

WM9C8-15 Polymeric and Composite Processing

21/22

Department

WMG

Level

Taught Postgraduate Level

Module leader

Neill Raath

Credit value

15

Module duration

5 days

Assessment

100% coursework

Study location

University of Warwick main campus, Coventry

Description

Introductory description

With the increased need for lightweighting, and advances in materials technology, polymers and polymer composites are being applied in automotive applications in greater volumes. This module will equip students with comprehensive knowledge of different polymer classes, including properties, processing techniques and finishing operations. Students will gain an understanding of the environmental considerations of utilising polymers, as well as the CAE techniques to predict component behaviour.

Module aims

- To enable automotive engineers to analyse and evaluate the use of the full range of composite materials and processes
- To provide comprehensive knowledge of different classes of polymers, their key properties, and characteristics, including processing techniques and post-finishing operations.
- To provide appreciation of robust design principles of selecting polymer and manufacturing processes.
- To provide comprehensive knowledge to enable students to take into account component performance, design for manufacture and assembly, light-weighting potential, manufacturing

volumes, investment, LCA and repairability for each material type.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

Polymer classes (thermoplastics, thermosets and elastomers)

Natural composites

Material properties (Physical, Thermal, Chemical, Reinforced and unreinforced polymer properties)

Polymer and composite processing methods

Joining methods

Repairability

Decoration (Painting, Plating, Graining)

Prediction of properties

CAE methods

Advanced Modelling Methods

Moldflow

Design for parts

Practical lab-based sessions (when circumstances allow)

Learning outcomes

By the end of the module, students should be able to:

- Evaluate the appropriate unreinforced and reinforced materials and manufacturing processes for each automotive engineering application, taking into account material, tooling and infrastructure investment cost as well as appraisal of the environmental impact of different polymer processing technologies.
- Conceptual creation of an advanced component or vehicle architecture; selecting of the ideal material and process to give a cost of weight saving suitable for the target vehicle's performance, packaging and structural requirements as well as selection of appropriate joining technologies.
- Evaluate the benefits of a reinforced and unreinforced polymer component in a range of vehicle structural applications as well as evaluating the opportunities for product enhancement and light-weighting.
- Interpret the applications of virtual validation and CAE methods to ensure robust polymer solutions for vehicle implementation.

Indicative reading list

Introduction to Composite Materials Design, E.J. Barbero. CRC Press, 2010. ISBN: 9781420079159

Composite Engineering and Structures for Engineering Students, S. Grove. Kindle Direct Publishing, 2018. ISBN: 978-1983344800

Analysis and Performance of Fiber Composites, B.D.Agarwal, L.J. Broutman, K. Chandrashekhara, Wiley, 2017. ISBN: 0471511528

Green composites : natural and waste-based composites for a sustainable future, C. Baillie and R. Jayasinghe. Woodhead Publishing, 2017. ISBN: 9780081008003

Principles of the manufacturing of composite materials, S.V. Hoa. DEStech Publications, 2018. ISBN: 9781605954219

Reinforced polymer composites: processing, characterization and post life cycle assessment, P.K. Bajpai and I. Singh. Wiley, 2020. ISBN: 9783527820962

Recycling of polymers : methods, characterization and applications, R. Francis. Wiley, 2016. ISBN: 9783527689002

Handbook of polymers, G. Wypych. ChemTec Publishing, 2016. ISBN: 9781927885116

High performance polymers, J.K. Fink. William Andrew Publishing, 2014. ISBN: 9780323311434

Subject specific skills

The module will develop the following subject specific skills: Appraisal of the suitability of a polymer or polymeric composite for specific automotive applications, Critical analysis of the difference in environmental impact between different processing methods; Evaluation of the appropriate material for specific automotive applications.

Transferable skills

Collaborative working, Critical thinking and analysis, Academic writing skills

Study

Study time

| Type | Required |
|-------------------------------|-----------------------------|
| Lectures | 25 sessions of 1 hour (17%) |
| Seminars | 3 sessions of 1 hour (2%) |
| Tutorials | 2 sessions of 1 hour (1%) |
| Supervised practical classes | 5 sessions of 1 hour (3%) |
| Online learning (independent) | 20 sessions of 1 hour (13%) |
| Assessment | 95 hours (63%) |
| Total | 150 hours |

Private study description

No private study requirements defined for this module.

Costs

No further costs have been identified for this module.

Assessment

You do not need to pass all assessment components to pass the module.

Assessment group A

| | Weighting | Study time | Eligible for self-certification |
|--|-----------|------------|---------------------------------|
| Assessment component | | | |
| Post-module Assessment | 80% | 90 hours | Yes (extension) |
| A written report investigating the environmental and manufacturing effects of implementing the optimal material for a selected automotive component/system. This report will consider areas such as suitable material properties and processing techniques, environmental impact of utilising materials and performing processing, sustainability of composites, investment costs, joining technologies, and end-of-life environmental impact. | | | |

Reassessment component is the same

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|--|-----|---------|----|
| Assessment component | | | |
| In-module Assessment | 20% | 5 hours | No |
| Critical evaluation of implementing a composite component in an automotive application, considering areas such as suitable material properties, processing, environmental impact and cost. | | | |

Reassessment component is the same

Feedback on assessment

Written feedback, of approximately 300 - 400 words, will be provided 4 weeks after the date of submission. The feedback

will be focussed on the strengths and weaknesses of the work with regards to the module learning objectives and the post module assessment marking guidelines. Suggestions for improvement will also be provided.

Availability

There is currently no information about the courses for which this module is core or optional.