

## WESTERN IOWA TECH COMMUNITY COLLEGE

### Course Syllabus

#### Mechanical Technician Level 4

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Course Title: Mechanical Technician – Level 4

Total Hours: 76

Meeting time/ location :TBA

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#### COURSE DESCRIPTION AND PREREQUISITES/COREQUISITES:

The Mechanical Maintenance Certificate combines the disciplines of Hydraulics, Power Transmission, and Pumps. Each of the levels contains portions of each of these disciplines to present a holistic and competency driven approach to the mastering of the skills necessary for an Mechanical Maintenance Technician. Each level is designed to be delivered in such a way that the student attends the levels in a sequential order to ensure a complete understanding of the material. This training can be transcribed into college credit. Test outs are available to ensure the students are prepared for each level prior to registering for the training.

#### COURSE OBJECTIVES

- Describe the function of a pressure sequence valve and give an application
- Describe the operation of a direct-acting sequence valve and give its schematic symbol
- Describe the function of a bypass check valve in a sequence valve circuit
- Describe the operation of an integral check valve and give its schematic symbol
- Describe the function of a two-sequence valve control circuit
- Explain why a sequence valve is externally drained
- Describe the function of a pressure reducing valve and give an application
- Describe the operation of a direct-acting PRV and give its schematic symbol
- Describe the function of a PRV's bypass check valve
- Explain why a PRV is externally drained
- Explain how actuator relaxation occurs in a multi-actuator circuit
- Describe the operation of a P-port check valve circuit
- Describe the construction of an integral P-port check valve
- Describe the function of a pilot-operated check valve and give an application
- Describe the operation of a pilot-operated check valve and give its symbol
- Describe the operation of load-lock circuits using one POC valve
- Describe the operation of load-lock circuits that use two POC valves
- Describe the operation of a double-POC check valve
- Describe the function of a prefill valve and give an application
- Define POC valve pilot ratio and explain its importance
- Describe how to calculate the pressure required opening a POC valve
- Define pressure intensification and explain its importance
- List five application guidelines for POC valves
- Describe the function and operation of a POC valve with decompression poppet
- Describe how to calculate the maximum pressure in a POC valve circuit
- Describe the function of an accumulator and give an application
- Describe the operation of three types of accumulators and give their schematic symbols
- Describe the operation of the four types of gas loaded accumulators
- Describe how to pre-charge a gas loaded accumulator
- Describe how to mount an accumulator
- Describe the function and operation of two types of safety bleed-down circuits
- Describe the function and operation of two accumulator unloading circuits
- List four accumulator safety rules

- Describe the operation of a circuit that uses an accumulator for auxiliary power
- Describe the operation of a circuit that uses an accumulator for emergency power
- Describe the effect of pre-charge pressure on accumulator operation
- Describe the operation of an accumulator leakage/temperature compensation circuit
- Describe the operation of a circuit that uses an accumulator for fluid dispensing
- Describe the operation of a circuit that uses an accumulator for energy savings
- Explain how bladder-type accumulators are specified
- Explain how to size a bladder-type accumulator
- Describe the operation of a circuit that uses an accumulator for pulsation dampening
- Describe the function of the three basic components of a chain drive
- Describe how to calculate sprocket ratio and explain its importance
- Describe how to calculate shaft speed and torque of a chain drive system
- List four types of chain drives and give an application of each
- Describe the operation of a chain puller
- Describe the operation of a single-strand roller chain drive
- Describe how to install, align, and remove a roller chain drive system with adjustable centers
- Describe how to determine allowable chain sag for a given application
- Describe two methods used to adjust chain sag
- Describe how to measure chain sag
- Describe the function and operation of a master link
- Describe two methods of installing a lightweight chain which uses a master link
- List four types of roller chain drives and give an application of each
- Describe the function of the three basic components of a chain drive
- OBJECTIVE 2 Describe how to calculate sprocket ratio and explain its importance
- Describe how to calculate shaft speed and torque of a chain drive system
- List four types of chain drives and give an application of each
- List four types of roller chain drives and give an application of each
- Describe the operation of a single-strand roller chain drive
- Describe how to install, align, and remove a roller chain drive system with adjustable centers
- Describe how to determine allowable chain sag for a given application
- Describe two methods used to adjust chain sag
- Describe how to measure chain sag
- Describe the function and operation of a master link
- Describe the operation of a chain puller
- Describe two methods of installing a lightweight chain which uses a master link
- Describe the function of the three components of a gear drive system
- Define the gear pitch, pitch circle, and pitch diameter and explain their importance
- Describe how to calculate the gear ratio of a gear drive
- Describe how to calculate the shaft speed and torque of a gear drive system
- Describe the functions of four types of gear drives and give an application of each
- Describe eleven features of a gear
- Identify the twelve dimensions of a gear and explain the importance of each
- Describe how to determine the allowable backlash in a gear drive
- Describe the operation of a spur gear drive
- Describe how to install and align a spur gear drive system
- Describe the function of backlash
- Identify the ten dimensions and features of a gear drive and explain the importance of each
- Describe how to calculate the speed and torque output in a multiple shaft gear drive
- Describe the function of a compound gear drive system and give an application
- Describe how to calculate the torque and speed output of a compound gear
- Describe the alignment procedure of a sleeve coupling
- Describe how to install and align a multiple shaft drive system
- Describe the function of a solid coupling and list two types
- Describe the operation of a sleeve coupling
- Describe how to determine the direction of rotation of a gear drive
- Describe four types of coupling flexibility
- List two categories of flexible couplings and give an application of each
- Describe the effect of thermal expansion on alignment and explain how to correct for it
- Describe the operation of an elastomer-in-shear coupling

