

**MINISTRY OF EDUCATION AND RESEARCH**  
**PETROLEUM-GAS UNIVERSITY OF PLOIESTI**  
**FACULTY: MECHANICAL AND ELECTRICAL ENGINEERING**  
**COORDINATING DEPARTMENT: MECHANICAL ENGINEERING**

## **CURRICULUM**

**Programme of study / specialization RISK MANAGEMENT AND RELIABILITY ENGINEERING  
OF PETROLEUM SYSTEMS - MMRFZ**

**Field of Master's studies Mechanical Engineering**

**Mode of study Full-time**

**Duration of study / Minimum total number of credits required for graduation: 1.5 years /  
90 + 10 credits**

**Academic year from which the curriculum is valid: 2026-2027**

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## 1. GENERAL OBJECTIVE OF THE PROGRAMME

- is to ensure the necessary skills to perform any monitoring tasks related to the operation, maintenance, and repair of mechanical components and systems, as well as to conduct entry-level risk analyses in any engineering department of companies that apply the principles of "Industry 4.0"

## 2. COMPETENCES AND LEARNING OUTCOMES

Qualification: NQF Level 7 - Master's degree studies

Target occupations from the representative COR/ESCO unit group:

**2144 35 - specialist inspector, mechanical engineer**

**2144 43 - industrial equipment mechanical maintenance specialist**

The competence profile developed in accordance with the National Qualifications Framework, together with the learning outcomes associated with these competences, is presented synthetically below. The detailed presentation of the competences and learning outcomes is provided in the course unit descriptions included in the curriculum.

| Competences and learning outcomes* provided by the study programme |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Professional competences                                           | Learning outcomes*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 1. Uses CAD/CAE software for technical design                      | K1: The student/graduate describes, identifies and summarizes fundamental concepts of design, operation and optimization of petroleum and petrochemical equipment.<br>K2: The student/graduate selects computer-aided modelling and simulation (CAD/CAE) techniques for analysing mechanical behaviour.<br>S1: The student/graduate selects and applies design and simulation software for diagnosing and optimizing equipment performance.<br>RA1: The student/graduate develops working and communication skills for effective collaboration in carrying out tasks specific to mechanical engineering.                                                                                                                                                                                                      |
| 2. Develops feasibility studies                                    | K1: The student/graduate describes, identifies and summarizes fundamental concepts concerning manufacturing technologies for petroleum and petrochemical equipment.<br>K2: The student/graduate explains and interprets concepts of quality management, reliability and risk assessment in equipment operation.<br>S1: The student/graduate selects and applies specific scientific methods and techniques for optimizing and monitoring manufacturing processes.<br>S2: The student/graduate interprets and explains issues related to the planning, coordination and implementation of manufacturing technologies using specific software applications.<br>RA1: The student/graduate plans and designs manufacturing processes and describes the results clearly and concisely, both orally and in writing. |
| 3. Conducts applied scientific research activities                 | K1: The student/graduate describes, identifies and summarizes fundamental concepts of design, operation and optimization of petroleum and petrochemical equipment.<br>K2: The student/graduate explains and interprets technical documentation specific to the design and manufacture of petrochemical equipment.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

|                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                  | <p>K2: The student/graduate explains and interprets technical documentation specific to the design and manufacture of petrochemical equipment.</p> <p>S1: The student/graduate selects and applies specific scientific methods and techniques in the development and implementation of manufacturing technologies and analyses the level of scientific documentation and the potential advantages and disadvantages of the proposed methods and procedures.</p> <p>S2: The student/graduate interprets and explains issues related to the planning, coordination and implementation of manufacturing technologies using specific software applications.</p> <p>RA1: The student/graduate develops working and communication skills for effective collaboration in carrying out tasks specific to mechanical engineering.</p> <p>RA2: The student/graduate demonstrates awareness of social responsibility and professional ethics.</p> |
| <b>Transversal competences</b>                                   | <b>Learning outcomes*</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 1. Works efficiently and achieves goals using limited resources. | <p>K1: The student/graduate describes, identifies and summarizes fundamental concepts of design, operation and optimization of petroleum and petrochemical equipment.</p> <p>K2: The student/graduate explains and interprets technical documentation specific to the design and manufacture of petrochemical equipment.</p> <p>S1: The student/graduate models and simulates concepts and processes when solving specific tasks in a computer-aided environment.</p> <p>S2: The student/graduate interprets and explains issues related to the planning, coordination and implementation of manufacturing technologies using specific software applications.</p> <p>RA1: The student/graduate develops working and communication skills for effective collaboration in carrying out tasks specific to mechanical engineering.</p>                                                                                                     |

\* K – knowledge; S – skills; RA – responsibility and autonomy.

