Appendix 1

ART. 1 - TYPOLOGY

The University of Pavia has activated a first-level Master's course in **"Design and Development of Vehicle Dynamics"** at the Department of Industrial Engineering and Information for the 2019/2020 academic year. The course takes advantage of the educational, logistic and organizational collaboration of ASC S.r.l. (Quattroruote Safe Driving Centre).

Edition: III

Subject field: Industrial Engineering

ART. 2 - EDUCATIONAL AIMS, PROFESSIONAL OPPORTUNITIES AND COURSE APPEAL

The Master's course is aimed at training highly qualified professionals, providing students with a solid preparation in the field of vehicle dynamics design so that they are able to work in all phases of vehicle setup and development, from dynamic simulation to the testing of prototypes right up until the realization of the pre-series vehicle. Specific competence will be acquired by Master's students in techniques of testing and in the trial of vehicles, both virtually, by means of CAE systems, in particular through the use of driving simulators, and experimentally by working directly on a vehicle (on the test circuit and on the road). An absolutely innovative element of the training course, alongside the lectures, are testing sessions on the circuit of the Quattroruote Safe Driving Centre during which the participants will be personally involved in learning the techniques and methodologies that are used in the testing, control and fine tuning of the dynamic behaviour of vehicles. For all participants, a specially designed advanced driving course is planned at the introductory level and oriented towards the successive phase of trials and testing on the track.

The Master's course is supplemented by targeted training and the continuous use of a static simulator installed in a designated room at the university and by a working session on a dynamic simulator at the VI-Grade centre of Tavagnacco (UD) or at the Danisi Engineering company of Nichelino (TO), partner companies of the program.

Qualified postgraduates of the Master's course can find employment with all those industrial groups which, in various capacities, operate in the field of design, development and the production of vehicles and more generally in the automotive sector. In particular, the skills acquired during the Master's course are of fundamental importance in the design, testing and development phases of the dynamic behaviour of new vehicles. This role of the professional design test engineer, urgently required by the market, is not available on the current panorama of academic training and is sought after both by mature markets like that of Italy and by markets that are just emerging from the point of view of the automotive industry. In addition, the Master's course, in what is a world first, contributes towards the training of a completely new professional position, which can be defined as a *"Certified" CAE Driving Simulator Engineer*, reserved for those students involved in internship activities who are specifically oriented towards in-depth training and the development of projects using the simulator.

The first level University Master's course in "Design and Development of Vehicle Dynamics," which is offered to international students, is aimed at young engineers who are passionate about the automotive world.
Companies such as Pirelli, Alfa Maserati, Seat, Magneti Marelli, Thyssen Presta, AudiSport, ZF-TRW, Continental, Xtrac, McLaren, Porsche, FCA, Abarth and Lamborghini are involved in the course in various capacities.

ART. 3 – COURSE ORGANIZATION

The Master's course lasts one year (1,500 total hours - 60 CFU) and can be broken down into:
lectures held at the University of Pavia (Faculty of Engineering and at Palazzo Vistarino), and the ASC - Centro di Guida Sicura (Vairano di Vidigulfo, PV), practical training at ASC – Safe Driving Centre (Vairano di Vidigulfo, PV), technical

visits to structures related to the course, final internship with partner companies, seminars, study activities, preparation and individual training.
Lessons for the Master's course are expected to begin in October 2019.

The Master's course is primarily based at the Faculty of Engineering, where lectures and training with the calculator are held. Seminars, meetings with company representatives and training activities involving the use of a compact driving simulator are held at Palazzo Vistarino, home to the Fondazione Alma Mater Ticinesis.

Technical seminars will be given by researchers from our university or from other universities, including the Federico II University of Naples, the University of Pisa and the Polytechnic of Milan, along with experts from various companies including FCA, Abarth, VI-Grade , Pirelli, Seat, CSI, MegaRide, Brembo, Danisi Engineering, Alfa Maserati, and Porsche. There will also be technical visits to the test centre of Balocco (FCA), the Driving Simulator Centre of Danisi Engineering, the CSI headquarters and laboratories, and the Pirelli circuit at Vizzola Ticino.
In the new edition of the Master's course, two unique and very innovative seminars will be introduced:

1) Theoretical and practical seminar on ADAS (Advanced Driver Assistance Systems) conducted by ASC technical staff; during the two-day seminar, the main issues concerning the technical characteristics and the evaluation of the effectiveness and efficiency of the ADAS systems currently used on road vehicles will be addressed. The experimental seminar will be conducted with the exclusive "UFO" (UltraFlat Overunnable robot) instrumentation supplied to the ASC centre.
2) Three-day experimental seminar on vehicles equipped with WFT (Wheel Force Transducer) sensors designed in collaboration with Oreste Berta, Michigan Scientific, Danisi Engineering, Maserati and Pirelli.

