These learning materials were designed to directly address the SOPEEC 2002 Canadian syllabus for 4th Class Power Engineering Certification.

Content

Book 1: Part A1
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Book 1 (Part A1)

Unit One: Applied Mathematics

1. Introduction to Power Engineering
   Learning Outcome
   Describe the overall industrial background and certification system for Power Engineering.
   Learning Objectives
   1. Define the terms, Power Plant and Power Engineer.
   2. Describe the power engineering certification system.
   3. List the national standards that are used in the Power Engineering industry.

2. SI Units
   Learning Outcome
   Perform simple calculations involving SI units.
   Learning Objectives
   1. List basic SI units; identify and list symbols for unit prefixes.
   2. Perform unit analyses in simple problems.
   3. List derived SI units and their symbols.
   4. Perform conversions between SI and Imperial units.

3. Basic Arithmetic Operations
   Learning Outcome
   Perform basic arithmetic operations without the use of a calculator.
   Learning Objectives
   1. Add and subtract integers.
   2. Multiply and divide whole and decimal numbers.
   3. Evaluate equations involving combinations of addition, subtraction, multiplication, division and powers in the proper sequence.
4. Fractions, Decimals & Percentages
   **Learning Outcome**
   Perform basic arithmetic operations involving fractions, decimals and percentages.

   **Learning Objectives**
   1. Identify proper and improper fractions and mixed numbers.
   2. Add, subtract and multiply fractions and reduce them to lowest terms.
   3. Convert fractions to decimal numbers and decimal numbers to fractions.
   4. Evaluate percentage problems.

5. Ratio & Proportion
   **Learning Outcome**
   Describe the concepts of ratio and proportion.

   **Learning Objectives**
   1. Find ratios of one quantity to another quantity.
   2. Solve word problems involving ratios and proportions.

6. Equations & Transposition
   **Learning Outcome**
   Transpose equations in order to find values for different variables in a formula.

   **Learning Objectives**
   1. Transpose and solve equations involving addition, subtraction, multiplication, division and powers, and solve word problems using transposition.

7. Length, Lines & Simple Plane Figures
   **Learning Outcome**
   Describe measurement of length, types of lines and angles, and calculate perimeters and areas of simple plane figures.

   **Learning Objectives**
   1. Describe linear measurement systems and convert measurement units from one system to another.
   2. Define parallel and perpendicular lines and types of angles.
   3. Describe types of simple plane figures, including triangles and quadrilaterals, and calculate their areas.
   4. Describe the components of a circle and find its circumference, area and diameter.

8. Areas & Volumes of Solids
   **Learning Outcome**
   Calculate: the volumes of rectangular objects, cylinders, and spheres; and the surface areas of cylinders and spheres.

   **Learning Objectives**
   1. Convert commonly used units to volume.
   2. Calculate the volume of a rectangular prism.
   3. Calculate the surface area and volume of a cylinder.
   4. Calculate the surface area and volume of a sphere.
Unit Two: Elementary Mechanics

9. Introduction to Basic Mechanics
   **Learning Outcome**
   Define basic terms used in the study of mechanics.

   **Learning Objectives**
   1. Define mass, force, acceleration, velocity and weight.
   2. Define and perform simple calculations involving force, pressure, work, power and energy.

10. Forces & Moments
    **Learning Outcome**
    Perform calculations using forces and moments, and determine whether or not a system is in equilibrium.

    **Learning Objectives**
    1. Define the moment of a force and its units.
    2. Determine the direction and calculate the magnitude of the moment of a force.

11. Simple Machines
    **Learning Outcome**
    Define simple machines and perform calculations relating to them.

    **Learning Objectives**
    1. Define the term ‘simple machine’ and calculate the mechanical advantage, velocity ratio and efficiency of simple machines.

12. Scalars & Vectors
    **Learning Outcome**
    Define and identify scalar and vector quantities and solve simple vector problems graphically.

    **Learning Objectives**
    1. Define scalar and vector quantities and draw a vector diagram to scale.

13. Linear Velocity & Acceleration
    **Learning Outcome**
    Define speed, velocity, distance, displacement, and acceleration and solve simple linear problems involving velocity, time, and distance.

    **Learning Objectives**
    1. Solve distance, displacement, speed and velocity problems.
    2. Draw graphs of velocity as a function of time.
    3. Define acceleration and state its units.
    4. Use the mathematical formula relating acceleration, velocity, distance and time to solve problems.

    **Learning Outcome**
    Differentiate among force, work, pressure, power and, energy and perform calculations involving the relationships between these mechanical terms.

    **Learning Objectives**
    1. Perform calculations involving force and work.
    2. Differentiate between and perform calculations involving gauge, atmospheric and absolute pressure.
    3. Differentiate between and perform calculations involving power and different forms of mechanical energy.
15. Friction
Learning Outcome
Describe and solve problems involving friction.