### 3. WEEKLY STRUCTURE OF THE ACADEMIC YEAR

Number of semesters: 3

Number of credits per semester: 30

Number of direct teaching hours / week: 14 / 17 / 13 (semesters I / II / III)

Number of weeks: 14 / semester

|         | Teaching activities (no. of weeks) |         | Examination sessions (no. of weeks) |        |        | Practical training (no. of weeks)      |
|---------|------------------------------------|---------|-------------------------------------|--------|--------|----------------------------------------|
|         | Sem. I                             | Sem. II | Winter                              | Summer | Resits |                                        |
| Year I  | 14                                 | 14      | 3                                   | 3      | 3      | During the semester / 4 hours per week |
| Year II | 14                                 |         | 3                                   |        | 3      | During the semester / 4 hours per week |

|                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                 | <p>S1: The student/graduate selects and applies specific scientific methods and techniques in the development and implementation of manufacturing technologies and analyses the level of scientific documentation and the potential advantages and disadvantages of the proposed methods and procedures.</p> <p>S2: The student/graduate interprets and explains issues related to the planning, coordination and implementation of manufacturing technologies using specific software applications.</p> <p>RA1: The student/graduate develops working and communication skills for effective collaboration in carrying out tasks specific to mechanical engineering.</p> <p>RA2: The student/graduate demonstrates awareness of social responsibility and professional ethics.</p>                                                                                                                                                                                                           |
| 4. Presents the results of the analyses         | <p>K1: The student/graduate describes, identifies and summarizes fundamental concepts of design, operation and optimization of petroleum and petrochemical equipment.</p> <p>K2: The student/graduate explains and interprets technical documentation specific to the design and manufacture of petrochemical equipment.</p> <p>S1: The student/graduate selects and applies specific scientific methods and techniques in the development and implementation of manufacturing technologies and analyses the level of scientific documentation and the potential advantages and disadvantages of the proposed methods and procedures.</p> <p>S2: The student/graduate interprets and explains issues related to the planning, coordination and implementation of manufacturing technologies using specific software applications.</p> <p>RA1: The student/graduate plans and designs manufacturing processes and describes the results clearly and concisely, both orally and in writing.</p> |
| 5. Monitors quality standards for manufacturing | <p>K1: The student/graduate describes, identifies and summarizes concepts of quality management, reliability and risk assessment in equipment operation.</p> <p>K2: The student/graduate explains and interprets technical documentation specific to modern manufacturing technologies integrated with quality standards.</p> <p>S1: The student/graduate selects and applies scientific methods and techniques specific to safety, quality and environmental protection requirements in operating processes.</p> <p>S2: The student/graduate interprets and explains issues related to the planning, coordination and implementation of manufacturing technologies.</p> <p>RA1: The student/graduate demonstrates awareness of social responsibility and professional ethics.</p>                                                                                                                                                                                                            |
| 6. Manages engineering projects                 | <p>K1: The student/graduate describes, identifies and summarizes fundamental concepts of design, operation and optimization of petroleum and petrochemical equipment.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

Practical training is organized during the semester / in a concentrated period after the summer examination session (the appropriate option shall be selected), for Years I, II and III, as applicable.

#### **4. ENSURING FLEXIBILITY OF THE LEARNING PATH**

Flexibility of the educational pathway is ensured by integrating optional and elective course units into the curriculum, giving students the opportunity to configure their own learning pathway in accordance with their interests and professional objectives.

Optional course units are structured in course packages designed to contribute to the deepening and diversification of the competences associated with the specialization pathway chosen by the student.

The student selects the course units to be taken (optional or elective) in the academic year preceding the year in which they are included in the curriculum, thereby ensuring predictability and coherence of the academic pathway.

Credits for elective course units are awarded upon successful completion of the course assessment.

ECTS credits obtained by completing elective course units are separate and may not be used to replace or substitute credits assigned to compulsory and optional course units included in the curriculum.

#### **5. CONDITIONS FOR ENROLMENT IN THE NEXT YEAR OF STUDY. CONDITIONS FOR PASSING AN ACADEMIC YEAR**

The conditions for enrolment in the next year of study, advance completion of course modules, and the criteria and conditions for progression are governed by the Regulations on Students' Professional Activity.

#### **6. FINAL EXAMINATION**

Period for preparing the final dissertation: beginning with the penultimate semester of study.

Finalization of the dissertation: during the last semester of study.

Period for defending the dissertation: the June-July session of the final year of study.

Number of credits for the final examination: 10 credits (in addition to the 90 credits).

