COURSE OUTLINE: HET812 - FLUID POWER SYSTEMS

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Course Code: Title	HET812: FLUID POWER SYSTEMS
Program Number: Name	6086: HDE TECH LEVEL III
Department:	MOTIVE POWER APPRENTICESHIP
Semesters/Terms:	20W
Course Description:	Upon successful completion of this course the apprentice will be able to interpret hydraulic system schematics, evaluate hydraulic circuit design and compare with manufacturers` schematics, recommend repairs for hydraulic accumulators and accessories, recommend repair procedures for hydraulic actuators following manufacturers` recommended procedures, recommend repairs to electronically managed hydraulic systems, diagnose hydraulic systems and recommend repairs all following manufacturers` recommendations.
Total Credits:	6
Hours/Week:	0
Total Hours:	40
Prerequisites:	There are no pre-requisites for this course.
Corequisites:	There are no co-requisites for this course.
Essential Employability Skills (EES) addressed in this course:	EES 1 Communicate clearly, concisely and correctly in the written, spoken, and visual form that fulfills the purpose and meets the needs of the audience. EES 2 Respond to written, spoken, or visual messages in a manner that ensures effective communication. EES 3 Execute mathematical operations accurately. EES 4 Apply a systematic approach to solve problems. EES 5 Use a variety of thinking skills to anticipate and solve problems. EES 6 Locate, select, organize, and document information using appropriate technology and information systems. EES 7 Analyze, evaluate, and apply relevant information from a variety of sources. EES 8 Show respect for the diverse opinions, values, belief systems, and contributions of others. EES 9 Interact with others in groups or teams that contribute to effective working relationships and the achievement of goals. EES 10 Manage the use of time and other resources to complete projects. EES 11 Take responsibility for ones own actions, decisions, and consequences.
Course Evaluation:	Passing Grade: 50%,
Other Course Evaluation & Assessment Requirements:	Grade Definition Grade Point Equivalent A+ 90 - 100% 4.00 A 80 - 89% B 70 - 79% 3.00

C 60 - 69% 2.00
D 50 - 59% 1.00
F (Fail)49% and below 0.00

CR (Credit) Credit for diploma requirements has been awarded.
S Satisfactory achievement in field /clinical placement or non-graded subject area.
U Unsatisfactory achievement in field/clinical placement or non-graded subject area.
X A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.
NR Grade not reported to Registrar`s office.
W Student has withdrawn from the course without academic penalty.

Books and Required Resources:

Modern Diesel Technology: Heavy Equipment Systems by Robert Huzij, Angelo Spano, Sean Bennett
Publisher: Cengage Learning Edition: 3rd Edition
ISBN: 10: 1-337-56758-2

Course Outcomes and Learning Objectives:

Course Outcome 1	Learning Objectives for Course Outcome 1
2.1 Hydraulic Principles Upon successful completion the apprentice is able to interpret hydraulic system schematics following manufacturers` recommendations.	2.1.1 Explain the fundamentals of hydraulic circuits and schematics. - graphic symbols - hydraulic circuit layouts - pictorial drawings - diagrams - schematics - Society of Automotive Engineers (SAE) - International Standards Organization (ISO) 2.1.2 Identify hydraulic component on diagrams and schematics. - component relationships - graphic symbols 2.1.3 Describe the oil flow circuit path through various hydraulic system diagrams and schematics. - open centre systems • series connections • series-parallel connections - closed centre systems • fixed displacement pump • variable displacement pump - interpret graphic symbols as applied to system circuit schematics 2.1.4 Perform calculations of hydraulic circuit applications. - pressure - force - area - delivery - cycle times - power
Course Outcome 2	**Learning Objectives for Course Outcome 2**

	2.2 Hydraulic Schematics and Circuit Design Upon successful completion the apprentice is able to evaluate hydraulic circuit design and compare with manufacturers` schematics.	2.2.1 Explain the purpose and fundamentals of hydraulic systems. open centre systems • series connections • parallel connections • series-parallel connections • power beyond • flow dividers - closed centre systems • fixed displacement pump and accumulators • variable displacement pump • pressure compensated • power beyond • pressure and flow compensated - special flow systems • demand • summation • pressure compensated • flow compensated 2.2.2 Identify the construction features of hydraulic systems. - open centre systems • series connections • parallel connections • series-parallel connections • power beyond • flow dividers - closed centre systems • fixed displacement pump and accumulators • variable displacement pump • pressure compensated • power beyond • pressure flow compensated - special flow systems • demand • summation • pressure compensated 2.2.3 Describe the principles of operation of hydraulic systems. - open centre systems • series connections • parallel connections • series-parallel connections • power beyond • flow dividers - closed centre systems • fixed displacement pump and accumulators • variable displacement pump • pressure compensated • power beyond • pressure flow compensated - special flow systems • demand • summation • pressure compensated

Course Outcome 3	Learning Objectives for Course Outcome 3
2.3 Hydraulic Accumulators and System Components Upon successful completion the apprentice is able to recommend repairs for hydraulic accumulators and accessories following manufacturers` recommendations.	2.3.1 Explain the purpose and fundamentals of hydraulic accumulators and hydraulic components. - accumulator safety precautions - accumulator types • pneumatic (gas charged) o bladder o piston o diaphragm • spring loaded • weighted - intensifiers - switches - gauges - sensors • pressure • flow • temperature - solenoids - component graphic symbols 2.3.2 Identify the construction features of hydraulic accumulators and hydraulic components. - accumulators • pneumatic (gas charged) o bladder o piston o diaphragm • spring loaded • weighted - intensifiers - switches • pressure • temperature • limit - sensors • pressure • flow • temperature • position 2.3.3 Describe the principles of operation of hydraulic accumulators and hydraulic components. - accumulators • pneumatic (gas charged) o bladder o piston o diaphragm • spring loaded • weighted - intensifiers - switches • pressure

