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ASIAXIS

EUR-ACE Guidelines

For Program Learning Outcomes definition

UNIVERSITÀ POLITECNICA DELLE MARCHE

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Programme Learning Outcome MATRIX

Please fill the programme learning outcome matrix.

How to fill the PLO matrix:

1. Identify the learning outcomes (LO) for each module taking into account that:
    a. Not all the LO must be in all the modules
    b. PLOs must be different between Bachelor and Master Science Modules
2. A list of PLO for bachelor and master Degree programmes are in the next section in the tables:
    a. EUR-ACE Programme Learning Outcomes for Bachelor Degree Programmes
    b. EUR-ACE Programme Learning Outcomes for Master Degree Programmes

MODULES	Ba_PLO1	Ba_PLO2	Ba_PLO3	Ba_PLO4	…	Ba_PLOX
	Please choose the PLO among those in the list in next section	Please choose the PLO among those in the list in next section	Please choose the PLO among those in the list in next section	Please choose the PLO among those in the list in next section	Add as you want	Add as you want
Internal Combustion Engine Principle						
Internal Combustion Engine Design						
Fundamentals of Combustion						

MODULES	MSc_PLO1	MSc_PLO2	MSc_PLO3	MSc_PLO4	…	MSc_PLOX
	Please choose the PLO among those in the list in next section	Please choose the PLO among those in the list in next section	Please choose the PLO among those in the list in next section	Please choose the PLO among those in the list in next section	Add as you want	Add as you want
Performance Simulation and Application of ICE						
Simulation of ICE Combustion and Emission forming process						
Simultion of Complicated Flow and Heat Transfer						

Technologies of New Energy Resource						

Programme Learning Outcomes:

Programme learning outcomes describe the knowledge, understanding, skills and abilities that an accredited engineering SP must enable a graduate to demonstrate.

They are described separately for both Bachelor and Master Degree programmes with reference to the following eight learning areas:

1. ***Knowledge and understanding*;**

   Ability to apply knowledge and understanding of mathematics, sciences and engineering disciplines underlying specialisation to solve / design / investigate / conduct complex engineering problems / products, processes and systems / issues / activities.

2. ***Engineering Analysis*;**

   Ability to analyse and solve complex engineering problems.

3. ***Engineering Design*;**

   Ability to design complex engineering products (devices, artefacts, etc.), processes and systems.

4. ***Investigations*;**

   Ability to investigate complex engineering issues.

5. ***Engineering Practice*;**

   Ability to use and apply practical knowledge and understanding to solve / design / investigate / conduct complex engineering problems / products, processes and systems / issues / activities

6. ***Making Judgements*;**

   Ability to manage complex and multidisciplinary work contexts and to take decisions and formulate judgments.

7. ***Communication and Team-working*;**

   Ability to use diverse methods and tools of communication to communicate clearly and unambiguously with specialist and non-specialist audiences in national and international contexts.

   Ability to function effectively in national and international contexts as leader of a team that may be composed of different disciplines and levels.

8. ***Lifelong Learning*.**

   Ability to engage in independent lifelong learning and to follow developments in science and technology and undertake further studies in new and emerging technologies.

Characteristics of PLOs

Programme learning outcomes *should be* ***S.M.A.R.T.***:

- **Specific** (*PLOs should adequately reflect the context, level, scope and content of the programme)*
- **Measurable** (*PLOs should be easily understandable and verifiable in terms of what the student has actually achieved at the end of the programme)*
- **Achievable** (*consistent with the institutional context and the available resources)*
- **Relevant** (*Only the 'key' learning outcomes should be established at programme level. There are no rules on the ideal number of PLOs. Experience suggests that between 10 and 12 is appropriate)*
- **Time-related** *(plannable and achievable within the specified workload)*

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EUR-ACE Programme Learning Outcomes for Bachelor Degree Programmes