- Describe the operation of a flange coupling and give an application
- Describe the operation of the rim and face alignment method
- Describe the operation of the reverse indicator method
- Describe the effect of indicator sag on alignment and explain how to correct for it
- List three types of elastomeric couplings and give an application of each
- List five types of flexible metal couplings and give an advantage of each
- Describe the operation of a chain coupling
- Describe the operation of a grid coupling
- Describe the operation of a gear coupling
- Describe how couplings are specified
- Describe how to select a coupling for an application
- Describe the operation of a silent chain drive
- Describe the operation of four types of sprockets and give an application of each
- Describe how to install and align a silent chain drive system
- Describe the operation of a multiple strand chain drive
- Describe how to install and align a multiple strand chain drive system
- Define chain pitch and pitch length of a chain drive and explain their importance
- Describe how chains are specified
- Describe the operation of a chain breaker
- Describe how to identify the size and type of chain and sprocket given a sample
- Describe how to select the type and size of chain and sprocket for a given application
- Describe four types of chain lubrication methods
- Describe how to select a lubrication system for a chain drive system
- Describe how to select a type of lubricant for a chain drive system
- Describe ten maintenance steps for chain drives
- Describe how to troubleshoot a chain drive system
- Describe how sprockets are specified
- Describe the function of a peristaltic pump and give an application
- Describe the operation of a peristaltic pump
- Describe how to install a peristaltic pump
- Describe how to start up and operate a peristaltic pump
- Describe the flow/pressure characteristics of a peristaltic pump
- Describe how to minimize the pulsation in a peristaltic pump
- Describe how to adjust the flow rate of a peristaltic pump
- Describe how to calculate peristaltic pump flow rate given displacement
- Describe how to select a peristaltic pump for an application
- Describe how to maintain a peristaltic pump
- Describe how to disassemble and inspect a peristaltic pump
- Describe how to troubleshoot a peristaltic pump
- Describe how to install a twin piston pump
- Describe the operation of a twin piston pump
- Describe the function of a piston pump and give an application
- Describe how to start up and operate a twin piston pump
- Describe how to calculate actual piston pump flow rate
- Describe the methods of adjusting the flow rate of a twin piston pump
- Describe how to calculate theoretical piston pump flow rate given displacement
- Describe the flow/pressure characteristics of a twin piston
- Describe how to maintain a twin piston pump
- Describe how to troubleshoot a twin piston pump
- Describe the operation of an external gear pump
- Describe the operation of an internal gear pump
- Describe how to install a gear pump
- Describe how to start up and operate a gear pump
- Describe the methods of adjusting the flow rate of a gear
- Describe the flow/pressure characteristics of a gear pump
- Describe how to calculate theoretical gear pump flow rate given displacement
- Describe how to calculate actual gear pump flow rate
- Describe how to select a gear pump for an application
- Describe how to maintain a gear pump

- Describe how to disassemble and inspect a gear pump
- Describe how to troubleshoot a gear pump