The total number of training activities that are envisaged corresponds to the acquisition of **60 university credits** (CFU) by enrolled students.
Student attendance at the various training activities is mandatory for at least 75% of the total number of hours.
The training period cannot be suspended.
Transfers to similar Master's courses at other universities are not permitted.
The Master's course, which mainly addresses an international market, may be conducted in English depending on the number and nationality of enrolled students.

The teaching modules are organized as follows:

Module	**SSD (academic discipline)**	**Contents**	**Number of lecture hours.**	**Hours of training / laboratory**	**Hours individual study.**	**Total number of hours**	**CFU**
I)	Integrated teaching: Design and Development of Vehicle Dynamics						
1) Setting up the Dynamics of the vehicle -Total Vehicle Design	ING-IND/13, ING-IND/14, ING-IND/15 ING-IND/06	International Scenario and methodology process. Total vehicle benchmark Analyses. Methodology processes for total vehicle Design. Aerodynamics for Dynamics performances improvement and fuel consumption control. Integration between Aerodynamics and Style.	60	0	90	150	6

2) Vehicle dynamics - Fundamental Driving Dynamics	ING-IND/13	The role of K&C Rig Testing with CAE models. Chassis subsystem modelling for R&H. Full vehicle virtual prototypes for Handling and Ride-Comfort. Road loads data prediction. Multi-attribute balancing. Coordinating with Control system development. Advanced experimental body modal contribution techniques. Integrated Engineering development process. Advanced driver assistance systems and autonomous driving.	40	0	60	100	4
3) Simulation of Dynamic Behaviour - Virtual Dynamics Design and Simulation	ING-IND/13	Multibody analyses introduction. Adams Car. Real-time analyses. From real-time virtual Dynamics to Dynamic driving simulator.	8	32	60	100	4
II) Integrated Teaching: Materials, Propulsion and Control							
4) Materials and Structural Resistance	ING-IND/21, ICAR/08	Materials for the Automotive Sector. Technologies, Processes. Features. Methods of topological optimization for verifying the body and components.	40	0	60	100	4
5) Propulsion: Thermic + Hybrid	ING-IND/08, ING-IND/32	Thermic Motors. Principal characteristics and features. Architecture. Consumption. Electric Motors. Generators. Accumulation Systems. Power supply. Recharging. Connection Systems. Wiring. Protocols. Diagnostics.	20	0	30	50	2
6) Dynamic Control of the Vehicle	ING-INF/04	Introduction to the main regulators. Braking control systems, stability, traction, and vector control.	10	0	15	25	1
III) Integrated Teaching: Vehicle experimentation and driver/vehicle interaction							
7) Vehicle Testing: Dynamics and Comfort - Total Vehicle Testing and Development	ING-IND/13, ING-IND/14, ING-IND/06	Total vehicle development process, experimental and CAE. Standardized subjective and objective experimental tests to develop and evaluate Dynamic and Ride Comfort behaviour. Driving course to learn Experimental Development Process: from test results to problem solving. Methodology to recognize problems and to approach problem solving. Failure Mode and Effect Analyses.	12	48	90	150	6

8) Biomechanics: Driver/Vehicle Interaction	ING-IND/13, ING-IND/34, ING-INF/05, BIO/09	Methodology and tools for the evaluation of driver/vehicle interaction. Comfort and features. Integrated system of measurement and monitoring. Driver physiology. Psychophysical stress and physiological adaptation. Environmental factors.	14	56	105	175	7
Partial total of hours			204	136	510	850	34
Internship-training-seminars						600	24
Final exam						50	2
Total hours						1500	60

ART. 4 – TRAINING ASSESSMENT

Training is evaluated throughout the course by those members of the teaching staff who hold the lectures and the training sessions, carry out the seminars and practical tests, and follow students' work.
Any additional assessments and the final test are not given a mark.