Syllabus Sections	EUR-ACE Programme Learning Outcomes for **Bachelor Degree Programmes**
Knowledge and understanding	**Knowledge and Understanding** • knowledge and understanding of the mathematics and other basic sciences underlying their engineering specialisation, at a level necessary to achieve the other programme outcomes; • knowledge and understanding of engineering disciplines underlying their specialisation, at a level necessary to achieve the other programme outcomes, including some awareness at their forefront; • awareness of the wider multidisciplinary context of engineering.
capacity to apply knowledge and understanding	**Engineering Analysis** • ability to analyse complex engineering products, processes and systems in their field of study; to select and apply relevant methods from established analytical, computational and experimental methods; to correctly interpret the outcomes of such analyses; • ability to identify, formulate and solve engineering problems in their field of study; to select and apply relevant methods from established analytical, computational and experimental methods; to recognise the importance of non-technical –societal, health and safety, environmental, economic and industrial – constraints.
	Engineering Design • ability to develop and design complex products (devices, artefacts, etc.), processes and systems in their field of study to meet established requirements, that can include an awareness of non-technical – societal, health and safety, environmental, economic and industrial– considerations; to select and apply relevant design methodologies; • ability to design using some awareness of the forefront of their engineering specialisation.
	Investigations • ability to conduct searches of literature, to consult and to critically use scientific databases and other appropriate sources of information, to carry out simulation and analysis in order to pursue detailed investigations and research of technical issues in their field of study; • ability to consult and apply codes of practice and safety regulations in their field of study; • laboratory/workshop skills and ability to design and conduct experimental investigations, interpret data and draw conclusions in their field of study.
	Engineering Practice • understanding of applicable techniques and methods of analysis, design and investigation and of their limitations in their field of study; • practical skills for solving complex problems, realising complex engineering designs and conducting investigations in their field of study; • understanding of applicable materials, equipment and tools, engineering technologies and processes, and of their limitations in their field of study;

	• ability to apply norms of engineering practice in their field of study; • awareness of non-technical -societal, health and safety, environmental, economic and industrial implications of engineering practice; • awareness of economic, organisational and managerial issues (such as project management, risk and change management) in the industrial and business context
Transversal skills	**Making Judgement** • ability to gather and interpret relevant data and handle complexity within their field of study, to inform judgements that include reflection on relevant social and ethical issues; • ability to manage complex technical or professional activities or projects in their field of study, taking responsibility for decision making.
	Communication • ability to communicate effectively information, ideas, problems and solutions with engineering community and society at large; •
	Team-working • ability to function effectively in a national and international context, as an individual and as a member of a team and to cooperate effectively with engineers and non-engineers.
	Lifelong Learning • ability to recognise the need for and to engage in independent life-long learning; • ability to follow developments in science and technology.

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EUR-ACE Programme Learning Outcomes for Master Degree Programmes

Syllabus Sections	EUR-ACE Programme Learning Outcomes for **Master Degree Programmes**
Knowledge and Understanding	**Knowledge and Understanding** • in-depth knowledge and understanding of mathematics and sciences underlying their engineering specialisation, at a level necessary to achieve the other programme outcomes; • in-depth knowledge and understanding of engineering disciplines underlying their specialisation, at a level necessary to achieve the other programme outcomes; • critical awareness of the forefront of their specialisation; • critical awareness of the wider multidisciplinary context of engineering and of knowledge issues at the interface between different fields.
capacity to apply knowledge and understanding	**Engineering Analysis** • ability to conceptualise engineering products, processes and systems; • ability to analyse new and complex engineering products, processes and systems within broader or multidisciplinary contexts; to select and apply the most appropriate and relevant methods from established analytical, computational and experimental methods or new and innovative methods; to critically interpret the outcomes of such analyses; • ability to identify, formulate and solve unfamiliar complex engineering problems that are incompletely defined, have competing specifications, may involve considerations from outside their field of study and non-technical – societal, health and safety, environmental, economic and industrial – constraints; to select and apply the most appropriate and relevant methods from established analytical, computational and experimental methods or new and innovative methods in problem solving; • ability to identify, formulate and solve complex problems in new and emerging areas of their specialisation.
	Engineering Design • ability to develop, to design new and complex products (devices, artefacts, etc.), processes and systems, with specifications incompletely defined and/or competing, that require integration of knowledge from different fields and non-technical - societal, health and safety, environmental, economic and industrial commercial – constraints; to select and apply the most appropriate and relevant design methodologies or to use creativity to develop new and original design methodologies. • ability to design using knowledge and understanding at the forefront of their engineering specialisation.
	Investigations • ability to identify, locate and obtain required data; • ability to conduct searches of literature, to consult and critically use databases and other sources of information, to carry out simulation in order to pursue detailed investigations and research of complex technical issues; • ability to consult and apply codes of practice and safety regulations;