**CONTENT OUTLINE:**

1. SEQUENCE VALVES
2. SEQUENCE VALVE APPLICATIONS
3. PRESSURE REDUCING VALVES
4. PRV APPLICATIONS
5. PRESSURE PORT CHECK VALV PILOT-OPERATED CHECK VALVES E CIRCUIT
6. PILOT-OPERATED CHECK VALVE APPLICATIONS
7. PILOT-OPERATED CHECK VALVE CIRCUIT DESIGN
8. ACCUMULATOR OPERATION
9. ACCUMULATOR CIRCUITS
10. ACCUMULATOR APPLICATIONS
11. ACCUMULATOR SIZING
12. CHAIN DRIVE CONCEPTS
13. CHAIN DRIVE OPERATION
14. CHAIN TENSIONING
15. CHAIN TENSION MEASUREMENT
16. FIXED CENTER CHAIN INSTALLATION
17. GEAR DRIVE CONCEPTS
18. GEAR DRIVE DESIGNS
19. SPUR GEAR OPERATION
20. SPUR GEAR INSTALLATION
21. SPUR GEAR ANALYSIS
22. MULTIPLE SHAFT GEAR ANALYSIS
23. MULTIPLE SHAFT DRIVE INSTALLATION
24. SLEEVE COUPLINGS
25. ELASTOMERIC COUPLINGS
26. FLANGE COUPLINGS
27. RIM AND FACE SHAFT ALIGNMENT METHOD'
28. REVERSE INDICATOR ALIGNMENT METHOD
29. CHAIN COUPLINGS
30. GRID AND GEAR COUPLINGS
31. COUPLING SELECTIONSILENT CHAIN DRIVES
32. CHAIN SELECTION
33. CHAIN LUBRICATION
34. CHAIN MAINTENANCE AND TROUBLESHOOTING
35. PUMP INSTALLATION
36. PUMP OPERATION
37. PUMP PERFORMANCES
38. PUMP SELECTION
39. PUMP MAINTENANCE AND TROUBLESHOOTING
40. PUMP INSTALLATION
41. PUMP PERFORMANCE
42. PUMP OPERATION
43. PUMP MAINTENANCE AND TROUBLESHOOTING
44. PUMP OPERATION
45. Describe the function of a gear pump and give an application
46. PUMP PERFORMANCE
47. PUMP SELECTION
48. PUMP MAINTENANCE AND TROUBLESHOOTING
49. PUMP INSTALLATION
50. PUMP OPERATIONS
51. PUMP SELECTIONS
52. PUMP MAINTENANCE AND TROUBLESHOOTING
53. PUMP MAINTENANCE AND TROUBLESHOOTING
54. PUMP OPERATION
55. PUMP INSTALLATION

## **COMPETENCIES:**

- Connect and adjust the pressure setting of a sequence valve
- Connect and operate a pressure sequence circuit
- Sequence valve operation with a check valve
- Design a pressure sequence circuit
- Design a two-sequence valve control circuit
- Sequence valve drain operation
- Connect and adjust the pressure setting of a PRV
- Connect and operate a reduced pressure circuit
- Design a hydraulic circuit that uses a pressure reducing valve
- Connect and operate a P-port check valve circuit
- Connect and operate a pilot-operated check valve
- Connect and operate a load-lock circuit
- Measure pilot-operated check valve pilot pressure
- Calculate the pilot pressure required to open a POC valve
- Calculate the maximum pressure in a POC valve circuit
- Design a POC valve circuit
- Pre-charge an accumulator
- Determine accumulator pre-charge pressure
- Connect and operate an accumulator bleed-down circuit
- Connect and operate an accumulator to safely provide auxiliary and/or emergency power
- Size a bladder-type accumulator
- Design an accumulator circuit to compensate for leakage
- Determine allowable chain sag for a given application
- Use a rule and a straight edge to measure chain sag
- Install and remove a chain with a master link using a chain puller
- Install and remove a chain with a master link using sprocket teeth
- Adjust chain sag to a specified amount using adjustable centers
- Adjust gear backlash to a specified amount
- Calculate the shaft speed and torque of a gear train drive system
- Install and align a spur gear drive system
- Determine the allowable backlash in a gear drive
- Calculate the shaft speed and torque of a multiple shaft gear drive system
- Calculate the torque and speed output of a compound gear drive system
- Determine the direction of rotation of a gear given its position in a gear drive
- Install and align a multiple shaft drive system
- Install and adjust a sleeve coupling and shaft
- Install and adjust a sleeve coupling and shaft
- Install and align an elastomer-in-shear coupling
- Install and align a flange coupling
- Align a coupling using the rim and face indicator method
- Measure and correct for indicator sag