ART. 5 - FINAL EXAMINATION AND CONFERMENT OF QUALIFICATION

At the end of the Master's course, participants who have completed all of the activities and fulfilled their obligations will, after passing a final exam, receive the 1st level University Master's degree in **"Design and Development of Vehicle Dynamics".**

The final exam will consist of the presentation and defence of a written thesis regarding the traineeship activity undertaken by the candidate.

ART. 6 – TEACHING STAFF

The Master's courses will be taught by Professors of the University of Pavia, by teachers from other universities, and by highly-qualified external experts.

ART. 7 - ADMISSION REQUIREMENTS

The Master's course is aimed at those who have obtained one of the following:

1. ***first-cycle degree, in conformance with Ministerial Decree 270/2004, within the family of degrees in:***
   - Industrial engineering - L-9
     with particular reference to degree courses in mechanical engineering, aerospace engineering, electrical engineering, energy engineering, mechatronics, automotive engineering, industrial engineering, and materials engineering
2. ***first-cycle degree, in conformance with Ministerial Decree 509/99, within the family of degrees in:***
   - Industrial Engineering - 10
     with particular reference to degree courses in mechanical engineering, aerospace engineering, electrical engineering, energy engineering, mechatronics, automotive engineering, industrial engineering, and materials engineering
3. ***second-cycle degree, in conformance with Ministerial Decree 270/2004, in one of the following:***
   - Mechanical Engineering - LM-33
   - Aerospace and astronautics engineering - LM-20
   - Electrical Engineering - LM-28
   - Energy and nuclear engineering - LM-30

- Science and the Engineering of Materials - LM-53
- Automation Engineering - LM-25

4. second-cycle degree, in conformance with Ministerial Decree 509/99, in one of the following:

- Mechanical engineering - 36 / S
- Aerospace and astronautics engineering - 25 / S
- Electrical Engineering - 31 / S
- Energy and nuclear engineering - 33 / S
- Science and the Engineering of Materials - 61 / S
- Automation Engineering - 29 / S

5. first-cycle degree in conformance with the previous system of university qualifications ('vecchio ordinamento') in:

- Mechanical engineering
- Industrial engineering
- Aerospace engineering
- Electrical engineering
- Nuclear engineering
- Materials engineering

In the event of an application for admission by a foreign student, the teaching staff will evaluate the equivalence of the qualification with a suitable Italian qualification for the purposes of admission to the Master's course.
The maximum number of enrolments is **16**.
The minimum number necessary for activation of the course is **10** enrolments.
The Academic Board may also assess whether the conditions exist for extending the aforementioned number of places.
In the event that the number of candidates exceeds the expected limit, a selection shall be made by a Commission consisting of the Coordinator and two teachers of the Master's course, and a list of merit shall be drawn up, expressed in marks out of one hundred, determined on the basis of the following evaluation criteria:

1. Up to a maximum of 30 points for the graduation mark as follows:
   - 10 points for a graduation mark <than 100/110
   - 11-21 points for graduation marks from 100/110 to 110/110 (for a mark of 100 points, 11 points are awarded, and the score is increased by one point for every additional mark achieved)
   - 30 points for marks of 110/110 'cum laude'

2. Up to a maximum of 70 points for an individual interview in Italian or English to evaluate the candidate's skills, abilities and motivations in relation to the specific contents and objectives of the Master's course. Particular emphasis will be placed on any work experience in the automotive sector - on scientific publications concerning particular topics of the Master's course - on knowledge of specifically developed software such as Matlab, Simulink, Adams etc.
   Students pass the interview with a score of at least 42/70.

In the case of a tie as regards scores, the youngest candidate is ranked higher.
Should one or more candidates who are admitted to the course renounce their place, such places shall be made available to those candidates whose names appear in the final classification, until all places are filled.

AUDITORS

Some companies have expressed an interest in having their employees take part in single modules of the Master's course for a fee. Therefore a small number of professionals are expected to be admitted to the course as auditors for this edition.
The auditors, employees of partner companies of the Master's course or professionals, must have proven experience in the automotive sector and can participate in up to 5 modules.
The cost of the modules is broken down as follows:
Module 1 (60 hours, classroom) € 3,000
Module 2 (40 hours, classroom) € 2,000
Module 3 (40 hours, classroom) € 2,000
Module 7 (60 hours: ASC driving course + ASC Vairano circuit activity) € 7,000
Module 8 (70 hours, classroom and practical activity) € 3,500.

