



CREDIT COURSE OUTLINE

I. COVER PAGE

(1) MAG 21

(2) EQUIPMENT TECHNICIAN: TRANSMISSIONS, TORQUE CONVERTERS, & AIR CONDITIONING

(3) 8

Number _____ Title _____ Units _____

(4) Lecture / Lab Hours:			(8) Classification:		
Course Hours					
	Weekly Lec hours:	6.00	Degree applicable:		X
	Weekly Lab hours:	6.00	Non-degree applicable:		
	Total Contact hours:	216.00	Basic skills:		
Lec will generate __ hour(s) outside work.			(9) RC Fulfills AS/AA degree requirement: (area)		
Lab will generate __ hour(s) outside work.			General education category:		
			Major: MECHANIZED AGRICULTURE		
			Certificate of: MECHANIZED AGRICULTURE		
			Certificate in: MAINTENANCE MECHANIC (MM)		
(5) Grading Basis:	Grading Scale Only	X	(10) CSU Baccalaureate:		
	Pass/No Pass option		X		
	Pass/No Pass only		(11) Repeatable: (A course may be repeated three times)		
(6) Advisories:			0		
(7) Pre-requisites (requires C grade or better):	<ul style="list-style-type: none"> Eligibility for English 252, English 262 and Mathematics 256 		(12) C-ID:		
Corequisites:	<ul style="list-style-type: none"> 		Proposed Start Date: Spring 2013		

(12) Catalog Description:
 This course provides in-depth instruction in equipment transmission systems and power equipment air conditioning and heating systems. Equipment transmission systems include clutches, torque converters, hydrostatic applications, and manual and powershift transmissions. Students will also receive career preparation instruction.

II. COURSE OUTCOMES:

(Specify the learning skills the student demonstrates through completing the course and link critical thinking skills to specific course content and objectives.)

Upon completion of this course, students will be able to:

- I. Achieve section 609 Certification as required to service/repair mobile vehicle air conditioning systems by the Clean Air Act
- II. Service, trouble-shoot, or repair mobile air conditioning and heating systems
- III. Trouble-shoot and repair transmission systems

III. COURSE OBJECTIVES:

(Specify major objectives in terms of the observable knowledge and/or skills to be attained.)

In the process of completing this course, students will:

- I. Demonstrate proper safety procedures relating to air conditioning systems as well as the tools and equipment used to repair these systems.
- II. Explain the role of heat and pressure in an air conditioning system.
- III. Describe the impact of refrigerants on the environment, and human health.
- IV. Recognize the characteristics of refrigerants and their oils.
- V. Identify basic system components of an air conditioning system used on power equipment.
- VI. Explain the operation of a basic air conditioning system including the state of the refrigerant and its cycles.
- VII. Correctly connect and disconnect air conditioning service equipment in order to minimize the venting of refrigerant into the atmosphere.
- VIII. Complete a performance test of a mobile air conditioning system.
- IX. Perform air conditioning system service practices such as recovering, recycling, evacuating, replenishing, re-charging, and leak detection.
- X. Use electrical schematics to troubleshoot electrical problems in machine air conditioning systems.
- XI. Troubleshoot air conditioning systems by interpreting pressure/temperature readings.
- XII. Demonstrate proper safety procedures related to transmissions as well as the tools and equipment used to repair these systems.
- XIII. Demonstrate knowledge and understanding of theory, operation, and terminology related to transmissions, including gear ratios, types of gears, and clutches.

- XIV. Demonstrate the ability to correctly disassemble, repair and reassemble a torque converter.
- XV. Demonstrate the ability to correctly disassemble, repair and reassemble a flywheel clutch.
- XVI. Perform correct disassembly and assembly and trace power flow of a planetary power-shift transmission.
- XVII. Perform correct disassembly and assembly and trace power flow of countershaft power-shift transmission.
- XXVIII. Demonstrate ability to disassemble, inspect and identify components, and reassemble hydraulic control valves used in power-shift transmissions.
- XIX. Identify various bearing common to drive systems and demonstrate correct procedures in handling bearings.
- XX. Measure clutch wear using outside micrometers and dial calipers to determine wear and reusability.
- XXI. Use reusability guidelines and service literature to determine component wear.
- XXII. Diagnose and repair transmission systems using pressure gauges, service literature and operational checks.
- XXIII. Use Service Information Systems to access parts, maintenance and service procedures, specifications, and testing and adjusting guides to service and repair components and equipment.
- XXIV. Exhibit habits of cleanliness and organization in shop practices.
- XXV. Demonstrate ability safely rig and lift heavy components using chains, straps and hoists.

