

**REGOLAMENTO DEL CORSO DI LAUREA MAGISTRALE IN
ELECTRONIC ENGINEERING FOR INTELLIGENT VEHICLES**

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**CORSO DI LAUREA MAGISTRALE INTERATENEEO
IN “ELECTRONIC ENGINEERING FOR INTELLIGENT VEHICLES”**

REGOLAMENTO DIDATTICO

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PIANO DIDATTICO

PARTE NORMATIVA

ARTICOLO 1. CONOSCENZE RICHIESTE PER L'ACCESSO

Per essere ammessi al corso di Laurea Magistrale in Electronic Engineering for Intelligent Vehicles occorre essere in possesso di una laurea o del diploma universitario di durata triennale, ovvero di altro titolo di studio conseguito all'estero, riconosciuto idoneo.

Occorre, altresì, il possesso di requisiti curriculari e il superamento di una verifica dell'adeguatezza della personale preparazione.

1.1 Requisiti Curriculari

Per l'ammissione al Corso di Laurea Magistrale è necessario:

- a. Essere in possesso di una laurea in una delle classi di laurea ai sensi del D.M. 270/04, del D.M. 509/99, oppure possedere una laurea di Ordinamenti previgenti, oppure ancora un titolo di studio equivalente anche conseguito all'estero.
- b. Avere acquisito almeno 85 crediti formativi universitari (CFU) distribuiti nei settori scientifico-disciplinari come segue:
 - almeno 48 CFU nei SSD ING-INF/01, ING-INF/02, ING-INF/03, ING-INF/04, ING-INF/05, ING-INF/07, ING-IND/31, ING-IND/32, ING-IND/33;
 - almeno 32 CFU nei SSD INF/01, MAT/02, MAT/03, MAT/05, MAT/06, MAT/07, MAT/08, MAT/09, SECS-S/02, CHIM/03, CHIM/07, FIS/01, FIS/02, FIS/03.

L'ammissione al corso di laurea è subordinata al superamento di una verifica dell'adeguatezza della personale preparazione che avverrà secondo le modalità definite nel punto "Modalità di ammissione".

Verrà, altresì, verificato il possesso di adeguate competenze linguistiche nella lingua inglese di livello B2.

1.2 Modalità di ammissione

Il corso di Laurea magistrale adotta un numero programmato a livello locale (ex art. 2 L. 264/99) in relazione alle risorse disponibili. Il numero di studenti iscrivibili e le modalità di svolgimento della selezione saranno resi pubblici ogni anno con il relativo bando di concorso.

L'ammissione al Corso di laurea è subordinata al superamento di una verifica dell'adeguatezza della personale preparazione che avverrà mediante la valutazione della carriera e del curriculum vitae e/o di una prova scritta e/o orale da parte di una commissione nominata dal Consiglio di Corso di Studio.

La verifica prevedrà l'accertamento della conoscenza della lingua Inglese di livello pari o superiore al B2 del CEFR, comprovata da una delle certificazioni che saranno indicate nel bando di ammissione.

Le modalità di verifica dell'adeguatezza della personale preparazione verranno definite annualmente con delibera del Consiglio di Corso di Studio e riportate nel bando di ammissione.

ARTICOLO 2. REGOLE DI MOBILITÀ FRA I CURRICULA DEL CORSO DI LAUREA MAGISTRALE. PIANI DI STUDIO INDIVIDUALI

Il primo anno è impartito presso l'Ateneo di Bologna, mentre il secondo presso l'Università degli Studi di Modena e Reggio Emilia oppure presso l'Università di Parma a seconda del curriculum scelto.

Le modalità di scelta del curriculum avverranno prima dell'immatricolazione e saranno definite nel bando di ammissione.

Nel caso di motivate esigenze, è prevista la possibilità per gli Studenti – ad eccezione degli iscritti al primo anno di corso - di presentare un piano di studi diverso da quello previsto dal Piano Didattico in vigore, purché nell'ambito delle discipline attivate e nel rispetto del numero di crediti per ciascun ambito previsti dall'Ordinamento del Corso di Studio.

Le richieste, presentate entro i termini determinati annualmente dalla struttura competente e resi noti tramite il Portale, saranno soggette all'approvazione da parte del Consiglio di Corso di Studio sulla base della loro congruenza con gli obiettivi formativi specifici e l'Ordinamento didattico del corso stesso.

ARTICOLO 3. MODALITÀ DI SVOLGIMENTO DI CIASCUNA ATTIVITÀ FORMATIVA E TIPOLOGIA DELLE FORME DIDATTICHE

Le attività formative sono interamente svolte in lingua inglese.

Ciascuna attività formativa può comportare diverse modalità di svolgimento e interazione fra Docenti e Studenti.

In particolare possono essere previste:

- Lezioni in aula
- Esercitazioni in aula
- Attività di Laboratorio
- Tutorato

- Esercizi di autovalutazione
- Interazione remota attraverso la rete

Con riferimento alla voce "Ore di attività frontale" riportata nel Piano Didattico allegato al presente Regolamento, valgono le seguenti regole:

- Nel caso delle attività per le quali è riportato un valore numerico alla voce "Ore di attività frontale", tale valore costituisce il massimo della somma delle ore dedicate a lezioni in aula e a esercitazioni in aula o laboratorio, incluse le prove *in itinere* e le attività di tutorato in aula. Il valore minimo è fissato all'80% del valore riportato.
- Nel caso delle attività formative diverse dai Laboratori e dal Tirocinio, la somma delle ore dedicate a lezioni e esercitazioni in aula è compresa fra due terzi e il totale del valore indicato alla voce "Ore di attività frontale". La parte rimanente è coperta dalle esercitazioni di laboratorio, dalle prove *in itinere* e dalle attività di tutorato.
- Per le attività formative di Laboratorio, la somma delle ore dedicate a lezioni e esercitazioni in aula non deve superare un quinto del valore indicato alla voce "Ore di attività frontale". La parte rimanente è svolta in laboratorio.

Le ore relative all'attività di Tirocinio sono stabilite in base ai criteri definiti dal Regolamento Tirocini vigente e s'intendono svolte presso la Struttura ospitante.

ARTICOLO 4. FREQUENZA E PROPEDEUTICITÀ

Lo Studente non può sostenere un esame se l'attività formativa non appartiene al suo Piano di Studio, o se l'attività formativa non è ancora terminata.

Per le attività formative di Laboratorio è obbligatoria la frequenza ad almeno il 70% delle ore complessive.

Per le attività di Tirocinio si applicano le indicazioni del Regolamento tirocini vigente

Le eventuali propedeuticità sono indicate nel Piano Didattico allegato al presente Regolamento.

ARTICOLO 5. PERCORSO FLESSIBILE

Lo studente può optare per il percorso flessibile che consente di completare il corso di studio in un tempo superiore o inferiore alla durata normale (3 anni per le Lauree e 2 anni per le Lauree Magistrali) secondo le modalità definite nel Regolamento Didattico di Ateneo.

Le attività formative previste dal percorso di studio, in caso di necessaria disattivazione, potranno essere sostituite, per garantire la qualità e la sostenibilità dell'offerta didattica.

ARTICOLO 6. PROVE DI VERIFICA DELLE ATTIVITÀ FORMATIVE

Ciascuna attività formativa può comportare diverse modalità di verifica del profitto. In particolare possono essere previste:

- Esame finale scritto e orale con assegnazione di un voto (V)
- Esame finale orale con assegnazione di un voto (V)
- Esame finale scritto con assegnazione di un voto (V)
- Prova finale con assegnazione del giudizio di idoneità (I)

Le attività formative per le quali la verifica comporta l'attribuzione di un voto (V), oppure un giudizio di idoneità (I), sono indicate nel Piano Didattico, parte integrante del presente Regolamento.

Le specifiche modalità di verifica del profitto (esame con prova orale, esame con prova scritta, ecc.) per ciascuna attività formativa sono stabilite dal Consiglio di Corso di Studio (o dal suo Coordinatore su delega del Consiglio stesso) su proposta del relativo Titolare.

L'esame è individuale e mira ad accertare la maturità intellettuale del Candidato e il possesso delle conoscenze e abilità che caratterizzano la materia sulla quale verte l'esame. La verifica finale del profitto può essere preceduta da prove *in itinere* il cui esito negativo non influisce sull'ammissione all'esame finale. Nel caso di attività formative che prevedono un esame finale con prova orale, questa può comunque essere preceduta da una prova scritta preliminare, il cui esito condiziona l'ammissione all'orale.

Per tutti gli insegnamenti le Commissioni sono proposte dal Titolare dell'attività e nominate dal Consiglio del Corso di Studio, o dal Coordinatore per delega del Consiglio stesso.

La verifica del profitto dell'attività di Tirocinio si svolge secondo le indicazioni del Regolamento di Tirocinio vigente di Ateneo.

ARTICOLO 7. ATTIVITÀ FORMATIVE AUTONOMAMENTE SCELTE DALLO STUDENTE

Lo studente può indicare come attività formative autonomamente scelte dallo studente una o più attività formative tra quelle che il Consiglio di Corso di studio individua annualmente e rende note tramite Portale di Ateneo.

Se lo studente intende sostenere un esame relativo ad una attività non prevista tra quelle individuate dal Consiglio di Corso di studio, deve fare richiesta al Consiglio di Corso nei termini previsti annualmente e resi noti tramite

pubblicazione sul Portale di Ateneo. Il Consiglio valuterà la coerenza della scelta con il percorso formativo dello studente.

Lo studente può fare richiesta di inserimento di un esame erogato da una dei 4 atenei consorziati, che sarà valutata dal Consiglio di Corso di studio in termini di coerenza con il percorso formativo dello studente.