## 7. COURSE UNITS BY YEAR OF STUDY

### CURRICULUM - 1st YEAR

| No. | Course unit name | Formative category of the course: DF, DS, DC1 | NOAD / week |   |   |   | Hours / semester |       |       |          | ECTS credits | Assessment form |
|-----|------------------|-----------------------------------------------|-------------|---|---|---|------------------|-------|-------|----------|--------------|-----------------|
|     |                  |                                               | C           | S | L | P | NOAD/sem         |       |       | NOSI/sem |              |                 |
|     |                  |                                               |             |   |   |   | C                | S,L,P | Total |          |              |                 |
|     |                  |                                               |             |   |   |   |                  |       |       |          |              |                 |

#### A. COMPULSORY (C) AND OPTIONAL (O) COURSES

##### SEMESTER 1

|                      |                                             |    |   |   |   |   |    |    |     |     |    |         |
|----------------------|---------------------------------------------|----|---|---|---|---|----|----|-----|-----|----|---------|
| 1                    | Computer Assisted Engineering               | DC | 2 | 2 | 0 | 0 | 28 | 28 | 56  | 94  | 5  | E1      |
| 2                    | Advanced Technologies of Petroleum and Gas  | DF | 1 | 1 | 0 | 0 | 14 | 14 | 28  | 122 | 5  | V1      |
| 3                    | Intelligent Measurement & Control Systems   | DF | 2 | 0 | 2 | 0 | 28 | 28 | 56  | 94  | 5  | E1      |
| 4                    | Technical Decision Making and Risk Analysis | DF | 1 | 1 | 0 | 0 | 14 | 14 | 28  | 122 | 5  | V1      |
| 5                    | Quality Engineering and Management          | DF | 1 | 0 | 1 | 0 | 14 | 14 | 28  | 122 | 5  | E1      |
| 6                    | Professional training 1*                    | DS | 0 | 0 | 0 | 8 | 0  | 60 | 112 | 38  | 5  | V1      |
| TOTAL hours assisted |                                             |    | 7 | 4 | 3 | 0 | 98 | 70 | 140 | 592 | 30 | 3E1+3V1 |

TOTAL hours partial assisted

8

##### SEMESTER 2

|                      |                                                              |    |   |   |   |   |    |     |     |     |    |         |
|----------------------|--------------------------------------------------------------|----|---|---|---|---|----|-----|-----|-----|----|---------|
| 7                    | Petroleum and Gas Industry Processes                         | DF | 1 | 0 | 1 | 0 | 14 | 14  | 28  | 122 | 5  | E2      |
| 8                    | Energy Management and RES                                    | DF | 2 | 0 | 2 | 0 | 28 | 28  | 56  | 94  | 5  | E2      |
| 9                    | Optimization and Monitoring of Drilling-Extraction Processes | DS | 2 | 0 | 1 | 0 | 28 | 14  | 42  | 108 | 5  | E1      |
| 10                   | Optimal Operation Engineering of Petroleum Equipment         | DS | 1 | 0 | 2 | 0 | 14 | 28  | 42  | 108 | 5  | E2      |
| 11                   | Theoretical and Experimental Research Methodology            | DS | 1 | 0 | 1 | 0 | 14 | 14  | 28  | 122 | 5  | E2      |
| 12                   | Professional training 2*                                     | DS | 0 | 0 | 0 | 8 | 0  | 60  | 60  | 90  | 5  | V2      |
| TOTAL hours assisted |                                                              |    | 7 | 0 | 7 | 0 | 70 | 144 | 214 | 536 | 30 | 4E2+1V2 |

TOTAL hours partially assisted

#### B. ELECTIVE (E) COURSES

##### SEMESTER 1

|   |                                                                                |    |   |   |   |   |    |    |    |    |   |    |
|---|--------------------------------------------------------------------------------|----|---|---|---|---|----|----|----|----|---|----|
| 1 | Advanced materials and technologies for the manufacture of petroleum equipment | DS | 1 | 0 | 2 | 0 | 14 | 28 | 42 | 58 | 4 | V1 |
|---|--------------------------------------------------------------------------------|----|---|---|---|---|----|----|----|----|---|----|

##### SEMESTER 2

|   |                                                   |    |   |   |   |   |    |    |    |    |   |    |
|---|---------------------------------------------------|----|---|---|---|---|----|----|----|----|---|----|
| 2 | Policies and strategies in the petroleum industry | DC | 2 | 1 | 0 | 0 | 28 | 14 | 42 | 58 | 4 | V1 |
|---|---------------------------------------------------|----|---|---|---|---|----|----|----|----|---|----|

1 : DF - fundamental; DS - specialty; DC - complementary;  
\*) partially assisted courses.



