تصميم البرنامج

مرفق 2-2/1/5

# Specifications of Mechanical Power Engineering Program (2022/2023)

## 2021 Bylaw

**University: Benha University**
**Faculty: Faculty of engineering at Shoubra**
**Department: Mechanical Engineering Department**
**Specification of Mechanical Power Engineering (B.Sc. Program) 2022/2023**

# A- Basic Information

**1- Program title:** Mechanical Power Engineering Program
**2- Program type:** Single
**3- Department:** Mechanical Engineering
**4- Coordinator:** Assoc. Prof. Dr. Mohamed Reda Salem
**5- External evaluator:** Prof. Dr. Mohamed Watani Mohamed El-Sayed, Faculty of engineering, Mataria, Helwan University
**6- Last date of program specifications approval:** 2021

# B- Professional Information

## 1. Faculty Mission:

The faculty of Engineering at Shoubra is committed to prepare a graduate with competencies and problem-solving skills that qualify each engineer to compete in local and regional labor markets, the graduate will be able to innovate and become an entrepreneur. The faculty also committed to the development of engineering sciences and producing internationally distinguished scientific research, with the framework of human values and social responsibility.

## 2. Program Mission:

The mechanical power engineering program is committed to graduating engineers who are able to understand the continuous development in scientific technologies and competition at the local and regional levels, equipped with basic and applied science foundations, able to produce innovative solutions to the needs of all sectors of society in the fields of mechanical power engineering, and are aware of the ethical and professional values and requirements of environmental protection. In addition to developing research and scientific studies and upgrading their quality in line with the needs of society.

To judge the compatibility between the program mission and faculty mission, both are divided to keywords and the matrix given in **Appendix A** is used.

## 3. Program Educational Objectives:

**The mechanical power engineering program objectives are:**

3.1. Apply and integrate knowledge and understanding of mathematics, physics, engineering sciences and skills to solve engineering problems in various topics and computer programs available to solve real problems in industries, heating, ventilation and air conditioning systems, and power plants to meet the required needs within realistic constraints.

3.2. Identify, formulate, and solve basic engineering problems and use appropriate engineering techniques, skills and tools necessary for engineering practice and project management.

3.3. Evaluating the sustainability and environmental issues related to mechanical energy systems and considering the impact of engineering solutions on society and the environment.

3.4. Use energy efficiently, demonstrate knowledge of contemporary engineering issues, and engage in self-learning and lifelong learning.
3.5. Apply industrial security, display professional and ethical responsibilities, understand context, and communicate effectively.
3.6. Work effectively within multi-disciplinary engineering teams and lead or supervise a group of engineers, technicians, and workforce.
3.7. Design, operation and maintenance of fluid and energy transmission systems, heating, ventilation and air conditioning systems, internal combustion engines and steam engines, verifying their performance and solving their basic operational problems.

To judge the compatibility of program mission with its Educational Objectives, the matrix given in **Appendix B** is used.

## 4. Graduate Attributes

According to the National Academic Reference Standard (NARS2018), the graduates of any engineering program must satisfy the following attributes:

1) Master a wide spectrum of engineering knowledge and specialized skills and can apply acquired knowledge using theories and abstract thinking in real life situations.
2) Apply analytic critical and systemic thinking to identify, diagnose and solve engineering problems with a wide range of complexity and variation.
3) Behave professionally and adhere to engineering ethics and standards.
4) Work in and lead a heterogeneous team of professionals from different engineering specialties and assume responsibility for own and team performance.
5) Recognize his/her role in promoting the engineering field and contribute in the development of the profession and the community;
6) Value the importance of the environment, both physical and natural, and work to promote sustainability principles.
7) Use techniques, skills and modern engineering tools necessary for engineering practice.
8) Assume full responsibility for own learning and self-development, engage in lifelong learning and demonstrate the capacity to engage in post- graduate and research studies.
9) Communicate effectively using different modes, tools and languages with various audiences; to deal with academic/professional challenges in a critical and creative manner.
10) Demonstrate leadership qualities, business administration and entrepreneurial skills.

Besides the above-mentioned general attributes of all engineering graduates, the Mechanical Power Engineering graduates must satisfy the following attributes:

11) Evaluate the sustainability and environmental issues related to mechanical power systems.
12) Use energy efficiently.
13) Apply industrial safety.
14) Apply and integrate knowledge, understanding and skills of different subjects and available computer software to solve real problems in industries and HVAC systems and power stations.
15) Lead or supervise a group of engineers, technicians, and work force.
16) Carry out preliminary designs of fluid transmission and power systems, investigate their performance and solve their essential operational problems.
17) Design, operate and maintain HVAC systems, internal combustion engines and steam engines.

To judge the compatibility of program mission as well as its Educational Objectives with the graduate attributes, the two matrices given in **Appendix C** are used.

