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ABSTRACT

This document presents an outline for a 135-hour course designed to provide the student with all the skills, technical knowledge, safety practices, and general information that is required to understand the theory of operation, to diagnose, and to service the units that make up the power flow system of the automobile. The course of study includes theory of operation and service procedures of clutches, transmissions, drive lines, differential and rear axles. The behavioral objectives and performance standards necessary for a person to become an automotive power flow system mechanic are specified. A ten item bibliography and a list of related job, information, assignment, and operation sheets together with a Quinmester post test sample are included. (KP)

AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

V-20

Course Outline
AUTOMOTIVE MECHANICS - ADVANCED - 9047
(Automotive Power Flow System II)
Department 48 - Quin 9047.03

DADE COUNTY PUBLIC SCHOOLS
DIVISION OF INSTRUCTION • 1973

D A D E C O U N T Y P U B L I C S C H O O L S

1 4 5 0 N O R T H E A S T S E C O N D A V E N U E

M I A M I, F L O R I D A 33132

Course Outline

AUTOMOTIVE MECHANICS - ADVANCED - 9047
(Automotive Power Flow System II)

Department 48 - Quin 9047.03

county office of

VOCATIONAL AND ADULT EDUCATION

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Dade County Public Schools
Miami, Florida 33132

December, 1972

Published by the School Board of Dade County

Course Description

9047	48	9047.03	Automotive Power Flow System II
State Category Number	County Dept. Number	County Course Number	Course Title

This course of study includes theory of operation and service procedures of clutches, transmissions, drive lines, differential and rear axles.

Clock Hours: 135

PREFACE

The following pages contain a course outline entitled, Automotive Power Flow System II. This is the third quinmester course in the twelfth grade course No. 9047.

This quinmester course is 135 hours in length and will be available to all students who satisfactorily complete the post test of course No. 9047.02. This outline consists of seven blocks of instruction which are subdivided into several units each. It includes the skills, technical knowledge, safety practices and general information that is required to understand the theory of operation, to diagnose, and to service the units that make up the power flow system of the automobile.

The instruction will consist of lectures, demonstrations and group discussions. Audio visual aids will be used to supplement instruction. Students will disassemble, service and adjust instructional units with the close supervision of the instructor. Actual service problems will be handled by the students as the instructor will accept live work on a production basis. The bibliography appearing on the last page of this outline lists several basic references along with supplementary references and audio visual aids.

This outline was developed through the cooperative efforts of the instructional and supervisory personnel, the Quinmester Advisory Committee, and the Vocational Curriculum Materials Service and has been approved by the Dade County Vocational Curriculum Committee.

GOALS

The automotive mechanic trainee must be able to demonstrate:

1. Safe work habits and proper shop behavior when working around and under the automobile.

2. An understanding of the function and theory of operation of the power flow systems.

3. The skills and knowledge required to diagnose, service and repair the units that make up the power flow system of the modern automobile.

4. Pride and respect of craftsmanship for the occupational field.

TABLE OF CONTENTS
with Suggested Hourly Breakdown

SPECIFIC BLOCK OBJECTIVES

BLOCK I - THE POWER FLOW SYSTEM

The student must be able to:

1. Identify the units that make up the power flow system.
2. State the purpose of each unit.
3. Trace the power flow through the system.

BLOCK II - CLUTCH ASSEMBLIES

The student must be able to:

1. Demonstrate an understanding of the principles of operation of a standard clutch assembly.
2. Remove, service and replace a clutch assembly and adjust the pedal clearance following the manufacturer's specifications.
3. Develop the skills necessary to diagnose malfunctions in the clutch system.

BLOCK III - STANDARD TRANSMISSIONS

The student must be able to:

1. Identify the individual parts that make up the standard speed transmission.
2. Trace the power flow through the standard three speed transmission.
3. Disassemble a three speed transmission completely, reassemble and make all adjustments maintaining factory specifications.
4. Demonstrate the ability to diagnose the probable cause of transmission problems when presented with the symptoms.
5. Demonstrate an understanding of the principles of operation of the automotive overdrive unit.

BLOCK IV - HYDRAULICALLY OPERATED TRANSMISSION

The student must be able to:

1. Demonstrate an understanding of the principle of hydraulics.
2. Develop an understanding of the role and function of the torque converter.
3. Exhibit an understanding of the operation of a planetary gear system.
4. Disassemble, inspect, reassemble and adjust to factory specifications an automatic hydraulic operated transmission.
5. Exhibit the ability to practice recommended safety precautions in the use of tools and equipment.

BLOCK V - DRIVE LINES

The student must be able to:

1. Demonstrate an understanding of the principles of operation of the drive line system.
2. Overhaul a universal joint.
3. Check alignment of a two piece propeller shaft assembly and make adjustments necessary to maintain factory specification.

