Lansing Community College

Course Cover Sheet

M-CAM Training Area:
☐CNC/Machining ☒Multi-Skilled Mechatronics ☐Production Operation ☐Welding/Fabrications

Program(s): Intro to Mechatronics Block 1-3

Course: Mechanical Systems/Mechanical Drivers/Power Transmissions

Course Description:
A mechanical system consists of a combination of components that function together to perform work and motion. Mechanical drive systems may also change the size, direction, and speed of the applied force.

This course covers transmission, calculation of speed and force, mechanical drawing, safe work practices, common hand tools. Participants will be introduced to the various components of mechanical systems such as bearing, shafts, seals, brakes, clutches, gears, and cams.

Participants will learn about flexible chain drives, how to install, align, and maintain shaft couplings.

Delivery method is hybrid, open entry/open exit.

Date Created: February/March, 2017

Employer/Industry Partner: Magna/DexSys, Lansing, Michigan and various manufacturing companies in Mid-Michigan.

Faculty Developer(s)/Instructional Designers(s): Sidney Mosley/Ann Lapo

College Contact: Jill Doederlein

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Additional Information/Comments: Due to the increased need to offer a flexible delivery format to meet the needs of students'/workers' busy schedules, LCC partnered with AMTEC (Automotive Manufacturing Technical Education Collaborative) led by Kentucky Community Technical College to offer open entry open exit modular courses in a hybrid format (lessons online and hands-on labs with an instructor on campus). LCC instructors added content based on the needs of local industry.

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DESCRIPTION:
A mechanical system consists of a combination of components that function together to perform work and motion. Mechanical drive systems may also change the size, direction, and speed of the applied force.

This course covers transmission, calculation of speed and force, mechanical drawing, safe work practices, common hand tools. Participants will be introduced to the various components of mechanical systems such as bearing, shafts, seals, brakes, clutches, gears, and cams.

Participants will learn about flexible chain drives, how to install, align, and maintain shaft couplings.

TOTAL TIME REQUIREMENT for the course is approximately 90 hours.

PREREQUISITES: Reading Level 4. Writing Level 4. Math Level 5. Basic OSHA Safety.

OBJECTIVES: (for a complete list of objectives, see each module)
After completing this course, the student should be able to:

- Describe and apply safety precautions for performing maintenance on mechanical systems.
- Describe lockout/tagout requirements and proper procedures.
- Identify proper uses and requirements for personal protective equipment.
- Describe the function of maintenance as it is related to the type of industry, process requirements and business.
- Define terms relating to basic mechanics.
- Describe Newton's three laws of motion.
- Explain the concept of friction.
- Identify basic machines and concepts used to transmit power.
- Describe the basic concepts of the three classes of levers.
- Describe the function of the pulley.
- Describe the concept of the inclined plane.
- Describe the operation of the wheel and axle.
- Describe the purpose and operation of the screw.
- Describe the process of mechanical power transmission and components used to transmit mechanical energy.
- Identify systems used to transmit power.
- Describe the two categories of driving machines.
- Identify the use of electrical motors (AC and DC) used to transmit power.
- Describe the function of a transmission to change the output torque and/or speed (RPM) of a motor or prime mover.
- Describe the two basic types of transmissions.
- Describe the machines whose purpose it is to drive other machines.
- Describe the types of machines whose purpose it is to transmit mechanical energy to a driven machine.
- List the advantages and disadvantages of gearboxes.

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OBJECTIVES *continued*: **(for a complete list of objectives, see each module)**

- Identify types of gears used with nonintersecting shafts.
- Describe the operation of differentials.
- Describe the characteristics of variable speed drives.
- Describe the operation of pumps.
- Identify the different types of pumps used to move materials.
- Identify the operation of compressors.
- Describe the use of industrial fans.
- Describe the use of electrical generators.
- Identify the use of blenders and mixers in industrial operations.
- Identify the operation of various machine tools.
- Explain the tolerance information on a print.
- Identify common types and styles of flexible belt drive systems.
- Identify common types and styles of chain drive systems.
- Explain the proper chain drive alignment and tensioning procedures.
- Describe characteristics of silent chain drives.
- Describe lubrication and chain guards.
- Name the types and functions of couplings.
- Install and replace various coupling systems.
- Maintain and troubleshoot various coupling systems.
- Install and troubleshoot plain bearings.
- Troubleshoot bearings, shafts and seals.
- Name the types of seals and their functions.
- Describe types of brakes and clutches used in manufacturing.
- Describe maintenance practices used in the inspection, disassembly, and assembly of clutch units.
- Describe the purpose and function of gears and gear drives.
- Describe seals, breathers, and lubrication.
- Describe industrial cam follower bushing types and operating clearances.