Learning Objectives
1. Define the types of friction and the laws governing them.
2. Define the coefficient of friction and solve problems involving friction forces on a horizontal plane.

16. Stress & Strain
Learning Outcome
Discuss the deformation of bodies caused by externally applied forces, and the internal forces that resist these deformations; discuss the physical properties of materials and explain how these properties affect their behaviour when external forces are applied.

Learning Objectives
1. Describe the significant characteristics of materials, including elasticity, stiffness, plasticity, ductility, toughness, brittleness and hardness.
2. Define stress and calculate tensile, compressive and shear stresses in rigid body members due to external loads.
3. Calculate the strain of members under load.

17. Power Transmission
Learning Outcome
Discuss the major types of power transmission systems.

Learning Objectives
1. Describe belt drive systems and calculate pulley speeds, transmitted power and efficiency.
2. Describe gear and chain drive systems and calculate gear speeds.

Unit Three: Elementary Thermodynamics

18. Introduction to Thermodynamics
Learning Outcome
Explain the principles of thermodynamics, including the laws of thermodynamics and the modes of heat transfer.

Learning Objectives
1. Define various terms associated with the study of thermodynamics.
2. Describe the laws and the different temperature scales used in thermodynamics.
3. Define heat and specific heat and perform sensible heat calculations.
4. Describe the expansion of solids and liquids.
5. Describe the three modes of heat transfer.

19. Thermodynamics of Steam
Learning Outcome
Describe the principles of the thermodynamics of steam and the associated terms.

Learning Objectives
1. Define the various terms related to steam.
2. Explain the various columns of the steam tables.
3. Explain the principles of the thermodynamics of steam using the steam tables.
20. **Basic Concepts About Matter**

**Learning Outcome**
Discuss the basic types of matter and their properties.

**Learning Objectives**
1. Describe the physical states of matter.
2. Define the properties of and distinguish between chemical and physical changes in matter.
3. Classify matter as a type of mixture or a pure substance.
4. Describe the purpose of the periodic table.

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**Unit Four: Sketching & Administration**

21. **Sketching Fundamentals**

**Learning Outcome**
Make basic engineering sketches of plant equipment.

**Learning Objectives**
1. Set up a sketch using centre lines and dimensioning.
2. Recognize standard views of an object.
3. Apply simple techniques for drawing circles, ellipses and parallel lines.
4. Apply and recognize cross hatching methods in sectional drawings.

22. **Writing Fundamentals I - Sentences**

**Learning Outcome**
Identify correct and effective sentence structures and revise poorly worded sentences for clarity, conciseness, and correctness.

**Learning Objectives**
1. Discuss how clarity, concrete language, conciseness and correctness assist with the creation of good writing skills.
2. Identify and correct errors in the punctuation of sentences.

23. **Writing Fundamentals II - Paragraphs**

**Learning Outcome**
Write a unified, coherent paragraph using a clear topic sentence, technical terminology and specific support, given a technical topic.

**Learning Objectives**
1. Discuss the structure, unity and coherence of a paragraph.
2. Identify the common patterns of paragraph development and summarize the rules for effective paragraphs.

24. **Writing Memos**

**Learning Outcome**
Plan, write, and edit routine and positive messages in memo format, given a work-related scenario.

**Learning Objectives**
1. Identify the parts of a memo and their functions.
2. Write effective subject lines and organize the contents of memos.
3. Describe effective format design.
4. Describe how to plan the writing task.
Unit Five: Codes & Standards

25. Industrial Legislation

Learning Outcome
Describe the purpose of codes and Provincial acts and regulations with respect to boilers and pressure vessels.

Learning Objectives
1. State the purpose and function of the ASME Boiler and Pressure Vessel Committee.
2. Describe provincial acts and regulations.
3. Discuss typical regulations pertaining to design, construction and installation of boilers and pressure vessels.
4. Discuss the regulations pertaining to Power Engineers and pressure welders.

Unit Six: Workplace Hazardous Materials

26. WHMIS Part I – Classification of Controlled Products

Learning Outcome
Explain the significance of the Workplace Hazardous Materials Information System (WHMIS) and its application to the worksite.

Learning Objectives
1. Describe the classification system for “controlled products”.
2. List the six WHMIS classes, their subdivisions and exempted materials.
3. Describe the criteria for classifications.

27. WHMIS Part II – Labeling of Controlled Products

Learning Outcome
Discuss the significance of the Workplace Hazardous Materials Information System (WHMIS) and it’s application to the worksite.

Learning Objectives
1. Describe the supplier and workplace labeling system.
2. Describe vessel and pipeline marking requirements.
3. Describe general label information with respect to bulk shipments and colour rules.