## 5. Academic Standards of Program

### 5.1. Program Competencies

**According to the National Academic Reference Standard, the program in Mechanical Power Engineering must satisfy the following Competencies:**

| 5.1. General Engineering NARS Competencies in 2018 | | |
|---|---|---|
| **Level A (NARS)** | **A.1** | Identify, formulate, and solve complex engineering problems by applying engineering fundamentals, basic science and mathematics. |
| | **A.2** | Develop and conduct appropriate experimentation and/or simulation, analyze and interpret data, assess and evaluate findings, and use statistical analyses and objective engineering judgment to draw conclusions. |
| | **A.3** | Apply engineering design processes to produce cost-effective solutions that meet specified needs with consideration for global, cultural, social, economic, environmental, ethical and other aspects as appropriate to the discipline and within the principles and contexts of sustainable design and development. |
| | **A.4** | Utilize contemporary technologies, codes of practice and standards, quality guidelines, health and safety requirements, environmental issues and risk management principles. |
| | **A.5** | Practice research techniques and methods of investigation as an inherent part of learning. |
| | **A.6** | Plan, supervise and monitor implementation of engineering projects, taking into consideration other trades requirements. |
| | **A.7** | Function efficiently as an individual and as a member of multi-disciplinary and multi- cultural teams. |
| | **A.8** | Communicate effectively – graphically, verbally and in writing – with a range of audiences using contemporary tools. |
| | **A.9** | Use creative, innovative and flexible thinking and acquire entrepreneurial and leadership skills to anticipate and respond to new situations. |
| | **A.10** | Acquire and apply new knowledge; and practice self, lifelong and other learning strategies. |

| 5.2. Mechanical Engineering NARS | | |
|---|---|---|
| **Level B (NARS)** | **B.1** | Model, analyze and design physical systems applicable to the specific discipline by applying the concepts of Thermodynamics, Heat Transfer, Fluid Mechanics, solid Mechanics, Material Processing, Material Properties, Measurements, Instrumentation, Control Theory and Systems, Mechanical Design and Analysis, Dynamics and Vibrations. |
| | **B.2** | Plan, manage and carry out designs of mechanical systems and machine elements using appropriate materials both traditional means and computer-aided tools and software contemporary to the mechanical engineering field. |

| 5.2. Mechanical Engineering NARS | | |
|---|---|---|
| | **B.3** | Select conventional mechanical equipment according to the required performance. |
| | **B.4** | Adopt suitable national and international standards and codes, integrate legal, economic, and financial aspects to design, build, operate, inspect and maintain mechanical equipment and systems. |

| 5.3. Mechanical Power ARS | | |
|---|---|---|
| **Level C (ARS)** | **C.1** | Prepare, supervise the implementation of engineering drawings, computer graphics and write, present technical reports. |
| | **C.2** | Plan, schedule and use workshop equipment according to the appropriate codes and standards. |
| | **C.3** | Prepare, supervise and carry out plans for operation and maintenance of power mechanical systems (fluid transmission networks, internal combustion engines, Refrigeration, HVAC, power plant equipment,,,,,,). |
| | **C.4** | Design, evaluate mechanical power and energy for engineering systems, process performance and propose, conduct improvements. |

## 6. National Academic References Standards (NARS)

The program is adopted exactly **NARS** as reference academic standards for levels A and B and **ARS** for level C of this program (*National Academic Reference Standards (NARS) for Engineering 2nd edition, issued in 2018*).

## 7. Curriculum Structure and Content

**7. 1. Program Duration:** 10 semesters (5-years)

The academic year is divided into two semesters as follows (or according to the decisions of the Supreme Council of Universities):

- First semester (fall-semester): starts at the beginning of the third week of September for a period of 15 weeks.
- Second semester (spring-semester): starts at the beginning of the second week of February for a period of 15 weeks.

**7. 2. Program Structure:** Contact Hours System

- **No. of Contact Hours:** 250 99 Lectures 151 Tutorial/Lab.
- **No. of Contact Hours:** 250 220 Compulsory 30 Elective
- **No. of Contact Hours of Basic Science:** 64 Hours = 25.6%
- **No. of Contact Hours of Social Science and Humanities:** 20 Hours = 8%
- **No. of Contact Hours of Specialized Courses:** 160 Hours = 64%

### 7. 3. Indicative Curricula Content by Subject Area

| NO | Subject Area | Contact Hours | % | % According to Reference Framework |
|---|---|---|---|---|
| 1 | Humanities & Social Science | 20 | 8 | 8-12 |
| 2 | Mathematics & Basic Sciences | 64 | 25.6 | 20-26 |
| 3 | Basic Engineering Science | 67 | 26.8 | 25-30 |
| 4 | Applied Engineering and Design | 71 | 28.4 | 25-30 |
| 5 | Business Administration | 11 | 4.4 | 2-4 |
| 6 | Engineering Knowledge | 7 | 2.8 | 3-6 |
| 7 | Projects &Training | 10 | 4 | 3-6 |
| | | **250** | **100** | **100** |

| NO | Subjects | Contact Hours | % | Min. Percentage According to Reference Framework (%) |
|---|---|---|---|---|
| 1 | University Requirements | 20 | 8 | 8 |
| 2 | Faculty Requirements | 70 | 28 | 20 |
| 3 | Major Specialization Subjects | 98 | 39.2 | 35 |
| 4 | Minor Specialization Subjects | 62 | 24.8 | Maximum 30 |
| | | **250** | **100** | |

### 7. 4. Program Levels (Years):

**Preparatory Year:** It is required to pass 50 hours distributed as follows:
48 compulsory 2 Elective

**First Year Mechanical Power:** It is required to pass 50 hours distributed as follows:
48 compulsory 2 Elective

**Second Year Mechanical Power:** It is required to pass 50 hours distributed as follows:
46 compulsory 4 Elective

**Third Year Mechanical Power:** It is required to pass 50 hours distributed as follows:
46 compulsory 4 Elective

**Fourth Year Mechanical Power:** It is required to pass 50 hours distributed as follows:
34 compulsory 16 Elective

| Year | Hours | | |
|---|---|---|---|
| | Compulsory | Elective | Total |
| Preparatory | 48 | 2 | 50 |
| First | 48 | 2 | 50 |
| Second | 46 | 4 | 50 |
| Third | 46 | 4 | 50 |
| Fourth | 34 | 16 | 50 |
| **Total Hours** | | | 250 |

