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## Course Outline - Mechanical Drives I & II

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**Course Topic:** Mechanical Drives I & II

**Contact Hours:** 120 hours

### Course Description:

The course covers the fundamentals of “Mechanical Transfer of Power”. Basic concepts of mechanical power transmission by addressing the principles of power transmission, calculations of speed and force and how they affect a power transmission systems ability to perform work will be introduced. This program emphasizes the basics of mechanical drawing, safe work practices for working around machinery, common hand tools associated with maintenance work and some of the more common terms and definitions. In addition, students will utilize overlapping instructional models to master the theory, practice, application, and troubleshooting of the three primary systems. Utilizing a coordinated on-line, classroom and hands-on instructional model the student will apply the theory as required while assembling “Belt”, “Chain”, and “Gear” transmission systems. Safety procedures are taught and reinforced throughout the program. The use of On-Line delivery allows for the ‘Flipping’ of the course content. The student will gain exposure to theory and concepts, simulate the applications, participate in inter active assessments outside of the traditional classroom. The in class activities will be focused on ‘Hands-On’ activities that build upon the theory and concepts studied. Student knowledge and skills will be measured by Outcome Based rubrics during the in class periods.

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### Course Outcomes and Objectives

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#### MPT-1 Safety

1. Analyze correctly the function of a mechanical power transmission system and give an advantage
2. Identify correctly five methods of rotary mechanical power transmission and give an appropriate application of each
3. Identify correctly six rules of safe dress for working with power transmission equipment
4. Identify correctly eight mechanical transmission safety rules
5. Identify the correct process of the lockout/tag out system
6. Explain common hazards and identify associated personal protective equipment (PPE)

#### Instructional Unit:

Mechanical Drives 1 (Amatrol); Introduction to Mechanical Drive Systems, Mechanical Power Transmission Safety





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### **Demonstrate mechanical diagnostic methods and approaches (MPT-5)**

#### **Instructional Unit:**

Mechanical Drives 1 (Amatrol); Lab (Hands-On) Activities related to the Theoretical Unit Above.

Analysis 1: Mechanical System Identification

Analysis 2: Mechanical Power Transmission Safety Test

Skill 1: Perform a Lockout/Tag out

### **MPT-2 Create and retain bolted connections in accordance with the sequence of parts and the torque**

1. Analyze the function of a foundation and give three types correctly
2. Analyze the function and construction of a bedplate correctly
3. Analyze the function of a spirit level and identify an appropriate application
4. Identify the correct process of applying a spirit level

#### **Instructional Unit:**

Mechanical Drives 1 (Amatrol); Introduction to Mechanical Drive Systems, Machine Installation

### **Demonstrate mechanical diagnostic methods and approaches(MPT-5)**

#### **Instructional Unit:**

Mechanical Drives 1 (Amatrol); Lab (Hands-On) Activities related to the Theoretical Unit Above.

Skill 1: Use a Spirit Level to Determine Orientation of a Surface

### **MPT-3 Install motors, gears and couplings**

1. Identify correctly three types of motor mounts and give an appropriate application of each
2. Identify the correct process used when fasteners are used to attach a motor mount to a bedplate
3. Identify the correct process to select fastener size and type for a motor mount
4. Identify the correct process to mount and level an electric motor

#### **Instructional Unit:**

Mechanical Drives 1 (Amatrol); Introduction to Mechanical Drive Systems, Motor Mounting

### **Demonstrate mechanical diagnostic methods and approaches (MPT-5)**

#### **Instructional Unit:**

Mechanical Drives 1 (Amatrol); Lab (Hands-On) Activities related to the Theoretical Unit Above.