BLOCK VI - DIFFERENTIALS

The student must be able to:

1. Identify the parts and trace the power flow through the parts that make up the differential.
2. Demonstrate the ability to disassemble and reassemble a differential unit using the tools and procedures specified in the factory manual.

BLOCK VI - REAR AXLES

The student must be able to:

1. Identify the various types of rear axle systems used in modern motor vehicles.
2. Demonstrate the ability to remove an axle and bearing, replace and make any adjustments necessary to return vehicle to factory specifications.

Course Outline

AUTOMOTIVE MECHANICS - ADVANCED - 9047
(Automotive Power Flow System II)

Department 48 - Quin 9047.03

I. THE POWER FLOW SYSTEM

A. Identification of Units

B. Purpose of Each Unit

C. Power Flow Through the System

II. CLUTCH ASSEMBLIES

A. Types and Classification

B. Nomenclature

C. Function of Parts
1. Flywheel
2. Pressure plate
3. Friction disc
4. Pressure plate
5. Operating linkage

D. Service Procedures
1. Safety precautions
2. Removal procedures
3. Inspection of components for wear and damage
4. Flywheel runout check
5. Installation procedures
   a. Alignment
   b. Balance precautions
   c. Adjustments
6. Diagnosis Procedures

III. STANDARD TRANSMISSIONS

A. Type and Classification

B. Function

C. Nomenclature of Parts

D. Principle of Operation
1. Gears and gear ratios
2. Power flow through gear trains
3. Shifting mechanics and synchranges
4. Constant mesh gear trains

III. STANDARD TRANSMISSIONS (Contd.)

E. Service Procedures
   1. Safety precautions
   2. Disassembly methods
   3. Inspection of parts
   4. Service precautions
      a. Bearing replacement
      b. Internal adjustment
   5. Assembly procedures
   6. Bench testing
   7. Installation adjustment

F. Diagnosis of Malfunctions
   1. Hard shifting
   2. Slipping out of gear
   3. Noise
   4. Oil leaks

G. Gear Shift Linkages
   1. Service
   2. Adjustments

H. Overdrive
   1. Principle of operation
   2. Function
   3. Nomeclature of parts
   4. Service procedures - mechanical
   5. Service procedures - electrical
   6. Diagnosis of malfunction

IV. HYDRAULICALLY OPERATED TRANSMISSION

A. Principles of Hydraulics

B. Fluid Couplings
   1. Principles of operations
   2. Functions
   3. Service procedures
   4. Work safety precautions

C. Torque Converters
   1. Principles of operation
   2. Function
   3. Service procedures

D. Automatic Transmission
   1. Theory of operation
   2. Nomenclature and function of units
      a. Planetary gear systems
      b. Multiple disc hydraulic clutches
      c. Servo and band assemblies
      d. Hydraulic systems

IV. HYDRAULICALLY OPERATED TRANSMISSIONS (Contd.)

(1) Pumps
(2) Control valves
e. Governor Controls
f. Vacuum controls
g. Cooling systems

3. Service Procedures
a. Safety precautions
b. Diassembly methods
c. Inspection of parts
d. Manufacturer's specifications
e. Service precautions
f. Assembly procedures
g. Bench testing
h. Installation procedures

4. Diagnosis of Malfunctions
a. Slipping
b. Hard shifting
c. Noise
d. Oil leaks

5. Transmission Control Linkage
a. Service
b. Adjustment

V. DRIVE LINES

A. Types and Classification

B. Function

C. Nomenclature of Parts

D. Theory of Joint Action

E. U Joints
1. Servicing U joints
2. Diagnosis of problems

F. Support Bearings

G. Propeller Shifts
1. Checking alignment
2. Balance
3. Diagnosing noises and vibrations

VI. DIFFERENTIALS

A. Types

B. Function

C. Nomeclature of Parts

VI. DIFFERENTIALS (Contd)

D. Theory of Operation

E. Service Procedures
   1. Dis-assembly
   2. Inspection of parts
   3. Service precautions
   4. Manufacturer's specifications
   5. Assembly procedures
   6. Adjustment
   7. Installation procedures

F. Diagnosis of Malfunctions

VII. REAR AXLES

A. Types and Classifications

B. Function

C. Nomenclature of Parts

D. Service Procedures
   1. Removing axles
   2. Replacing bearing and seals
   3. Diagnosing malfunctions
   4. Adjusting end play
   5. Manufacturer's specifications

VIII. QUINMESTER POST-TEST

BIBLIOGRAPHY
(Automotive Power Flow System II)

Basic References:

1. Crouse, William H. Automotive Transmission and Power Trains. New York: Webster Division McGraw-Hill Book Co., 1967. Pp. 626.

2. _____. Automotive Mechanics. New York: Webster Division, McGraw-Hill Book Company, 1965. Pp. 600.