## 7. 5. Program Levels and Courses

### Year of Program 1 - Preparatory Year (Semester 1) - Compulsory

| Code | Course Title | No. of Hours/Week | | | | Intended Learning Outcomes (ILO's) |
|---|---|---|---|---|---|---|
| | | Lect. | Tut. | Lab. | Total | |
| BAS010 | Differential Calculus and Algebra | 2 | 2 | 0 | 4 | As Attached Matrix |
| BAS011 | Statics | 2 | 1 | 2 | 5 | |
| BAS012 | Engineering Chemistry | 2 | 1 | 2 | 5 | |
| BAS013 | Physics of Materials & Electricity | 2 | 1 | 3 | 6 | |
| MEC010 | Engineering Drawing (1) × | 0 | 3 | 0 | 3 | |
| GEN0x0 | Elective - Language requirements List | 2 | 0 | 0 | 2 | |
| | | **10** | **8** | **7** | **25** | |

### Year of Program 1 - Preparatory Year (Semester 2) - Compulsory

| Code | Course Title | No. of Hours/Week | | | | Intended Learning Outcomes (ILO's) |
|---|---|---|---|---|---|---|
| | | Lect. | Tut. | Lab. | Total | |
| BAS014 | Integral Calculus & Analytical Geometry | 2 | 2 | 0 | 4 | As Attached Matrix |
| BAS015 | Dynamics | 2 | 1 | 2 | 5 | |
| BAS016 | Physics of Light, Heat and Magnetism | 2 | 1 | 2 | 5 | |
| MEC011 | Principles of Manufacturing Engineering† | 1 | 0 | 2 | 3 | |
| MEC012 | Engineering Drawing (2) × | 0 | 3 | 1 | 4 | |
| GEN011 | Computer Skills × | 1 | 0 | 1 | 2 | |
| GEN012 | History of Engineering & Technology | 2 | 0 | 0 | 2 | |
| | | **10** | **7** | **8** | **25** | |

### Year of Program 2 - First Year Mechanical Power (Semester 1) – Compulsory

| Code | Course Title | No. of Hours/Week | | | | Intended Learning Outcomes (ILO's) |
|---|---|---|---|---|---|---|
| | | Lect. | Tut. | Lab. | Total | |
| MEC110 | Mechanical Drawing *× | 1 | 3 | 0 | 4 | As Attached Matrix |
| ELE170 | Electrical Engineering | 2 | 2 | 0 | 4 | |
| MEC111 | Materials Science | 1 | 1 | 3 | 5 | |
| BAS110 | Statistics & Theory of Probability | 2 | 2 | 0 | 4 | |
| BAS111 | Engineering Mechanics | 1 | 3 | 0 | 4 | |
| MEC112 | Manufacturing Technology (1)† | 2 | 1 | 1 | 4 | |
| | | **9** | **12** | **4** | **25** | |

### Year of Program 2 - First Year Mechanical Power (Semester 2) - Compulsory

| Code | Course Title | No. of Hours/Week | | | | Intended Learning Outcomes (ILO's) |
|---|---|---|---|---|---|---|
| | | Lect. | Tut. | Lab. | Total | |
| MEC120 | Thermodynamics | 2 | 2 | 1 | 5 | As Attached Matrix |
| BAS112 | Differential Equations | 2 | 2 | 0 | 4 | |
| MEC121 | Fluid Mechanics (1) | 2 | 1 | 2 | 5 | |
| MEC113 | Mechanics & Testing of Materials | 2 | 1 | 2 | 5 | |
| MEC102 | Computer Aided Engineering Mathematics | 1 | 0 | 3 | 4 | |
| GEN9XX | Elective from University Requirements | 1 | 1 | 0 | 2 | |
| | | **10** | **7** | **8** | **25** | |

### Year of Program 3 - Second Year Mechanical Power (Semester 1) - Compulsory

| Code | Course Title | No. of Hours/Week | | | | Intended Learning Outcomes (ILO's) |
|---|---|---|---|---|---|---|
| | | Lect. | Tut. | Lab. | Total | |
| MEC210 | Engineering Economy & Accounting | 2 | 2 | 0 | 4 | As Attached Matrix |
| MEC201 | Theory of Measurements & Sensors | 1 | 1 | 3 | 5 | |
| BAS211 | Numerical & Complex Analysis | 2 | 2 | 0 | 4 | |
| MEC211 | Kinematics & Dynamics of Rigid Bodies | 2 | 2 | 1 | 5 | |
| MEC212 | Manufacturing Technology (2)† | 2 | 1 | 2 | 5 | |
| GEN9XX | Elective from University Requirements | 1 | 1 | 0 | 2 | |
| | | **11** | **8** | **6** | **25** | |