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Skill 2: Select a Fastener Size and Type for a Motor Mount

Skill 3: Mount an Electric Motor and Correct for a Soft Foot Condition

Skill 4: Level an Electric Motor

Skill 5: Use a Digital Tachometer to Measure Motor Speed

### MPT-4 Determine correct fasteners and bolted connections

1. Analyze correctly the function and operation of a key fastener
2. Identify correctly the construction of six types of keys and give an appropriate application of each
3. Analyze correctly the process of specifying keys and key seats
4. Identify correctly the process to measure the actual size of a key and keyseat
5. Analyze correctly six types of set screws
6. Identify correctly the process to assemble a hub to a shaft using a key fastener
7. Identify correctly the process to measure the actual size of a key and keyseat
8. Identify and Analyze correctly six types of set screws
9. Identify correctly the process to assemble a hub to a shaft using a key fastener
10. Identify correctly two methods of loading a mechanical drive system
11. Identify correctly the process to calculate rotary mechanical power
12. Identify correctly the process to calculate mechanical efficiency and explain its importance
13. Identify correctly two process of measuring shaft torque and give an appropriate application of each
14. Identify correctly three process of measuring electric motor current

#### Instructional Unit:

Mechanical Drives 1 (Amatrol); Key Fasteners, Keyseat Fasteners, Key Assembly, Torque and Power Management, Mechanical Efficiency

### Demonstrate mechanical diagnostic methods and approaches (MPT-5)

#### Instructional Unit:

Mechanical Drives 1 (Amatrol); Lab (Hands-On) Activities related to the Theoretical Unit Above.

Skill 6: Select a Key for a Given Application

Skill 7: Measure the Actual Size of a Key and Keyseat Given a Sample

Skill 8: Cut and File Key Stock to Fit Keyseat

Skill 9: Assemble a Hub to a Shaft Using a Key Fastener

Skill 10: Use a Prony Brake to Measure Shaft Torque

Skill 11: Calculate Rotary Mechanical Power

Skill 12: Convert between US Customary and SI Units of Motor Power





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Skill 13: Calculate Mechanical Efficiency

Skill 14: Measure Electric Motor Current

### **MPT-5 Demonstrate mechanical diagnostic methods and approaches**

#### **MPT-6 Identify and explain power transmission systems:**

1. Analyze correctly the function of a shaft and give an appropriate application
2. Identify correctly four types of shaft materials and give an appropriate application of each
3. Analyze correctly the process of specifying shafts characteristics
4. Analyze correctly the function of a bearing and give an appropriate application
5. Identify correctly three types of bearing loads and give an appropriate example of each
6. Analyze correctly how bearings are positioned to support a load
7. Analyze correctly the operation of two categories of bearings and give an appropriate application of each
8. Identify correctly two process of mounting a shaft bearing and give an appropriate application of each
9. Analyze correctly the function of a coupling and give an appropriate application
10. Analyze correctly the function and application of four categories of mechanical couplings
11. Analyze correctly the operation of a flexible jaw coupling
12. Analyze correctly the purpose of shaft alignment and identify correctly two types of misalignment
13. Identify correctly a general procedure for shaft alignment and correctly identify four measurement methods
14. Identify correctly the process using the straight edge and feeler gauge alignment method

#### **Instructional Unit:**

Mechanical Drives 1 (Amatrol); Power Transmission Systems, Introduction to Shafts, Introduction to Bearings, Introduction to Couplings, Shaft Alignment

### **Demonstrate mechanical diagnostic methods and approaches (MPT-5)**

#### **Instructional Unit:**

Mechanical Drives 1 (Amatrol); Lab (Hands-On) Activities related to the Theoretical Unit Above.

Skill 15: Identify Shaft Size Given a Sample

Skill 16: Install and Adjust a Pillow Block Anti-Friction Bearing and Shaft.