IV. COURSE OUTLINE:

Lecture Content:

1. Introduction to Power Trains
2. Clutches
 - a. Purpose
 - b. Dry type assemblies
 - c. Oil type assemblies
3. Torque Converters
 - a. Application, theory, components
 - b. Operation principles
4. Introduction to Transmissions
 - a. Power flow
 - b. Transmission design
 - c. Operating principles and functions
5. Transmission Types
 - a. Manual shift
 - b. Planetary powershift
 - c. Countershaft powershift
 - d. Hydrostatic
6. Basics of Air Conditioning
 - a. Basic principles of refrigeration and heating systems
 - b. States of matter
7. Refrigerants and Oil Refrigerants
 - a. Refrigerants – R 12 and R 134 A
 - b. Refrigeration oils
8. Service Equipment
 - a. Gauge and manifold set
 - b. Refrigerant recovery – recycling station
9. Inspecting and Diagnosing the System
 - a. Visual inspection
 - b. Troubleshooting customer complaints
10. Career Preparation
 - a. Orientation to college
 - b. Career opportunities
 - c. Job applications

- d. Resume
- e. Job search

Lab Content:

- Transmission & Torque Converters
- Lab 1: Clutch Disassembly & Assembly
- Lab 2: Torque Converter D & A
- Lab 3: Torque Converter Stall Test
- Lab 4: Torque Divider D & A
- Lab 5: Backhoe Loader Transmission D & A
- Lab 6: Row Crop Challenger Countershaft Transmission D & A
- Lab 7: Row Crop Challenger Transmission Control Valve
- Lab 8: 920 Wheel Loader Transmission D & A
- Lab 9: 920 Wheel Loader Transmission Control Valve
- Lab 10: Challenger 65 Transmission D & A
- Lab 11: Challenger 65 Transmission Control Valve
- Lab 12: Challenger 65 Transmission Testing & Adjusting
- Lab 13: D6 Track Type Tractor Transmission Testing & Adjusting

Air Conditioning

- Lab 1: Air Conditioning Service Tools
- Lab 2: Temperature/Pressure Relationships
- Lab 3: System Diagnosis
- Lab 4: Orifice tube System
- Lab 5: Thermostatic Expansion Valve System
- Lab 6: "H" Block Expansion Valve System
- Lab 7: Recovering A/C Refrigerant
- Lab 8: A/C System Evacuation
- Lab 9: A/C Leak Detection
- Lab 10: A/C System Flushing
- Lab 11: Servicing System Components
- Lab 12: Electrical System Schematic
- Lab 13: Troubleshooting and Repairing A/C and heating Systems

V. APPROPRIATE READINGS

Reading assignments may include but are not limited to the following:

I. Sample Text Title:

II. Other Readings

1. Recommended - *Power Trains I (Transmissions and Torque Converters, Caterpillar, Inc., 2004*
2. Recommended - *Power Equipment Air Conditioning, Caterpillar, Inc., 2004*
3. Recommended - *Machine specific service literature, Caterpillar, Inc. 2004*
4. Recommended - *Tech Prep Job Manual, SCCCD*

Global or international materials or concepts are appropriately included in this course

Multicultural materials and concepts are appropriately included in this course

If either line is checked, write a paragraph indicating specifically how global/international and/or multicultural materials and concepts relate to content outline and/or readings.

VI. METHODS TO MEASURE STUDENT ACHIEVEMENT AND DETERMINE GRADES:

Students in this course will be graded in at least one of the following four categories. Please check those appropriate. A degree applicable course must have a minimum of one response in category A, B, or C.

A. Writing			
Check either 1 or 2 below			
X	1. Substantial writing assignments are required. Check the appropriate boxes below and provide a written description in the space provided.		
	2. Substantial writing assignments are NOT required. If this box is checked leave this section blank. For degree applicable courses you must complete category B and/or C.		
	a) essay exam(s)	X	d) written homework
	b) term or other paper(s)		e) reading reports
X	c) laboratory report(s)		f) other (specify)

Required assignments may include but are not limited to the following:

Service reports will be written for all lab assignments. Students will complete lab write-ups outlining work performed, service literature uses, procedures followed, and relevant details of machine or component status. See Attached Caterpillar Equipment Technician Service Report.