### Year of Program 3 - Second Year Mechanical Power (Semester 2) - Compulsory

| Code | Course Title | No. of Hours/Week | | | | Intended Learning Outcomes (ILO's) |
|---|---|---|---|---|---|---|
| | | Lect. | Tut. | Lab. | Total | |
| MEC213 | Mechanical Design (1) | 2 | 4 | 0 | 6 | As Attached Matrix |
| MEC220 | Heat Transfer | 2 | 1 | 2 | 5 | |
| MEC214 | Mechanical Vibrations | 2 | 2 | 0 | 4 | |
| ELE270 | Electrical Machines | 2 | 1 | 1 | 4 | |
| MEC221 | Fluid Mechanics (2) | 2 | 1 | 1 | 4 | |
| GEN9XX | Elective from University Requirements | 1 | 1 | 0 | 2 | |
| | | **11** | **10** | **4** | **25** | |

### Year of Program 4 - Third Year Mechanical Power (Semester 1) – Compulsory

| Code | Course Title | No. of Hours/Week | | | | Intended Learning Outcomes (ILO's) |
|---|---|---|---|---|---|---|
| | | Lect. | Tut. | Lab. | Total | |
| MEC310 | Engineering Project Management | 2 | 2 | 0 | 4 | As Attached Matrix |
| MEC320 | Hydraulic & Pneumatic Systems | 2 | 0 | 3 | 5 | |
| MEC330 | System Dynamics | 2 | 2 | 0 | 4 | |
| MEC321 | Applied Thermodynamics | 1 | 2 | 2 | 5 | |
| MEC322 | Heat & Mass Transfer | 1 | 2 | 2 | 5 | |
| GEN9XX | Elective from University Requirements | 1 | 1 | 0 | 2 | |
| MEC300 | Field Training (1) | 0 | 0 | 0 | 0 | |
| | | **9** | **7** | **9** | **25** | |

### Year of Program 4 - Third Year Mechanical Power (Semester 2) – Compulsory

| Code | Course Title | No. of Hours/Week | | | | Intended Learning Outcomes (ILO's) |
|---|---|---|---|---|---|---|
| | | Lect. | Tut. | Lab. | Total | |
| MEC331 | Automatic Control | 2 | 2 | 0 | 4 | As Attached Matrix |
| MEC324 | Computer App. in Energy Field | 1 | 0 | 3 | 4 | |
| MEC325 | Gas Dynamics | 2 | 2 | 1 | 5 | |
| MEC326 | Fuel & Combustion | 2 | 2 | 1 | 5 | |
| MEC327 | Renewable Energy& Environ. Prot. | 2 | 1 | 2 | 5 | |
| GEN9XX | Elective from University Requirements | 1 | 1 | 0 | 2 | |
| | | **11** | **7** | **7** | **25** | |

### Year of Program 5 - (Fourth Year Mechanical (Power)) (Semester 1) - Compulsory

| Code | Course Title | No. of Hours/Week | | | | Intended Learning Outcomes (ILO's) |
|---|---|---|---|---|---|---|
| | | Lect. | Tut. | Lab. | Total | |
| MEC420 | Internal Combustion Engines (ICE) | 2 | 2 | 1 | 5 | As Attached Matrix |
| MEC421 | Turbomachines | 2 | 2 | 1 | 5 | |
| MEC422 | Refrigeration & Air Conditioning | 2 | 2 | 1 | 5 | |
| MEC4xx | Elective (1) | 1 | 2 | 1 | 4 | |
| MEC4xx | Elective (2) | 1 | 2 | 1 | 4 | |
| GEN9XX | Elective from University Requirements list | 1 | 1 | 0 | 2 | |
| MEC400 | Field Training (2) | 0 | 0 | 0 | 0 | |
| | | **9** | **11** | **5** | **25** | |

### Year of Program 5 - Fourth Year Mechanical Power (Semester 2) – Compulsory

| Code | Course Title | No. of Hours/Week | | | | Intended Learning Outcomes (ILO's) |
|---|---|---|---|---|---|---|
| | | Lect. | Tut. | Lab. | Total | |
| MEC414 | Feasibility Study of Eng. Projects | 1 | 2 | 0 | 3 | As Attached Matrix |
| MEC423 | Power Stations | 2 | 2 | 0 | 4 | |
| MEC4xx | Elective (3) | 2 | 1 | 0 | 3 | |
| MEC4xx | Elective (4) | 2 | 1 | 0 | 3 | |
| GEN9XX | Elective from University Requirements | 1 | 1 | 0 | 2 | |
| MEC490 | Graduation Project * | 0 | 0 | 10 | 10 | |
| | | **9** | **6** | **10** | **25** | |

### List of Technical Languages Elective Courses (Selected by students)

| Code | Course Title | No. of hours / week | | | | Intended Learning Outcomes (ILO's) |
|---|---|---|---|---|---|---|
| | | Lect. | Tut. | Lab | Total | |
| GEN010 | English Language | 2 | 0 | 0 | 2 | As Attached Matrix |
| GEN020 | German Language | 2 | 0 | 0 | 2 | |
| GEN030 | French Language | 2 | 0 | 0 | 2 | |

**List of Elective Courses from University Requirements (Selected by Students)**

| Code | Course Title | No. of Hours/Week | | | | Intended Learning Outcomes (ILO's) |
|---|---|---|---|---|---|---|
| | | Lect. | Tut. | Lab | Total | |
| GEN900 | Communication & Presentation Skills | 1 | 1 | 0 | 2 | As Attached Matrix |
| GEN901 | Theory of Sustainability | 1 | 1 | 0 | 2 | |
| GEN902 | Societal Issues | 1 | 1 | 0 | 2 | |
| GEN903 | Research & Analysis Skills | 1 | 1 | 0 | 2 | |
| GEN904 | Entrepreneurship | 1 | 1 | 0 | 2 | |
| GEN905 | Professional Ethics | 1 | 1 | 0 | 2 | |
| GEN906 | Critical Thinking | 1 | 1 | 0 | 2 | |
| GEN907 | Human Resources Management | 1 | 1 | 0 | 2 | |
| GEN908 | Contracts and Legislation | 1 | 1 | 0 | 2 | |
| GEN909 | Method of Scientific Research and Writing | 1 | 1 | 0 | 2 | |