Skill 17: Install a Flexible Jaw Coupling

Skill 19: Align Two Shafts Using a Straight Edge and Feeler Gauge





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### **MPT-7 Describe the purpose and function of belt drives**

1. Analyze correctly the function of the three basic components of a belt drive
2. Analyze correctly pitch and explain its importance
3. Identify correctly the pitch circle, pitch diameter and pitch length of a belt drive and explain their importance
4. Identify correctly the process to calculate the pulley ratio and explain its importance
5. Identify correctly the process to calculate the shaft speed and torque of a belt drive system
6. Identify correctly five types of belt drives and give an appropriate application of each
7. Analyze correctly three types of v-belts and give an appropriate application of each
8. Analyze correctly the operation of a fractional horsepower v-belt drive
9. Identify correctly the process to install and align a v-belt drive
10. Identify correctly the process to determine belt tension for an application
11. Identify and Analyze correctly three methods of adjusting belt tension

### **MPT-8 Describe the purpose and function of chain drives**

1. Analyze correctly the function of the three basic components of a chain drive
2. Identify correctly the process to calculate sprocket ratio and explain its importance
3. Identify correctly the process to calculate shaft speed and torque of a chain drive system
4. Identify and Analyze correctly four types of chains and give an appropriate application of each
5. Identify correctly four types of roller chain drives and give an appropriate application of each
6. Analyze correctly the operation of a single-strand roller chain drive
7. Identify correctly the process to install, align, and remove a roller chain drive system with adjustable
8. Identify correctly the process to determine allowable chain sag for a given application
9. Identify correctly the two process used to adjust chain sag
10. Identify correctly the process to measure chain sag
11. Analyze correctly the function and operation of a master link
12. Identify correctly two process of installing a lightweight chain that uses a master link
13. Identify the correct operation of a chain puller
14. Perform chain and sprocket alignment and tension.
15. Identify and describe silent chain drives.
16. Identify and describe the three types of chain lubrication and the correct application of each.
17. Install chain guards.
18. Perform chain drive system identification and visual inspection.
19. Check for excessive wear and run-out of the sprockets.
20. Perform sprocket fit to shaft.
21. Inspect for sprocket wear.
22. Perform chain or drive unit replacement.





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23. Properly perform alignment and chain tension.

**Instructional Unit:**

Mechanical Drives 1 (Amatrol); Introduction to Chain Drives, Chain Drive Concepts, Chain Drive Operation, Chain Tensioning, Chain Tension Measurement, Fixed Center Chain Installation.

**Demonstrate mechanical diagnostic methods and approaches (MPT-5)**

**Instructional Unit:**

Mechanical Drives 1 (Amatrol); Lab (Hands-On) Activities related to the Theoretical Unit Above.

- Skill 26: Calculate Sprocket Ratio
- Skill 27: Calculate Shaft Speed and Torque of a Chain Drive System
- Skill 28: Install and Align a Roller Chain Drive System with Adjustable Centers
- Skill 29: Determine Allowable Chain Sag for a Given Application
- Skill 30: Use a Rule and a Straight Edge to Measure Chain Sag
- Skill 31: Adjust Chain Sag to a Specified Amount Using Adjustable Centers
- Skill 32: Install and Remove a Chain with a Master Link Using Sprocket Teeth
- Skill 33: Install and Remove a Chain with a Master Link Using a Chain Puller

**MPT-9 Identify and demonstrate clutch and brake function**

- Identify clutch and brake functions and uses.
- Identify friction and electromagnetic types of clutches.
- Identify mechanical-lockup interfaces and actuation methods.
- Perform clutch and brake identification and visual inspection.
- Install a clutch/brake assembly.
- Disassemble a clutch and/or brake.