		• temperature • limit - sensors • pressure • flow • temperature • position 2.3.4 Demonstrate inspection, testing, and diagnostic procedures following manufacturers` recommendations to hydraulic accumulators and hydraulic components. - internal and external leakage of accumulators - examine defective components - intensifiers - gauges - sensors • pressure • flow • temperature • position - switches • pressure • temperature • limit 2.3.5 Recommend reconditioning or repairs following manufacturers` recommendations to hydraulic accumulators and hydraulic components. - safety procedures for servicing accumulators - intensifiers - gauges - sensors • pressure • flow • temperature • position - switches • pressure • temperature • limit - demonstrate safe charging and repair procedures for accumulators
	Course Outcome 4	**Learning Objectives for Course Outcome 4**
	2.4 Hydraulic Actuators Upon successful completion the apprentice is able to recommend repair procedures for hydraulic actuators following manufacturers` recommended procedures.	2.4.1 Explain the purpose and fundamentals of hydraulic actuators. - displacement - horsepower - flow rate - aeration - pressure and force - cavitation - friction

- graphic symbols
- contamination and importance of cleanliness
- torque
- torque rates
- rod speed
- shaft speed

2.4.2 Identify the construction features of hydraulic actuators.
- motors
  - gear
  - vane

o balanced
o unbalanced
  - compensating valves
  - piston

o variable displacement
o radial
o axial
o bent axis
- cylinders
  - single acting
  - double acting
  - series telescoping
  - regenerating

2.4.3 Describe the principles of operation of hydraulic actuators.
- motors
  - high speed low torque
  - anti-cavitation check valves
  - low speed high torque
  - gear
  - vane

o balanced
o unbalanced
  - piston
  - radial
  - axial
  - bent axis

- cylinders
  - single acting
  - double acting

o differential
o non differential
o single rod end
o double rod end
  - series telescoping

2.4.4 Demonstrate inspection, testing, and diagnostic procedures following manufacturers` recommendations for hydraulic actuators.
- motors
  - case drain requirements

cylinders
  - by-passing

	- failure analysis of hydraulic motor and cylinder components 2.4.5 Recommend reconditioning or repairs following manufacturers` for hydraulic actuators. - outline the recommended procedures to remove and replace hydraulic motors and cylinders safe depressurization • priming • bleeding • case drain line - disassemble and reassemble hydraulic actuators
Course Outcome 5	**Learning Objectives for Course Outcome 5**
2.5 Electronically Managed Hydraulic Systems Upon successful completion the apprentice is able to recommend repairs to electronically managed hydraulic systems following manufacturers` recommendations.	2.5.1 Explain the purpose and fundamentals of electronically managed hydraulic systems - area networks - data links - twisted pair wiring - solenoids - feedback circuits • control feedback - valve mounted ECM`s - actuator mounted ECM`s - electrically controlled pilot circuits - servo valves 2.5.2 Identify the construction features of electronically managed hydraulic systems - area networks - data links - twisted pair wiring - solenoids - feedback circuits - valve mounted ECM`s - actuator mounted ECM`s - electrically controlled pilot circuits - servo valves - electronic displacement control 2.5.3 Describe the principles of operation of electronically managed hydraulic systems - ECM inputs and outputs - data link communication - ECM logic - control parameters - deadband - hysteresis - proportional control - open loop control circuits - closed loop control circuits - CAN networks - programmable logic control - distributive control 2.5.4 Demonstrate an electronically managed hydraulic system

	diagnostic evaluation according to comparison to manufacturers` specifications. - calibrations - diagnostic tooling • display menu - cycle times - sensor testing
Course Outcome 6	**Learning Objectives for Course Outcome 6**
2.6 Hydraulic System Diagnosis Upon successful completion the apprentice is able to diagnose hydraulic systems and recommend repairs following manufacturers` recommendations.	2.6.1 Explain the fundamentals of diagnosing hydraulic systems. - interpret manufacturers` diagnostic troubleshooting procedures for hydraulic systems - interpret manufacturers` schematics 2.6.2 Identify primary causes of failures for hydraulic systems - cavitation - aeration - contamination - oil starvation - overheating - overloading - mechanical - electrical 2.6.3 Describe the procedures to inspect and test the hydraulic system. - step-by-step procedures of the troubleshooting charts related to hydraulic systems tests • flow • pressure • bypass • cycle times 2.6.4 Perform hydraulic system diagnostics following the manufacturers` recommended procedures. - step-by-step procedures of the troubleshooting charts related to hydraulic systems test for: • flow • pressure • bypass • cycle times  2.6.5 Recommend reconditioning or repairs following the manufacturers` recommended procedures. - demonstrate failure analysis as related to the following components: • pumps • piston • vane • gear • control valves

	• pressure • flow • directional • actuators • linear • rotary • conductors • adapters

Evaluation Process and Grading System:

Evaluation Type	Evaluation Weight
Practical Application Testing	40%
Theory Assignments/Technical Reports	10%
Theory Testing	50%

Date: February 10, 2020

Addendum: Please refer to the course outline addendum on the Learning Management System for further information.