The activities of module 7 take place exclusively on the ASC circuit in Vairano. Any registrations received by UniPV for this teaching module will therefore be assigned to ASC S.R.L.

ART. 8 - CLOSING DATE FOR ADMISSION APPLICATIONS

Candidates must send off their application for admission, according to the procedures established by the Call for Applications, **from 18 June 2019 until the deadline of 2 September 2019.**

ART. 9 - ATTACHMENTS REQUIRED WHEN APPLYING FOR ADMISSION

Candidates must attach the following documentation during the online registration procedure for the Master's course:

- **application form (see page 8)**
- **photocopy (double-sided) of the personal identification document included during registration;**
- in the case of a qualification obtained abroad:
  - ✓ copy of the qualification required for admission, together with the details of the exams taken and the marks obtained, translated into Italian
  - ✓ copy of the "declaration of value" issued by the Italian Embassy/Consulate in the country where the academic qualification was obtained (only if already available)
- **Transcript of records or self-certification of exams passed during university studies in Italy with details of the marks obtained;**
- **references;**
- **motivational letter;**
- **curriculum vitae highlighting any professional experience in work areas pertaining to the Master's course;**

Please note that as indicated in Article 3 of the General Call for admissions, candidates holding a qualification obtained abroad must, **before the deadline of 10/01/2020**, deliver **the original** of the following documentation, legalized by the Italian Embassy or Consulate in the country where the aforementioned qualification was obtained, to the Health and Post-Graduate Service - Exams of State (via Ferrata No. 5 Pavia):

- academic qualification required for admission with the indication of the exams taken and the marks obtained, translated into Italian
- "declaration of value"

The above requisites must already be in the candidate's possession by the deadline for the submission of the application for admission.

ART. 10 - UNIVERSITY TUITION AND FEES

Enrolment:

Those enrolled in the Master's course must pay the sum of € 15,000.00 inclusive of: € 16.00 (stamp duty) and € 142.00 (administrative fees) for the 2019/2020 academic year.

This amount must be paid in two instalments:

- First instalment of € 10,000.00 to be paid upon enrolment;
- Second instalment of € 5,000.00 to be paid by 10/01/2019.

Final test:

In order to be admitted to the final exam, candidates must submit a special application with stamp duty to the value of € 16.00 and pay € 100.00 (which includes the € 16.00 stamp duty on the parchment, paid virtually) that covers the cost of the actual Master's diploma.

ART. 11 - UNIVERSITY WEBSITE AND ADMINISTRATIVE OFFICE

Any communication to candidates will be announced by means of publication on the following **websites:**
http://iii.unipv.it/index_en.php?pag=teaching/master.html
http://vehicledynamics.unipv.it

For information on the organization of the course:

Administrative Office

Department of Industrial Engineering and Information

Prof. Carlo E. Rottenbacher, Ms. Laura Pecoraro,

Department of Industrial Engineering and Information,

Tel. 0382/6992200

Fax 0382/6992228

E-mail: info.vehicledyn@unipv.it

UNIVERSITÀ DI PAVIA

Servizio Sanità e Post laurea

APPLICATION FORM

I[st] LEVEL MASTER IN "DESIGN AND DEVELOPMENT OF VEHICLE DYNAMICS"

(this form, duly filled in, must be uploaded during the on-line procedure for admission to the Master's course as specified in Article 9 of Appendix 1 to the Call for Admissions)

The undersigned (NAME, SURNAME)_____

Date of birth _____City_____State_____

State of residence _____Permanent address _____

_____

E-mail _____

HEREBY APPLIES

for admission to the aforementioned Master's course

and ATTACHES

the following documents, which are **to be submitted mandatorily for application evaluation**:

1. photocopy of the personal ID document/passport uploaded during the on-line registration procedure;

2. transcript of records/self-declaration of exams passed during the applicant's course of studies, together with the respective marks.

3. In addition, whoever has obtained an academic qualification abroad must attach:
   - ✓ copy of the Degree diploma
   - ✓ copy of the "declaration of value" issued by the Italian Embassy/Consulate in the country where the academic qualification was obtained (only if already available)

4. references;

5. motivational letter;

6. CV listing professional experience in work environments pertaining to the above Master's course;

7. Receipt of payment of the € 35,00 application fee *(*only in case of international wire transfers; not required if this fee is paid by means of an electronic deposit slip [MAV]).

Date, _____ Signature_____