SECOND CLASS (EDITION 2.5) PART A1
COURSE OUTLINE WITH OUTCOMES

These learning materials were designed to directly address the SOPEEC 2015 Canadian syllabus for 2nd Class Power Engineering Certification.

Content

Book 1 (Part A1): Code Calculations and Legislation

1. **A.S.M.E. Code Calculations - Cylindrical Components**

   ### Learning Outcome
   Apply the appropriate formulae from ASME Sections I and VIII to calculations involving cylindrical components, openings, and compensations in boilers and pressure vessels.

   ### Learning Objectives
   1. Calculate the minimum required thickness or the maximum allowable working pressure of ferrous tubing, up to and including 125 mm O.D.
   2. Using ASME Sections I and VIII, calculate the required minimum thickness or the maximum allowable working pressure of ferrous piping, drums, and headers.
   3. Calculate the required thickness or maximum allowable working pressure of a seamless, unstayed dished head.
   4. Calculate the minimum required thickness or maximum allowable working pressure of unstayed flat heads and welded covers.
   5. Determine whether or not reinforcement is required for openings in a cylindrical shell, header, or head.
   6. Using the ligament efficiency method, calculate the minimum required thickness of a cylindrical drum with two or more openings in the pressure boundary.

2. **ASME Code Calculations: Stayed Surfaces, Pressure Relief Valves and Furnaces**

   ### Learning Outcome
   Apply the appropriate formulae from A.S.M.E. Sections 1 and 8 to calculations involving pressure vessel stayed surfaces, safety and safety relief valves, and firetube boilers.

   ### Learning Objectives
   1. Calculate the required thickness and maximum allowable working pressure for braced and stayed surfaces in pressure vessels.
   2. Calculate the minimum required cross-sectional area of stays and staybolts in firetube boilers, including diagonal stays.
   3. Calculate the required size and capacity of pressure relief valves.
   4. Explain design considerations for various circular furnaces and calculate the required thickness of corrugated furnaces.

3. Boiler and Pressure Vessel Legislation

Learning Outcome

Describe the components and application of boiler and pressure vessel legislation within Canadian jurisdictions.

Learning Objectives

1. Identify the types and sources of Laws and the levels and scope of the Courts.
2. Define Statutory Delegation of Powers as they apply to the Boilers and Pressure Vessels Act.
3. Describe the authority that Safety Officers (Inspectors) have within their jurisdiction.
4. Determine what are the offences and penalties under the Act and the appeal process.
5. Describe the typical Regulations under the Boilers and Pressure Vessels Act.
6. Describe the typical Codes and Standards referenced by the Boilers and Pressure Vessels Act.

4. Plant Design and Installation

Learning Outcome

Explain the codes and procedures involved in the design and construction of a new plant.

Learning Objectives

1. State the codes and standards that must be followed when designing and building a new plant.
2. Describe the steps involved in developing specifications and contracts for new installations and modifications.
3. Explain the major steps involved in the design and construction of a new plant.
4. Explain the roles and responsibilities in the design and construction of a new plant.
5. Explain how the design and construction of a new plant are administered and controlled.

5. Management and Supervision

Learning Outcome

Describe the roles and basic competencies of a supervisor and manager.

Learning Objectives

1. Define management and explain the general functions of management.
2. Explain how management goals and objectives are developed through planning.
3. Describe how business decisions are made.
4. Describe methods of selecting new employees.
5. Explain how employees are trained.
6. Explain how to provide leadership and motivate employees.
7. Explain how to manage employee performance and behaviours.
8. Demonstrate proper communication skills by writing a formal report.

6. **Plant Maintenance**

   Learning Outcome

   Describe plant maintenance management systems.

   Learning Objectives

   1. Describe the major aspects of managing maintenance activities including management of maintenance, maintenance program development, planning, scheduling, performing maintenance, assessment and improvement.
   2. Describe the different approaches to maintenance including preventive, and corrective.
   3. Describe how routine maintenance activities are planned, scheduled, and controlled.
   4. Describe the use of Gantt and PERT charts and the critical path method to schedule major maintenance activities.
   5. Describe the steps involved in preparing for and conducting a pressure vessel inspection.
   6. Describe the use of computerized systems in managing maintenance, including a work order system.
   7. Describe various methods of monitoring equipment, including log sheets and trending.
   8. Describe the steps involved in developing a plant budget and controlling maintenance costs.