B. Problem Solving			
Computational or non-computational problem-solving demonstrations, including:			
X	a) exam(s)		d) laboratory reports
X	b) quizzes	X	e) field work
X	c) homework problems		f) other (specify):

Required assignments may include but are not limited to the following:

Determine failures of components based on observation, measurement, and component reusability guidelines. Use clutch pressure readings to diagnose transmission problems.

C. Skill demonstrations, including:			
X	a) class performance(s)		c) performance exams(s)
X	b) field work		d) other (specify)

Required assignments may include but are not limited to the following:

Recover, Recycle, Repair, Evacuate, Replenish, and Re-charge mobile vehicle air conditioning systems.

D. Objective examinations including:			
X	a) multiple choice	X	d) completion
X	b) true/false	X	e) other (specify): drawings, schematics
X	c) matching items		

COURSE GRADE DETERMINATION:

Description/explanation: Based on the categories checked in A-D, it is the recommendation of the department that the instructor's grading methods fall within the following departmental guidelines; however, the final method of grading is still at the discretion of the individual instructor. The instructor's syllabus must reflect the criteria by which the student's grade has been determined. (A minimum of five (5) grades must be recorded on the final roster.)

If several methods to measure student achievement are used, indicate here the approximate weight or percentage each has in determining student final grades.

Exams and Quizzes 25% Assignments 25% Lab Participation 25% Lab Assignments 25%

VII. EDUCATIONAL MATERIALS

For degree applicable courses, the adopted texts, as listed in the college bookstore, or instructor-prepared materials have been certified to contain college-level materials.

Validation Language Level (check where applicable):

- Textbook
- Reference materials
- Instructor-prepared materials
- Audio-visual materials

College-Level Criteria Met	
YES	NO
X	_____
X	_____
X	_____
X	_____

Indicate Method of evaluation:

- Used readability formulae (grade level 10 or higher) _____
- Text is used in a college-level course X _____
- Used grading provided by publisher _____
- Other: (please explain; relate to Skills Levels) _____

Computation Level (Eligible for MATH 101 level or higher where applicable)

Content

- Breadth of ideas covered clearly meets college-level learning objectives of this course X _____
- Presentation of content and/or exercises/projects: _____
- Requires a variety of problem-solving strategies including inductive and deductive reasoning. X _____
- Requires independent thought and study X _____
- Applies transferring knowledge and skills appropriately and efficiently to new situations or problems. X _____

List of Reading/Educational Materials

Comments:

_____ This course requires special or additional library materials (list attached).
 _____ This course requires special facilities:
X _____ Requires adequate shop facility

Attached Files:

[CAT Equipment Technician Service Report](#)

BASIC SKILLS ADVISORIES PAGE The skills listed are those needed for eligibility for English 125, 126, and Math 201. These skills are listed as the outcomes from English 252, 262, and Math 250. In the right hand column, list at least three major basic skills needed at the beginning of the target course and check off the corresponding basic skills listed at the left.

Check the appropriate spaces.

_____ Eligibility for Math 201 is advisory for the target course.
 _____ Eligibility for English 126 is advisory for the target course.
 _____ Eligibility for English 125 is advisory for the target course.

If the reviewers determine that an advisory or advisories in Basic Skills are all that are necessary for success in the target course, stop here, provide the required signatures, and forward this form to the department chair, the appropriate associate dean, and the curriculum committee.

REQUISITES

Prerequisite -- ENGL 260 BASIC READING

<ul style="list-style-type: none"> • apply a variety of prereading, reading and postreading strategies that facilitate comprehension of below 8th grade level texts. • distinguish between major supporting details and minor supporting details in text. • interpret visual data and determine its supporting relationship to text. 	<ul style="list-style-type: none"> • Explain the operation of a basic air conditioning system including the state of the refrigerant and its cycles. • Use electrical schematics to troubleshoot electrical problems in machine air conditioning systems. • Demonstrate knowledge and understanding of theory, operation, and terminology related to transmissions, including gear ratios, types of gears, and clutches. • Use reusability guidelines and service literature to determine component wear. • Diagnose and repair transmission systems using pressure gauges, service literature and operational checks. • Use Service Information Systems to access parts, maintenance and service procedures, specifications, and testing and adjusting guides to service and repair components and equipment.
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ESTABLISHING PREREQUISITES OR COREQUISITES

Every prerequisite or corequisite requires content review plus justification of at least one of the seven kinds below. Prerequisite courses in communication and math outside of their disciplines require justification through statistical evidence. Kinds of justification that may establish a prerequisite are listed below.