ARTICOLO 8. CRITERI DI RICONOSCIMENTO DEI CREDITI ACQUISITI IN CORSI DI STUDIO DELLA STESSA CLASSE

Il riconoscimento dei crediti nella carriera degli Studenti persegue il fine della mobilità degli Studenti ed è deliberato dal Consiglio di Corso di Studio, fino a concorrenza dei crediti dello stesso SSD previsti dall'Ordinamento didattico, nel rispetto dei relativi ambiti scientifico-disciplinari e della tipologia delle attività formative.

Qualora, effettuati i riconoscimenti in base alle norme del presente regolamento, restino crediti non utilizzati, il Consiglio di Corso di Studio può riconoscerli valutando il caso concreto sulla base delle affinità didattiche e culturali.

Il riconoscimento è relativo ad insegnamenti impartiti in lingua inglese o alle attività formative svolte in tale lingua. Al fine di integrare eventuali carenze di crediti in un determinato Settore Scientifico-Disciplinare, a seguito del riconoscimento operato ai sensi del presente Regolamento, il Consiglio di Corso di Studio ha la facoltà di istituire alcune attività formative integrative, distinte per Settore Scientifico-Disciplinare o gruppi di settori omogenei, quali cicli di seminari, attività di laboratorio, attività di studio guidato, ecc. Il valore in crediti delle attività integrative varia da uno a tre e comunque deve essere inferiore al valore previsto per l'insegnamento da integrarsi. La valutazione avviene mediante giudizio di idoneità.

ARTICOLO 9. CRITERI DI RICONOSCIMENTO DEI CREDITI ACQUISITI IN CORSI DI STUDIO DI DIVERSA CLASSE, PRESSO UNIVERSITÀ TELEMATICHE E IN CORSI DI STUDIO INTERNAZIONALI

I crediti formativi universitari acquisiti sono riconosciuti dal Consiglio di Corso di Studio sulla base dei seguenti criteri:

- Analisi del programma svolto.
- Numero complessivo di ore di didattica svolte.
- Valutazione della congruità dei SSD (o, in mancanza di questi, delle discipline) e dei contenuti delle attività formative in cui lo Studente ha maturato i crediti con gli obiettivi formativi specifici del Corso di Studio e delle singole attività formative da riconoscere, perseguendo comunque la finalità di mobilità degli Studenti.

Il riconoscimento è effettuato fino a concorrenza dei crediti formativi universitari previsti dall'Ordinamento didattico del Corso di Studio.

Qualora, effettuati i riconoscimenti in base alle norme del presente Regolamento, restino crediti non utilizzati, il Consiglio di Corso di Studio può riconoscerli valutando il caso concreto sulla base delle affinità didattiche e culturali. Il riconoscimento è relativo ad insegnamenti impartiti in lingua inglese o alle attività formative svolte in tale lingua.

ARTICOLO 10. CRITERI DI RICONOSCIMENTO DELLE CONOSCENZE E ABILITÀ EXTRAUNIVERSITARIE

Possono essere riconosciute competenze acquisite fuori dall'Università nei seguenti casi:

- conoscenze e abilità professionali certificate ai sensi della normativa vigente in materia;
- conoscenze e abilità maturate in attività formative di livello post secondario alla cui realizzazione e progettazione abbia concorso l'Università.

La richiesta di riconoscimento sarà valutata dal Consiglio di Corso di studio tenendo conto delle indicazioni date dagli Organi Accademici e del numero massimo di crediti riconoscibili fissato nell'ordinamento didattico del corso di studio, ovvero 12 CFU.

Il riconoscimento potrà avvenire qualora l'attività sia coerente con gli obiettivi formativi specifici del corso di studio e delle attività formative che si riconoscono, visti anche il contenuto e la durata in ore dell'attività svolta.

ART. 11 TIROCINIO FINALIZZATO ALLA PREPARAZIONE DELLA PROVA FINALE O COLLEGATO AD UN PROGETTO FORMATIVO

Il Corso di Studio, su richiesta dello studente, può consentire, con le procedure stabilite dal Regolamento tirocini vigente o dai programmi internazionali di mobilità per tirocinio, e in conformità alle norme comunitarie, lo svolgimento di un tirocinio finalizzato alla preparazione della tesi di laurea o comunque collegato ad un progetto formativo mirato ad affinare il suo processo di apprendimento e formazione

Tali esperienze formative della durata massima di 12 mesi, che dovranno concludersi entro la data del conseguimento del titolo di studio, potranno essere svolte prevedendo l'attribuzione di crediti formativi per attività di tirocinio previsto dal piano didattico.

ARTICOLO 12. CARATTERISTICHE DELLA PROVA FINALE

La prova finale è pubblica e consiste nella elaborazione e discussione di una tesi scritta, redatta in modo originale dallo studente con la supervisione di un docente relatore. In particolare può consistere in:

- **presentazione e discussione di un progetto originale che può comprendere una parte sperimentale e di laboratorio**, sviluppato sotto la supervisione di un docente relatore;
- presentazione e discussione dell'attività svolta presso aziende o enti esterni, identificati sulla base di apposite convenzioni e anche durante un periodo di tirocinio per tesi opportunamente previsto oppure presso un laboratorio di ricerca dell'Università o di altri enti di ricerca pubblici o privati, con la supervisione di un docente e, quando opportuno, di un referente segnalato dalle aziende o dagli enti esterni.

Il lavoro deve essere svolto con adeguato livello di autonomia e capacità di analisi critica, e deve essere esposto e discusso dal candidato con appropriate capacità comunicative.

Modalità di svolgimento della prova finale

Per l'ammissione alla prova finale lo studente deve avere acquisito tutti i crediti formativi per le attività diverse dalla prova finale, distribuiti nelle differenti tipologie secondo le indicazioni del piano didattico.

Dall'elaborato di tesi, in lingua inglese, deve emergere padronanza degli argomenti trattati e degli strumenti teorici e tecnici utilizzati dal candidato, nonché coerenti con gli obiettivi del Corso di Studio.

L'argomento della relazione è svolto sotto la supervisione di un Docente di attività formative previste nella programmazione didattica dell'Ateneo.

Le Commissioni sono nominate dal Coordinatore del Consiglio di corso di studio.

Il voto di Laurea Magistrale è espresso in centodecimi. Il conferimento della lode richiede il giudizio unanime della Commissione esaminatrice.

Art. 13. Coerenza fra i crediti assegnati alle singole attività formative e gli specifici obiettivi formativi programmati

La Commissione Paritetica e il Consiglio della Scuola di Ingegneria dell'Università di Bologna – nelle sedute rispettivamente del 26/11/2020 e del 27/11/2020 - hanno espresso parere favorevole in materia di coerenza fra i crediti assegnati alle singole attività formative e gli specifici obiettivi formativi programmati, ai sensi dell'articolo 12, comma 3, del D.M. 270/04.

RULES

ARTICLE 1 - ADMISSION REQUIREMENTS

To be admitted to the Programme in **Electronic Engineering for Intelligent Vehicles** (hereinafter called "EEIV"), Applicants should hold an Italian Bachelor degree or a foreign degree evaluated as eligible. Moreover, Applicants must comply with the curriculum requirements as well as having a suitable prior preparation.

1.1 Curriculum requirements

To be admitted to the Programme in EEIV, Applicants:

- Must possess a First-cycle degree in one of the degree classes pursuant to D.M. 270/04 and D.M. 509/99, Italian Law 508/99 or a degree from a previous degree system, or an equivalent qualification obtained abroad.
- Must have gained at least 85 ECTS credits (CFU) in the following groups of SSD:
 - At least 48 CFU in ING-INF/01, ING-INF/02, ING-INF/03, ING-INF/04, ING-INF/05, ING-INF/07, ING-IND/31, ING-IND/32, ING-IND/33;
 - At least 32 CFU in INF/01, MAT/02, MAT/03, MAT/05, MAT/06, MAT/07, MAT/08, MAT/09, SECS-S/02, CHIM/03, CHIM/07, FIS/01, FIS/02, FIS/03}.

The assessment of Applicants' prior preparation satisfying curriculum requirements will be done in compliance with rules and regulations laid out on the following subsection "Admission procedure". Moreover, eligible Applicants must possess English proficiency no lower than B2 level (according to CEFR).

1.2 Admission procedure

The Programme adopts a limited admission quotas (according to Italian Law 264/99 – art. 2) on account of resources available. A "Call for Applications" will set out yearly the selection procedure and how many students can be admitted.

Admission to the Master's degree is granted upon assessment of adequacy of the personal preparation, by checking academic records and/or résumé and/or written examination and/or oral examination. A Committee appointed by the Degree Board shall carry out such an assessment.

Moreover, applicants must hold an English proficiency no lower than B2 (according to CEFR), demonstrated through an international language certificate.

The procedure detailing the aforementioned admission criteria will be laid out yearly by the Degree Board and made available on the "Call for Applications".

ARTICLE 2: CURRICULA-STUDENT COURSE SELECTION

The first year is taught at the University of Bologna, whereas the second year is taught either at the University of Modena and Reggio Emilia or at the University of Parma depending on the curriculum chosen.

The choice of the curriculum will take place before enrollment and will be defined in the "Call for Applications".

When Students register for their first year, they are automatically enrolled in the mandatory courses. In case of properly motivated requests, starting from the second year of enrollment, Students can submit an individual Study Plan.

The request must be issued within the date specified each year by the education services area in charge and addressed to the EEIV Degree Board, which will consider the rationale for the submission and whether it can be accepted or not, on the basis of the coherence with the learning outcomes of the Programme and according with the provisions contained in the Degree Teaching Regulation.

