

EN 341
Metallurgy
3 Credits

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EN 341 Version: 3



Metallurgy

Calendar Description

This advanced metallurgy course covers the structure of metals, non-ferrous metal, alloys, heat treatment of metals, iron-carbon phase diagram, and the engineering properties of ferrous metal. Mechanical tests of materials are also discussed. Weldment defects and non-destructive examination methods of welding are explored, as well as metal corrosion mechanisms.

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, students will be able to

1. discuss the study of metallurgy and the atomic and crystalline structure of metals.
2. explain the significance of the iron-carbon equilibrium diagram.

3. describe the purposes of, and processes used, in the heat treatment of steels.
4. interpret metal specifications.
5. discuss typical selection of metals for process plant applications (what is selected and why).
6. relate the composition, physical properties, and uses of copper, lead, and tin.
7. relate the composition, physical properties, and uses of aluminum and aluminum alloys.
8. differentiate between destructive and non-destructive testing and explain the procedures and interpretation of tensile, hardness, and impact tests.
9. describe the purpose and procedure of a Proof (Hydrostatic Deformation) Test.
10. discuss the causes and significances of welding discontinuities.
11. explain Non-Destructive Examination, its applications and benefits.
12. explain visual inspection, and the procedures used.
13. explain magnetic particle inspection and the procedures used.
14. explain liquid penetrant testing and the procedures used.
15. explain ultrasonic testing and the procedures used.
16. explain radiographic testing, including interpretation of results.
17. explain acoustic emission testing and the procedures used.
18. explain leak and pressure testing.
19. discuss how to monitor and test metals for creep, fatigue and corrosion.
20. define corrosion and explain the electrochemical principles involved.
21. relate how the environment can affect corrosion.
22. discuss the most common corrosion mechanisms.
23. describe the predominant corrosion mechanisms that potentially affect various power plant systems and equipment.
24. explain methods used to control and prevent corrosion at the design stages and during operation.
25. explain the main components of a corrosion failure analysis and a typical corrosion failure report.
26. explain the purpose of welding symbols.
27. relate the common weld joints and weld types, including groove, fillet, plug, and slot welds, with weld terminology.
28. recognize and describe symbols that identify weld types.
29. identify and explain the meaning of the reference line, the arrow, and the tail in a welding symbol.
30. identify and explain supplemental welding symbols, not specific to the weld itself.
31. for groove and fillet welds, identify and explain welding symbols that relate to the weld configuration and joint preparation.

Resource Materials

Required Text:

Power Engineering Second Class (2015) A-2 Thermodynamics and Metallurgy (2nd ed.).

Calgary, AB: PanGlobal Training Systems Ltd.

Reference Text(s):

B.J. Moniz. (2012). *Metallurgy* (5th ed.). Orland Park, Illinois: American Technical

Publishing Inc.

ISBN: 978-0-8269-3522-9 Available in college library. 2 hour loan.

ASME Boiler and Pressure Vessel Code, Sections II, V, IX. Available on line through college library.

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 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 or 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

Metallurgy

(Discuss the structure and uses of various metals and metal alloys)

Testing of Metals

(Discuss the common procedures and parameters for testing of metals)

Corrosion of Metals

(Discuss the various corrosion mechanisms and methods used to control corrosion)

Introduction to Welding Symbols

(Discuss the relationship between weld symbols and weld types)

