| | Department of Mechanical Power Engineering | Cairo University<br>Faculty of Engineering | |
|---|---|---|---|

# Course Specifications

| | |
|---|---|
| **Program(s) on which this course is given** | Bachelor Degree of Mechanical Power Engineering |
| **Department offering the program** | Mechanical Power Engineering |
| **Department offering the course** | Mechanical Power Engineering |
| **Academic Level** | Fourth Year |
| **Date** | 2023-2024 |
| **Semester(based on final exam timing)** | Fall √ Spring |

## A- Basic Information

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **1. Title:** | Application of Virtual Labs in Mechanical Power Systems (Case Study: Gas Turbine Control systems) | | | **Code:** | MEP 4006 (New 2018 Bylaws) | | | |
| **2. Units/Credit hours per week:** | Lectures | 1 | Tutorial | 1 | Practical | **1** | Total | 3 |

## B- Professional Information

**1. Course description:**

**Overview:** This is an interactive computer-based training course that includes the following items: GT Design- Operating Principles- GT Case and Air inlet- Compressor Section- Diffuser and Combustion- Turbine and Exhaust- GT Ignition System- Bearing and Seals- Lubrication and Lube Oil- Lube Oil Pumps- Lube Oil Filters and Coolers- Lube Oil Instrumentation- Hydraulic Oil System- Trip Oil System- GT Fuel System – Fuel Gas Supply System- Fuel Gas Control System- Liquid Fuel System- Liquid Fuel system Operation- Pneumatic Starting System- Hydraulic Starting System- Diesel Starting System- Enclosures- Fire Detection- Gas Detection-Fire Extinguisher Systems- Principles of Power Generation- Generator Components- Generator Lube Oil- Generator Control- Principles of Compression- Compressor Components- Compressor Lube Oil- Compressor Control System.

The course uses Virtual Lab method by practical on-line interactive program. This control Virtual Lab is E-self-learning software. The software includes large number of examples for GT parts, 3-D animations, E-learning labs, quizzes..etc. The Virtual Lab along with professional course notes and training sheets provide typical example for modern Blended, self-learning education technique. In this course, it is used for studying and analyzing various aspects related to GT automatic control and energy systems transfer.

**2. Learning Outcomes of Course (LOs):**

a) Knowledge and Understanding:
Having successfully completed this course, the student should have knowledge and understanding of:
- Theories, Information, sciences and specialized technologies in the fields of automatic control of mechanical power equipments and systems of Industrial GT Plants.
- Moral, legal essentials and quality control principals related to the graduate's professional practices in automatic control fields.
-Various effects of engineering professional practices of Industrial GT Plants on different components of the environment.
-Methods used for emission/pollution control & energy rationalization and maximization of the benefits of Industrial GT Plants.

b) Intellectual Skills:
Having successfully completed this course, the student should have the ability to:
-Identify scientific and practical problems related to automatic control of Industrial GT Plants.
- Analyze and propose professional, technical solutions and algorithms for automatic control problems.
- Analytical reading of research and report topics related to control of Industrial GT Plants.
- Evaluate & estimate various risks involved in professional practices related to of Industrial GT Plants.
-Take effective actions and professional decisions in accordance with and/or based on available data and technical information.

c) Professional and Practical Skills:
Having successfully completed this course, the student should have the ability to:
Apply professional and practical skills in the fields of automatic control of Industrial GT Plants.
Execute short term project & write engineering technical report that involves graphs, charts, & diagrams.
Perform professional presentation and suggest possible alternative solutions for automatic control problems of Industrial GT Plants.
Write technical requirements & selecting engineering reference standards for Industrial GT Plants.

d) General and Transferable Skills:
Having successfully completed this course, the student should have the ability to:
-Perform engineering calculations, draw feed-back control circuits, block diagrams, graphical presentation

| | |
|---|---|
| | of experimental data, and perform data-regression analysis.<br>-Transfer knowledge, Work in group, & Communicate in written & oral forms, in English.<br>- Use IT& evolutionary technological tools& PC applications (Excel, Mat lab, Virtual labs, .etc).<br>- Prepare & write reports, Manipulate & sort data, Think logically, and continuous self-E-learning.<br>- Identify practical problems, compare between different technologies for measurement systems.<br>-Organise & manage time & resources effectively; for short-term and longer-term commitments.<br>**********<br>Short Learning Outcomes as per NARS 2018<br>1. Recognize various types & applications of Virtual Lab Techniques to study automatic control systems.<br>2. Comprehend and follow recent developments of both Hardware and Software of IT & recent modern Virtual Lab Computer Applications in practical automatic control systems.<br>3. Apply educational-practical training Virtual Lab to understand basics & essentials of GT Systems.<br>4. Identify various types and main essential parts of Industrial Gas Turbine Systems.<br>5. Study different methods for emission/pollution control & energy rationalization and maximization of the benefits of Industrial GT Plants.<br>6. Recognize different types and applications of practical GT automatic control systems and subsystems.<br>7. Understand various schematics & symbols of GT Hydraulic/Pneumatic control subsystems &circuits.<br>8. Apply engineering standards & practice reading symbol-schematics of GT vibration control systems.<br>9. Perform Evaluation&function analysis to select proper GT control systems with optimum performance.<br>10. Examine of Maintenance and Troubleshooting of GT automatic control systems and subsystems.<br>11. Exchange knowledge with engineering community.<br>12. Work in stressful environment and within constraints.<br>13. Communicate effectively, Effectively manage tasks and resources, Refer to relevant literature |