ARTICLE 3: TEACHING METHODS

Each teaching activity may be carried out in different ways, e.g.:

- Theoretical lessons in class
- Exercises in class
- Laboratory work
- Tutoring
- Self-evaluation exercises
- E-learning

With reference to the item "Class hours", as further described in the Course Structure, the following apply:

- For the course bearing a numerical value of the item "class hours", such a value is the maximum of the sum of the hours devoted to theoretical lessons in class, to class exercises, and to laboratory work (the latter under the supervision of the teacher or tutor), including the time devoted to intermediate exams and to the tutoring in class. The minimum is fixed to 80% of the numerical value of the item "class hours".
- For the teaching activities whose name does not contain the word "Laboratory", the total hours devoted to theoretical lessons in class and exercises in class must range between two thirds and the total of the numerical value of the item "class hours". The remaining part (if any) is covered by laboratory work, intermediate exams and tutoring.
- For the teaching activities whose name contains the word "Laboratory", the total hours devoted to theoretical lessons in class and exercises in class must not exceed one fifth of the numerical value of the item "class hours". The remaining part is carried out in the laboratory.

The hours concerning internship activities are defined in accordance with criteria specified in the running *Internship Regulation*. These hours are held in the host structure.

ARTICLE 4. COURSE ATTENDANCE. SPECIFIED ORDER OF THE EXAMS

Students are not entitled to access an exam if they are not registered in the corresponding course. They are not entitled to access the course exam where they are registered for a specific Academic Year, too, if the lessons of such a course in the same A.Y. have not been completed yet.

For the teaching activities whose name contains the word "Laboratory", Students are not entitled to access the exam if they have not attended at least 70% of the hours indicated in the item as "Class hours".

For the teaching activities held at CLA (Centro Linguistico di Ateneo), the attendance rules are specified by CLA itself.

The exams of some courses must be undertaken in a specified order. Such cases, if any, are indicated herein below in the Course Structure.

ARTICLE 5. FLEXIBLE TRACK

Students may choose the so-called flexible track in order to finish off their studies in a time span higher or lower than that normally foreseen, that is, 3 academic years for Bachelor degrees and 2 academic years for Master's degrees. Such a procedure should abide by the relevant stipulations set forth in the University's Teaching Regulation.

ARTICLE 6. STRUCTURE AND OUTCOME OF THE EXAMS

Each teaching activity may have a different structure and outcome of the exam, e.g.:

- Written and oral exam, evaluation by numerical rating
- Oral-only exam, evaluation by numerical rating
- Written-only exam, evaluation by numerical rating
- Any of the above, evaluation by "pass/fail"

For each teaching activity the outcome of the exam is indicated herein below in the Course Structure.

The structure of the exam is proposed by the teacher and is approved by the EEIV Degree Board, or by the Coordinator if the latter is so entrusted by the Board. The exam is personal and aims at determining the intellectual maturity of the Student along with his/her holding the knowledge and abilities typical of the course's subject. Intermediate exams on the course's subject are allowed, whose possible negative result does not influence the Student's access to the exam. For the oral-only exams, a preliminary written exam is anyhow allowed, whose outcome influences the Student's access to the oral exam.

For the teaching activities held at CLA, the structure and outcome of the exam are specified by CLA.

For the Internship activities, the procedures for the exam are defined according to the Internship Regulation.

ARTICLE 7. ELECTIVE LEARNING ACTIVITIES - COURSES FREELY CHOSEN BY THE STUDENT

As far as elective courses are concerned, Students can pick and choose those suggested by the Degree board and published on the degree website (so-called pre-accepted electives).

In order to select other electives, a request to the Degree board should be submitted within the deadlines and following the instructions published yearly on the website. The Degree board will accept such a request should it be deemed consistent with the student's study plan.

Electives can be moreover chosen among all the courses available at the University of Bologna, the University of Modena and Reggio Emilia, the University of Parma, and the University of Ferrara. In the latter case, a request to the Degree board should be submitted: it will be accepted if deemed consistent with the student's study plan.

ARTICLE 8. ACKNOWLEDGEMENT OF CREDITS ACQUIRED FROM PROGRAMMES BELONGING TO THE SAME CLASS

This article applies only to Students owning an Italian Second-cycle Degree conforming to the provisions of the Ministry Decree n. 270/2004, belonging to the LM-29 class. The acknowledgement is carried out according to the rules stated in the Article 7 written in Italian (*"Criteri di riconoscimento dei crediti acquisiti in Corsi di Studio della stessa classe"*).

ARTICLE 9. ACKNOWLEDGEMENT OF CREDITS ACQUIRED FROM PROGRAMMES BELONGING TO A DIFFERENT CLASS, FROM E-LEARNING PROGRAMS, OR FROM INTERNATIONAL PROGRAMS

The credits may be acknowledged by the EEIV Degree Board after an analysis based on the following criteria:

- Contents of the course whence the credits have been acquired
- Total number of teaching hours of the course
- Evaluation of the consistency of the sectors (or of the subjects, if the sectors are not defined), and of the contents of the courses whence the Student has acquired the credits, with the specific teaching objective of the EEIV Programme, as indicated in the Degree Programme Regulation (*"Ordinamento didattico del Corso di Studio"*).

Credits are acknowledged to the extent of those reported in this very document.

If, after recognition under the above rules, there are residual unused credits, the EEIV Degree Board may acknowledge them after evaluation of the specific case according to cultural affinity.

ARTICLE 10. ACKNOWLEDGEMENT OF CREDITS FOR EXTRA-UNIVERSITY COMPETENCIES AND SKILLS

Competencies acquired outside of the University may be recognized in the following cases:

- professional knowledge and skills certified under the terms of the applicable law;
- competences and skills acquired in post-graduate learning activities run or planned by the University.

The request for recognition shall be assessed by the Degree Board considering the indications of the academic bodies and the maximum number of recognizable credits laid down in the Degree Teaching Regulations (12 CFU).

Such a recognition is subject to the activities being coherent with the specific learning outcomes of the Degree Programme and the learning activities which are recognized, also in consideration of their contents and duration in hours.

ARTICLE 11. INTERNSHIP FOR THE PREPARATION OF THE FINAL EXAMINATION OR LINKED TO A PROJECT AIMING TO DEVELOP LEARNING AND ACADEMIC SKILLS

At the request of the student, the EEIV Degree Programme may, following the procedures laid down in the University Regulations concerning internships and international mobility programmes, and in compliance with EU laws, authorise an internship for the purposes of the **final examination or preparing the dissertation** or in any case linked to a project aiming to develop learning and academic skills.

These learning experiences shall not exceed 12 months, and shall be completed by the date of graduation; learning credits may be awarded for the internship activities laid down in the course structure diagram.

ARTICLE 12. FINAL EXAM

The contents of the final exam consist of a significant project or research activity carried out by the Student on a subject chosen by himself/herself. The final exam may imply:

- a. Presenting and discussing an original project which can include research and laboratory findings, developed under the supervision of a Professor (so-called "Relatore")
- b. Presenting and discussing activities performed in a company, external institution, external or internal research laboratory, according to an agreement with the University of Bologna that can foresee internship-based final project. In these cases, a supervising professor must oversee student's experience and, if required, an external tutor shall be appointed.

The results of this work are illustrated in an original document, prepared by the Student on the Thesis' subject and discussed in public before a Commission.

The final exam must show the Student's ability to master the subject, his/her attitude to work autonomously, and high-level communication skills.

Admission to the final exam

To access the final exam, the Student must acquire all the credits in the teaching activities (apart from the final exam) distributed into the different types as defined herein below in the Course Structure.

The final work, drawn up in English, must demonstrate student's ability to master the topics addressed as well as the technical tools deployed, which must be coherent with the Programme's goals.

The final project shall be carried out under the supervision of a lecturer in charge of teaching activities foreseen in the University's teaching planning.

Graduation commission shall be appointed by the Coordinator.

The evaluation of the final exam is expressed in the form $n/110$, where n must not exceed 110. The unanimous agreement of the Commission is mandatory for attributing the evaluation 110/110 *cum laude*.

ARTICLE 13. COHERENCE BETWEEN ECST CREDITS RELATED TO TEACHING ACTIVITIES AND THEIR LEARNING OUTCOMES

The Steering Committee and the Council of the School of Engineering of the University of Bologna (November 26, 2020 and November 27, 2020, respectively) have agreed on the coherence between ECTS credits related to teaching activities and their learning outcomes, according to DM 270/2004 (article 3, subsection 3).

PIANO DIDATTICO

Curriculum Electronic and Communication Systems (ECS)

Primo anno

Attività formative obbligatorie - Mandatory courses Tipologie B e C - Type B and C (39 CFU)

| Attività formativa | | S.S.D. | Ambit o | TAF | Ore | CFU | Ciclo | Modalità di verifica |
|--------------------|---|------------|-----------------|-----|-----|-----|-------|-------------------------|
| | <p>SIGNALS AND SYSTEMS FOR VEHICULAR COMMUNICATIONS M <i>Obiettivi formativi/Learning outcomes:</i> The course will provide the fundamentals of wireless communications, starting from time and frequency domain analysis of signals and systems, to digital modulations and wireless access techniques. In particular, the course will provide the tools to design a wireless link in vehicular scenarios and assess its performance and reliability.</p> <ul style="list-style-type: none"> • Modulo 1 (30 ore) • Modulo 2 (30 ore) | ING-INF/03 | Affine | C | 60 | 6 | 1 | Voto |
| (95598) | <p>AUTOMATIC CONTROL M <i>Obiettivi formativi/Learning outcomes:</i> After a brief summary on elementary concepts of linear algebra, complex analysis and of the Laplace/Z Transforms, the course will provide students with the fundamental tools for the modelling and analysis of (multivariable) dynamic systems and their structural properties. Basic tools of system theory will be introduced, and the design of advanced control schemes addressed.</p> | ING-INF/04 | Affine | C | 60 | 6 | 2 | Voto Mark |
| | <p>ADVANCED AUTOMOTIVE SENSORS M <i>Obiettivi formativi/Learning Outcomes:</i> Aim of the course is to give a basic preparation, design skills, and understanding the specifications of sensors and measuring systems for automotive applications.</p> | ING-INF/07 | Caratterizzante | B | 60 | 6 | 1 | Voto Mark |
| | <p>WIRED AND WIRELESS INTERCONNECTIONS M <i>Obiettivi formativi/Learning Outcomes:</i> In this course, students acquire the basic knowledge of the electromagnetic theory needed to understand the problems of interest in the automotive framework. Through examples concerning the main bus systems currently in use inside vehicles, students learn to know, face and solve the problems related to the distribution of signals in electromagnetically complex environments, in which other sources and disturbances of different nature can prevent the creation of a reliable system. Students also learn how to orient themselves within the technical standards for automotive, how to organize emission measurements and how to prepare the set-up for an immunity test.</p> <ul style="list-style-type: none"> • Modulo 1 (30 ore) – Primo ciclo • Modulo 2 (30 ore) – Secondo ciclo • Modulo 3 (30 ore) – Secondo ciclo | ING-INF/02 | Caratterizzante | B | 90 | 9 | E | Voto Mark |

