



# ILLINOIS VALLEY COMMUNITY COLLEGE

## COURSE OUTLINE

**DIVISION: Workforce Development**

**COURSE: ATO 2230 Automatic Transmissions**

Date: Spring 2022

Credit Hours: 4.5

*Complete all that apply or mark "None" where appropriate:*

Prerequisite(s): None

Enrollment by assessment or other measure?  Yes  No

If yes, please describe:

Corequisite(s): None

Pre- or Corequisite(s): None

Consent of Instructor:  Yes  No

Delivery Method:  **Lecture**                      **2 Contact Hours** (1 contact = 1 credit hour)  
 **Seminar**                              **0 Contact Hours** (1 contact = 1 credit hour)  
 **Lab**                                        **5 Contact Hours** (2-3 contact = 1 credit hour)  
 **Clinical**                                **0 Contact Hours** (3 contact = 1 credit hour)  
 **Online**  
 **Blended**  
 **Virtual Class Meeting (VCM)**

Offered:  **Fall**     **Spring**     **Summer**

### **CATALOG DESCRIPTION and IAI NUMBER (if applicable):**

This course includes information relative to automatic transmissions and transaxles found on the modern day motor vehicle. Classroom topics covered will include: planetary gear operation, application devices, hydraulics, torque converters and diagnosis. The main emphasis in lab will be the diagnosing of transmission problems, service procedures and rebuilding of automatic transmissions/transaxles.

## **ACCREDITATION STATEMENTS AND COURSE NOTES:**

The Automotive Technology program at Illinois Valley Community College is a ASE Education Foundation Master Certified Automotive Technology Program.

The program goes through an on-site evaluation every five years and the ASE Education Foundation tasks that are taught in this course are also updated every five years to align with any changes made by the ASE Education Foundation national automotive advisory council.

## **COURSE TOPICS AND CONTENT REQUIREMENTS:**

### **I. Gear Types**

- A. The shape and location of gear teeth determine a gear's determine a gear's type.
  - 1. Spur gear teeth cut parallel to axis.
  - 2. Helical gear teeth cut at angle to axis
  - 3. External gear teeth cut on outer circumference.
  - 4. Internal gear teeth cut on inner circumference.
- B. Gear combinations transmit motion in varying ways.
- C. Meshed internal and external gears rotate in same direction.
- D. Meshed external gear rotate in opposite directions.
- E. Both combinations transmit motion along same or parallel axes.
- F. Other gear types can change axis of rotation.
- G. Bevel gears change axis of rotation by 90°.
- H. A large and small bevel is called a ring and pinion.
- I. When pinion centerline is below ring centerline, it's called a hypoid.
- J. Worm gears can change axis of rotation, they are more like a screw.

### **II. Gear Ratios**

- A. The relationships between the speeds of the gears.
- B. When drive gear must rotate more than once to turn driven gear once, set is in gear reduction.
- C. When driven gear turns faster than drive gear, set is in overdrive.

### **III. Torque, Speed, and Power**

- A. Torque is twisting force.
- B. Multiply force applied times distance from pivot.
- C. Constant input speed, torque decreases as output speed increases and vice versa.
- D. Torque multiplied or divided by a gearset, depending on ratio.
- E. Gear ratios selection matches engine torque curve.

### **IV. Planetary Gear Systems**

- A. Allows gear ratio changes without meshing and unmeshing.
- B. A simple planetary is made up of:
  - 1. Central sun gear.
  - 2. Planet Carrier and pinions.
  - 3. Internal ring gear
- C. To transmit power through the set.
  - 1. One member rotated (input).
  - 2. One member held (reaction).
  - 3. One member driven (output).

V. Planetary Gear Operations

- A. Gear reduction obtained when carrier is the output
- B. Overdrive obtained when carrier is the input.
- C. Reverse obtained by holding the carrier
- D. Direct drive obtained by turning two members at same input speed.
- E. Simpson gearset is a compound planetary
  - 1. Two ring gears
  - 2. Two carrier assemblies
  - 3. One common sun gear
- F. Ravigneaux gearset is a compound planetary system
  - 1. Two sun gears
  - 2. Two carrier assemblies
  - 3. One common ring gear

VI. Hydraulic Principles

- A. Force is amount of push or pull causing motion
- B. Pressure is force exerted on a given unit of surface area.
- C. Liquid cannot be compressed.
- D. It will assume the shape of its container.
- E. If areas of input and output pistons are the same, motion and force are equal at input and output.
- F. Force equals pressure times area.
- G. Pressure equals force divided by area.
- H. Changing piston size affects output motion.

