# EN 453

# Instrumentation

## 2 Credits

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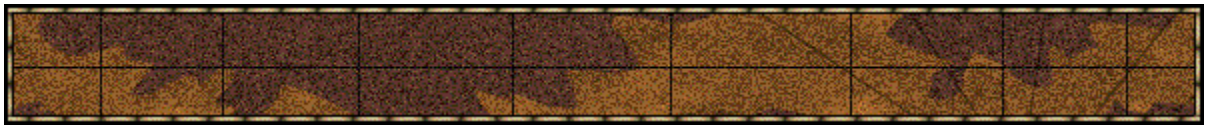

# Instrumentation

## Calendar Description

Modern electrical and electronic measuring devices and their installation for pressure, temperature, flow and level are studied as well as the final control elements for all. Other topics include: the control for steam productions such as boiler feed water controls and steam temperature, pressure control; automatic control methods and distributed control system, and programmable logic controllers.

## Rationale

This course has been developed to support students seeking to further their careers, as Second Class Power Engineers, with an ever increasing industry demand to replace retiring Power Engineers and operate new facilities.

Industry has shifted their focus from employing the 4th and 3rd class levels of Power Engineering certification to higher levels of certification.

Upon successful completion of this program the student is eligible for a 9 month reduction in qualifying time experience granted by ABSA.

The six parts of the program are divided into 15 courses where the student has the option of registering for individual courses, Part A, Part B, or both Part A and Part B.

## Prerequisites

EN 310, EN 320, EN 410, EN 420, or Third Class Power Engineer's Certificate of Competency.

## Co-Requisites

None

## Course Learning Outcomes

Upon successful completion of this course, the student will be able to

1. describe, using a sketch, the design and operation of fuel oil supply systems.

2. describe, using a sketch, the design and operation of fuel gas supply systems.
3. describe, using a sketch, the design and operation of solid fuel supply systems.
4. describe, using a sketch, the design and operation of feedwater systems.
5. describe, using a sketch, the design and operation of steam distribution systems.
6. describe, using a sketch, the design and operation of condensate systems.
7. describe, using a sketch, the design and operation of cooling water systems.
8. describe, using a sketch, the design and operation of waste handling systems.
9. explain how different power plant water systems interconnect and what parameters are significant to each.
10. describe the design, use, and placement of electrical and electronic pressure measuring devices.
11. describe the design, use, and placement of electrical and electronic temperature measuring devices.
12. describe the design, use, and placement of venturi tubes, orifice plates, flow nozzles, and pilot tubes.
13. describe the design and use of: manometers, ring balance, force balance, and electric flow indicating mechanisms.
14. describe the design, use, and placement of the following liquid level measurement devices: ball-float, displacement-type, hydrostatic head, electric and pneumatic level transmission, electric and magnetic type level-limit devices, and remote water-level indicators.
15. describe the types, construction, and flow characteristics of control valves.
16. describe the design, operation, and application of the following valve operators: solenoid, pneumatic-diaphragm, power cylinder and electric motor.
17. describe the principle, design, application, and limitations of the following automatic control methods: proportional, proportional-plus-reset, and proportional-plus-reset-plus-rate.
18. describe the principle, design, application, and limitations of single, two, and three-element boiler feedwater control systems.
19. describe the principle, design, application, and limitations of superheated and reheated steam temperature control systems.
20. describe the principle, design, components, application, and limitations of Distributed Control Systems (DCS).
21. describe the principle, design, components, application, and limitations of Programmable Logic Controllers (PCL).
22. describe the nature of combustion and the different types of fuels.
23. calculate the mass and volumetric analysis of a fuel.
24. describe the proximate and ultimate analysis and calculate the heating value of fuel.
25. given the results of a bomb calorimeter test, calculate the heating value of a fuel.
26. calculate the amount of air and excess air required for combustion of a fuel.
27. explain the flue gas analysis parameters and their significance.
28. calculate theoretical draft, flue gas velocity and stack diameter.
29. calculate draft fan power and efficiency.

## Resource Materials

***Required Text:***

Power Engineering Second Class (2015) B-2 Combustion and Plant Systems (2nd ed.).

Calgary, AB: PanGlobal Training Systems Ltd.

NOTE:

Additional resource material is provided or accessed through D2L.

## Conduct of Course

This course follows the syllabus as set out by the Standardization of Power Engineer's Examination Committee (SOPEEC) and the curriculum recommended by the Interprovincial Power Engineer Curriculum Committee (IPECC).

This course builds on the student knowledge gained through the Fourth Class and Third Class Power Engineering courses.

This course is delivered face to face with a component of online directed study, and includes class lectures, group discussions, demonstrations, assignments, and projects.

Cutaway models, videos, and actual equipment may be used to support instruction and demonstrations.

Desire2learn (D2L) is an online course management suite and is used as an educational resource for tracking attendance, administering quizzes, and reporting grades. Students will access D2L directly, from any computer, and may view their progress, grades and attendance at any time.

This course consists of four chapters. There is an exam at the end of each chapter as well as a midterm and final exam.

The exams consist of seven written questions of which the student chooses five questions to answer. Each question is worth 20 marks and partial marks are awarded for correct methods and partial answers.

## Evaluation Procedures

Lakeland College is committed to the highest academic standards. Students are expected to be familiar with Lakeland College policies related to academic conduct and academic honesty and to abide by these policies.

The marking scheme for this course is:

| | |
|---|---|
| Assignments and Projects | 20% |
| Chapter Exams | 20% |
| Midterm Exam | 30% |
| Final Exam | 30% |

The lectures and dates of exams are determined in class.

Examinations contain long answer written type questions.

A minimum grade of 65% is required to pass this course.

A GRADE OF AT LEAST 50% IS REQUIRED ON THE FINAL EXAM TO PASS THIS COURSE.

Those students seeking a qualifying time reduction must achieve a grade of 65% for sections A-1, A-2. A-3. B-1, B-2, B-3 and maintain at least 80% attendance in the program.

Students receive a certificate from Lakeland College indicating successful completion of the program.

NOTE:

This program consists of six components; each component corresponds to one examination paper of the SOPEEC examination process.

The requirements for a second class power engineer consist of six examinations and 30 months of qualifying industry experience, with the exception of a 9 month credit for completion of all courses in the program.

## Grade Equivalents and Course Pass Requirements

***A minimum grade of C+ (65%) is required to pass this course.***

| Letter | F | C+ | B- | B | B+ | A- | A | A+ |
|---|---|---|---|---|---|---|---|---|
| Percent Range | 0-64 | 65-69 | 70-74 | 75-79 | 80-84 | 85-89 | 90-94 | 95-100 |
| Points | 0.00 | 2.30 | 2.70 | 3.00 | 3.30 | 3.70 | 4.00 | 4.00 |

## Attendance

For those students seeking the nine (9) month experience qualifying time reduction granted by ABSA, a minimum attendance of 80% in all courses is required, as per the Student Handbook. If the experience credit is not desired, there is no mandatory attendance requirement.

## Course Units/Topics

Power Plant Fuel Systems

(Describe the design and operation of typical power plant fuel systems)

Power Plant Water and Steam Systems

(Describe the design and operation of power plant systems)

Measurement and Control Components

(Explain the design and application of measuring devices and final control elements)

Control Instrumentation systems

(Explain and apply the theory of automatic, distributed control, and programmable logic control systems)

Fuels and Combustion Calculations

(Perform combustion and furnace draft calculations and explain flue gas analysis)


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