UNIVERSITY OF BIRMINGHAM

Module Name:	**Polymer Science and Soft Matter**
Module Code:	**04 18515**
Presenter(s):	**Dr Stephen Kukureka, Dr Mike Jenkins**
Credit Rating:	**10**
Venue:	**School of Metallurgy & Materials, University of Birmingham**

Description:

Lectures *(topics subject to modification)*

Introduction to polymers I, II and III

Polymer synthesis. Step-growth and free radical polymerisation. The glass transition temperature and spherulites. DSC and FT-ir. ôRough guidesô to the techniques. Factors affecting T_g, miscibility and crystallisation. TPE and thermally-reversible cross-links.

Polymer blends

Thermodynamics of mixing applied to polymer blends. Flory-Huggins theory of miscibility.

Cyclic polymers

Principles of cyclic polymers. *In situ* polymerisation, crystallisation and blending. Case study of blending and instrumental techniques.

Liquid crystal polymers and block copolymers

Thermodynamics of melting applied to thermotropic liquid crystal polymers. Examples of thermotropic, mouldable polyesters. Lyotropic liquid crystal polymers. Summary of block copolymer features and morphologies.

Laboratories (15 %)

Each student will complete a linked series of three labs on DSC, FTIR and mechanical properties of a series of polymers. Assessment by completion of a lab pro-forma.

Case Studies (25 %)

Groups of three students will jointly investigate a topic to be given out on Monday morning. Each group to present a 20-min seminar on Friday morning.

Examination (60 %)

This will be a two-hour examination with three questions to be chosen from five. It will be Open Book in that notes etc (but not textbooks) can be brought into the exam. It is expected that successful attendance at the course and notes issued during the week should be sufficient for the examination.

Syllabus:

Optional preliminary reading

a) Polymers_1, **Polymers_2** and **Polymers_3** (attached in pdf form) from Professor Athene Donald FRS at Cambridge. (Don't worry too much about the maths - but the rest is interesting and useful.) These notes are from an extensive collection on her web-site http://www.poco.phy.cam.ac.uk/teaching/A_Donald/ and other lectures may be of interest through they're not all relevant for this course. *(Used with permission.)*

b) Review of Polymer Structure from Professor Andrew Long at Nottingham. He has a great collection of notes at http://www.nottingham.ac.uk/~eazacl/H3CPOE/Notes.htm *Review of Polymer Structure* and other notes can be viewed on-line or downloaded in pdf form - they're a little more straightforward than those in (a) above and biased more to engineering than physics. Many of them are relevant for the engineering aspects of the course this week. *(Used with permission.)*

Essential reference

c) Macrogalleria - 'a cyberwonderland of polymer fun' http://www.pslc.ws/macrog/index.htm *(NB You need to scroll down to the bottom of the first page to see the full index)*

Other background reading and reference

None of these is essential but all of them are interesting and useful in some way.

J.M.G Cowie, *Polymers: Chemistry & Physics of Modern Materials* (2/e, Blackie, 1991)
R.J. Young and P.A. Lovell, *Introduction to Polymers* (2/e, Chapman & Hall, 1991)
L.H. Sperling, *Introduction to Physical Polymer Science*, (3/e, Wiley, 2001)
D. Campbell, R.A. Pethrick, J.R. White, *Polymer Characterization*, (2/e, Thornes, 2000)
F. Rodriguez, C. Cohen, C.K. Ober, L.A. Archer, *Principles of Polymer Systems*, (5/e, Taylor & Francis, 2003)
L.H. Sperling, *Polymeric Multicomponent Materials*, (Wiley, 1997)
G.W. Ehrenstein, *Polymeric Materials*, (Hanser, 2001)
W. Michaeli, *Plastics Processing*, (Hanser, 1995)
T.A. Osswald & G. Menges, *Materials Science of Polymers for Engineers*, (Hanser 1996)
A.M. Donald & A.H. Windle, *Liquid Crystalline Polymers*, (Cambridge, 1992) Chapter 3
R.W. Dyson, *Engineering Polymers*, (Blackie, 1990) Chapter 1.6, Chapter 3.
I.W. Hamley, *Introduction to Soft Matter*, (Wiley, 2000)
P.M. Ajayan, L.S. Schadler, P.V. Braun, *Nanocomposite Science and Technology*, (Wiley-VCH 2003) Chapter 2.
M. C. Petty, *Molecular Electronics*, (Wiley, 2007)

é ..and finally, some light bed-time reading from a Nobel laureate:

P-G. de Gennes, J. Badoz, *Fragile Objects: soft matter, hard science and the thrill of discovery* (Copernicus, 1996)

Learning Outcomes:

On successful completion of the module, students should be able to:

- Explain the principal features of modern methods of polymer synthesis.
- Relate synthesis and processing to morphology to explain polymer structures.
- Predict polymer properties from structures for a variety of examples in modern polymer science.

- Use laboratory techniques and be familiar with selected polymer characterisation techniques.
- Investigate, summarise and explain an advanced topic.

Assessment:

Examination (plus seminar and assignment if appropriate). Laboratory and case study assignment (unless excused by previous attendance). Seminar presentation. More details see Module Description.