alan Emsley,Ian Hamerton 2003, *Polymers*, John Wiley & Sons [ISBN: 9780470862186]**
- **Caroline Baillie 2004, *7. Green composites: Polymer composites and the environment*, Woodhead Publishing**

Reference Book Resources

- **Martin Šalaa, Yuki Kitaharaa, Seiji Takahashia, Toshihiro Fujiia 2010, *Effect of atmosphere and catalyst on reducing bisphenol A (BPA) emission during thermal degradation of polycarbonate*„ Chemosphere**
- **Valerie Shulman 2004, *Tyre Recycling*, iSmithers Rapra Publishing [ISBN: 9781859574898]**
- **Emo Chiellini,Roberto Solaro 2003, *Biodegradable Polymers and Plastics*, Springer Science & Business Media [ISBN: 0306478846]**

Article/Paper List

Reference Article/Paper Resources

- **Martin Šalaa, Yuki Kitaharaa, Seiji Takahashia, Toshihiro Fujiia, (Chemosphere) 2010, Effect of atmosphere and catalyst on reducing bisphenol A (BPA) emission during thermal degradation of polycarbonate, Volume 78, Issue 1, January 2010, Pages 42–45, 42**

Other References

- **book Caroline Baillie 2004, *Green composites: Polymer composites and the environment* , Woodhead Publishing, London, UK**