7. **Safety**

   Learning Outcome

   Explain the components and application of safety programs, safety audits, and safety training.

   Learning Objectives

   1. Describe the elements of a comprehensive safety program for a power plant.
   2. Explain the purpose of and the process used for safety checklists, inspections, audits and reviews.
   3. Explain the purpose of and the process used for safety orientation, education, and training.

8. **Linear Motion**

   Learning Outcome

   Apply the theory of applied mechanics to bodies at rest and in linear motion.

   Learning Objectives

   1. Calculate the displacement, velocity, and acceleration of bodies moving in a straight line.
   2. Calculate the displacements and flight times of projectiles.
   3. Describe the relationship between mass, force, acceleration and weight.
   4. Explain inertia, momentum, and conservation of momentum and perform related calculations.
   5. Demonstrate graphically the relationship between work, force, and distance.
   6. Define and calculate the kinetic energy of moving objects.
   7. Define and calculate the potential energy of stationary objects.
   8. Explain the Law of Conservation of Energy.
   9. Define and calculate indicated power and power cylinder dimensions.

9. **Angular Motion**

   Learning Outcome
   Apply the theory of applied mechanics to bodies in angular motion.

   Learning Objectives
   1. Define and calculate angular displacement, angular velocity and angular acceleration.
   2. Define and calculate moment of inertia, radius of gyration and torque.
   3. Define and calculate the kinetic energy of rotating masses, including flywheels.
   4. Define rotational work and power. Calculate brake power and mechanical efficiency of a reciprocating engine.
   5. Calculate the power transmitted by a belt drive.
   6. Define centrifugal and centripetal force, centripetal acceleration, and perform calculations involving them.
   7. Calculate the distance of movement of a governor due to centrifugal force.
   8. Explain the balancing of masses about a center of rotation and perform simple balancing calculations for single and multiple masses.

10. **Friction**

    Learning Outcome
    Perform calculations related to frictional force.

    Learning Objectives
    1. Describe the concept, types and laws of friction.
    2. Define and calculate the coefficient of friction and applied forces for objects moved on a horizontal surface by forces parallel to the surface.
    3. Define and calculate the applied forces for objects moved on a horizontal surface by forces not parallel to the surface.
    4. Define and calculate the applied forces for objects moved on an inclined plane.
    5. Define and calculate the frictional forces on a screw jack.
    6. Define and calculate maximum torque on a belt drive.

11. **Static and Dynamic Forces**

    Learning Outcome
    Perform calculations related to static and dynamic forces acting on a body.

    Learning Objectives
    1. Define and evaluate forces in terms of moments and couples.
    2. Define and calculate centroids and first and second moments of areas.
    3. Define and calculate the different types of stress.
    4. Define strain, modulus of elasticity, Poisson's ratio and perform calculations.
    5. Describe the thermal expansion of bars, including reactions, under conditions of restricted expansion and reactions of bars composed of dissimilar metals.
    6. Define and calculate shear forces and bending moments for simply supported beams and cantilevers.
    7. Perform calculations involving the fundamental torsion equation and explain the relationship between torque and stress.
    8. Explain the relationship between torque and power, and calculate maximum and mean torque for solid shafts of circular cross section.
    9. Calculate stress in coupling bolts due to torque.

12. **Fluid Mechanics**

    Learning Outcome
    Perform calculations related to fluid flows and pressures.

    Learning Objectives
    1. Describe the basics of fluid mechanics.
    2. Perform calculations related to pressure in a fluid, including center of pressure.
    3. Explain buoyancy and perform calculations involving buoyancy principles.
    4. Define and calculate thermal expansion of a vessel and its liquid contents.
    5. Describe flow in open channels and calculate fluid flow through a weir.
    6. Describe liquid flow in a pipe using the continuity equation.
    7. Apply the law of conservation of energy to fluid flow and define Bernoulli's equation.
    8. Calculate fluid flow from a vessel orifice.
    9. Calculate flow using a venturi meter.