Supplementary References:

3. Chilton Auto Repair Manual. 35th ed. Philadelphia: Chilton Company, 1964. Pp. 1250.

4. Glenn Auto Repair Manual. 3rd ed. Philadelphia: Chilton Company, 1962. Pp. 478.

5. Motors Auto Repair Manual. 27th ed. New York: Motor Magazine, 1964. Pp. 1280.

6. Stockel, Martin W. Auto Mechanics. Chicago: Goodheart-Willcox Company, Inc., 1963. Pp. 480.

7. _____. Auto Mechanics Fundamentals. Illinois: Goodheart-Willcox Company, Inc., 1969. Pp. 480.

8. Tobolt, William K., and Johnson, Larry. Motor Services Automotive Encyclopedia. Illinois: Goodheart-Willcox Company, Inc., 1970. Pp. 768.

ASSIGNMENT SHEETS:

#4-1 Clutches
#4-2 Clutch Service
#4-3 Transmissions - Principles of Operation
#4-4 Standard Transmission Service
#4-5 Overdrive Construction, Operation and Service
#4-6 Fluid Couplings and Torque Converters
#4-7 Universal Joints and Drive Shafts
#4-8 Rear Axles and Differentials

INFORMATION SHEETS:

Automatic Transmission Pumps
Adjusting Fordomatic Three Speed Bands
Mechanical and Hydraulic Advantage
Danger Signals - Automatic Transmissions
General Diagnosis Procedures for Automatic Transmission
Principles of Hydraulics
Torque Converters - Theory of Operation
Duties of Drive Shaft
Gears and Bearings in the Power Flow System
The Planetary Gear System

JOB SHEETS:

Removing and Replacing Falcon Transmission
Overhauling the Falcon Transmission

OPERATION SHEET:

Adjusting the Falcon Clutch Pedal

A P P E N D I X

Quinmester Post Test Sample

QUINMESTER POST TEST

Name _____ Date _____ Score _____

I. Multiple Choice Test - Each statement needs a word or phrase to make it correct. Only one of the choices listed is correct. Select the correct letter.

1. A 12 inch diameter clutch would be capable of transmitting:

   a. More torque than a 13 inch clutch.
   b. More torque than a 10 inch clutch.
   c. Less torque than a 10 inch clutch.
   d. Less torque than an 11 inch clutch. _____

2. The loss of clutch pedal free travel indicates:

   a. Wear in the linkage.
   b. Oil on the clutch disc.
   c. A defective pilot shaft bearing.
   d. Wear in the clutch facing. _____

3. The purpose of coil springs in the clutch disc is to:

   a. Stop the rattle.
   b. Cushion the engagement.
   c. Strengthen the disc.
   d. Hold the pressure plate against the disc. _____

4. The purpose of the springs in the pressure plate assembly is to:

   a. Stop the rattles.
   b. Cushion the engagement.
   c. Hold the pressure plate against the clutch.
   d. Strengthen the pressure plate. _____

5. At high engine speed, a centrifugal-assisted clutch tends to:

   a. Increase clutch apply pressure.
   b. Decrease clutch apply pressure.
   c. Release.
   d. Slip. _____

6. Clutch pedal free travel adjustment is made:

   a. To prevent shifting into two gears at once.
   b. To provide clearance between throwout bearing and clutch release levers.
   c. To provide clearance between clutch disc and input shaft.
   d. To allow pedal to be operated with light foot pressure. _____

7. If marks on the clutch cover and flywheel are not aligned during clutch installation:

   a. The clutch pedal will be stiff.
   b. A vibration may be felt when the engine is running.
   c. The transmission gears will grind when shifted into low.
   d. Oil will leak from the transmission. _____

8. The main purpose of a clutch is to:

   a. Provide a way to disengage the engine from the transmission when manual shifts are being made.
   b. Help slow down the flywheel so a quiet shift can be made.
   c. Stop the vehicle from rolling if it is parked on a hill.
   d. Allow engine to race to a higher speed by disengaging the transmission out-put shaft. _____

9. If a customer complained that his clutch slipped under a heavy load, what condition could you expect to find:

   a. Not enough grease in the transmission.
   b. Marks on flywheel and clutch cover not lined up.
   c. Too much clutch pedal free travel.
   d. Grease on clutch disc. _____

10. Flywheel runout would be measured with a:

   a. Dial indicator.
   b. Depth gauge.
   c. Micrometer
   d. Feeler gauge. _____

11. If a standard three speed transmission is in third gear, the output shaft will turn:

   a. Faster than the input shaft.
   b. Slower than the input shaft.
   c. At the same speed as the input shaft.
   d. Opposite to the input shaft. _____

12. The interlock mechanism in a standard transmission:

   a. Prevents thefts.
   b. Stops car from rolling when parked on a hill.
   c. Prevents shifting into two gears at one time.
   d. Synchronized gear shift. _____