VII. Principal Parts of a Hydraulic System

- A. Basic Parts
  - 1. Reservoir
  - 2. Input Source
  - 3. Control Valving
  - 4. Output Device
- B. Hydrodynamics in study of fluids in motion.
- C. Pressure occurs from resistance to flow.
- D. The 1-way overrunning clutch will hold mechanically when rotated in one
- E. direction, but unlocks and overruns in the opposite direction.
- F. Accumulators act to cushion clutch and servo engagement by slowing the
- G. buildup of pressure in an apply circuit.

VIII. Fluids, Seals, and Bearings

- A. Jobs done by ATF
  - 1. Provide a fluid coupling between engine and transmission.
  - 2. Move spool valves
  - 3. Transmit hydraulic pressure
  - 4. Operate apply devices
  - 5. Cool and lubricate
- B. ATF is a petroleum-based oil.
- C. Fiber, paper, or screen filters are used to filter fluid before it enters the pump.
- D. Gaskets conform to irregular surfaces to seal parts together.

- E. Synthetic rubber seals include o-rings, square cut, a lip seal.
- F. Thrust washers, bushing, and bearings control axial motion, radial play, and lubrication.
- G. Properties of Dexron IIE the first multi-weight ATF.
- H. Selective thrust washer location.

## IX. Fluid Couplings and Converters

### A. Fluid Coupling

- 1. Consists of an internally coned turbine and impeller enclosed in a housing.
- 2. A fluid coupling cannot multiply torque; a torque converter can.

### B. Torque Converter

- 1. Consists of three elements:
  - a. Impeller (drive member)
  - b. Turbine (driven member)
  - c. Stator (reaction member)
- 2. Rotary and vortex flow combine into resultant force.
- 3. Lock-up Torque Converters
  - a. Hydraulically locked converters
  - b. Centrifugally locked converters
  - c. Lockup controls
    - 1. brake switch
    - 2. low vacuum switch
    - 3. governor switch
    - 4. 3rd gear switch
    - 5. 4th gear switch
    - 6. TCC solenoid

### C. Torque Converter Clutch

- 1. Lock-up converters eliminate slippage at cruising speeds and increase fuel economy.
- 2. Operation
- 3. Types of Clutches
  - a. TCC – Torque Converter Clutch
  - b. VCC – Viscous Converter Clutch
- 4. Types of Lock-up
  - a. Partial lock-up
  - b. Full lock-up
  - c. Gradual unlock
- 5. Solenoids
  - a. Torque converter solenoid
  - b. Force motor
  - c. Pulse width modulated solenoid
  - d. Testing and diagnosis

## X. Computer Controlled Transmission Operation

### A. System operation

### B. Sensors/inputs

- 1. PRNDL switch
- 2. Neutral switch
- 3. Transmission temperature sensor

4. Turbine speed sensor
5. Output speed sensor
6. Brake switch
7. Throttle position sensor
8. Vehicle speed sensor
- C. Solenoids/Outputs
  1. Shift solenoids
  2. Solenoid assemblies
  3. Torque converter clutch solenoid
  4. Modulated converter clutch solenoid (MCCC)
  5. Electronic pressure control solenoid
  6. Force motor
  7. Pulse width modulated solenoid
- D. Testing and Diagnosis
  1. On-board diagnostics
  2. Scan tool
  3. Limp-in mode
  4. Solenoid testing
  5. Common problems

#### **INSTRUCTIONAL METHODS:**

1. Lecture
2. Homework
3. Videos
4. Demonstration of lab procedure
5. Lab practice (hands on)
6. Power Point Presentations

#### **EVALUATION OF STUDENT ACHIEVEMENT:**

1. Complete lab objectives (ASE Education Foundation Tasks)
2. Pass written and practical exams
3. Attendance
4. Safety Practices
6. Attitude

#### **INSTRUCTIONAL MATERIALS:**

##### **Textbooks**

Chris Johnson and James E. Duffy, Automatic Transmissions and Transaxles, Fifth Edition, Goodheart-Willcox 2021.