**MPT-10 Take out devices and assembly parts, taking into account their function, mark parts regarding to their position and function**

**MPT-11 Determine mechanical gear and linkage ratios**

**MPT-12 Determine correct fasteners and bolted connections**





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1. Describe the Function and Operation of a Key Fastener
2. Describe the Construction of Six Types of Keys and Give an Application of Each
3. Describe How Keys and Keyseats Are Specified
4. Describe How to Measure the Actual Size of a Key and Keyseat
5. Describe Six Types of Set Screws
6. Describe How to Assemble a Hub to a Shaft Using a Key Fastener
7. Describe How to Measure the Actual Size of a Key and Keyseat
8. Describe Six Types of Set Screws
9. Describe How to Assemble a Hub to a Shaft Using a Key Fastener
10. Describe Two Methods of Loading a Mechanical Drive System
11. Describe How to Calculate Rotary Mechanical Power
12. Describe How to Calculate Mechanical Efficiency and Explain Its Importance
13. Describe Two Methods of Measuring Shaft Torque and Give an Application of Each
14. Describe Three Methods of Measuring Electric Motor Current

### **MPT-13 Demonstrate mechanical diagnostic methods and approaches**

#### **MPT-14 Operate and Maintain Power Transmission Systems:**

1. Describe the Function of a Shaft and Give an Application
2. List Four Types of Shaft Materials and Give an Application of Each
3. Describe How Shafts Are Specified
4. Describe the Function of a Bearing and Give an Application
5. Define Three Types of Bearing Loads and Give an Example of Each
6. Describe How Bearings Are Positioned to Support a Load
7. Describe the Operation of Two Categories of Bearings and Give an Application of Each
8. Describe Two Methods of Mounting a Shaft Bearing and Give an Application of Each
9. Describe the Function of a Coupling and Give an Application
10. Describe the Function and Application of Four Categories of Mechanical Couplings
11. Describe the Operation of a Flexible Jaw Coupling
12. Describe the Purpose of Shaft Alignment and Give Two Types of Misalignment
13. Describe a General Procedure for Shaft Alignment and Give Four Measurement Methods
14. Describe the Operation of the Straight Edge and Feeler Gauge Alignment Method
15. Identify and describe various types of seals
16. Troubleshoot and install
  - Plain bearings
  - Ball bearings
  - Roller bearings
  - Angular contact bearings





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- Associated seals

### MPT-15 Operate and Maintain Belt Drive Systems:

1. Describe the Function of the Three Basic Components of a Belt Drive
2. Define Pitch and Explain Its Importance
3. Define the Pitch Circle, Pitch Diameter and Pitch Length of a Belt Drive and Explain Their Importance
4. Describe How to Calculate the Pulley Ratio and Explain Its Importance
5. Describe How to Calculate the Shaft Speed and Torque of a Belt Drive System
6. List Five Types of Belt Drives and Give an Application of Each
7. List Three Types of V-Belts and Give an Application of Each
8. Describe the Operation of a Fractional Horsepower V-Belt Drive
9. Describe How to Install and Align a V-Belt Drive
10. Describe How to Determine Belt Tension for an Application
11. Describe Three Methods of Adjusting Belt Tension
12. Describe Three Methods of Measuring Belt Tension and Give an Application of each
13. Perform run-out and balance of a pulley
14. Perform pulley fit to shaft
15. Troubleshoot pulley wear
16. Perform belt or drive unit replacement

### MPT-16 Operate and Maintain Chain Drives Systems

1. Describe the Function of the Three Basic Components of a Chain Drive
2. Describe How to Calculate Sprocket Ratio and Explain Its Importance
3. Describe How to Calculate Shaft Speed and Torque of a Chain Drive System
4. List Four Types of Chains and Give an Application of Each
5. List Four Types of Roller Chain Drives and Give an Application of Each
6. Describe the Operation of a Single-Strand Roller Chain Drive
7. Describe How to Install, Align, and Remove a Roller Chain Drive System with adjustable
8. Describe How to Determine Allowable Chain Sag for a Given Application
9. Describe Two Methods Used to Adjust Chain Sag
10. Describe How to Measure Chain Sag
11. Describe the Function and Operation of a Master Link
12. Describe Two Methods of Installing a Lightweight Chain That Uses a Master Link
13. Describe the Operation of a Chain Puller







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### **MPT-17 Identify and demonstrate gear drive function**

