Subject Description Form

Subject Code	ME6301
Subject Title	Properties, Applications and Modeling of Advanced Materials
Credit Value	3
Level	6
Pre-requisite / Co-requisite/ Exclusion	N.A.
Objectives	To provide students with theories, properties, applications and modeling methods of advanced composite materials, smart materials, and nano-materials.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. understand the mechanics of advanced composite materials, especially the mechanics of a lamina and laminates, including failure mechanisms; b. possess the state-of-the-art knowledge on smart materials and smart structure design; c. recognize the importance of nano-materials in advanced technology; and d. understand the applications of advanced composites, smart materials and nano-materials. e. understand advanced theories in mechanics of solids.
Subject Synopsis/ Indicative Syllabus	***Advanced Composite Materials*** **-** Composite constituents; principles of fibre-reinforced composites; mechanics of a lamina; mechanics of laminates, tooling and manufacturing processes; failure criteria for composites; design issues. ***Selected Topics of Advanced Theories in Mechanics of Solids*** **-** such as Theory of Plasticity, Theory of Fracture Mechanics. ***Piezoelectric Materials*** - The fundamental mechanisms of piezoelectric materials and major applications, Curie temperature, concept of piezoelectric moduli and applications of these moduli in design of sensors and actuators, smart structure design issues. ***Shape Memory Alloys (SMA)*** **-** Phenomena & mechanisms of temperature controlled shape memory effect, critical temperatures, stress effect on critical temperatures, mechanical properties of SMA at different phases and temperatures, shape memory and superelasticity, modeling of the effects of temperature and stress, special design considerations at joints, continuum vs. discrete applications of SMA, major applications of SMA. ***Nanomaterials*** **-** properties, applications and modeling of nano-materials. ***Laboratory Works:*** • Mechanical properties of shape memory alloys. • Strain measurement of composite structures using embedded fibre-optic sensors.

Teaching/Learning Methodology

1. The teaching and learning methods include lectures/tutorial sessions, homework assignments, test, mini-project or case study and examination.

2. The continuous assessment and examination are aimed at providing students with integrated knowledge required for advanced materials and structural design.

3. Technical/practical examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	Intended subject learning outcomes				
	a	b	c	d	e
1. Lectures	√	√	√	√	√
2. Tutorials	√	√	√	√	√
3. Homework assignments	√	√		√	√
4. Mini-project/Case study report and presentation		√	√	√	

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed				
		a	b	c	d	e
1. Homework assignments	15%	√	√		√	√
2. Mid-term test	25%	√				√
3. Mini-project/Case study report and presentation	10%		√	√	√	√
4. Examination	50%	√	√	√	√	√
Total	100%					

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

1. The assessment is comprised of 50% continuous assessment and 50% examination.

2. The continuous assessment consists of three components: homework assignments, mid-term test, mini-project or case study report & presentation. They are aimed at evaluating the progress of students study, assisting them in self-monitoring of fulfilling the respective subject learning outcomes, and enhancing the integration of the knowledge learnt.

3. The examination is used to assess the knowledge acquired by the students for understanding and analyzing the problems critically and independently; as well as to determine the degree of achieving the subject learning outcomes.

Student Study Effort Expected	Class contact:	
	▪ Lecture	33 Hrs.
	▪ Tutorial/Lab	6 Hrs.
	Other student study effort:	
	▪ Self Study	45 Hrs.
	▪ Mini-project/Case study report preparation and presentation	21 Hrs.
	Total student study effort	105 Hrs.
Reading List and References	1. Alan Baker, Stuart Dutton and Donald Kelly, *Composite Materials for Aircraft Structures*, AIAA, latest edition. 2. Ronald F. Gibson, *Principles of Composite Material Mechanics*, McGRAW-HILL, latest edition. 3. Srinivasan A. V. and McFarland D. M., *Smart Structures*, Cambridge University Press, latest edition. 4. Banks H. T., Smith R. C. and Wang Y., *Smart Material Structures*, John Wiley & Sons, latest edition. 5. Nanostructured Materials - Processing, Properties, and Applications, edited by Carl C. Koch, William Andrew Publishing, latest edition. 6. T.L. Anderson, *Fracture Mechanics: fundamentals and applications*, CRC Press Inc., latest edition. 7. A.S. Khan and S.J. Huang, *Continuum Theory of Plasticity*, John Wiley & Sons Inc., latest edition.	

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