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108 Mechanical Systems/Mechanical Drives/Power Transmissions consists of six modules:

1081 – Basic Mechanical Power Transmission (12 lessons to read and review on your own.)
The purpose of this module is to introduce students to the basic concepts of Mechanical Power Transmission. It covers the principles of power transmission, calculations of speed and force and how they affect a power transmission systems ability to perform work. Understanding 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.

1082 – Flexible Drives (4 lessons to read on your own, 12 labs to do at LCC with an instructor)
A mechanical drive system is a combination of mechanical components that transfer power from one location to another. Mechanical drive systems may also change the size, direction, and speed of the applied force. This includes V-belts, chains, sprockets, and components. This module will introduce the learner to the various types and styles of flexible belt and chain drives.

1083 – Couplings and Alignment (7 lessons to read on your own, 6 labs to do at LCC)
This module examines the types and functions of couplings used in industrial power transmissions. Students will learn how to install, align, and maintain shaft couplings.

1084 – Bearings, Shafts, and Seals (7 lessons to read on your own, 8 labs to do at LCC)
A mechanical system consists of a combination of components that function together to perform work and motion. Bearings, shafts and seals are fundamental components that help comprise a power transmission system. This module will introduce the student to the basic types and functions of these components.

1085 – Brakes and Clutches (4 lessons to read on your own, 4 labs to do at LCC)
A mechanical drive system is a combination of mechanical components that transfer power from one location to another. Mechanical drive systems may also change the size, direction, and speed of the applied force. This includes the application of brake systems and clutch components. This module will introduce the learner to the various types and styles of braking systems and clutches used in industrial applications.

1086 – Gears and Cams (4 lessons to read on your own, 4 labs to do at LCC)
A mechanical system is a combination of mechanical components that transfer power from one location to another. Mechanical drive systems may also change size, direction, and speed of the applied force. This includes the application of the various forms of gears and cam follower components. This module will introduce the learner to the various types and styles of gears and cam follower components used in industrial applications.

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MATERIALS:

Online portion of the class:

Software: Internet access, Web browser, word-processing software, Adobe Reader, up-to-date virus protection for the online portion of this course.

- Go to elearning.autoworkforce.org – modules 1081-1086 to access the lessons, labs specifications and assessments for this course.

Hands-on labs portion of the class:

- Tools and equipment per module for each hands-on lab.

AMT 1081: Basic Mechanical Power Transmission
NO LABS

AMT 1082: Flexible Drives
Lab 1: Belt Drive System Identification, Visual Inspection, & Lockout/Tagout/Blockout
Belt sample set
Assorted pulleys and sheaves
Sheave inspection gauge set
DAC Belt Drive Trainer 201 (or equivalent)
Lab 2: Run-Out
Combination wrench set
Adjustable wrench
Hex wrench set
Magnetic base/dial indicator set
File
Pencil and paper
A piece of chalk
Horizontal shaft precision bearing balancer
DAC Belt Drive Trainer 201 (or equivalent)
Lab 3: Pulley Fit to Shaft, Set Screws & Keys, and Pulley Wear
Combination wrench set
Screw driver set
Hex wrench set
Sheave/bearing puller
Torque wrench (optional)
Sheaves and sheave bushings
DAC Belt Drive Trainer 201 (or equivalent)

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MATERIALS: *(continued)*

1082 (continued)