1. Identify and describe open gears and enclosed gears
2. Identify and describe associated seals, breathers, and lubrication.
3. Explain gear ratings and application
4. Recognize and explain gear identification
5. Assemble
  - A parallel shaft gear drive
  - Assemble a worm and wheel gearbox drive unit
  - Assemble an angle shaft gear drive

### **MPT-18 Identify and demonstrate industrial cam function**

1. Identify industrial cam followers and functions
2. Identify industrial cam follower bushing types and operating clearances
3. Identify the common types of cam followers and rod ends
4. Replace, install, and adjust cam followers and rod ends

### **MPT-19 Describe the purpose and function of spur gear drives**

1. Analyze correctly the function of the three components of a gear drive system
2. Identify and analyze correctly; gear pitch, pitch circle, and pitch diameter and explain their importance
3. Identify correctly the process to calculate the gear ratio of a gear drive
4. Identify correctly the process to calculate the shaft speed and torque of a gear drive system
5. Identify and analyze correctly the functions of four types of gear drives and give an appropriate application of each
6. Identify correctly four types of parallel shaft gears and give an appropriate application of each
7. Identify and Analyze correctly eleven features of a gear
8. Identify and analyze correctly the twelve dimensions of a gear and explain the importance of each
9. Identify and analyze correctly the ten dimensions and features of a gear drive and explain the importance of each
10. Analyze correctly the operation of a spur gear drive
11. Identify correctly the process to install and align a spur gear drive system
12. Identify and analyze correctly the function of backlash
13. Identify correctly the process to determine the allowable backlash in a gear drive





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14. Identify correctly two process of measuring spur gear backlash

**Instructional Unit:**

Mechanical Drives 1 (Amatrol); Spur Gear Drives, Gear Drive Concepts, Gear Drive Designs, Spur Gear Operation, Spur Gear Installation, Spur Gear Analysis

**Demonstrate mechanical diagnostic methods and approaches ( MPT-5)**

**Instructional Unit:**

Mechanical Drives 1 (Amatrol); Lab (Hands-On) Activities related to the Theoretical Unit Above.

1. Analysis 4: Gear Feature Identification
2. Analysis 5: Gear Drive Analysis
  - Skill 34: Calculate Gear Ration
  - Skill 35: Calculate the Shaft Speed and Torque of a Gear Drive System
  - Skill 36: Install and Align a Spur Gear System
  - Skill 37: Determine the Allowable Backlash in a Gear System
  - Skill 38: Measure Gear Backlash
  - Skill 39: Adjust Gear Backlash

**MPT-20 Describe the purpose and function of multiple shaft drives:**

1. Identify correctly the process to calculate the speed and torque output in a multiple shaft gear drive
2. Analyze correctly the function of a compound gear drive system and give an appropriate application
3. Identify correctly the process to calculate the torque and speed output of a compound gear drive system
4. Identify correctly the process to determine the direction of rotation of a gear drive
5. Identify correctly the process to install and align a multiple shaft drive system
6. Identify and analyze correctly the function of a solid coupling and list two types
7. Analyze correctly the operation of a sleeve coupling and give an appropriate application
8. Identify correctly the alignment procedure of a sleeve coupling

**Instructional Unit:**

Mechanical Drives 1 (Amatrol); Multiple Shaft Drives, Multiple Shaft Gear Analysis, Multiple Shaft Drive Installation, Sleeve Couplings

**Demonstrate mechanical diagnostic methods and approaches (MPT-5)**

**Instructional Unit:**





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Mechanical Drives 1 (Amatrol); Lab (Hands-On) Activities related to the Theoretical Unit Above.

- Skill 40: Calculate the Shaft Speed and Torque of a Multiple Shaft System
- Skill 41: Calculate the Torque and Speed Output of a Compound Gear Drive System
- Skill 42: Determine the Direction of Rotation of a Gear Given Its Position in a Gear Drive
- Skill 43: Install and Align a Multiple Shaft Drive System
- Skill 44: Install and Adjust a Sleeve Coupling and Shaft

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