13. The sychronizer mechanism in a standard transmission:

a. Synchronized throttle opening with gearshift lever position.
b. Prevents gear clash when shifting.
c. Synchronized engine speed with manifold vacuum.
d. Allows the output shaft to turn at a lower speed than the input shaft when turning corners. _____

14. Synchronizer failure in a standard transmission could be caused by:

a. Too much clutch pedal free travel.
b. Excessive engine speed.
c. An engine too powerful for the transmission.
d. Speed shifting. _____

15. A slip-joint is used in drive (propeller) shafts because:

a. The distance between the transmission and rear axle changes with road and load conditions.
b. The manufacturer cannot maintain accurate specifications so a slip-joint covers up his mistakes.
c. It is easier to take apart.
d. It is cheaper to make than a solid joint. _____

16. There is less vibration in a drive-shaft when it is equipped with:

a. Two slip joints.
b. Three slip joints.
c. An automatic balance control.
d. Constant velocity U joints. _____

17. The alignment angles of a drive shaft could be checked with a:

a. Steel rule.
b. Protractor.
c. Outside Micrometer.
d. Slide rule. _____

18. The main function of a universal joint is to:

a. Provide a way to disassemble the drive line.
b. Permit the driving force to be transmitted through an angle.
c. Decrease the hump in the vehicle floor.
d. Provide a place to grease the drive shaft. _____

19. Torque tube drive requires:

a. One U joint.
b. Two U joints.
c. Three U joints.
d. Four U joints. ____

20. The three major parts of a torque converter are:

a. Pump, disc clutch, servo.
b. Servo, governor, turbine.
c. Turbine, synchronizer, governor.
d. Pump, turbine and startor. ____

21. When a car is cruising steadily at 50 M.P.H.:

a. The stator is rotating in the same direction as the pump.
b. The stator is rotating opposite to the rotation of the pump.
c. The stator is held stationary by the sprag clutch.
d. The stator and the turbine are both stationary. ____

22. The part of an automatic transmission that senses vehicle speed is:

a. The servo.
b. The front pump.
c. The governor.
d. The sun gear. ____

23. A sprag clutch could be described as a:

a. Wet clutch.
b. One-way clutch.
c. Disc clutch.
d. Disc brake ____

24. The transmission front pump is driven by the:

a. Stator shaft.
b. Output shaft.
c. Converter.
d. Turbine. ____

25. The typical transmission front pump is a:

a. Positive displacement type.
b. Piston type.
c. Centrifugal type.
d. Plunger type. ____

26. When diagnosing automatic transmission problems, you should first:

a. Make a stall test.
b. Jack up rear wheels.
c. Block the rear wheels.
d. Check transmission oil level. ____

27. When a T.V. (throttle valve) rod or linkage is used on an automatic transmission, it serves to sense:

a. Engine temperature.
b. Engine load.
c. Road speeds.
d. Stall speeds. ____

28. When the driver moves the selector level from N to D, he changes the position of the:

a. Throttle valve.
b. Governor valve.
c. Manual valve.
d. Accumulator valve. ____

29. On many automatic transmissions, engine load information is sensed by:

a. Vacuum modulator.
b. Governor.
c. Rear pump.
d. Manual valve. ____

30. The gear in the center of a planetary gear set is the:

a. Planet gear.
b. Ring gear.
c. Reverse gear.
d. Sun gear. ____

31. Locking together any tow members of the planetary gear set provides:

a. Increased torque.
b. Gear reduction.
c. Direct drive.
d. Reverse rotation ____

32. Conventional rear axles use hypoid gears because they are quiet and:

a. Allow car floor to be built lower.
b. Need no service.
c. Are cheaper to build.
d. Allow more possible gear ratios. ____

33. If a differential ring gear has 37 teeth and the dirve pinion has 9 teeth, the gear ratio will be:

a. 5 : 1.
b. 3.97 : 1.
c. 4.11 : 1.
d. 2:30 : 1. ____

34. If you change a differential from a ratio of 3.50 : 1 to a ratio of 5 : 1, the vehicle will have:

a. Slower acceleration.
b. Quicker acceleration.
c. A noisy rear axle.
d. Better cornering ability. ____

35. With a limited slip differential:

a. Both rear wheels will slip when the brakes are applies.
b. Both rear wheels tend to turn at the same speed.
c. One rear wheel can stay stationary while the other spins.
d. One rear wheel always does the driving. ____

ANSWER KEY TO QUINMESTER POST-TEST

1. b
2. d
3. b
4. c
5. a
6. b
7. b
8. a
9. d
10. a
11. c
12. c
13. b
14. d
15. a
16. d
17. b
18. b
19. a
20. d
21. a
22. c
23. b
24. c
25. a
26. d
27. b
28. c
29. a
30. d
31. c
32. a
33. c
34. b
35. b