Lab 4: Belt or Drive Unit Replacement
Combination wrench set
Adjustable wrench
Hex wrench set
File
Pencil and paper
A piece of chalk
A variety of v-belts
DAC Belt Drive Trainer 201 (or equivalent)
Lab 5: Take-up Equipment Function
Combination wrench set
Adjustable wrench
Hex wrench set
File
Pencil and paper
DAC Belt Drive Trainer 201 (or equivalent)
Lab 6: Alignment and Belt Tension
Combination wrench set
Hex wrench set
Belt tensioning gauge (i.e. Gates belt tension gauge)
6" rule
Straightedge
Length of string
Soft-faced mallet
Pencil and paper
Piece of chalk
Tape measure
Two fractional horsepower sheaves ("L" belt size)
Correct size fractional horsepower belt (2L, 3L, etc.)
V-belt Laser Alignment System
DAC Belt Drive Trainer 201 (or equivalent)
Lab 7: Chain Drive System Identification, Visual Inspection, and Lockout/Tagout/Blockout
Chain sample set
Assorted sprockets
AMTEC Integrated Manufacturing Simulator or equivalent

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MATERIALS: *(continued)*

1082 (continued)

Lab 8: Inspection of Excessive Roller Chain Wear and Run-out of the Sprockets
Combination wrench set
Screw driver set
Hex wrench set
Sprocket/bearing puller
Torque wrench (optional)
DAC Belt Drive Trainer 201 (or equivalent)
Lab 9: Alignment and Chain Tension
Combination wrench set
Hex wrench set
Chain puller
6" rule
Straightedge
Length of string
Soft-faced mallet
Pencil and paper
Piece of chalk
Tape measure
Two #40 roller chain sprockets
A significant length of #40 roller chain
DAC Belt Drive Trainer 201 (or equivalent)
Lab 10: Sprocket Fit to Shaft, Set Screws & Keys, and Sprocket Wear
Combination wrench set
Screw driver set
Hex wrench set
Sprocket/bearing puller
Torque wrench (optional)
AMTEC Integrated Manufacturing Simulator (or equivalent)
Sample chain drive sprockets
Lab 11: Take-up Equipment Function (Chain Drives)
Combination wrench set
Adjustable wrench
Hex wrench set
File
Pencil and paper
DAC Belt Drive Trainer 201 (or equivalent)

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MATERIALS: *(continued)*

1082 (continued)

Lab 12: Chain or Drive Unit Replacement
Combination wrench set
Adjustable wrench
Hex wrench set
File
Pencil and paper
Piece of chalk
Sufficient length of roller chain
DAC Belt Drive Trainer 201 (or equivalent)

AMT 1083: Couplings & Alignment
Lab 1: Lockout, Tagout, Blockout, Coupling Identification, and Visual Inspection
Power supply that may be locked out
Power transmission simulator (or motor - pump/gearbox assembly)
Various coupling assemblies (some damaged, if possible)
Lab 2: Coupling Fit to Shaft, Set Screws & Keys, and Coupling Wear
Power transmission simulator (or motor – pump/gearbox assembly)
Various couplings (some damaged, if possible)
Shafts and keys
Lab 3: Installation and Assembly of a Rigid Coupling
Power transmission simulator (or motor – pump/gearbox assembly) with the shafts aligned
Rigid coupling
Lab 4: Installation and Assembly of a Flexible Coupling
Power transmission simulator (or motor – pump/gearbox assembly) with the shafts aligned
Flexible coupling
Lab 5: Shaft Alignment by Either Rough Alignment or Rim & Face Method
Power transmission simulator (or motor – pump/gearbox assembly) with a mounted coupling assembly
Lab 6: Shaft Alignment by Either the Reverse Dial or Laser Method
Power transmission simulator (or motor – pump/gearbox assembly) with a mounted coupling assembly

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MATERIALS: *(continued)*

AMT 1084: Bearings, Shafts, & Seals
Lab 1: Lockout, Tagout, Blockout
AMTEC Integrated Manufacturing Simulator or training equipment with various energy sources and lockout, tagout, blockout devices
Lab 2: Seal Identification, Installation, Lubrication, & Troubleshooting
Various Shafts
Seals
Hand Tools (needed to install, remove, and inspect the seals)
Lab 3: Shaft Identification, Selection, Inspection, & Troubleshooting
Various Shafts
Measuring Instruments
Hand Tools
Lab 4: Plain Bearing Identification, Installation, Lubrication, & Troubleshooting
Various plain bearings
Measuring instruments
Hand tools (needed to identify and inspect plain bearings)
Lab 5: Roller Bearing Identification, Installation, Lubrication, & Troubleshooting
Various rolling element bearings
Measuring instruments
Hand tools (Needed to identify and inspect roller bearings.)
Lab 6: Bearing Installation and Removal with a Hammer and a Mandrel
Various bearings
Mounted bearings
Hand tools (Needed to install and remove bearing with hammer and mandrel.)
Lab 7: Bearing Installation and Removal with an Arbor Press
Various bearings
Mounted bearings
Hand tools (Needed to install and remove bearing with arbor press.)
Lab 8: Bearing Installation with an Induction Heater
Various bearings
Mounted bearings
Hand tools (Needed to install and remove bearing with induction heater.)