Check one of the following that apply. Documentation may be attached.

_____ Significant statistical evidence indicates that the absence of the prerequisite course is related to unsatisfactory performance in the target course.
 Justification: Indicate how this is so.
 _____ The health or safety of the students in this course requires the prerequisite.
 Justification: Indicate how this is so.
 _____ The prerequisite course is part of a sequence of courses within or across a discipline.
 _____ The prerequisite is required in order for the course to be accepted for transfer to the UC or CSU systems.
 Justification: Indicate how this is so.
 _____ The prerequisite/corequisite is required by law or government regulations.
 Explain or cite regulation numbers:
 _____ The safety or equipment operation skills learned in the prerequisite course are required for the successful or safe completion of this course.
 Justification: Indicate how this is so.
X _____ The safety or equipment operation skills learned in the prerequisite course are required for the successful or safe completion of this course.
 Justification: Indicate how this is so.
 _____ Three CSU/UC campuses require an equivalent prerequisite or corequisite for a course equivalent to the target course:

Justification: In order for students to be successful as Power Equipment Technicians they need to be able to read and comprehend

text. Our industry advisory committee strongly recommends this course as a prerequisite.

Prerequisite -- ENGL 252 Writing Improvement

- complete sentences which includes correct capitalization, spelling, use of homophones, etc.
- an avoidance of major grammatical errors including verb tense issues, subject-verb agreement, pronoun agreement problems, fragments, fused sentences and comma splices
- writing that is free from plagiarism
- an evaluation and analysis of ideas at the appropriate course level
- appropriate use of academic language and descriptive vocabulary
- Plan and revise with guidance, employing all stages of the writing process when necessary.

- Explain the role of heat and pressure in an air conditioning system.
- Describe the impact of refrigerants on the environment, and human health.
- Explain the operation of a basic air conditioning system including the state of the refrigerant and its cycles.
- Use Service Information Systems to access parts, maintenance and service procedures, specifications, and testing and adjusting guides to service and repair components and equipment.

ESTABLISHING PREREQUISITES OR COREQUISITES

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Justification: Indicate how this is so.

_____ Three CSU/UC campuses require an equivalent prerequisite or corequisite for a course equivalent to the target course:

Justification: In order for students to be successful as Power Equipment Technicians they need to be able to write. Our industry advisory committee strongly recommends this course as a prerequisite.

Prerequisite -- MATH 250 COLLEGE ARITHMETIC

- Apply the four arithmetic operations to fractions.
- Apply the four arithmetic operations to integers.
- Apply the four arithmetic operations to decimals.

- Explain the role of heat and pressure in an air conditioning system.
- Complete a performance test of a mobile air conditioning system.
- Perform air conditioning system service practices such as recovering, recycling, evacuating, replenishing, re-charging, and leak detection.
- Use electrical schematics to troubleshoot electrical problems in machine air conditioning systems.
- Troubleshoot air conditioning systems by interpreting pressure/temperature readings.
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Significant statistical evidence indicates that the absence of the prerequisite course is related to unsatisfactory performance in the target course.

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The health or safety of the students in this course requires the prerequisite.

Justification: Indicate how this is so.

The prerequisite course is part of a sequence of courses within or across a discipline.

The prerequisite is required in order for the course to be accepted for transfer to the UC or CSU systems.

Justification: Indicate how this is so.

The prerequisite/corequisite is required by law or government regulations.

Explain or cite regulation numbers:

The safety or equipment operation skills learned in the prerequisite course are required for the successful or safe completion of this course.

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Three CSU/UC campuses require an equivalent prerequisite or corequisite for a course equivalent to the target course:

Justification: In order for students to be successful as Power Equipment Technicians they need to be able to do basic math. Our industry advisory committee strongly recommends this course as a prerequisite.

JUSTIFICATION OF LIMITATION ON ENROLLMENT

Enrollment in courses or blocks of courses may be limited based on performance, honors, or other performance based criteria. Be mindful of the disproportionate impact the limitation will have on specific groups of students. It is important to determine if the limitation will disproportionately keep under-represented students from enrolling in the course or block of courses.

Describe the reasons for limiting the enrollment.

Course Designator: MAG 21

Course Title(s): EQUIPMENT TECHNICIAN: TRANSMISSIONS, TORQUE CONVERTERS, & AIR CONDITIONING

Rationale for Limiting Enrollment:

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