- Align a coupling using the reverse indicator method
- Install and align a chain coupling
- Install and align a grid coupling that uses bushings
- Install and align a gear coupling
- Identify the size and type of a coupling given a sample
- Select a coupling for a given application
- Troubleshoot a coupling system
- Install and align a silent chain drive system
- Install and align a multiple strand chain drive system using a taper lock bushing
- Identify the size and type of a chain and sprocket given a specification
- Identify the size and type of chain and sprocket given a sample
- Select a chain and sprocket for a given application
- Select a lubrication system for a chain drive system
- Lubricate a chain drive system using the manual lubrication method
- Check a chain for elongation
- Cut a chain using a chain breaker
- Troubleshoot a chain drive system
- Disassemble and inspect an air-operated double-diaphragm pump
- Install a peristaltic pump
- Start up and operate a peristaltic pump
- Measure and graph the flow/pressure characteristics of a peristaltic pump
- Calculate peristaltic pump flow rate given displacement
- Determine the size of a peristaltic pump given name plate data
- Disassemble and inspect a peristaltic pump
- Troubleshoot a peristaltic pump
- Select a peristaltic pump for an application
- Calculate the actual flow rate of a piston pump
- Install a twin piston pump
- Measure and graph the flow/pressure characteristics of a twin piston pump
- Start up and operate a twin piston pump
- Measure and graph the flow/pressure characteristics of a gear pump
- Calculate the theoretical flow rate or displacement of a gear pump
- Calculate the actual flow rate of a gear pump
- Determine the size of a gear pump given nameplate data
- Select a gear pump for an application
- Disassemble and inspect a magnetic pump
- Determine the size of a magnetic pump given nameplate data
- Select a magnetic pump for an application
- Troubleshoot a magnetic pump
- Measure and graph the flow/pressure characteristics of a magnetic pump

#### **EVALUATION/GRADING CRITERIA:**

QUIZZES

OBJECTIVE TESTS

HANDS ON ASSESSMENTS

FINAL TEST

NOTE: REVIEWS AND QUIZZES WILL NOT BE ACCEPTED LATE AFTER THE INDIVIDUALLY ASSIGNED DATE !!!! REVIEWS OR QUIZZES NOT TURNED IN ON TIME WILL BE GIVEN "0" MISSED PRACTICAL TESTS AND FINAL EXAM CAN BE MADE UP ONLY BY THE APPROVAL OF THE INSTRUCTOR.

#### **ATTENDANCE:**

Students are expected to attend all sessions of classes for which they are enrolled. Absences do not excuse the student from meeting the course requirements. The student must take the initiative in making up any missed work. Each instructor will provide policies concerning course attendance.

**ACADEMIC HONESTY:**

Students are responsible for their own learning and development. They have a responsibility to be an active learner by attending class, completing class and laboratory assignments, and preparing in advance of the scheduled class session. Students are expected to understand and maintain high standards of academic honesty. Examples of academic dishonesty include, but are not limited to, the following:

- Cheating
- Plagiarism
- Fabrication
- Dual Submission
- Facilitating Academic Dishonesty

**COMPUTER CONDUCT:**

College computer systems are provided by WITCC for use by students, faculty, and staff for the purpose of furthering the educational mission of the College. This includes course work, college-related educational endeavors, and business operations. Each user is expected to follow established computer conduct policies and not to interfere with or disrupt the orderly processes of WITCC resources. Users accept the responsibility for utilizing services in ways that are ethical, that demonstrate academic integrity and respect for others who share this resource. Users must follow all existing federal, state, and local laws as they relate to computer conduct.

**AMERICANS WITH DISABILITIES ACT (A):**

Persons with documented disabilities may request reasonable accommodations through Disability Services, located in the Admissions & Advising Center, A300, or at (712) 274-8733, Ext. 3216.

**DISCRIMINATION:**

Western Iowa Tech Community College does not discriminate on the basis of race, creed, color, gender, national origin, religion, age, disability, sexual orientation, gender identity, veteran status or any other protected basis as defined in Iowa or federal law as amended from time to time in its educational programs, activities, admission procedures or employment practices. Individuals who believe they have been discriminated against may file a complaint through the College's Grievance or Complaint Procedures. Complaint or Grievance Forms and Procedures may be obtained from the WITCC Human Resources Department, Dr. Robert H. Kiser Building, Room A242, and (712) 274-6400, Ext. 1220.

**SAFETY AND SECURITY:**

WITCC has produced videos regarding safety features and procedures that can be taken by students, staff and faculty. These videos have been posted on the my WIT homepage under the "Safety" tab and may be viewed at any time. An Emergency Response Guide along with Tornado, Fire and Secure Your Area posters have been placed in each classroom and work space area which list specific precautions that should be taken. If you have any questions or concerns, please call the Safety/Security Supervisor at 712-274-8733, extension 3210. If you have an emergency situation at the Sioux City campus, call 1316 or 911 from any telephone on campus immediately. For the outlying campuses call 911 immediately.

***As a comprehensive community college, our mission is to provide quality education and to economically enhance the communities we serve.***