**List Of Elective Courses (Selected by Students)**

| Code | Subject | Contact Hrs | | | |
|---|---|---|---|---|---|
| | | Lec. | Tut. | Lab. | Total |
| **List (1) of Elective Courses** | | | | | |
| MEC450 | Water Desalination & Wastewater Treatment | 1 | 2 | 1 | 4 |
| MEC451 | Pipeline Networks | 1 | 2 | 1 | 4 |
| **List (2) of Elective Courses** | | | | | |
| MEC452 | Thermal Equipment | 1 | 2 | 1 | 4 |
| MEC453 | Aerodynamics Engineering | 1 | 2 | 1 | 4 |
| MEC454 | Computational Fluid Mechanics (CFD) | 1 | 2 | 1 | 4 |
| **List (3) of Elective Courses** | | | | | |
| MEC455 | Numerical Methods in Energy Science | 2 | 1 | 0 | 3 |
| MEC456 | Energy Management Systems | 2 | 1 | 0 | 3 |
| MEC457 | Fire Fighting and Safety Systems | 2 | 1 | 0 | 3 |
| **List (4) of Elective Courses** | | | | | |
| MEC458 | Advanced Refrigeration & Air Conditioning | 2 | 1 | 0 | 3 |
| MEC459 | Vehicle Engineering | 2 | 1 | 0 | 3 |

## 8. Program Admission Requirements

Having Egyptian Secondary education or equivalent certificate with major in Mathematics, then after passing the preparatory year and fulfilling the admission requirements the students will be able to attend the program.

## 9. Regulations for progression and program completion First Year/Level/Semester

a) The student is considered successful if he/she passes the examinations in all courses of his class. The student is promoted to the next higher level if he/she fails in not more than two subjects of his class or from lower classes,

b) The referred student has to sit the examination in the courses in which he/she has failed together with the students studying the same courses. The student gets a pass grade when he/she passes the examination successfully. In case the student was considered absent with acceptable excuse in a course, he/she gets the actual grade,

c) The grades of the successful student in a course and in the general grade are evaluated as follows

- **Distinction:** From 85% of the total mark and upwards.
- **Very good:** From 75% to less than 85% of the total mark.
- **Good:** From 65% to less than 75% of the total mark
- **Pass:** From 50% to less than 65% of the total mark
- The grades of a failing student in a course are estimated in one of the following grades:
  - Weak: From 30% to less than 50% of the total mark
  - Very weak: Less than 30% of the total mark.

| Grade | Percentage | |
|---|---|---|
| | From | Up to |
| **Distinction** | 85% | 100% |
| **Very good** | 75% | 85% |
| **Good** | 65% | 75% |
| **Pass** | 50% | 65% |
| The grades of a failing student in a course are estimated in one of the following grades: | | |
| **Weak** | 30 | 50% |
| **Very weak** | | Less than 30% |

- The B.Sc. general grade for students is based on the cumulative marks obtained during all the years of study. The students are then arranged serially according to their cumulative sum.
- The student is awarded an honor degree if his cumulative sum is distinction or very good provided that he/she gets a grade not less than very good in any class of study other than the preparatory year. Moreover, he/she should not have failed in any examination he/she has sat in any class other than the preparatory year.

## 10. Teaching and Learning Methods

Considering that the program competences illustrate a wholistic status that would be achieved through a journey involves many different courses within different levels, and the final competence achievement can only be assessed at the end of its journey, each single competence is broken-down into measurable Learning Outcomes LOs that should be achieved in different courses. Thus, the program graduate competence may be considered as the final goal, while the courses LOs may be considered as the procedural aims/objectives. Hence, different teaching and learning methods are applied in program courses to cover the three domains given by the following table. For more details, please refer to the course specifications.

- **Teaching and Learning Methods**
  - Face-to-face Lecture
  - Online Education
  - Tutorial / Exercise
  - Group Discussions
  - Laboratory
  - Site Visit
  - Presentation
  - Collaborate Learning (Team Project)
  - Research and Reporting
  - Class Activity
  - Case Study
  - Assignments/homework
  - Brain Storming

| Teaching & Learning Methods | Learning Outcomes Domains (Courses LOs) | | |
|---|---|---|---|
| | Cognitive | Psychomotor | Affective |
| Face-to-face Lecture | √ | √ | √ |
| Online Education | √ | | √ |
| Tutorial / Exercise | | √ | √ |
| Group Discussions | √ | | |
| Laboratory | √ | √ | |
| Site Visit | | | √ |
| Presentation | √ | | √ |
| Collaborate Learning (Team Project) | √ | | √ |
| Research and Reporting | | √ | √ |
| Class Activity | √ | √ | |
| Case Study | √ | √ | |
| Assignments/homework | | √ | √ |
| Brain Storming | √ | √ | |

## 11. Assessment Methods of Program Intended Learning Outcomes:

Different assessment methods are applied in the program courses to assess these Learning Outcomes. The following table illustrates the assessment methods and what they assess in most cases. For further detail, refer to the courses' specifications