28. WHMIS Part III – Material Safety Data Sheets

Learning Outcome
Explain the components of the WHMIS Material Safety Data Sheet, its application in the worksite and the terminology used on the MSDS.

Learning Objectives
1. State the purpose and describe the general content of each section of the Material Safety Data Sheet (MSDS).
2. Discuss WHMIS exposure limits.
3. Discuss the training requirements for WHMIS and describe the Hazardous Materials Information Review Act in relation to the MSDS.
4. Define various terms used on the MSDS.
5. Relate Hazard symbols to Classes.
Unit Seven: Safety

29. The Cost & Effects of Workplace Injuries

   **Learning Outcome**
   Describe the cost and effects of workplace injuries on the individual worker and the business.

   **Learning Objectives**
   1. Describe the financial cost of injuries and the impact an injury has on the injured person.
   2. Discuss the social and legal implications of injuries.
   3. List the steps that can be taken by management to minimize the effects of workplace injuries.

30. Personal Protective Equipment

   **Learning Outcome**
   Describe the use, selection, and care of personal protective equipment.

   **Learning Objectives**
   1. Describe the basic types of personal protective equipment available.
   2. Describe the various types and the training, care and maintenance of respiratory protection.

31. Isolation of Mechanical & Electrical Equipment

   **Learning Outcome**
   Describe the general procedures involved in the isolation of plant equipment.

   **Learning Objectives**
   1. Outline and discuss the proper procedures for the mechanical and electrical isolation of equipment.
   2. Describe the typical safe isolation of various pieces of plant equipment.

32. Confined Space Entry

   **Learning Outcome**
   Describe procedures needed to enter into and work safely within confined spaces.

   **Learning Objectives**
   1. Define and describe the hazards of being in a confined space.
   2. Describe procedures to be used when performing a confined space entry, including completion of an entry checklist.

33. Handling & Storage of Gases

   **Learning Outcome**
   Describe the procedures for safe storage and handling of cylinders containing compressed gases.

   **Learning Objectives**
   1. Describe gas cylinder markings.
   2. Describe the safe procedures for handling gas pressure regulators and changing gas cylinders.
   3. Describe the care, maintenance and storage of gas cylinders.
   4. Describe gas cylinder safety features and inspection.

34. Handling of Hydrocarbon Fluids

   **Learning Outcome**
   Describe the safe procedures for the loading, storage, unloading and transportation of hydrocarbon fluids.

   **Learning Objectives**
   1. Describe the significant properties of the most common hydrocarbon fluids.
   2. Describe the sources of ignition for a hydrocarbon.
   3. List the safety requirements for the loading and unloading of hydrocarbon fluids.
   4. Describe the general safety issues associated with the storage and gauging of hydrocarbon liquids.
   5. Describe the important health and safety guidelines associated with bulk sour oilfield products.
35. **Hydrogen Sulphide Safety**

**Learning Outcome**
Discuss hydrogen sulphide (H₂S) in terms of its properties, its effects on humans, and its presence in the workplace.

**Learning Objectives**
1. Describe the physical and chemical characteristics of hydrogen sulphide.
2. Describe the effects on humans of various concentrations of H₂S.
3. Briefly outline how to respond to an H₂S emergency.

36. **First Aid & CPR for Adult Casualties**

**Learning Outcome**
Identify possible or potential medical difficulties in a person, and provide assistance until professional medical aid can be obtained.

**Learning Objectives**
1. Identify and discuss the steps in the assessment process.
2. Describe the ABC’s of first aid.
3. Describe the first aid procedures associated with heart attack and stroke.
4. Describe standard emergency assistance procedures.

*Note: This chapter is not intended to replace training in first aid or CPR provided by organizations such as the Canadian Red Cross and Saint John's Ambulance. It is strongly recommended that people take proper practical training in first aid or CPR given by those organizations.*

**Unit Eight: Plant Fire Protection**

37. **Fires & Extinguishing Media**
Describe the fire classifications and the types of extinguishing media suitable for each classification.

**Learning Objectives**
1. Discuss the theory, terminology and the life safety issues associated with fires.
2. Explain the four classes of fires and describe the types of fire extinguishing media and how they act on these fires.
3. Describe the design and operation of standpipe and sprinkler systems.

38. **Portable Fire Extinguishers**
Describe the types of portable fire extinguishers, and their application for each fire classification.

**Learning Objectives**
1. Describe the applicability, types, construction and operation of various types of portable fire extinguishers.
2. Discuss the inspection and maintenance of portable fire extinguishers.

39. **Electrical Fires**
Discuss the causes of, and preventive measures for electrical fires.

**Learning Objectives**
1. List the causes of electrical fires.
2. Describe the hazardous location classifications, divisions and groups in relation to electrical equipment.
3. Describe suitable fire extinguishing systems for electrical equipment.
4. Discuss the ways that fire can be prevented in electrical equipment.