| Attività formativa | | S.S.D. | Ambito | TAF | Ore | CFU | Ciclo | Modalità di verifica |
|--------------------|--|------------|-----------------|-----|-----|-----|-------|----------------------|
| 85732 | HARDWARE-SOFTWARE DESIGN OF EMBEDDED SYSTEMS M. I. C 85730-ARCHITECTURES AND FIRMWARE M <i>Obiettivi formativi/Learning Outcomes:</i> The main objective of the class is to give a practical knowledge of hardware-software platforms and a clear understanding of the design tradeoffs in energy-efficient embedded systems. The class is divided in three blocks of lectures: (I) system-on-chip hardware design - fundamental concepts, (II) microcontroller systems design-hardware and software, (III) Parallel software and programming for advanced embedded systems. Mutua da 93322 - Hardware-Software Design of Iot Systems M master sulla LM 0934 - Ingegneria elettronica | ING-INF/01 | Caratterizzante | B | 60 | 6 | 2 | Voto Mark |
| | 85728-REAL TIME OS M <i>Obiettivi formativi/Learning Outcomes:</i> The course covers the fundamentals of modern real-time operating systems. Arguments that are addressed in the course are architecture, organization, and functionalities of modern operating systems, task management and resource allocation, mechanisms and tools for synchronisation and concurrent programming, characteristics of real-time operating systems and main scheduling algorithms for hard real-time periodic processes. <ul style="list-style-type: none"> • Modulo 1 (30 ore) – secondo ciclo mutua dal modulo 3 di 78810 – Real time systems for automation erogato dalla LM 8891 – Automation Engineering • Modulo 2 (30 ore) – primo ciclo | ING-INF/05 | Affine | C | 60 | 6 | E | |

Attività formative a scelta guidata - restricted elective courses Tipologie B - Type B (12 CFU)

| Attività formativa | | S.S.D. | Ambito | TAF | Ore | CFU | Ciclo | Modalità di verifica |
|--------------------|---|------------|-----------------|-----|-----|-----|-------|----------------------|
| 85733 | POWER ELECTRONICS FOR AUTOMOTIVE M <i>Obiettivi formativi/Learning Outcomes:</i> The aim of the course is to provide principles of operation, analysis techniques and basic design criteria of power electronics converters and systems. | ING-INF/01 | Caratterizzante | B | 60 | 6 | 1 | Voto Mark |
| 85734 | TEST, DIAGNOSIS AND RELIABILITY M <i>Obiettivi formativi/Learning Outcomes:</i> The course will first address the problem of fault modeling, with reference to the automotive environment, to then study testing, design for testability and hardware in the loop approaches. Then, onboard monitoring and diagnosis will be addressed, to finally study fault tolerant techniques for reliable systems' design. The course will include laboratory experiences, and possible seminars given by experts in the field from the industrial world. | ING-INF/01 | Caratterizzante | B | 60 | 6 | 1 | Voto Mark |
| (95599) | STATISTICAL SIGNAL PROCESSING M <i>Obiettivi formativi/Learning outcomes:</i> The course aims at reviewing basic concepts of probability, operator theory and optimization and using them in the development of fundamental signal processing methods ranging from filtering to spectrum estimation, linear prediction, adaptive sampling and dimensionality reduction. <ul style="list-style-type: none"> • Modulo 1 (30 ore) • Modulo 2 (30 ore) | ING-INF/01 | Caratterizzante | B | 60 | 6 | 2 | Voto Mark |

Attività formative a scelta guidata - restricted elective courses
Tipologia C - Type C (6 CFU)

| Attività formativa | | S.S.D. | Ambito | TAF | Ore | CFU | Ciclo | Modalità di verifica |
|--------------------|--|------------|--------|-----|-----|-----|-------|----------------------|
| | <p>DYNAMICS AND COMPLIANT DESIGN OF ROAD VEHICLES M <i>Obiettivi formativi/Learning Outcomes:</i> The course is divided in two modules. The aim of the first module is to provide knowledge about vehicle dynamics. Theoretical and numerical approaches will be discussed to this end, as tools that will allow the students to predict the performance of cars in terms of longitudinal dynamics, lateral dynamics, handling, comfort and stability. The aim of the second module is to provide the theoretical basis and the practical skills required to design embedded hardware and firmware compliant with industrial standards (safety, interoperability, maintainability). In addition, model-based design and automatic code generation using Matlab/Simulink will be considered.</p> <ul style="list-style-type: none"> • Modulo 1 (30 ore) - Il modulo 1 mutua dal modulo 1 di 93737 - Dynamics and compliant control of electric vehicles M erogato dalla LM 5699 - Electric Vehicle Engineering • Modulo 2 (30 ore) | ING-IND/32 | Affine | C | 60 | 6 | 2 | Voto Mark |
| | <p>DEEP LEARNING FOR ENGINEERING APPLICATIONS M <i>Obiettivi formativi/Learning Outcomes:</i> This course enables students to manage and develop systems based on deep neural networks. Students will be able to deal with basic DL topologies, to apply supervised and unsupervised approaches, to investigate and understand the concept of latent space, and also to learn more recent advances. Moreover, specific focus will be put on adversarial and generative models. Laboratory activities will be used to allow students to be also able to apply such technologies to a number different problems.</p> | ING-INF/05 | Affine | C | 60 | 6 | 2 | Voto Mark |

Attività formative a scelta guidata - restricted elective courses
Tipologia F - Type F (3 CFU)

| Attività formativa | | S.S.D. | Ambito | TAF | Ore | CFU | Ciclo | Modalità di verifica |
|--------------------|--|--------|----------------|-----|-----|-----|-------|----------------------|
| 90373 | <p>GROUND VEHICLES DYNAMICS M <i>Obiettivi formativi/Learning Outcomes:</i> This course provides basic concepts about the dynamics of ground vehicles. The students who attend this class acquire the necessary competencies to model, understand and analyse the dynamics of ground vehicles by means of the linearization of nonlinear models, determination of the associated modes and the analysis of their stability.</p> | - | Altre attività | F | 30 | 3 | 1 | Idoneità Pass/Fail |
| 90374 | <p>LAB OF REAL-TIME OPERATING SYSTEMS M <i>Obiettivi formativi/Learning Outcomes:</i> At the end of the course, the student is able to:</p> <ul style="list-style-type: none"> - use the tools provided by modern general-purpose and real-time operating systems; - write simple concurrent programs; - build simple applications for real time systems. <p>Il corso mutua dal modulo 2 dell'insegnamento 78810 - Real Time Systems For Automation M master sulla LM 8891- Automation Engineering</p> | - | Altre attività | F | 30 | 3 | 2 | Idoneità Pass/Fail |
| 99185 | <p>CONNECTED VEHICLES M <i>Obiettivi formativi/Learning outcomes:</i> The course will provide an overview of the wireless technologies for connected vehicles and introduce the main standards for long and short-range communications. Particular emphasis will be on the solutions deriving from Wi-Fi and cellular networks applied to cooperative intelligent transport systems.</p> | - | Altre attività | F | 30 | 3 | 2 | Idoneità Pass/Fail |

Secondo anno

Attività formative obbligatorie - Mandatory courses

Tipologia B - Type B (12 CFU)

Tipologia E - Type E (24 CFU)

| Attività formativa | | S.S.D. | Ambito | TAF | Ore | CFU | Ciclo | Modalità di verifica |
|--|--|------------|-----------------|-----|-----|------|-------|----------------------|
| <p>APPLIED TOPICS IN AUTOMOTIVE ELECTRONICS M. I. C.</p> <p>ELECTRONIC SYSTEMS DESIGN M <i>Obiettivi formativi/Learning Outcomes:</i> The aim of this course is to reverse engineer some automotive electronic systems to gain the complete picture of their design and implementation. Companies are involved in choosing some representative case studies and to contribute with lectures, seminars and other activities. In particular, innovative energy harvesting systems, noise management (e.g. pedestrian alert, Active noise cancellation, Road noise cancellation, Engine sound enhancement, ...) systems will be studied and new solutions will be designed and proposed to the industry.</p> <p>AUTOMOTIVE TECHNOLOGIES FOR RANGING, VISION, AND CONNECTIVITY M <i>Obiettivi formativi/Learning Outcomes:</i> The aim of the course is to provide the students the knowledge required to understand the operating principles, design skillset, and installation aspects of antennas and RADAR/LIDAR systems for automotive applications such as radiolocation, millimeter-wave, inter- and intra-vehicle communications, and anticollision systems for safety and autonomous driving. The course will also provide knowledge about the operation and relevant parameters of optical elements, LEDs, and lasers used in headlights and rear lights, and the ability to manage issues related to the design and integration constraints of the systems described above in the lighting equipment.</p> | | ING-INF/01 | Caratterizzante | B | 120 | 12 | | Voto Mark |
| | | ING-INF/02 | Caratterizzante | B | 60 | 6 | 1 | |
| <p>FINAL EXAMINATION M <i>Obiettivi formativi/Learning Outcomes:</i> Preparation for the final examination according to the provisions of the Teaching Regulation of the Programme.</p> <p><i>Nota: lo Studente può scegliere solo "FINAL EXAMINATION" (24 cfu), oppure "Final examination" più una delle attività fra "Internship for preparation for the final examination", "Internship abroad for preparation for the final examination" o "Preparation for the final examination abroad".</i></p> <p><i>Note: Students can choose only the "Final examination" (24 credits) or the "Final examination and one of the learning activities among "Internship for preparation for the final examination", "Internship abroad for preparation for the final examination" or "Preparation for the final examination abroad".</i></p> <p>FINAL EXAMINATION + -INTERNSHIP FOR PREPARATION FOR THE FINAL EXAMINATION</p> <p>FINAL EXAMINATION + INTERNSHIP ABROADFOR PREPARATION FOR THE FINAL EXAMINATION</p> <p>FINAL EXAMINATION + PREPARATION FOR THE FINAL EXAMINATION</p> | | - | - | E | - | 24 | E | Voto Mark |
| | | | | | | 3+21 | | |
| | | | | | | 3+21 | | |
| | | | | | | 3+21 | | |