- Written Exams
- Online Exams
- Oral Exam
- Quizzes
- Lab Exam
- Take-Home Exam
- Research Assignments
- Reporting Assignments
- Project Assignments
- In-class Questions
- Class activities

| Formative Assessment | Learning Outcomes Domains (Courses LOs) | | |
|---|---|---|---|
| | Cognitive | Psychomotor | Affective |
| Quizzes | √ | √ | √ |
| Research Assignments | √ | | √ |
| In-class Questions | √ | √ | √ |
| Class activities | √ | √ | √ |

| Summative Assessments | Learning Outcomes Domains (Courses LOs) | | |
|---|---|---|---|
| | Cognitive | Psychomotor | Affective |
| Written Exams | √ | √ | √ |
| Online Exams | √ | √ | |
| Oral Exam | √ | √ | √ |
| Lab Exam | √ | √ | |
| Take-Home Exam | √ | √ | √ |
| Reporting Assignments | √ | | √ |
| Project Assignments | √ | √ | √ |

## 12. Evaluation of Program Intended Learning Outcomes (200)

| No. | Evaluator | Tool | Sample |
|---|---|---|---|
| 1. | Senior students | Evaluation sheet | 50% |
| 2. | Alumni | Evaluation sheet & interview | 15% |
| 3. | Stakeholders (Employers) | Evaluation sheet & interview | 15% |
| 4. | External Evaluator(s) (External Examiner(s)) | Report | 20% |
| 5. | Other | None | - |

**Coordinator of**
**Program Quality Assurance Committee**

**Assoc. Prof. Dr. Mohamed Reda Salem**

**Head of**
**Mechanical Engineering Department**

**Prof. Dr. Sameh Shawky Habib**

# Appendix A

**To judge the compatibility between the program mission and faculty mission, the following matrix is used.**

| Key Words of Program Mission \ Key Words of Faculty Mission | prepare a graduate with competencies and problem-solving skills | compete in local and regional labor markets | innovate and become an entrepreneur | development of engineering sciences | producing internationally distinguished scientific research | human values and social responsibility |
|---|---|---|---|---|---|---|
| Development of scientific technologies | √ | | | √ | | |
| Competition at the local and regional levels | | √ | | | | |
| Basic and applied science foundations | | | | | √ | |
| Produce innovative solutions | | | √ | | | |
| Ethical and professional values and requirements of environmental protection | | | | | | √ |
| Developing research and scientific studies | | √ | | √ | | |

# Appendix B

**To judge the compatibility of program mission with its objectives, the following matrix is used:**

| Key Words of Program Mission / Program Objectives | Development of scientific technologies | Competition at the local and regional levels | Basic and applied science foundations | Produce innovative solutions | Ethical and professional values and requirements of environmental protection | Developing research and scientific studies |
|---|---|---|---|---|---|---|
| **Objective #1** | √ | | √ | √ | | √ |
| **Objective #2** | √ | | √ | √ | | √ |
| **Objective #3** | √ | √ | √ | | √ | |
| **Objective #4** | √ | | | √ | | |
| **Objective #5** | √ | | | | √ | |
| **Objective #6** | | √ | | √ | √ | |
| **Objective #7** | √ | √ | √ | √ | | √ |

# Appendix C

**To judge the compatibility of graduate attributes with program objectives, the following matrix is used:**

| Program Objectives / Graduate Attributes | Objective #1 | Objective #2 | Objective #3 | Objective #4 | Objective #5 | Objective #6 | Objective #7 |
|---|---|---|---|---|---|---|---|
| Attribute #1 | √ | | | | | | |
| Attribute #2 | | √ | | | | | |
| Attribute #3 | | | | | | √ | |
| Attribute #4 | | | | | √ | | |
| Attribute #5 | √ | | √ | | | | |
| Attribute #6 | | | √ | | | | |
| Attribute #7 | | √ | | | | | |
| Attribute #8 | | | | √ | | | |
| Attribute #9 | | | | | √ | √ | |
| Attribute #10 | | | | | √ | √ | |
| Attribute #11 | | | √ | | | | |
| Attribute #12 | | | | √ | | | |
| Attribute #13 | | | | | √ | | |
| Attribute #14 | √ | | | | | | |
| Attribute #15 | | √ | | | √ | √ | |
| Attribute #16 | | | | | | | √ |
| Attribute #17 | | | | | | | √ |

# Appendix D

**To judge the compatibility of program objectives with its competencies, the following matrix is used:**

| Program Objectives | Program Competencies | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | B1 | B2 | B3 | B4 | C1 | C2 | C3 | C4 |
| Objective #1 | √ | √ | | √ | | | | | | √ | √ | | | | √ | | √ | |
| Objective #2 | √ | | √ | | √ | | | | √ | | √ | √ | | | | | √ | √ |
| Objective #3 | | √ | √ | √ | | | | | | √ | | √ | √ | | √ | | | √ |
| Objective #4 | | | | √ | | | √ | | | | | | | √ | | √ | | |
| Objective #5 | | | | | | √ | √ | | √ | | | | | | | √ | | |
| Objective #6 | | | √ | | | | | | | | | | | | | √ | | |
| Objective #7 | | √ | √ | | | | | | | | √ | √ | | | | | √ | √ |

