



PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 38th cycle

Research Area n. 1 - Advanced Materials and Smart Structures

Number of scholarship offered	7
Department	DIPARTIMENTO DI MECCANICA

Description of the Research Area
<p>Research on advanced materials and smart structures is playing a crucial role in all the branches of mechanical and production engineering. The design and development of innovative materials is relevant to enhance specific functional properties customized on engineering applications. Both the innovative and existing materials require new processes to enhance material performance, to integrate new features and/or reduce the effect on the environment (i.e., eco-friendly production).</p> <p>New (numerical and experimental) multiscale models have to be investigated in order to characterize the mechanical behaviour of materials under different service conditions and degradation patterns. Moving from the material to the component and then to the mechanical systems, smartness and metamaterials can further help reaching customized functional performance. Development of smart materials, smart components and integrated measurement and control systems can lead to significant benefits (e.g. structural health monitoring, vibration attenuation, energy harvesting, quality control).</p> <p>Eventually, advanced modelling and experimental investigation of the interaction between the structure and the environment (e.g., bridge aeroelasticity, tall buildings and roof aerodynamics, cable dynamics) can aid designing a new generation of large structures where dynamic control is included at the design level.</p> <p>There are 7 available scholarships in this area:</p> <ul style="list-style-type: none"> - 1 generic - 3 thematic (to be specifically selected during application procedure) - 3 interdoctoral (to be specifically selected during application procedure) <p>The generic scholarship refers to the following field:</p>



- Advanced Modelling and Testing of Materials for Machine Design

3 thematic scholarships, on the following topics:

- Actively controlled system to test bridge decks in wind tunnel
- Metamaterials for cloaking and acoustic stealth
- Innovative materials and advanced processes

One thematic interdoctoral scholarship, jointly supervised by the PhD Programme in Mechanical Engineering and by the PhD Programme in Mathematical Models and Materials in Engineering, is available on the following research topic:

Real-time optimal control and monitoring of mechanical structures by PDE constrained optimization and reduced order modeling

One thematic interdoctoral scholarship, jointly supervised by the PhD Programme in Mechanical Engineering and by the PhD Programme in Structural Seismic and Geotechnical Engineering, is available on the following research topic:

Tailored piezoelectric materials and optimally designed metamaterials for enhanced mechanical energy harvesting

One thematic interdoctoral scholarship, jointly supervised by the PhD Programme in Mechanical Engineering and by the PhD Programme in Industrial Chemistry and Chemical Engineering, is available on the following research topic:

Smart technologies for vertical and precision farming

Applicants should select thematic scholarships following the instructions provided in the call for application/application procedure.

The PhD scholarships available in this area are partially funded with the support of the Italian Ministry of Education, University and Research, through the project Department of Excellence LIS4.0 (Integrated Laboratory for Lightweight e Smart Structures).

Further information on the thesis topics available in this can be found at the following link: <https://www.mecc.polimi.it/us/phd/admission/>



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Research Area n. 1 - Advanced Materials and Smart Structures

**OPEN SUBJECT Research Field: ADVANCED MODELLING AND TESTING OF MATERIALS
FOR MACHINE DESIGN**

Monthly net income of PhDscholarship (max 36 months)
€ 1325.0
<p style="font-size: small;">In case of a change of the welfare rates or of changes of the scholarship minimum amount from the Ministry of University and Research, during the three-year period, the amount could be modified.</p>

Context of the research activity	
<p>Motivation and objectives of the research in this field</p>	<p>Working in the Machine and vehicle design group requires motivation in developing experimental and computational methods for the assessment of the structural integrity and advanced design of mechanical components and vehicles. The objectives of the research may range from the definition of new models of materials behaviour to the assessment of the structural integrity of large structures, from the experimental investigation on new materials (or materials processed with new manufacturing processes) to the design of components or vehicles with innovative features. In particular, the attention may be addressed to the detailed fatigue and fracture assessment of additively manufactured critical components, as well as to the design of structures under extreme loading conditions focusing on composite components subjected to impacts and blast loading.</p>
<p>Methods and techniques that will be developed and used to carry out the research</p>	<p>Depending on the specific research topic assigned, methods and techniques will comprise finite element modelling, boundary element modelling, fracture mechanics, multi-axial fatigue tests on specimens or on parts, non-destructive tests, high temperature tests, residual stress tests, tests on vehicle components, tests on gears, tests on power transmission.</p>



Educational objectives	The Doctor in Mechanical Engineering will be able to define, start and carry out original research by working in a team or leading a research group. Both theoretical and experimental skills are mastered.
Job opportunities	<p>Structures/organizations aimed at innovation and/or research and technical development, high-tech SMEs, government departments ruling on public needs. The following Companies, Universities and Institutions are cooperating in the research:</p> <p>Tenaris Dalmine S.p.A Leonardo S.p.A. ENI S.p.A Technical University of Clausthall, German MIT, Boston, USA Imperial College London University of California at Berkeley European Space Agency (ESA) Auburn University, National Center for Additive Manufacturing Excellence (NCAME) Avio-Aero, Rivalta (To) EAMIT (Pr) Thales Alenia Space</p> <p>Our last survey on MeccPhD Doctorates highlighted a 100% employment rate within the first year and a 35% higher salary, compared to Master of Science holders in the same field.</p>
Composition of the research group	6 Full Professors 14 Associated Professors 6 Assistant Professors 25 PhD Students
Name of the research directors	P. Giglio, Beretta, Gobbi, Guaigliano, Mastinu, Vergani

Contacts	
First contact, to be redirected to one of the research directors: Prof. Chiara Colombo chiara.colombo@polimi.it. For questions about scholarship/support: phd-dmec@polimi.it.	

Additional support - Financial aid per PhD student per year (gross amount)	
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Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	662.5 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Financial aid is available for all PhD candidates (purchase of study books and materials, funding for participation in courses, summer schools, workshops and conferences) for a total amount of euro 5401, 42.

Accommodation in Politecnico's Residences (<http://www.residenze.polimi.it>) is available for PhD candidates; special rates will be applied to selected out-of-town candidates (detailed info in the call for application). Our candidates are strongly encouraged to spend a research period abroad, joining high-level research groups in the specific PhD research topic, selected in agreement with the Supervisor.

An increase in the scholarship will be applied for periods up to 6 months (approx. 660 euro/month - net amount).

Teaching assistantship: availability of funding in recognition of supporting teaching activities by the PhD candidate. There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.