Attività formative a scelta guidata - restricted elective courses
 Tipologia C - Type C (12 CFU)

| Attività formativa | | S.S.D. | Ambito | TAF | Ore | CFU | Ciclo | Modalità di verifica |
|--------------------|--|------------|--------|-----|-----|-----|-------|----------------------|
| 85740 | <p>AUTOMOTIVE CONNECTIVITY M <i>Obiettivi formativi/Learning Outcomes:</i> The aim of this course is to prepare students to set automotive communication systems, intra and inter vehicles, and between vehicle and infrastructures, which can be both terrestrial and satellite. Issues related to driver and passenger safety involving communications systems in the car will be addressed, too.</p> | ING-INF/03 | Affine | C | 54 | 6 | 1 | Voto Mark |
| 85741 | <p>AUTOMOTIVE CYBER SECURITY M <i>Obiettivi formativi/Learning Outcomes:</i> This course provides basic concepts on network and systems security for the automotive ecosystem. Main topics include cryptography, security protocols, authentication systems, attack techniques and protection methodologies.</p> | ING-INF/05 | Affine | C | 54 | 6 | 1 | Voto Mark |
| 85745 | <p>INDUSTRIAL CO-TEACHING M <i>Obiettivi formativi/Learning Outcomes:</i> The aim of this course is to integrate real world industrial experience into an Electronic Engineering course. The course lecturer covers the theoretical parts, whereas industry engineers exposed students to current R&D works in the company. It is expected that bringing professionals into the Advanced Automotive Electronic Engineering class positively impact on students' learning. This case bridges the gap between students' competencies and the needs of industrial life. Topics will be proposed yearly in agreement with Industries participating to the program.</p> | ING-IND/32 | Affine | C | 54 | 6 | 1 | Voto Mark |
| 85746 | <p>MODELING AND CONTROL OF ELECTROMECHANICAL SYSTEMS M <i>Obiettivi formativi/Learning Outcomes:</i> The aim of this course is to provide the basic concepts for modeling, simulation and control of electromechanical systems. In particular, some electromechanical examples in the Automotive and Industrial fields will be considered. The modeling and the simulation of the considered examples will be performed in the Matlab/Simulink environment.</p> | ING-INF/04 | Affine | C | 54 | 6 | 1 | Voto Mark |
| 93188 | <p>PLATFORMS AND ALGORITHMS FOR AUTONOMOUS DRIVING M <i>Obiettivi formativi/Learning Outcomes:</i> the course aims at providing the required notions to understand the processing pipeline of an autonomous driving system, including perception, planning and actuation on high-performance embedded platforms. It will apply a heterogeneous set of techniques ranging from computer vision and machine/deep learning techniques to embedded robotics and control, addressing multiple problems in the automotive domain, like lane and object detection, state estimation, precise positioning, sensor fusion and path planning.</p> <ul style="list-style-type: none"> • Modulo 1 (30 ore) • Modulo 2 (24 ore) | ING-INF/05 | Affine | C | 54 | 6 | 1 | Voto Mark |
| 95600 | <p>ARTIFICIAL INTELLIGENCE FOR AUTOMOTIVE M <i>Obiettivi formativi/Learning Outcomes:</i> The course will introduce the basic aspects of modern artificial intelligence for reasoning on data, and the software for learning by data, with a specific use of Neural Networks. In particular it will discuss: -Fundamentals of AI: giving examples and models of computer-based solutions that are capable of intelligent behavior, using a priori knowledge, Sensing, Perception, Knowledge, Reasoning and Learning. -Fundamentals of Machine Learning: developing on tools and systems that can learn from and make predictions on data, for getting machines to act without being explicitly programmed. -Fundamentals of Deep Learning: for modeling and implementing deep neural network architectures and algorithms. The course will be based on laboratory for applications in automotive fields such as in autonomous driving and in automatic classification of external sensory data. Specific topics selected by companies will be considered for lab projects.</p> <ul style="list-style-type: none"> • Modulo 1 (18 ore) • Modulo 2 (36 ore) | ING-INF/05 | Affine | C | 54 | 6 | 1 | Voto Mark |

Attività formative a scelta guidata - open elective courses Tipologia D - Type D (12 - 18 CFU)

Scegliere 12 crediti. Il Corso di Studio considera coerenti con il percorso formativo le attività elencate di seguito o qualunque insegnamento a scelta del piano non precedentemente selezionato. Oltre a ciò, invita lo studente ad orientare le eventuali proprie scelte al di fuori di questa tabella considerando gli insegnamenti erogati dalla LM 9239 - Advanced Automotive Engineering. Lo studente può anche richiedere l'inserimento di attività formative erogate dai 4 atenei consorziati.

Choose 12 credits. The Degree Board considers the activities listed below, as well as any other elective not chosen before, as coherent with the overall educational project. Furthermore, the Degree Board invites students willing to choose activities not in this table to consider the courses given by the LM 9239 - Advanced Automotive Engineering. Students may also request to enter exams delivered by the University of Bologna, the University of Modena and Reggio Emilia, the University of Parma, the University of Ferrara.

| Attività formativa | | S.S.D. | Ambito | TAF | Ore | CFU | Ciclo | Modalità di verifica |
|--------------------|---|------------|-----------------|-----|-----|-----|-------|----------------------|
| | <p>TACC 1 - TRAINING FOR AUTOMOTIVE COMPANIES CREATION M</p> <p><i>Learning outcomes</i> experiencing the latest trends in the automotive sector (autonomous driving, connectivity, electric vehicles, innovative mobility) through an academic project based on entrepreneurship and learning-by-doing.</p> <p>The course is delivered at the University of Modena and Reggio Emilia</p> <p>Il corso è mutuato dal CdLM 5699 – Electric Vehicle Engineering</p> | ING-INF/07 | A scelta libera | D | 54 | 6 | 1 | Voto Mark |
| | <p>TACC 2 - TRAINING FOR AUTOMOTIVE COMPANIES CREATION M</p> <p><i>Learning outcomes</i> experiencing the latest trends in the automotive sector (autonomous driving, connectivity, electric vehicles, innovative mobility) through an academic project based on entrepreneurship and learning-by-doing.</p> <p>The course is delivered at the University of Modena and Reggio Emilia</p> <p>Il corso è mutuato dal CdLM 5699 – Electric Vehicle Engineering</p> | ING-INF/07 | A scelta libera | D | 54 | 6 | 2 | Voto Mark |
| 85752 | <p>PRODUCT SAFETY, PRODUCT LIABILITY AND AUTOMOTIVE M</p> <p><i>Obiettivi formativi/Learning Outcomes:</i> The main purpose of the course is to provide students with a thorough knowledge of the core concepts of tort law in the automotive industry issues not only from a national perspective but also from the perspective of the harmonization of European Union Law and the US legal system. The course aims at providing the student with a general knowledge of basic principles and concepts of European Union and US tort law and consumer protection law focused on the automotive industry issues. It also focuses on Corporate social responsibility and environmental and technological innovation issues that the automotive industry faces. Using the method of the economic analysis of law, the current UE and US legal system will be evaluated in the light of a pragmatic proposal to check that the basic liability law can still function properly in the light of rapid changes to some of the products that it covers. The attention will focus on the new issues arising from highly automated vehicles. In this prospective it will be investigated the role of the precautionary principle governing the UE consumer protection law, and the risks development doctrine which can be seen as a limit to the manufacturer liability. The automotive litigation prospective also leads to focus the attention on class action and punitive damages which play a crucial role in the American legal system and are not still implemented in UE legal system. At the end of the course the student is expected to become familiar with the legal notions of producer, consumer, tort law, damage, product liability law and product safety law governing the automotive industry, in order to observe the problem of the automotive litigation in a globalized prospective. At the end of the course the student is expected to become familiar with the legal notions of producer, consumer, tort law, damage, product liability law and product safety law governing the automotive industry, in order to observe the problem of the automotive litigation in a globalized prospective.</p> <p>The course is delivered at the University of Modena and Reggio Emilia</p> <p>Il corso è mutuato dall'omonima attività master sulla LM 9239 – Advanced Automotive Engineering</p> | IUS/01 | A scelta libera | D | 60 | 6 | 1 | Voto Mark |

| Attività formativa | | S.S.D. | Ambit o | TAF | Ore | CFU | Ciclo | Modalità di verifica |
|--------------------|--|--------|------------|-----|-----|-----|-------|-------------------------|
| XXX | Qualunque insegnamento a scelta del piano non precedentemente selezionato | | | | | | | |