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MATERIALS: *(continued)*

AMT 1085: Brakes & Clutches
Lab 1: Clutch and Brake Identification, Visual Inspection, and Lockout, Tagout, and Blockout
Power transmission simulator (or motor - brake/clutch assembly) with various brake/clutch assemblies
Lab 2: Disassembly, Friction Pad/Brake Shoe Replacement, and Inspection of a Brake/Clutch Unit
Power transmission simulator (or motor - brake/clutch assembly) with various brake/clutch assemblies
Lab 3: Installation of a Clutch/Brake Assembly
Power transmission simulator (or motor - brake/clutch assembly) with various brake/clutch assemblies

AMT 1086: Gears & Cams
Lab 1: Gear Identification, Common Terms, Shaft Orientation, and Visual Inspection
Power transmission simulator (or motor – gearbox assembly)
Various gear sets (some damaged, if possible)
Lab 2: Assembly of a Parallel Shaft Gear Drive and Checking Backlash
Power transmission simulator (or motor – gearbox assembly) or a parallel shaft gearbox
Component to perform the proper lockout, tagout, and blockout
Lab 3: Assembly of an Angled Shaft Gear Drive
Power transmission simulator (or motor – gearbox assembly) or an angled shaft gearbox
Component to perform the proper lockout, tagout, and blockout
Lab 4: Assembly of a Worm and Wheel Gearbox Drive Unit
Power transmission simulator (or motor – gearbox assembly) or an worm and wheel gearbox drive unit
Component to perform the proper lockout, tagout, and blockout

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GRADING POLICY:

- Successful completion of all Labs (at least 80% recommended). Rubrics provided in AMTEC online specify how grading is determined.
- Successful completion of each module's post-assessment (at least 80% recommended).

College Grading Standards	Percent
4.0 Excellent	91-100%
3.5	86-90%
3.0 Good	81-85%
2.5	76-80%
2.0 Satisfactory	71-75%
1.5	66-70%
1.0	60-65%
0.0	0-59%

ACCEPTABLE USE POLICY:

Computer Resources

Use of College-owned computer resources is a privilege extended by the College to students, employees, and other authorized users as a tool to promote the mission of the College. All users agree to be bound by the terms and conditions of the LCC Acceptable Use Policy at the time they complete an account application form. Copies of the LCC Acceptable Use Policy are available at the Library Circulation Desk and may also be accessed on the World Wide Web. The URL is http://www.lcc.edu/policy/policies_1.aspx#ACCEPTABLE_USE_POLICY

Transfer Potential

For transferability information, please consult the Transfer Equivalency Information located at the LCC website at http://www.lcc.edu/transfer. For additional transferability information, contact the LCC Academic Advising Center, (517) 483-1904.

The MACRAO Transfer Agreement simplifies the transfer of students from one Michigan institution to another. The most current MACRAO Transfer Agreement information can be found at http://www.lcc.edu/transfer/macrao_agreement.aspx.

Student Code of Conduct and General Rules and Guidelines

LCC supports a positive educational environment that will benefit student success. In order to ensure this vision, the College has established the LCC Student Code of Conduct and the Student General Rules and Guidelines to ensure the protection of student rights and the health and safety of the College community, as well as to support the efficient operation of College programs. In addition, the College has established guidelines for the redress of grievances by individuals accused in such proceedings. A copy of the most current Code can be found on the College's website at http://www.lcc.edu/catalog/policies_procedures/studentrulesguidelines.aspx#code.