##### **Resources**

1. Pro-Demand – Information System
2. All Data Pro - Information System\
3. Power Point Presentations
4. Videos
5. Handouts

## **LEARNING OUTCOMES AND GOALS:**

### **Institutional Learning Outcomes**

- 1) Communication – to communicate effectively;
- 2) Inquiry – to apply critical, logical, creative, aesthetic, or quantitative analytical reasoning to formulate a judgement or conclusion;
- 3) Social Consciousness – to understand what it means to be a socially conscious person, locally and globally;
- 4) Responsibility – to recognize how personal choices affect self and society.

### **Course Outcomes and Competencies**

## **II. AUTOMATIC TRANSMISSION AND TRANSAXLE**

### **A. General**

- 2. Identify automatic transmission and transaxle components and configurations.
- 4. Inspect transmission fluid condition; check fluid level; inspect for leaks on transmission or transaxle equipped with a dipstick.
- 5. Inspect transmission fluid condition; check fluid level; inspect for leaks on transmission or transaxle not equipped with a dipstick.
- 6. Diagnose transmission/transaxle gear reduction/multiplication concerns using driving, driven, and held member (power flow) principles.
- 7. Diagnose pressure concerns in a transmission using hydraulic principles (Pascal's Law).
- 8. Identify and interpret transmission/transaxle concerns, differentiate between engine performance and transmission/transaxle concerns; determine needed action.
- 9. Diagnose fluid loss and condition concerns; determine needed action.
- 10. Perform stall test; determine needed action.
- 11. Perform lock-up converter system tests; determine needed action.
- 12. Perform pressure tests on transmissions/transaxles equipped with electronic pressure control; determine needed action.

## **II. AUTOMATIC TRANSMISSION AND TRANSAXLE**

### **B. In-Vehicle Transmission/Transaxle**

- 1. Inspect, adjust, and/or replace external manual valve shift linkage, transmission range sensor/switch, and/or park/neutral position switch.
- 2. Drain and replace fluid and filter(s); use proper fluid type per manufacturer specification.
- 4. Inspect, replace/or and align powertrain mounts.
- 5. Inspect for leakage; replace external seals, gaskets, and bushings.

## **II. AUTOMATIC TRANSMISSION AND TRANSAXLE**

### **C. Off-Vehicle Transmission and Transaxle**

- 1. Describe the operational characteristics of a continuously variable transmission (CVT). P-2
- 2. Describe the operational characteristics of a hybrid vehicle drive train.
- 3. Remove and reinstall transmission/transaxle and torque converter; inspect engine core plugs, rear crankshaft seal, dowel pins, dowel pin holes, and mounting surfaces.
- 4. Inspect, leak test, flush, and/or replace transmission/transaxle oil cooler, lines, and fittings.

5. Inspect converter flex (drive) plate, converter attaching bolts, converter pilot, converter pump drive surfaces, converter end play, and crankshaft pilot bore.
6. Disassemble, clean, and inspect transmission/transaxle.
7. Inspect, measure, clean, and replace valve body (includes surfaces, bores, springs, valves, switches, solenoids, sleeves, retainers, brackets, check valves/balls, screens, spacers, and gaskets).
8. Inspect servo and accumulator bores, pistons, seals, pins, springs, and retainers; determine needed action.
9. Assemble transmission/transaxle.
10. Inspect, measure, and reseal oil pump assembly and components.
11. Measure transmission/transaxle end play and/or preload; determine needed action.
12. Inspect, measure, and/or replace thrust washers and bearings.
13. Inspect oil delivery circuits, including seal rings, ring grooves, and sealing surface areas, feed pipes, orifices, and check valves/balls.
14. Inspect bushings; determine needed action.
15. Inspect and measure planetary gear assembly components; determine needed action.
16. Inspect case bores, passages, bushings, vents, and mating surfaces; determine needed action.
17. Diagnose and inspect transaxle drive, link chains, sprockets, gears, bearings, and bushings; determine needed action.
18. Inspect measure, repair, adjust or replace transaxle final drive components.
19. Inspect clutch drum, piston, check-balls, springs, retainers, seals, friction plates, pressure plates, and bands; determine needed action.
20. Measure clutch pack clearance; determine needed action.
21. Air test operation of clutch and servo assemblies.
22. Inspect one-way clutches, races, rollers, sprags, springs, cages, retainers; determine needed action.