# Appendix E

**To judge the compatibility of program's graduate attributes with its competencies, the following matrix is used:**

| Graduate Attributes | Program Competencies | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | B1 | B2 | B3 | B4 | C1 | C2 | C3 | C4 |
| Attribute #1 | √ | | | | | | | | | | | | | | | | | |
| Attribute #2 | √ | | | | | | | | √ | | | | | | | | | |
| Attribute #3 | √ | | √ | √ | | | | | | | | | | | | | | |
| Attribute #4 | | | | | | √ | √ | | | | | | | | | | | |
| Attribute #5 | | | √ | √ | | √ | | | √ | | | | | | | | | |
| Attribute #6 | | | √ | √ | | | | | | | | | | | | | | |
| Attribute #7 | | √ | | | | | | | | | | | | | | | | |
| Attribute #8 | | | | | √ | | | | | √ | | | | | | | | |
| Attribute #9 | | | | | | | | √ | | | | | | | | | | |
| Attribute #10 | | | | | | | | | √ | | | | | | | | | |
| Attribute #11 | | | √ | | | | | | | | | | | | | | | |
| Attribute #12 | √ | √ | | √ | | | | | | | √ | | √ | | | | | |
| Attribute #13 | | | | √ | | | | | | | | √ | | | | √ | | |
| Attribute #14 | | | | | | | | | | | √ | √ | | √ | | | √ | |
| Attribute #15 | | | | | | | √ | | | | | | | | √ | | | |
| Attribute #16 | | | | | | | | | | | | | | √ | | | | √ |
| Attribute #17 | | | | | | | | | | | | | | √ | | | | √ |

# Appendix F

## Course Matrix with Program Competences

**The following matrix is used to judge the compatibility between the program competences and program courses**

| Course Code | Course Name | Engineering Competencies (2018) | | | | | | | | | | "Department" Mechanical Engineering Competencies (NARS) | | | | "Discipline" Mechanical Power Engineering Competencies (ARS) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | B1 | B2 | B3 | B4 | C1 | C2 | C3 | C4 |
| GEN0X0 | Technical Language | | | | | | | √ | √ | | | | | | | | | | |
| GEN011 | Computer Skills | | | | | | | | √ | | √ | | | | | | | | |
| GEN012 | History of Engineering & Technology | | | √ | √ | | | | | | | | | | | | | | |
| GEN900 | Communication & Presentation Skills | | | | | √ | | | √ | √ | | | | | | | | | |
| GEN901 | Theory of Sustainability | | | √ | | | | √ | | | | | | | | | | | |
| GEN902 | Societal Issues | | | √ | | | | √ | √ | | | | | | | | | | |
| GEN903 | Research & Analysis Skills | | √ | | | √ | | | | | | | | | | | | | |
| GEN904 | Entrepreneurship | | | √ | | | | | | √ | | | | | | | | | |
| GEN905 | Professional Ethics | | | √ | | | | | √ | √ | | | | | | | | | |
| GEN906 | Critical Thinking | | | | | | | | | √ | √ | | | | | | | | |
| GEN907 | Human Resources Management | | | | √ | | √ | | | | | | | | | | | | |
| GEN908 | Contracts and Legislation | | | √ | √ | | | | | | | | | | | | | | |
| GEN909 | Method of Scientific Research and Writing | | √ | | | √ | | | | | | | | | | | | | |
| BAS010 | Differential Calculus and Algebra | √ | | √ | | | | | | | | | | | | | | | |
| BAS011 | Statics | √ | | √ | | | | | | | | | | | | | | | |
| BAS012 | Engineering Chemistry | √ | √ | | | | | √ | | | | | | | | | | | |
| BAS013 | Physics of Materials & Electricity | √ | √ | | | | | √ | | | | | | | | | | | |

| Course Code | Course Name | Engineering Competencies (2018) | | | | | | | | | | "Department" Mechanical Engineering Competencies (NARS) | | | | "Discipline" Mechanical Power Engineering Competencies (ARS) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | B1 | B2 | B3 | B4 | C1 | C2 | C3 | C4 |
| MEC010 | Engineering Drawing (1) | √ | | | | | √ | | √ | | | | | | | | | | |
| MEC012 | Engineering Drawing (2) | | √ | | √ | | | | √ | | | | | | | | | | |
| BAS014 | Integral Calculus & Analytical Geometry | √ | | √ | | | | | | | | | | | | | | | |
| BAS015 | Dynamics | √ | | √ | | | | | | | | | | | | | | | |
| BAS016 | Physics of Light, Heat and Magnetism | √ | √ | | | | | √ | | | | | | | | | | | |
| MEC011 | Principles of Manufacturing Engineering | | √ | | | | √ | | | √ | | | | | | | | | |
| MEC110 | Mechanical Drawing *× | | | √ | | | | | √ | | √ | | | | | | | | |
| ELE170 | Electrical Engineering | √ | | | | | | | √ | | | √ | | | | | | | |
| MEC111 | Materials Science | √ | √ | √ | | √ | | | | | √ | √ | √ | | | | | | |
| BAS110 | Statistics & Theory of Probability | √ | | | | | | | √ | √ | | | | | | | | | |
| BAS111 | Engineering Mechanics | √ | | | | | | | | | √ | √ | | | | | | | |
| MEC112 | Manufacturing Technology (1) † | | | | | | | | | | | | √ | √ | | | | | |
| MEC120 | Thermodynamics | √ | | | | | | √ | | | | √ | | | | | | | |
| BAS112 | Differential Equations | √ | | | | | | √ | | | | | | | | | | | |
| MEC121 | Fluid Mechanics (1) | √ | √ | | | | | | √ | | | √ | | | | | | | |
| MEC113 | Mechanics & Testing of Materials | √ | √ | √ | √ | | | | | | | √ | | | | | | | |
| MEC102 | Engineering Math. Using Computer | √ | √ | | | | | √ | | | | | | | | | | | |
| MEC210 | Engineering Economy & Accounting | √ | | √ | | | | | √ | √ | | | | | | | | | |
| MEC201 | Theory of Measurements & Sensors | √ | √ | | | √ | | | | | | √ | | | √ | | | | |
| BAS211 | Numerical Analysis | √ | √ | | | √ | | | | | | √ | | | | | | | |
| MEC211 | Kinematics & Dynamics of Rigid Bodies | √ | | | | | | √ | | | | √ | | | | | | | |
| MEC212 | Manufacturing Technology (2) † | | | | | | | | | | | | √ | √ | √ | | | | |
| MEC213 | Mechanical Design (1) | | | √ | | | | | | | | √ | √ | | √ | | | | |
| MEC220 | Heat Transfer | √ | √ | | | √ | | | | | | √ | | | | | | | |
| MEC214 | Mechanical Vibrations | √ | | √ | | | | | | | | √ | | | | | | | |