TOTALE CREDITI - COURSE CREDITS: 120 CFU

PIANO DIDATTICO

Curriculum Autonomous Driving Engineering (ADE)

Primo anno

Attività formative obbligatorie - Mandatory courses Tipologie B e C - Type B and C (45 CFU)

| Attività formativa | | S.S.D. | Ambito | TAF | Ore | CFU | Ciclo | Modalità di verifica |
|--------------------|--|------------|-----------------|-----|-----|-----|-------|----------------------|
| (95598) | <p>AUTOMATIC CONTROL M <i>Obiettivi formativi/Learning outcomes:</i> After a brief summary on elementary concepts of linear algebra, complex analysis and of the Laplace/Z Transforms, the course will provide students with the fundamental tools for the modelling and analysis of (multivariable) dynamic systems and their structural properties. Basic tools of system theory will be introduced, and the design of advanced control schemes addressed.</p> | ING-INF/04 | Affine | C | 60 | 6 | II | Voto Mark |
| 85738 | <p>ADVANCED AUTOMOTIVE SENSORS M <i>Obiettivi formativi/Learning Outcomes:</i> Aim of the course is to give a basic preparation, design skills, and understanding the specifications of sensors and measuring systems for automotive applications.</p> | ING-INF/07 | Caratterizzante | B | 60 | 6 | I | Voto Mark |
| 69661 | <p>IMAGE PROCESSING AND COMPUTER VISION M <i>Obiettivi formativi/Learning outcomes:</i> Introducing basic knowledge about algorithms, tools and systems for the management, processing and analysis of digital images. The main topics of the course are filtering aspects of digital images, algorithms for image processing, algorithms for segmentation and classification of objects in digital images. Theoretical aspects that are introduced in the course are then applied to the design and manufacturing capabilities of simple systems oriented to real world applications. At the end of the course students are able to master basic digital image processing techniques and know potentials of this technology in applicative research and industrial contexts. Il corso viene mutuato dall'omonima attività master sul corso di LM 8891 - Automation engineering / ingegneria dell'automazione</p> | ING-INF/05 | Affine | C | 60 | 6 | I | Voto Mark |
| | <p>VEHICULAR RADIO PROPAGATION M <i>Obiettivi formativi/Learning outcomes:</i> At the end of the course the student knows: i) fundamentals of electromagnetic fields as the basics of radio propagation in free space with or without sources; the fundamentals of antennas and their main parameters (radiation pattern, directivity, gain, efficiency, and effective area); the formula of the radio link power budget (Friis' formula); ii) more advanced concepts as the basics of radio propagation in presence of obstacles and the fundamental concepts of geometrical theory of propagation, including the concepts of ray, spreading factor and of ray interactions on canonical obstacles; knows the architecture and characteristics of vehicular radiocommunication systems as well as the characteristics of the corresponding dynamic multipath radio channel; knows the concepts of radar cross-section, radar equation. Finally, the student has acquired the basic principles of radiolocation using radar, GNSS systems and cellular signals.</p> <ul style="list-style-type: none"> • Modulo 1 (30 ore) – 1° ciclo – Mutuato dal modulo 1 di Wired and Wireless Interconnections M erogato dal curriculum ECS • Modulo 2 (60 ore) – 2° ciclo | ING-INF/02 | Caratterizzante | B | 90 | 9 | E | Voto Mark |

| Attività formativa | | S.S.D. | Ambito | TAF | Ore | CFU | Ciclo | Modalità di verifica |
|--------------------|--|------------|-----------------|-----|-----|-----|-------|----------------------|
| | <p>DEEP LEARNING FOR ENGINEERING APPLICATIONS M <i>Obiettivi formativi/Learning Outcomes:</i> This course enables students to manage and develop systems based on deep neural networks. Students will be able to deal with basic DL topologies, to apply supervised and unsupervised approaches, to investigate and understand the concept of latent space, and also to learn more recent advances. Moreover, specific focus will be put on adversarial and generative models. Laboratory activities will be used to allow students to be also able to apply such technologies to a number different problems.</p> | ING-INF/05 | Affine | C | 60 | 6 | II | Voto Mark |
| 85732 | <p>HARDWARE-SOFTWARE DESIGN OF EMBEDDED SYSTEMS M. I. C.</p> <p>85730-ARCHITECTURES AND FIRMWARE M <i>Obiettivi formativi/Learning Outcomes:</i> The main objective of the class is to give a practical knowledge of hardware-software platforms and a clear understanding of the design tradeoffs in energy-efficient embedded systems. The class is divided in three blocks of lectures: (I) system-on-chip hardware design - fundamental concepts, (II) microcontroller systems design-hardware and software, (III) Parallel software and programming for advanced embedded systems. Mutua da 93322 - Hardware-Software Design Of Iot Systems M master sulla LM 0934 - Ingegneria elettronica</p> <p>85728-REAL TIME OS M <i>Obiettivi formativi/Learning Outcomes:</i> The course covers the fundamentals of modern real-time operating systems. Arguments that are addressed in the course are architecture, organization, and functionalities of modern operating systems, task management and resource allocation, mechanisms and tools for synchronisation and concurrent programming, characteristics of real-time operating systems and main scheduling algorithms for hard real-time periodic processes.</p> <ul style="list-style-type: none"> • Modulo 1 (30 ore) Secondo ciclo – Il modulo 1 mutua dal modulo 3 di 78810 - Real time systems for automation erogato dalla LM 8891 - Automation Engineering • Modulo 2 (30 ore) Primo ciclo | ING-INF/01 | Caratterizzante | B | 60 | 6 | II | Voto Mark |
| | | ING-INF/05 | Affine | C | 60 | 6 | E | |

Attività formative a scelta guidata - restricted elective courses Tipologia B - Type B (12 CFU)

| Attività formativa | | S.S.D. | Ambito | TAF | Ore | CFU | Ciclo | Modalità di verifica |
|--------------------|--|------------|-----------------|-----|-----|-----|-------|----------------------|
| 85733 | <p>POWER ELECTRONICS FOR AUTOMOTIVE M <i>Obiettivi formativi/Learning Outcomes:</i> The aim of the course is to provide principles of operation, analysis techniques and basic design criteria of power electronics converters and systems.</p> | ING-INF/01 | Caratterizzante | B | 60 | 6 | I | Voto Mark |
| 85734 | <p>TEST, DIAGNOSIS AND RELIABILITY M <i>Obiettivi formativi/Learning Outcomes:</i> The course will first address the problem of fault modeling, with reference to the automotive environment, to then study testing, design for testability and hardware in the loop approaches. Then, onboard monitoring and diagnosis will be addressed, to finally study fault tolerant techniques for reliable systems' design. The course will include laboratory experiences, and possible seminars given by experts in the field from the industrial world.</p> | ING-INF/01 | Caratterizzante | B | 60 | 6 | I | Voto Mark |
| (95599) | <p>STATISTICAL SIGNAL PROCESSING M <i>Obiettivi formativi/Learning outcomes:</i> The course aims at reviewing basic concepts of probability, operator theory and optimization and using them in the development of fundamental signal processing methods ranging from filtering to spectrum estimation, linear prediction, adaptive sampling and dimensionality reduction.</p> <ul style="list-style-type: none"> - Modulo 1 (30 ore) - Modulo 2 (30 ore) | ING-INF/01 | Caratterizzante | B | 60 | 6 | II | Voto Mark |

Secondo anno

Attività formative obbligatorie - Mandatory courses

Tipologie B e F - Type B and F (15 CFU)

Tipologia E – Type E (24 CFU)

| Attività formativa | | S.S.D. | Ambito | TAF | Ore | CFU | Ciclo | Modalità di verifica |
|--|---|--------------------------|-----------------|-----|-----|------|--------------------|----------------------|
| <p>ELECTRONICS AND LIGHTING TECHNOLOGIES FOR AUTOMOTIVE M I.C.</p> <p>ELECTRONICS FOR AUTOMOTIVE SYSTEMS M <i>Obiettivi formativi/Learning Outcomes:</i> This module aims to provide students with the knowledge required to analyze and design electronic systems for automotive applications. The module will address the main components of ADAS systems, as well as project management in the automotive context. Practical cases will be presented with the contribution of experts from the automotive industry.</p> <p>AUTOMOTIVE LIGHTING AND RANGING TECHNOLOGIES M <i>Obiettivi formativi/Learning Outcomes:</i> The aim of the course is to provide the students the basic knowledge needed to understand operation principles and relevant parameters of lens, reflectors, mirrors, LEDs and lasers used in headlighth and rearlights, and to be able to manage issues related to the design of intelligent adaptive lighting and LIDAR systems.</p> | | | | | 120 | 12 | | Voto Mark |
| | | ING-INF/01 | Caratterizzante | B | 60 | 6 | I | |
| | | ING-INF/02 | Caratterizzante | B | 60 | 6 | I | |
| <p>COMPUTER ENGINEERING LABORATORY M <i>Obiettivi formativi/Learning Outcomes:</i> The main objective of the course is to introduce students to advanced software development techniques through specific practical laboratory tasks. Students will be able to manage version control systems, will be introduced to software guidelines to facilitate the development of safe software for mission critical devices. Moreover, specific topics will be selected according to elective course chosen by each student.</p> | - | Altre attività formative | F | 30 | 3 | I | Idoneità Pass/Fail | |
| <p>FINAL EXAMINATION M <i>Obiettivi formativi/Learning Outcomes:</i> Preparation for the final examination according to the provisions of the Teaching Regulation of the Programme.</p> <p><i>Nota: lo Studente può scegliere solo "FINAL EXAMINATION" (24 cfu), oppure "Final examination" più una delle attività fra "Internship for preparation for the final examination", "Internship abroad for preparation for the final examination" o "Preparation for the final examination abroad".</i></p> <p><i>Note: Students can choose only the "Final examination" (24 credits) or the "Final examination and one of the learning activities among "Internship for preparation for the final examination", "Internship abroad for preparation for the final examination" or "Preparation for the final examination abroad".</i></p> <p>FINAL EXAMINATION + -INTERNSHIP FOR PREPARATION FOR THE FINAL EXAMINATION</p> <p>FINAL EXAMINATION + INTERNSHIP ABROADFOR PREPARATION FOR THE FINAL EXAMINATION</p> <p>FINAL EXAMINATION + PREPARATION FOR THE FINAL EXAMINATION</p> | | | E | | | 24 | E | Voto Mark |
| | | | | | | 3+21 | | |
| | | | | | | 3+21 | | |
| | | | | | | 3+21 | | |