## 3. Contents

| Topic | Total No. of hrs | *Lecture & Practical* | Tutorial |
|---|---|---|---|
| This is an interactive computer-based training course that includes the following topics items: GT Engine Design- Operating Principles- GT Engine Case and Air inlet- Compressor Section- Diffuser & Combustion- Turbine & Exhaust- Ignition System- Bearing & Seals- Lubrication & Lube Oil- Lube Oil Pumps- Lube Oil Filters & Coolers- Lube Oil Instrumentation- Hydraulic Oil System- Trip Oil System- Fuel System – Fuel Gas Supply System- Fuel Gas Control System- Liquid Fuel System- Liquid Fuel system Operation- Pneumatic Starting System- Hydraulic Starting System- Diesel Starting System- Enclosures- Fire Detection- Gas Detection- Fire Extinguisher Systems- Principles of Power Generation- Generator Components- Generator Lube Oil- Generator Control- Principles of Compression- Compressor Components- Compressor Lube Oil- Compressor Control System. | 42 hrs | 2hrs/week for 14 weeks before The Final Term Exam | 1hr/week for 14 weeks before The Final Term Exam |
| Time for Preparing for the term exam | 3 | 2 | 1 |
| **Total teaching hours in 15 weeks (+1 office hr/wk)** | **45** | **30** | **15** |

| | | | |
|---|---|---|---|
| **4. Teaching and Learning Methods** | Lectures (√) | Practical Training/ Virtual Laboratory (√) | Seminar/Workshop (x) |
| | Class Activity (√) | Case Study/Reports (√) | Projects (x) |
| | E-learning (√) | Assignments /Homework (√) | Other: Reports |

**Also for Teaching and Learning:** أنظرأيضاً ملف نظام الدراسة الهجين والتعليم الذاتى للمقرر

- Lectures and problem solving in tutorial classes.
- Information collection from text material, class notes and the Internet sites.
- Report and research assignments. Three assignment Sheets (1, 2 and 3)
- Group discussions in lectures and tutorial classes.
- Hand-outs materials.

## 5. Student Assessment Methods:

| • **Assessment Schedule** | **Week** |
|---|---|
| -Assessment 0: Sheet-0 | Week#2 |
| -Assessment 1; Sheet-1 | Week#3 |
| -Assessment 2; Sheet-2 | Week#5 |
| -Assessment 3; Sheet-4 | Week#7 |
| -Assessment 4; Sheet-6 | Week#9 |
| -Assessment 5; Sheet-8 | Week#11 |
| -Assessment 6; Sheet-10 | Week#12 |
| -Assessment7; Sheet-12 & Sheet-13 Review General Report | Week#13 |
| Mid-term Exam | Week8 |

| | |
|---|---|
| Final Term Exam to assess gains of all completed topics and the entire course LO's. | End of Term |
| • **Weighting of Assessments** | |
| Assignments & class performance | 5 pts |
| Attendance & Written Reports | 10 pts |
| Mid-term Exam | 15 pts |
| Final-term Examination | 45 pts |
| -Total | 75 pts |

**6- List of References (Note that this is a Self-Study Virtual Lab Course):**

1- Several Class Notes, Reports, and Self-study Materials prepared by Course Instructor.

2- "Fundamentals of Gas Turbine Operation, Version 2.0 for Windows": E-Learning Software and GT Virtual Lab program developed by "Systran, Inc. 800.851.8830"

ملاحظة: يوجد عدد كبير من المادة العلمية والأفلام والمراجع للمقررموجودة على موقع معمل التحكم acc-vlab.cu.edu.eg

**7. Facilities Required for Teaching and Learning: Data Show, Laptop Computer and access to the net.**

| | |
|---|---|
| **Course Coordinator:** | **Associate Prof. Mohsen S. Soliman** |
| **Head of Department:** | **Prof. Dr. Sayed Kaseb** |
| **Date:** | **July 2023** |