2026 年度シラバス

科目分類/Subject Categories			
学部等/Faculty	/大学院工芸科学研究科（博士前期課程）：/Graduate School of Science and Technology (Master's Programs)	今年度開講/Availability	/有：/Available
学域等/Field	/物質・材料科学域：/Academic Field of Materials Science	年次/Year	/1～2年次：/1st through 2nd Year
課程等/Program	/材料制御化学専攻：/Master's Program of Material's Properties Control	学期/Semester	/春学期：/Spring term
分類/Category	/授業科目：/Courses	曜日時限/Day & Period	/ : /

科目情報/Course Information				
時間割番号 /Timetable Number				
科目番号 /Course Number	61760018			
単位数/Credits	2			
授業形態 /Course Type	講義・演習・実験：Lecture/Practicum/Lab			
クラス/Class				
授業科目名 /Course Title	Science and Technology of Composite Materials : Science and Technology of Composite Materials			
担当教員名 / Instructor(s)	/トリノ工科大学教員（材料創製化学専攻および材料制御化学専攻ダブル・ディグリープログラムコース）：Related teacher of Polytechnic University of Turin (Double Degree Program course in the Master's Program of Innovative Materials and Material's Properties Control)			
その他/Other	インターンシップ実施科目 Internship	国際科学技術コース提供科目 IGP	PBL 実施科目 Project Based Learning	DX 活用科目 ICT Usage in Learning
	実務経験のある教員による科目 Practical Teacher			
科目ナンバリング /Numbering Code				

授業の目的・概要 Objectives and Outline of the Course	
日	This course is aimed at the completion of the knowledge about the materials of the greatest interest for engineering; composite materials are presented also exploiting the knowledge previously acquired by the students about conventional metallic, polymeri
英	This course is aimed at the completion of the knowledge about the materials of the greatest interest for engineering; composite materials are presented also exploiting the knowledge previously acquired by the students about conventional metallic, polymeric and ceramic materials. Since the composite materials are processed by coupling two or more conventional materials a specific set of pre-fixed properties can be achievd. The second phase dispersed in the composite matrix frequently is processed according to specific processing paths that are presented in the first part of the course. Afterwards the main classes of composite materials (with polymeric, metallic and ceramic matrices) and their production technologies are discussed. The main properties of the composite materials(mechanical, thermal, thermo-mechanic and electric behaviour) and the fields of possible application are then presented. Composite materials showing pre-fixed properties fulfilling specific performance requirements can be designed, thus offering to engineers several solutions for practical applications. Micro-mechanical models suitable for designing a composite with tailored properties will be introduced. Finally the degradation processes that can affect composite materials will be discussed.

学習の到達目標 Learning Objectives	
日	completion of the knowledge about the materials of the greatest interest for engineering
英	completion of the knowledge about the materials of the greatest interest for engineering

学習目標の達成度の評価基準 / Fulfillment of Course Goals（JABEE 関連科目のみ）	
日	
英	

授業計画項目 Course Plan			
No.		項目 Topics	内容 Content
1	日		
	英	Introduction	The concept of composite material.
2	日		
	英	Production processes(1)	Physical, chemical and mechanical properties of: organic and inorganic long fibers, particles, whiskers and chopped fibers.
3	日		
	英	Production processes(2)	Classification of composites with polymeric, metallic and ceramic matrix. In-situ composites. Role of interfaces in composites.
4	日		
	英	Elastic behavior of composites containing long fibers(1)	Voigt an Reuss equations. Adoption of the mixture rule for the forecast of other composite properties.
5	日		
	英	Elastic behavior of composites containing long fibers(2)	Elastic behavior of composites containing long fibers(2)
6	日		
	英	Anisotropy of the single lamina of composite material:	Stiffness in different directions. Residual stresses.
7	日		
	英	Fiber strength(1)	statistical distribution according to Weibull equations. Strength of multi-filament fibers. Effect of fiber length on strength.
8	日		
	英	Fiber strength(2)	Micro-mechanical models for the calculation of the strength of both the single composite sheet (with long fibers) and the multi-layer laminate.
9	日		
	英	Fiber strength(3)	Experimental methods for interfacial strength measurement.
10	日		
	英	Strength of composites with short fibers, whiskers and platelets(1)	Adaptation of Shear-Leg model, Arsenault and Shi model (for MMCs).
11	日		
	英	Strength of composites with short fibers, whiskers and platelets(2)	Degradation of different kinds of composites owing to environmental conditions.
12	日		
	英	Strength of composites with short fibers, whiskers and platelets(3)	Creep and corrosion resistance. Detrimental reactions at the matrix/reinforcement interface in composites.
13	日		
	英	Toughness and fracture mechanisms(1)	Debonding, post debonding friction and pull-out.
14	日		
	英	Toughness and fracture mechanisms(2)	Toughening of ceramic matrices through the adoption of a not-continuous second phase.
15	日		
	英	Toughness and fracture mechanisms(3)	Fatigue behavior of different classes of composites.

履修条件 Prerequisite(s)	
日	
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授業時間外学習（予習・復習等） Required study time, Preparation and review	
日	Basic knowledge of Chemistry, Physics, Mathematics. Knowledge about traditional metallic, polymeric and ceramic materials. Standards for the measurement of: tensile strength of fibers; tensile, compression, flexural strength, toughness and hardness of composites with polymeric, metallic and ceramic matrices. Laboratory practice: measurement of tensile strength, modulus and toughness of composites. Laboratory practice: observation of composite microstructure by optical microscope.
英	Basic knowledge of Chemistry, Physics, Mathematics. Knowledge about traditional metallic, polymeric and ceramic materials. Laboratories and/or tutorial or practice classes. Standards for the measurement of: tensile stregth of fibres; tensile, compression, flexural strength, toughness and hardness of composites with polymeric, metallic and ceramic matrices. Laboratory practice: measurement of tensile strength, modulus and toughness of composites. Laboratory practice: observation of composite microstructure by optical microscope. Use of a software for the selection of materials based on material charts of Ashby. Use of simple micro-mechanical models for the forecasting of composite properties.

教科書／参考書 Textbooks/Reference Books	
日	Learming materials. Reference book: a) C. Badini , Materiali Compositi per l¿Ingegneria 2° Ed, Celid, Torino 2008; Other study materials: b) F.L. Matthews, R.D. Rawlings, Composite Materials: Engineering and Science, Chapman & Hall, Londra 1994; c) B. Har
英	Learming materials. Reference book: a) C. Badini , Materiali Compositi per l¿Ingegneria 2° Ed, Celid, Torino 2008; Other study materials: b) F.L. Matthews, R.D. Rawlings, Composite Materials: Engineering and Science, Chapman & Hall, Londra 1994; c) B. Harris, Engineering Composite Materials, IOM Communication Ltd (London), The University Press, Cambridge 1999

成績評価の方法及び基準 Grading Policy	
日	Written test dealing with problems with calculation. Compulsory subsequent oral test. Both these test will be carried out by exploiting the "virtual classroom" facility. The final exam consists of two tests: written and oral. During the written test, the
英	Written test dealing with problems with calculation. Compulsory subsequent oral test. Both these test will be carried out by exploiting the "virtual classroom" facility. The final exam consists of two tests: written and oral. During the written test, the candidates are requested to answer some questions (from 15 to 20) and solve three problems (with the help of a calculator). The help of books, notes of internet connections during the written test is not permitted.

留意事項等 Point to consider	
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