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Subject Matter Expert (SME) Course Review Summary
College: Lansing Community College
M-CAM Training Area: ☐CNC/Machining ☒Multi-Skilled/Mechatronics ☐Production Operation ☐Welding/Fabrication
Degree Program Name:
Title of Course: Mechatronics Mechanical Systems/ MechanicalDrives/Power Transmissions
Subject Matter Expert (SME) Reviewer Information **Name: Robert C. Hess** **Title: Senior Instructional Designer/Trainer** **Phone: 566-322-1033** **Email: bob.hess@mhtechnologies.net** **Organization/Affiliation: MH Technologies**
Attach Resume or provide credentials (showing years of experience and work experience that is relevant to course content):
Synopsis of Findings: **1. All labs good for training.**

Reviewers Signature Robert C. Hess Date: 3/8/17

Michigan Coalition for Advanced Manufacturing
Subject Matter Expert Course Review

1. Course Overview and Objectives	Exceptional	Satisfactory	Ineffective
The goals and purpose of the course is clearly stated.		X	
Prerequisites and/or any required competencies are clearly stated.		X	
Learning objectives are specific and well-defined.		X	
Learning objectives describe outcomes that are measurable.		X	
Outcomes align to occupational focus (industry skills and standards).		X	
Comments or recommendations:			

2. Material and Resources	Exceptional	Satisfactory	Ineffective
The instructional materials contribute to the achievement of the course learning objectives.		X	
The materials and resources meet/reflect current industry practices and standards.		X	
The instructional materials provide options for a variety of learning styles.		X	
Resources and materials are cited appropriately. If applicable, license information is provided.		X	
Comments or recommendations:			

3. Learning Activities	Exceptional	Satisfactory	Ineffective
Provide opportunities for interaction and active learning.		X	
Help understand fundamental concepts, and build skills useful outside of the learning object.		X	
Activities are linked to current industry practices and standards.		X	

Michigan Coalition for Advanced Manufacturing
Subject Matter Expert Course Review

Comments or recommendations:			
4. Assessment Tools/Criteria for Evaluation	**Exceptional**	**Satisfactory**	**Ineffective**
The course evaluation criteria/course grading policy is stated clearly on syllabus.		X	
Measure stated learning objectives and link to industry standards.		X	
Align with course activities and resources.		X	
Include specific criteria for evaluation of student work and participation.		X	
Comments and recommendations:			
5. Equipment/Technology	**Exceptional**	**Satisfactory**	**Ineffective**
Meets industry standards and needs.		X	
Supports the course learning objectives.		X	
Provides students with easy access to the technologies required in the course/module.		X	
Comments and recommendations:			

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Robert C. Hess

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bob.hess@mhtechnologies.net

Qualifications

Dedicated, articulate, and enthusiastic with strong analytical and organizational abilities. Effective communication and interpersonal skills. Ability to work independently or as an integral part of a team to accomplish goals. Experience prioritizing and completing numerous concurrent responsibilities while meeting time and organizational goals. Sound professional attitude, strong work ethic and pride in personal performance.

Experience

2015 – Present **M H Technologies LLC** **Warren, MI**
Senior Instructional Designer/Trainer

- Perform Needs Analysis and quote training programs
- Develop on-line training programs, system manuals, student workbooks, and job aids
- Deliver on-site training programs

2002 – 2015 **R.C. Technologies** **Shelby Twp. MI**
Business Owner – R.C. Technologies

- Research and quote training programs
- Development of training programs for Ford Motors, DaimlerChrysler, General Motors, Kuka Robotics, Fame Conveyor, Lamb Technicon, Delphi, Magna, and SPX
- Design training programs, system manuals, student workbooks, PowerPoint presentations, and job aids
- Deliver on-site training programs
- Professional Industrial photography

1995 – 2002 **DCT Inc.** **Sterling Heights, MI**
Training Designer

- Research and quote training programs
- Design training programs, system manuals, student workbooks, and job aids
- Deliver on-site training programs

1990 – 1995 **Bond Robotics** **Sterling Heights, MI**
Training Manager / Field Service Engineer

- Managed Training Department
- Research and quote training programs
- Design operation and maintenance manuals plus training guides
- Deliver all training programs
- Perform on-site electrical and mechanical customer support for installation, start-up, and debugging of pressroom automation

1986 – 1990 **Robotic Vision Systems, Inc.** **Sterling Heights**
Field Service Engineer / Trainer

- Research, installation, programming and training of 3D vision guided robotic welding and sealant systems for military, aerospace, and automotive industry

Education **1977 – 1981** **Ferris State University** **Big Rapids, MI**

- BSEE