| Course Code | Course Name | Engineering Competencies (2018) | | | | | | | | | | "Department" Mechanical Engineering Competencies (NARS) | | | | "Discipline" Mechanical Power Engineering Competencies (ARS) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | B1 | B2 | B3 | B4 | C1 | C2 | C3 | C4 |
| ELE270 | Electrical Machines | | | | | | | √ | | | √ | √ | | | | | | | |
| MEC221 | Fluid Mechanics (2) | √ | √ | | | √ | | | | | | √ | | | | | | | |
| MEC310 | Engineering Project Management | | | | | | √ | | | √ | | | | √ | | | √ | | |
| MEC320 | Hydraulic & Pneumatic Systems | | | | | | | | | | √ | √ | | √ | √ | √ | | √ | √ |
| MEC330 | System Dynamics | √ | | | | | | | | | | √ | | √ | | | | √ | |
| MEC321 | Applied Thermodynamics | | | | | | | | √ | | | √ | √ | | | √ | | √ | √ |
| MEC322 | Heat & Mass Transfer | | | | | | √ | | | | | √ | √ | | | √ | | √ | √ |
| MEC300 | Field Training (1) | | | | | | | | | | | | | √ | √ | √ | √ | | |
| MEC331 | Automatic Control | | | | | | | | | | | √ | √ | | | √ | | √ | √ |
| MEC324 | Computer App. in Energy Field | | √ | | | | | | √ | | | | √ | | | √ | | √ | √ |
| MEC325 | Gas Dynamics | | | | | √ | | | | | | √ | | | | | | | √ |
| MEC326 | Fuel & Combustion | | | | | | | | | | | √ | | | | √ | | √ | √ |
| MEC327 | Renewable Energy & Environ. Prot. | | | | | √ | | | | | | √ | | √ | | √ | | √ | √ |
| MEC420 | Internal Combustion Engines (ICE) | | √ | | | | | | | | | | √ | | | √ | √ | √ | √ |
| MEC421 | Turbomachines | √ | | √ | | √ | | | | | | | √ | √ | | √ | | √ | √ |
| MEC422 | Refrigeration & Air Conditioning | | | | | | | | | | √ | | √ | √ | √ | √ | √ | √ | √ |
| MEC400 | Field Training (2) | | | | | | | √ | | | √ | | | | | | √ | | |
| MEC414 | Feasibility Study of Eng. Projects | | | √ | | | √ | | | | | | | | | | | | |
| MEC423 | Power Stations | | | | | | | | | | | √ | √ | | | √ | | √ | √ |
| MEC490 | Graduation Project * | √ | √ | √ | | √ | | √ | | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Elective Courses | | | | | | | | | | | | | | | | | | | |
| MEC450 | Water Desalination & Wastewater Treatment | | | | | | | | | | | | √ | √ | | √ | | √ | √ |
| MEC451 | Pipeline Networks | | | | | | | | | | | | √ | | √ | √ | | √ | √ |
| MEC452 | Thermal Equipment | | | | | | | | | | | √ | | | √ | √ | | √ | √ |
| MEC453 | Aerodynamics Engineering | | | | | | | | | | | √ | | | | √ | | √ | √ |

| Course Code | Course Name | Engineering Competencies (2018) | | | | | | | | | | "Department" Mechanical Engineering Competencies (NARS) | | | | "Discipline" Mechanical Power Engineering Competencies (ARS) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | B1 | B2 | B3 | B4 | C1 | C2 | C3 | C4 |
| MEC454 | Computational Fluid Mechanics (CFD) | | √ | | √ | | | | | | | | √ | | | | | √ | √ |
| MEC455 | Numerical Methods in Energy Science | | | | | √ | | | | | | √ | √ | | | | | | |
| MEC456 | Energy Management Systems | | | | | | | | | | | √ | | | √ | | | √ | √ |
| MEC457 | Fire Fighting and Safety Systems | | | | | | | | | | | | | | √ | √ | | √ | √ |
| MEC458 | Advanced Refrigeration & Air Conditioning | | | | | | | | | | | | | | √ | √ | √ | √ | √ |
| MEC459 | Vehicle Engineering | | | | | | | | | | | | | | | √ | √ | √ | √ |