	• advanced laboratory/workshop skills and ability to design and conduct experimental investigations, critically evaluate data and draw conclusions; • ability to investigate the application of new and emerging technologies at the forefront of their engineering specialisation.
	Engineering Practice • comprehensive understanding of applicable techniques and methods of analysis, design and investigation and of their limitations; • practical skills, including the use of computer tools, for solving complex problems, realising complex engineering design, designing and conducting complex investigations; • comprehensive understanding of applicable materials, equipment and tools, engineering technologies and processes, and of their limitations; • ability to apply norms of engineering practice; • knowledge and understanding of the non-technical – societal, health and safety, environmental, economic and industrial - implications of engineering practice; • critical awareness of economic, organisational and managerial issues (such as project management, risk and change management).
Transversal skills	**Making Judgement** • ability to integrate knowledge and handle complexity, to formulate judgements with incomplete or limited information, that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgement; • ability to manage complex technical or professional activities or projects that can require new strategic approaches, taking responsibility for decision making.
	Communication • ability to use diverse methods to communicate clearly and unambiguously their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences in national and international contexts.
	Team-working • ability to function effectively in national and international contexts, as a member or leader of a team, that may be composed of different disciplines and levels, and that may use virtual communication tools.
	Lifelong Learning • ability to engage in independent life-long learning; • ability to undertake further study autonomously.

Syllabus

Please provide for each module:

1. the previous syllabus of not enhanced module (in your own language)
2. the original syllabus of enhanced module (in your own language). Please highlight the new and enhanced topics.
3. the ASIAXIS syllabus (provided as an annex) filled with all the info reported in the original syllabus. Please highlight the new and enhanced topics. Please take into account the Program Learning Outcomes selected in the matrix.

P.S: in the following section an example on how to fill the new syllabus

The syllabus must contain information about PLO chosen for the Module.

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Example on how to fill the new syllabus

Institution	**Università Politecnica delle Marche**
Module (Title)	Internal Combustion Engines
Hours:	72
Program	Master degree in Mechanical Engineering
Learning outcomes	You should also mention the following three fields, by considering the PLOs chosen in the previous section (PLO Matrix): • knowledge and understanding • capacity to apply knowledge and understanding • Transversal skills As an example, I report the syllabus of the master degree course "internal combustion engine" **Knowledge and Understanding**. The course enables students to acquire advanced knowledge on the thermo-fluid dynamic processes taking place in volumetric internal combustion engines. Topics covered in the course will form the basis for an in-depth knowledge of the architecture and the main components of internal combustion engines. In this way, students enrich their knowledge on energy machines **Capacity to apply Knowledge and Understanding**. The student will have the ability to undertake the evaluation of the thermal and energy performance of the components of an engine and will be able to choose the engine selection criteria on the basis of the application field. These capabilities will consist in a series of professional skills, such as: 1. ability to organize the modeling and design of an internal combustion engine; 2. ability to assess the engine performance in a given application 3. ability to properly understand the formation mechanisms of the main pollutants in the exhausts of an engine and choose the methodologies for their removal

	Transversal Skills. Since the performance of the engine depend on mechanical, fluid-dynamical, thermal, and environmental choices the course will contribute to the completion of the basic technical training, with contributions from various cultural areas that contribute to the culture and professional role of an engineer. The in depth knowledge of such a machine will allow students to test their ability in integrating their knowledge and interfacing with specialists of different areas
Content	*Brief historical introduction Internal combustion engines classification Engine design and operating parameters Internal combustion engines operating cycles Air inlet and exhaust processes in two- and four-strokes cycle engines Supercharging and turbocharging Ignition plants Fuel metering in spark- and compression-ignited engines Combustion in spark- and compression ignited engines Pollutants formation and control Engines cooling Friction losses and lubrication*
Methodology	You should also mention the following section: • Learning Evaluation Methods • Learning Evaluation Criteria • Learning Measurement Criteria • Final Mark Allocation Criteria Below an example taken from ICE UnivPM course: **Learning Evaluation Methods**. The exam procedure consists in an oral examination. At least three main topics addressed in the course will be discussed during the oral. The starting topic is at student's choice **Learning Evaluation Criteria**. The evaluation consists first in verifing the student's knowledge and understanding of the basic functioning of an internal combustion engine. Then the student will be required to demonstrate his in-depth knowledge on the thermo-fluidodynamic processes taking place both in spark ignited and compression ignited engines with particular attention to gas exchange processes, fuel metering, charge motion in the cylinder, combustion, pollutant formation and pollutant control techniques.

	Learning Measurement Criteria. A thirty-points scale is used for grading, with possible praise **Final Mark Allocation Criteria**. The outcome of the evaluation is positive if the student proves to have knowledge of all the basic subjects covered in the course. The highest score is achieved by demonstrating in-depth knowledge of the course contents. Praise is given to students who are particularlly brilliant in exposure and/or demonstrat particular mastery of the matters treated in the course, being able to analyze topics not explicitly covered or to treat standard topics in alternative ways
Bibliography	
Educational resources	Laboratory facilities… Simulation tools … …