Subject Description Form

Subject Code	AP30008
Subject Title	Polymers and Composites
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	This subject aims to provide a basic understanding of the structure, properties, behaviour and applications of polymers and composites.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) explain the fundamental concepts and terminologies in polymers and polymer-based composites; (b) classify polymers in terms of their molecular structures, repeat units and skeletal structures; (c) explain the physical properties of polymers based on their molecular and skeletal structures; (d) describe the mechanical behaviors of polymers under different conditions and the typical techniques used for their measurement; (e) use mechanical models to describe the viscoelastic behavior of polymers; (f) apply the time-temperature superposition principle to predict the viscoelastic behavior of polymers; (g) describe the principles and methods of toughening and reinforcing polymers; (h) use the rule of mixtures to predict the elastic properties of long-fiber and short-fiber reinforced unidirectional composites; and (i) perform standard tests to characterize polymers and composites.
Subject Synopsis/ Indicative Syllabus	**Structure**: crystalline, glassy and partially crystalline; LRO, SRO, crystallites, liquid crystals, linear and 3D network; Tg and Tm, structure and bonding. **Polymers**: thermoplastics, thermosets, elastomers, linear, branched, cross-linked and network; polymerization; average molecular weights; commercial polymers; nylon and hydrogen bond, engineering plastics; environmental effects, flammibility; copolymers, blends and alloys. **Properties**: viscosity, newtonian fluid, hookean solid, maxwell, voigt and general purpose viscoelastic models; elastic, anelastic and viscous behaviour, brittle fracture, fracture toughness, time-temperature equivalence; creep and stress relaxation, fatigue, tensile and compressive strengths, hardness, impact and abrasion; viscoelastic modulus. **Composites**: rule of mixture, fillers and reinforcements; aspect ratio; reinforcement types; matrix materials, fabrication techniques, costs, properties, applications and service behaviour; catergories, GRP and other reinforced composites; metal matrix, polymer matrix and ceramic matrix composites.

Teaching/Learning Methodology

Lectures are the basic medium to deliver the fundamental knowledge of the physical properties of radiation, its production and interactions with matter. The lecture materials are reinforced with figures and animations to facilitate students to learn and understand the concepts easily and intuitively.

Tutorials are scheduled for students to work on in-class exercises so as to help them understand the teaching materials and apply the knowledge in solving problems. The students are encouraged to discuss and share their idea with their classmates in doing the exercises (promoting cooperative learning).

Experiments are also scheduled for students to help them understand the properties and behaviour of polymers and composites and the corresponding standard tests.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)								
		a	b	c	d	e	f	g	h	i
(1) Continuous assessment	40	✓	✓	✓	✓	✓	✓	✓	✓	✓
(3) Examination	60	✓	✓	✓	✓	✓	✓	✓	✓	✓
Total	100									

Continuous assessment consists of assignments, laboratory reports and mid-term test.
Assignments are used to strengthen the basic knowledge of students and their analytical skill to solve the problems related to polymers and composites.
Laboratory reports are used to measure the student capability in understanding, describing and analyzing the physical properties and behaviour of polymers and composites.
Problem questions, including short and long questions, are used in tests and final examination to measure the student knowledge of polymers and composites. The questions are designed to cover all the intended learning outcomes. The students are required, through answering all the questions, to demonstrate their capability in comprehending, explaining and analyzing the physical properties and behaviour of polymers and composites.

Student Study Effort Expected

Class contact:	
• Lecture	26 h
• Tutorial	6 h
• Laboratory	9 h
Other student study effort:	
• Self-study	79 h
Total student study effort	120 h

Reading List and References

Fried Joel R., Polymer Science and Technology 2nd ed. 2003, Prentice Hall.

McCrum N.G., Buckley C.P. and Bucknall C.B., Principles of Polymer Engineering 2nd ed. 1997, Oxford Science.

	Young R.J. and Lovell P.A., Introduction to Polymers 3rd 2011, Chapman & Hall. Michael M. Coleman, Paul C. Painter, Fundamentals of Polymer Science: An Introductory Text 2nd ed. 1998, CRC Press. Robert O. Ebewele, Polymer Science and Technology 2000, CRC Press. Billmeyer Fred W., Jr, Textbook of Polymer Science 3rd ed. 1984, John Wiley & Son.