## **FOUNDATIONAL TASKS – 2022**

### **Shop and Personal Safety**

1. Identify general shop safety rules and procedures.
2. Utilize safe procedures for handling of tools and equipment.
3. Identify and use proper placement of floor jacks and jack stands.
4. Identify and use proper procedures for safe lift operation.
5. Utilize proper ventilation procedures for working within the lab/shop area.
6. Identify marked safety areas.
7. Identify the location and the types of fire extinguishers and other fire safety equipment; demonstrate knowledge of the procedures for using fire extinguishers and other fire safety equipment.
8. Identify the location and use of eye wash stations.
9. Identify the location of the posted evacuation routes.
10. Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities.
11. Identify and wear appropriate clothing for lab/shop activities.
12. Secure hair and jewelry for lab/shop activities.
13. Identify vehicle systems which pose a safety hazard during service such as: supplemental restraint systems (SRS), electronic brake control systems,

- stop/start systems, and remote start systems.
14. Identify vehicle systems which pose a safety hazard during service due to high voltage such as: hybrid/electric drivetrain, lighting systems, ignition systems, A/C systems, injection systems, etc.
  15. Locate and demonstrate knowledge of safety data sheets (SDS).

### **Tools and Equipment**

1. Identify tools and their usage in automotive applications.
2. Identify standard and metric designation.
3. Demonstrate safe handling and use of appropriate tools.
4. Demonstrate proper cleaning, storage, and maintenance of tools and equipment.
5. Demonstrate proper use of precision measuring tools (e.g., micrometer, dial-indicator, dial-caliper).
6. Perform common fastener and thread repair, including removing broken bolts, restoring internal and external threads, and repairing internal threads with a thread insert.

### **Preparing for Vehicle Service**

1. Identify information needed and the service requested on a repair order.
2. Identify purpose and demonstrate proper use of vehicle protection such as: fender covers, mats, seat, and steering wheel covers.
3. Perform a vehicle walk-around inspection; identify and document existing vehicle conditions such as body damage, paint damage, windshield damage.
4. Perform a vehicle multi-point inspection and complete a vehicle inspection report.
5. Demonstrate use of the three C's (concern, cause, and correction).
6. Create a plan of action for each specific service or diagnostic situation.
7. Review vehicle service history.
8. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.

### **Preparing Vehicle for Customer**

1. Ensure vehicle is prepared to return to customer per school/company policy (floor mats, steering wheel cover, etc.).

### **Personal Standards**

1. Reports to work daily on time; able to take directions and motivated to accomplish the task at hand.
2. Dresses appropriately and uses language and manners suitable for the workplace.
3. Maintains personal hygiene appropriate for the workplace.
4. Meets and maintains employment eligibility criteria, such as drug/alcohol-free status, clean driving record, etc.
5. Demonstrates honesty, integrity, and reliability.

### **Work Habits / Ethic**

1. Complies with workplace policies/laws.
2. Contributes to the success of the team, assists others and requests help when

needed.

3. Works well with all customers and coworkers.
4. Negotiates solutions to interpersonal and workplace conflicts.
5. Contributes ideas and initiative.
6. Follows directions.
7. Communicates effectively, both in writing and verbally, with customers and coworkers.
8. Reads and interprets workplace documents; writes clearly and concisely.
9. Analyzes and resolves problems that arise in completing assigned tasks.
10. Organizes and implements a productive plan of work.
11. Uses scientific, technical, engineering and mathematics (STEM) principles and reasoning to accomplish assigned tasks.
12. Identifies and addresses the needs of all customers, providing helpful, courteous, and knowledgeable service and advice as needed.
13. Respectful of tools and property used in school and workplace environment.
14. Contributes to an inclusive environment where every coworker and customer feels welcomed, heard, and valued.