COURSE OUTLINE
Manual Drive Trains and Axles

Course Description
AT 207. Manual Drive Trains and Axles. 4 hours credit. Prerequisite: AT 218 with a C or better. This course will enable the student to diagnose and repair clutches, drivelines, axles and transmissions within a variety of vehicle platforms.

Required Materials
For complete material(s) information, refer to https://bookstore.butlercc.edu

Butler-Assessed Outcomes
The intention is for the student to be able to
1. Repair driveline systems.
2. Repair manual transmissions/transaxles.

Learning PACT Skills that will be developed and documented in this course
Through involvement in this course, the student will develop ability in the following PACT skill area(s):

Analytical Thinking Skills
Critical thinking - Through analyzing data from a variety of sources, the student will formulate and execute repair strategies.

Major Summative Assessment Task(s)
These Butler-assessed Outcome(s) and Learning PACT skills will be demonstrated by
1. Completing a driveline systems repair according to manufacturer specifications.
2. Completing a manual transmission/transaxle diagnosis and repair according to manufacturer specifications.

Skills or Competencies
These actions are essential to achieve the course outcomes:
(The following skills and competencies are taken from the National Automotive Technical Education Foundation [NATEF] standards and incorporated into each specific course.)
1. Perform general drive train diagnosis procedures
   (Linked external standards: 3A1-3A6, 3C1-3C17)
2. Perform removal, inspection and repair of clutch assembly and related components
   (Linked external standards: 3B1-3B8)
3. Determine the power flow of manual transmissions and transaxles
   (Linked external standards: 3C1, 3C4)
4. Perform manual transmission and transaxle inspection and repair according to service specifications
   (Linked external standards: 3C2-3C17)
5. Perform diagnosis, inspection, repair and/or replacement of drive axle shafts and related components
   (Linked external standards: 3E1-3E5, 3D1-3D6, and 3E.2-3E.5)
6. Perform inspection, diagnosis, adjustment and repair of 4-wheel and all-wheel drive components.
   (Linked external standards: 3F1-3F7)
7. Perform differential inspection, diagnosis and repair according to service specifications.
   (Linked external standards: 3E1-3E11, 3E2.1-3E2.4, and 3E3.1-3E3.5)

Learning Units
I. Clutches
   A. Design variations: purpose and function
   B. Components and operation
   C. Clutch problem diagnosis
   D. Clutch symptom guide
   E. Clutch replacement
   F. Clutch adjustments
   G. Linkage diagnosis
   H. Hydraulic clutch operation

II. Manual transmissions/transaxles
   A. Torque, speed and power flow
   B. Gear types
   C. Synchronizer components and operation
   D. Five speed torque flow
   E. Removal and replacement procedures
   F. Diagnosing shift related concerns
   G. General disassembly techniques
   H. Lubrication requirements

III. Drive axle shafts and C.V. service
   A. Design and balance
   B. U-joint design and operation
   C. C.V. joint design and operation
   D. Replacement techniques
   E. Lubrication
   F. Operating angles
   G. Replacement assemblies

IV. Differentials
   A. Components and function
   B. Ratios and torque multiplication
   C. Differential designs
   D. Bearings and axles
   E. Inspection and diagnosis
   F. Noise diagnosis
   G. Disassembly procedures
H. Reassembly and set-up procedures  
I. Bearing pre-load  
J. Lubrication requirements

V. 4-wheel and all-wheel drive  
   A. 4-wheel drive systems  
   B. All-wheel drive  
   C. Front and Rear axle ratios  
   D. Transfer case design  
   E. Removal and replacement procedures  
   F. Problem diagnosis and service  
   G. Hub diagnosis and service  
   H. Inter-axle differentials

**Learning Activities**
Learning activities will involve the student developing skills for the diagnostic analysis and repair of driveline and transmission related issues. Lectures, discussions, projects, research assignments and assessment tasks may be used at the discretion of the instructor.

**Grade Determination**
The student will be evaluated on learning activities and assessment tasks. Grade determinants may include the following: class participation, project completion, research assignments, quizzes, tests and other methods of evaluation at the discretion of the instructor.