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DEAN,

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**CURRICULUM - 2nd YEAR**

CURRICULUM - 2nd YEAR

| No.                                        | Course unit name                                 | Formative category of the course: DF, DS, DC1 | NOAD / week |   |   |   | Hours / semester |         |       |          | ECTS credits | Assessment form |
|--------------------------------------------|--------------------------------------------------|-----------------------------------------------|-------------|---|---|---|------------------|---------|-------|----------|--------------|-----------------|
|                                            |                                                  |                                               | C           | S | L | P | NOAD/sem         |         |       | NOSI/sem |              |                 |
|                                            |                                                  |                                               |             |   |   |   | C                | S, L, P | Total |          |              |                 |
| A. COMPULSORY (C) AND OPTIONAL (O) COURSES |                                                  |                                               |             |   |   |   |                  |         |       |          |              |                 |
| SEMESTER 3                                 |                                                  |                                               |             |   |   |   |                  |         |       |          |              |                 |
| 13                                         | Degradation and Maintenance of Technical Systems | DS                                            | 2           | 0 | 2 | 0 | 28               | 28      | 56    | 94       | 5            | E3              |
| 14                                         | Advanced Simulation Techniques and Digital Twins | DS                                            | 0           | 0 | 0 | 2 | 0                | 28      | 28    | 122      | 5            | P3              |
| 15                                         | Off-Shore Installations and Construction         | DS                                            | 1           | 0 | 2 | 0 | 14               | 28      | 42    | 108      | 5            | E3              |
| 16                                         | Distributed Supervision and Control Systems      | DF                                            | 1           | 0 | 2 | 0 | 14               | 28      | 42    | 108      | 5            | E3              |
| 17                                         | Management of Industrial Technology              | DF                                            | 0           | 0 | 0 | 2 | 0                | 28      | 28    | 122      | 5            | P3              |
| 18                                         | Professional training 3*                         | DS                                            | 0           | 0 | 0 | 8 | 0                | 60      | 60    | 90       | 5            | V2              |
| TOTAL                                      |                                                  |                                               | 4           | 0 | 6 | 4 | 56               | 260     | 316   | 674      | 30           | 3E3+3V3         |
| SEMESTER 4                                 |                                                  |                                               |             |   |   |   |                  |         |       |          |              |                 |
| 19                                         | Internship (for dissertation)*                   | DS                                            | 0           | 0 | 0 | 0 | 0                | 60      | 60    | 240      | 10           | V3              |
| 20                                         | Elaboration of dissertation paper*               | DS                                            | 0           | 0 | 0 | 0 | 0                | 60      | 60    | 240      | 10           | V3              |
| 21                                         | Graduation of the dissertation                   |                                               | 0           | 0 | 0 | 0 | 0                | 0       | 0     | 300      | 10           | ED              |
| TOTAL                                      |                                                  |                                               |             |   |   |   | 0                | 120     | 120   | 780      | 30           | 2V3+1D          |
| B. ELECTIVE (E) COURSES                    |                                                  |                                               |             |   |   |   |                  |         |       |          |              |                 |
| SEMESTER 3                                 |                                                  |                                               |             |   |   |   |                  |         |       |          |              |                 |
| 21                                         | Legislation in the petroleum industry            | DC                                            | 2           | 1 | 0 | 0 | 28               | 14      | 42    | 58       | 4            | V3              |
| SEMESTER 4                                 |                                                  |                                               |             |   |   |   |                  |         |       |          |              |                 |

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**GENERAL BALANCE**

| TYPE OF COURSE UNITS           | HOURS IN THE CURRICULUM |                   |                   |            | ECTS CREDITS         |            |
|--------------------------------|-------------------------|-------------------|-------------------|------------|----------------------|------------|
|                                | COURSE                  | S, L, P           | TOTAL             | %          | TOTAL                | %          |
| COMPULSORY (C)                 | 224                     | 224 + 240*        | 448 + 240*        | 76.2       | 58 + 16*             | 82.2       |
| OPTIONAL (O)                   | 56                      | 84                | 140               | 23.8       | 16                   | 17.8       |
| <b>TOTAL NUMBER OF HOURS</b>   |                         |                   |                   |            |                      |            |
| <b>COMPULSORY COURSE UNITS</b> | <b>280</b>              | <b>308 + 240*</b> | <b>588 + 240*</b> | <b>100</b> | <b>74 + 16* + 10</b> | <b>100</b> |

**Total number of applicative activities / Total number of course hours:**  $(84+84+140+60\text{-training})/(112+112+56)=368/280=1.31$

**Total number of exams / Total numbers of verifications:**  $(3E1+4E2+3E3)/(3V1+1P1+1V2+2V3+2P3)=10E/9V$ .

PROGRAMME COORDINATOR,

Prof. habil. Marius Gabriel PETRESCU, Ph.D. Eng.