Attività formative a scelta guidata - restricted elective courses
 Tipologia C - Type C (12 CFU)

| Attività formativa | S.S.D. | Ambito | TAF | Ore | CFU | Ciclo | Modalità di verifica |
|--|------------|--------|-----|-----|-----|-------|----------------------|
| 3D PERCEPTION, LEARNING-BASED DATA FUSION M <i>Obiettivi formativi/Learning Outcomes:</i> The course enable students with skills for data fusion when many and different kind sensors are involved to enable a full 3D reconstruction of the environment all around a vehicle/robot. Therefore, students will acquire knowledge for single sensor calibration, sensors inter-calibration, data synchronization and others. Moreover they will be also able to use artificial intelligence approaches for extracting 3D information from multi-sensor suites. | ING-INF/05 | Affine | C | 60 | 6 | I | Voto Mark |
| AUTONOMOUS DRIVING AND ADAS TECHNOLOGIES M <i>Obiettivi formativi/Learning Outcomes:</i> The main objective of the course is to prepare students to develop and design intelligent systems for autonomous vehicles. More specifically, students will acquire relevant skill on different topics of Advanced Driving Assistance Systems like: autonomous driving levels (0-5), main perception systems (cameras, lidar, radar, ultrasonic sensors, IMUs, GPS...), processing systems (traditional approaches, embedded, GPU, CVFlow...), map for autonomous navigation, data fusion, and control approaches. | ING-INF/05 | Affine | C | 60 | 6 | I | Voto Mark |
| VISUAL PERCEPTION FOR SELF-DRIVING CARS M <i>Obiettivi formativi/Learning Outcomes:</i> At the end of the course, students will be able to implement some "basic" algorithms of image processing for vehicles like lane detection, obstacle detection, classification and tracking of obstacles, visual odometry, SLAM, and others. These algorithms are part of the group of "Advanced driver assistance systems" and therefore their knowledge enables students for the development of autonomous and intelligent vehicles. | ING-INF/05 | Affine | C | 60 | 6 | I | Voto Mark |
| VIRTUAL SYSTEMS AND HUMAN MACHINE INTERFACE M <i>Obiettivi formativi/Learning Outcomes:</i> The aim of this course is to introduce students to simulation and to main principles of Human Machine Interfaces for autonomous/intelligent vehicles. At the end of the course, students will be able to deal with simulation environments and vehicle/road models, to equip those models with sensors, to acquire data, and to test real-time control systems. Students are also introduced to specific issues for the development of HMI for intelligent vehicles. | ING-INF/05 | Affine | C | 60 | 6 | I | Voto Mark |
| PATH AND TRAJECTORY PLANNING M <i>Obiettivi formativi/Learning Outcomes:</i> The student will be able to use basic techniques from operations research and optimal control to solve path and trajectory planning problems for mobile vehicles. The student will be able to address scenarios with obstacles, and with kinematic and dynamic constraints. The student will be able to solve problem involving multiple vehicles, cooperating in a common environment. | ING-INF/04 | Affine | C | 60 | 6 | I | Voto Mark |
| VEHICULAR COMMUNICATIONS M <i>Obiettivi formativi/Learning Outcomes:</i> The main objective of this course is to introduce the student to vehicular communications, providing the fundamentals of communications and networks to understand and design vehicle-to-everything (V2X) communication systems. More specifically students will acquire knowledge on the following topics: Applications and requirements, Intra-vehicle communications, Extra-vehicle communications, Protocol stacks, Physical layer (L1) concepts, Link layer (L2) concepts, Network layer (L3) concepts, Routing: broadcast, geocast, ad-hoc, WiFi-based technologies: IEEE 802.11p and IEEE 1609, ETSI ETS G5, Cellular-based technologies: LTE-V2X, 5G C-V2X, Security principles, advanced applications, visible light communications. | ING-INF/03 | Affine | C | 60 | 6 | I | Voto Mark |

Attività formative a scelta guidata - open elective courses Tipologia D - Type D (12 - 18 CFU)

Scegliere 12 crediti. Il Corso di Studio considera coerenti con il percorso formativo le attività elencate di seguito o qualunque insegnamento a scelta del piano non precedentemente selezionato. Oltre a ciò, invita lo studente ad orientare le eventuali proprie scelte al di fuori di questa tabella considerando gli insegnamenti erogati dalla LM 9239 - Advanced Automotive Engineering. Lo studente può anche richiedere l'inserimento di attività formative erogate dai 4 atenei consorziati.

Choose 12 credits. The Degree Board considers the activities listed below, as well as any other elective not chosen before, as coherent with the overall educational project. Furthermore, the Degree Board invites students willing to choose activities not in this table to consider the courses given by the LM 9239 - Advanced Automotive Engineering. Students may also request to enter exams delivered by the University of Bologna, the University of Modena and Reggio Emilia, the University of Parma, the University of Ferrara.

| Attività formativa | | S.S.D. | Ambito | TAF | Ore | CFU | Ciclo | Modalità di verifica |
|--------------------|---|------------|-----------------|-----|-----|-----|-------|----------------------|
| | <p>TACC 1 - TRAINING FOR AUTOMOTIVE COMPANIES CREATION M</p> <p><i>Learning outcomes</i> experiencing the latest trends in the automotive sector (autonomous driving, connectivity, electric vehicles, innovative mobility) through an academic project based on entrepreneurship and learning-by-doing.</p> <p>The course is delivered at the University of Modena and Reggio Emilia</p> <p>Il corso è mutuato dal CdLM 5699 – Electric Vehicle Engineering</p> | ING-INF/07 | A scelta libera | D | 54 | 6 | 1 | Voto Mark |
| | <p>TACC 2 - TRAINING FOR AUTOMOTIVE COMPANIES CREATION M</p> <p><i>Learning outcomes</i> experiencing the latest trends in the automotive sector (autonomous driving, connectivity, electric vehicles, innovative mobility) through an academic project based on entrepreneurship and learning-by-doing.</p> <p>The course is delivered at the University of Modena and Reggio Emilia</p> <p>Il corso è mutuato dal CdLM 5699 – Electric Vehicle Engineering</p> | ING-INF/07 | A scelta libera | D | 54 | 6 | 2 | Voto Mark |
| 85752 | <p>PRODUCT SAFETY, PRODUCT LIABILITY AND AUTOMOTIVE M</p> <p><i>Obiettivi formativi/Learning Outcomes:</i> The main purpose of the course is to provide students with a thorough knowledge of the core concepts of tort law in the automotive industry issues not only from a national perspective but also from the perspective of the harmonization of European Union Law and the US legal system. The course aims at providing the student with a general knowledge of basic principles and concepts of European Union and US tort law and consumer protection law focused on the automotive industry issues. It also focuses on Corporate social responsibility and environmental and technological innovation issues that the automotive industry faces. Using the method of the economic analysis of law, the current UE and US legal system will be evaluated in the light of a pragmatic proposal to check that the basic liability law can still function properly in the light of rapid changes to some of the products that it covers. The attention will focus on the new issues arising from highly automated vehicles. In this prospective it will be investigated the role of the precautionary principle governing the UE consumer protection law, and the risks development doctrine which can be seen as a limit to the manufacturer liability. The automotive litigation prospective also leads to focus the attention on class action and punitive damages which play a crucial role in the American legal system and are not still implemented in UE legal system. At the end of the course the student is expected to become familiar with the legal notions of producer, consumer, tort law, damage, product liability law and product safety law governing the automotive industry, in order to observe the problem of the automotive litigation in a globalized prospective. At the end of the course the student is expected to become familiar with the legal notions of producer, consumer, tort law, damage, product liability law and product safety law governing the automotive industry, in order to observe the problem of the automotive litigation in a globalized prospective.</p> <p>The course is delivered at the University of Modena and Reggio Emilia</p> <p>Il corso è mutuato dall'omonima attività master sulla LM 9239 – Advanced Automotive Engineering</p> | IUS/01 | A scelta libera | D | 60 | 6 | 1 | Voto Mark |

| Attività formativa | | S.S.D. | Ambit o | TAF | Ore | CFU | Ciclo | Modalità di verifica |
|--------------------|---|--------|------------|-----|-----|-----|-------|-------------------------|
| XXX | Qualunque insegnamento a scelta del piano non precedentemente selezionato | | | | | | | |

