

PhD Program in Automotive for Intelligent Mobility

A Joint Program between the University of Bologna,
the University of Modena and Reggio Emilia and the University of Parma



List of the Confirmed Educational Activity for the 38th cycle

Information:

- A. On-line calendar is available
- B. In case of Webinars, the links and the login instructions to attend are usually provided with specific emails.
- C. Activities are compulsory for all curricula or for single curriculum unless otherwise specified

Title	Artificial Intelligence Algorithms and Machine Learning Techniques with Applications to the Automotive Sector
Year	First Year
Hours	20
Description	<p>This course covers data analysis and Machine Learning techniques in MATLAB® using the functionality offered by the Statistics and Machine Learning Toolbox™ and Deep Learning Toolbox™. The course illustrates the use of unsupervised learning to detect features in large datasets and supervised learning to develop predictive models. Examples and exercises highlight useful techniques for visualising and evaluating the achieved results, with particular reference to the automotive sector. List of topics:</p> <ul style="list-style-type: none">- Data organisation and pre-processing- Data clustering- Creation of classification and regression models- Interpretation and evaluation of models- Simplification of data sets- Use of ensembles to improve model performance
Curriculum	Curriculum I – II – III

Title	Reduction of CO2 emissions for automotive powertrains
Year	Second Year
Hours	24
Description	<p>The course will present the main technologies currently used and under development for reducing the environmental impact of vehicle propulsion systems with particular reference to CO2 emissions. The course will be divided into modules that will cover the following topics: optimisation of the efficiency of traditional, electric and hybrid powertrain components (electric motor, thermal motor, inverter and battery); general sizing criteria and control strategies for hybrid powertrains (MHEV, FHEV, PHEV); use of alternative low-carbon and bio-fuels. The topics may, in the coming years, be subject to further development based on technological developments in the sector.</p>
Curriculum	Curriculum II

Title	Advanced materials and manufacturing technologies
Year	Second Year
Hours	24
Description	<p>In the automotive industry, the “additive manufacturing” has played a key role as a prototyping technology in the past. With the advancement of technology, however, the possibility of using additive technologies for the series production of components is becoming increasingly important. Various aspects of additive manufacturing will be covered in the proposed course, in particular:</p> <ul style="list-style-type: none"> ° automotive - development processes and intellectual property ° technological aspects of additive manufacturing of metals: process overview, potential and challenges ° metallurgical aspects of metals processed using additive technologies: raw materials, microstructure, post-process heat treatments and mechanical properties ° topological optimisation for advanced manufacturing ° design guidelines for additive manufacturing ° design and qualification of automotive components produced by additive manufacturing
Curriculum	Curriculum I

Title	Connected and Autonomous Vehicles
Year	Second Year
Hours	24
Description	<p>The course aims to provide doctoral students with training in ICT and its applications to the automotive world. This course will focus on the research topics of the lecturers and groups involved in the doctoral college. In particular, the course will be structured in 4 monothematic lessons of 6 hours on the following topics:</p> <ul style="list-style-type: none"> - Vehicular networks, vehicular sensors and Big Data for mobility - 5GB and 6G networks for vehicular applications - Cloud infrastructures and Edge Computing for mobility - Connectivity for V2I - Vehicle to Infrastructure, V2V - Vehicle to Vehicle and V2G - Vehicle to Grid <p>These subjects may also be updated or refined depending on the research topics that will open in the coming years.</p>
Curriculum	Curriculum III

Title	Data-driven methods in engineering
Year	Third Year
Hours	16
Description	<p>The course consists of 12 hours of lectures and aims to provide the main elements concerning machine learning techniques for modelling complex dynamic systems. The course is divided into the following main phases</p> <ol style="list-style-type: none"> 1) Introduction. The singular-value decomposition (SVD) 2) Compressed sensing, optimal sensor placement 3) Robust principal component analysis and dynamic-mode decomposition (DMD) 4) Implementation of modal decompositions 5) Deep-learning applications and developments <p>Theoretical/practical exercises are offered during the course. Applications are also developed for the application of machine learning techniques to simplified models. At the end of the course, a small project, with an approximate duration of 4 hours, is assigned as a final assessment.</p>
Curriculum	Curriculum I – II – III

Title	Language training
Hours	24
Description	24-hour course in "Academic English Skills (AcES)", a course organised by the University of Bologna and designed specifically for PhD students, with the aim of acquiring specific skills in written and spoken English communication and aimed at writing articles and oral presentations at conferences and international events. Specific courses will be offered for levels B1+/B2 (upper intermediate) and B2+/C1 (advanced). The level to be attended will be ascertained through the compulsory online placement test. The course includes the production of written and oral papers and the completion of selected modules of the interactive Epigeum course.
Curriculum	Curriculum I – II – III

Title	Seminars
Hours	8
Description	<p>The first level of career guidance modules consists of meetings in which various topics will be addressed in a non-formal manner that favours peer-to-peer learning dynamics, group work and the active involvement of the participants, depending on the size of the class. Each meeting must include a specific time for personal and community reflection to monitor the progress of one's doctoral programme.</p> <ul style="list-style-type: none"> - The doctoral student as protagonist of innovation, duration 1h30 - The transversal skills of the doctoral student, duration 1h30 - Enhancing the role of the doctorate in the context of the ecosystem, duration 1h30 - Entrepreneurship and Design Thinking, duration 1h30 - Tech and Skill foresight, duration 2h
Curriculum	Curriculum I – II – III

Title	Seminars
Hours	7h 30
Description	<p>The second level of career guidance modules consists of meetings in which various topics will be addressed in a non-formal manner that favours peer-to-peer learning dynamics, group work and the active involvement of the participants, depending on the size of the class. Each meeting must include specific time for personal and community reflection to monitor the progress of one's doctoral programme.</p> <ul style="list-style-type: none"> - The valorisation of know-how and models of collaborative innovation (open innovation) Module I, duration 1h30 - The valorisation of know-how and models of collaborative innovation (open innovation) module II, duration 1h30 - Open Innovation in the Emilia-Romagna ecosystem. The "Eroi" Platform and other relevant case studies in ER, duration 1h30 - ISO 56000 certification basic elements, duration 1h30 - Responsible Research and Innovation, duration 1h30
Curriculum	Curriculum I – II – III