TOTALE CREDITI - COURSE CREDITS: 120 CFU

REGOLAMENTO DIDATTICO DEL CORSO DI LAUREA IN ELECTRONIC ENGINEERING
FOR INTELLIGENT VEHICLES

Facoltà -

Dipartimento 106154 - Dipartimento di Ingegneria e Architettura

Corso di Studio 5076 - ELECTRONIC ENGINEERING FOR INTELLIGENT VEHICLES

Regolamento 5076-22-22

Anno 2022

PERCORSO 389 - Percorso AUTONOMOUS DRIVING ENGINEERING

| Tipo Attività Formativa: Caratterizzante | CFU | Range | Gruppo | SSD | Attività Formativa | CFU AF |
|--|-----------|---------|--------|------------|--------------------|--------|
| Ingegneria elettronica | 45 | 45 - 72 | | ING-INF/01 | | |
| | | | | ING-INF/02 | | |
| | | | | ING-INF/07 | | |
| Totale Caratterizzante | 45 | | | | | |

| Tipo Attività Formativa: Affine/Integrativa | CFU | Range | Gruppo | SSD | Attività Formativa | CFU AF |
|---|-----------|---------|--------|------------|--------------------|--------|
| Attività formative affini o integrative | 36 | 21 - 42 | | ING-IND/32 | | |
| | | | | ING-INF/03 | | |
| | | | | ING-INF/04 | | |
| | | | | ING-INF/05 | | |
| Totale Affine/Integrativa | 36 | | | | | |

| Tipo Attività Formativa: A scelta dello studente | CFU | Range | Gruppo | SSD | Attività Formativa | CFU AF |
|--|-----------|--------|--------|-----|--------------------|--------|
| A scelta dello studente | 12 | 8 - 15 | | | | |
| Totale A scelta dello studente | 12 | | | | | |

| Tipo Attività Formativa: Lingua/Prova Finale | CFU | Range | Gruppo | SSD | Attività Formativa | CFU AF |
|--|-----------|---------|--------|-----|--------------------|--------|
| Per la prova finale | 24 | 15 - 24 | | | | |
| Totale Lingua/Prova Finale | 24 | | | | | |

| Tipo Attività Formativa: Altro | CFU | Range | Gruppo | SSD | Attività Formativa | CFU AF |
|--------------------------------|-----|-------|--------|-----|--------------------|--------|
| | | | | | | |

| | | | | | | |
|---|---|--------|--|--|--|--|
| Altre conoscenze utili per l'inserimento nel mondo del lavoro | 3 | 3 - 12 | | | | |
| Totale Altro | 3 | | | | | |

| | |
|-----------------------------------|------------|
| Totale CFU Minimi Percorso | 120 |
| Totale CFU AF | |

PERCORSO 390 - Percorso ELECTRONIC AND COMMUNICATION SYSTEMS

| Tipo Attività Formativa: Caratterizzante | CFU | Range | Gruppo | SSD | Attività Formativa | CFU AF |
|--|-----------|---------|--------|------------|--------------------|--------|
| Ingegneria elettronica | 45 | 45 - 72 | | ING-INF/01 | | |
| | | | | ING-INF/02 | | |
| | | | | ING-INF/07 | | |
| Totale Caratterizzante | 45 | | | | | |

| Tipo Attività Formativa: Affine/Integrativa | CFU | Range | Gruppo | SSD | Attività Formativa | CFU AF |
|---|-----------|---------|--------|------------|--------------------|--------|
| Attività formative affini o integrative | 36 | 21 - 42 | | ING-IND/32 | | |
| | | | | ING-INF/03 | | |
| | | | | ING-INF/04 | | |
| | | | | ING-INF/05 | | |
| Totale Affine/Integrativa | 36 | | | | | |

| Tipo Attività Formativa: A scelta dello studente | CFU | Range | Gruppo | SSD | Attività Formativa | CFU AF |
|--|-----------|--------|--------|-----|--------------------|--------|
| A scelta dello studente | 12 | 8 - 15 | | | | |
| Totale A scelta dello studente | 12 | | | | | |

| Tipo Attività Formativa: Lingua/Prova Finale | CFU | Range | Gruppo | SSD | Attività Formativa | CFU AF |
|--|-----------|---------|--------|-----|--------------------|--------|
| Per la prova finale | 24 | 15 - 24 | | | | |
| Totale Lingua/Prova Finale | 24 | | | | | |

| Tipo Attività Formativa: Altro | CFU | Range | Gruppo | SSD | Attività Formativa | CFU AF |
|---|----------|--------|--------|-----|--------------------|--------|
| Altre conoscenze utili per l'inserimento nel mondo del lavoro | 3 | 3 - 12 | | | | |
| Totale Altro | 3 | | | | | |

| | |
|-----------------------------------|------------|
| Totale CFU Minimi Percorso | 120 |
| Totale CFU AF | |

**MASTER'S DEGREE IN ELECTRONIC ENGINEERING FOR INTELLIGENT
VEHICLES
(Class LM-29)**

All the lectures will be held in English

1ST YEAR

**Curriculum "Electronic and Communication System" (ECS)
(Place of teaching: University of Bologna)**

| Period | Mandatory courses | SSD | ECTS (CFU) |
|--------------------------|--|--------------------------|---------------------|
| 1 st semester | Advanced automotive sensors | ING-INF/07 | 6 |
| Annual course | Hardware-software design of embedded systems I.C. Architectures and firmware M Real time os | ING-INF/01 ING_INF/05 | 12 6 6 |
| 2 nd semester | Automatic control | ING-INF/04 | 6 |
| 1 st semester | Signals and systems for vehicular communications | ING-INF/03 | 6 |
| Annual course | Wired and wireless interconnections | ING-INF/02 | 9 |

| Period | Elective courses | SSD | ECTS (CFU) |
|--------------------------|--|------------|------------|
| | ELECTIVE COMPLEMENTARY COURSES (pick 2/3)^(*) | | |
| 1 st semester | Power electronics for automotive | ING-INF/01 | 6 |
| 1 st semester | Test, diagnosis and reliability | ING-INF/01 | 6 |
| 2 nd semester | Statistical signal processing | ING-INF/01 | 6 |
| | ELECTIVE COMPLEMENTARY COURSES (pick 1/2)^(*) | | |
| 2 nd semester | Dynamics and compliant design of road vehicles | ING-IND/32 | 6 |
| 2 nd semester | Deep learning for engineering applications | ING-INF/05 | 6 |
| | ELECTIVE COMPLEMENTARY COURSES (pick 1/2)^(*) | | |
| 1 st semester | Ground vehicle dynamics | NN | 3 |
| 2 nd semester | Connected vehicles | NN | 3 |

1ST YEAR
Curriculum “Autonomous Driving Engineering” (ADE)
(Place of teaching: University of Bologna)

| Period | Mandatory courses | SSD | ECTS (CFU) |
|--------------------------|--|--------------------------|---------------------|
| 1 st semester | Advanced automotive sensors | ING-INF/07 | 6 |
| Annual course | Hardware-software design of embedded systems I.C. Architectures and firmware M Real time os | ING-INF/01 ING-INF/05 | 12 6 6 |
| 2 nd semester | Automatic control | ING-INF/04 | 6 |
| 1 st semester | Image processing and computer vision | ING-INF/05 | 6 |
| Annual course | Vehicular radio propagation | ING-INF/02 | 9 |
| 2 nd semester | Deep learning for engineering applications | ING-INF/05 | 6 |

| Period | Elective courses | SSD | ECTS (CFU) |
|--------------------------|--|------------|------------|
| | ELECTIVE COMPLEMENTARY COURSES (pick 2/3)^(*) | | |
| 1 st semester | Power electronics for automotive | ING-INF/01 | 6 |
| 1 st semester | Test, diagnosis and reliability | ING-INF/01 | 6 |
| 2 nd semester | Statistical signal processing | ING-INF/01 | 6 |

2ND YEAR
Curriculum “Electronic and Communication System (ECS)
(Place of teaching: University of Modena and Reggio)

| Period | Mandatory courses | SSD | ECTS (CFU) |
|--------------------------|---|--------------------------|---------------------|
| 1 st semester | Applied topics in automotive electronics Electronic systems design Automotive technologies for ranging, vision, and connectivity | ING-INF/01 ING-INF/02 | 12 6 6 |

| Period | Elective courses | SSD | ECTS (CFU) |
|--------------------------|--|------------|--------------------|
| | ELECTIVE COMPLEMENTARY COURSES (pick 2/6)^(‡) | | |
| 1 st semester | Artificial intelligence for automotive | ING-INF/05 | 6 |
| 1 st semester | Industrial co-teaching | ING-IND/32 | 6 |
| 1 st semester | Automotive connectivity | ING-INF/03 | 6 |
| 1 st semester | Automotive cyber security | ING-INF/05 | 6 |
| 1 st semester | Modeling and control of electromechanical systems | ING-INF/04 | 6 |
| 1 st semester | Platforms and algorithms for autonomous driving | ING-INF/05 | 6 |
| | ELECTIVE FREE-CHOICE COURSES * | | 12 |
| Other activities | Final examination or Final examination+ internship | | 24 3+21 |

2ND YEAR
Curriculum "Autonomous Driving Engineering" (ADE)
(Place of teaching: University of Parma)

| Period | Mandatory courses | SSD | ECTS (CFU) |
|--------------------------|---|--------------------------|--------------|
| 1 st semester | Electronics and lighting technologies for automotive Electronics for Automotive systems Automotive lighting and ranging technologies | ING-INF/01 ING-INF/02 | 12 6 6 |
| 1 st semester | Computer engineering laboratory | NN | 3 |

| Period | Elective courses | SSD | ECTS (CFU) |
|--------------------------|--|------------|------------|
| | ELECTIVE COMPLEMENTARY COURSES (pick 2/6)^(‡) | | |
| 1 st semester | 3D perception, learning-based data fusion | ING-INF/05 | 6 |
| 1 st semester | Autonomous driving and adas technologies | ING-INF/05 | 6 |
| 1 st semester | Visual perception for self-driving cars | ING-INF/05 | 6 |
| 1 st semester | Virtual systems and human machine interface | ING-INF/05 | 6 |
| 1 st semester | Path and trajectory planning | ING-INF/04 | 6 |

| | | | |
|--------------------------|---|------------|--------------------|
| 1 st semester | Vehicular communications | ING-INF/03 | 6 |
| | ELECTIVE FREE-CHOICE COURSES * | | 12 |
| Other activities | Final examination or Final examination+ internship | | 24 3+21 |