I. CATALOG DESCRIPTION

Prerequisite: AUT101
9 semester hours credit

Wheel, Frame, and Suspension Systems will involve the study of automotive steering, suspension, and brake systems. The emphasis is placed on wheel alignment principles and the diagnosis and repair of automotive drum brakes, diagnosis and repair of automotive drum brakes, disc brakes, hydraulic systems, power assist units, and suspension systems. This course will help prepare the student for the National Institute for Automotive Service Excellence (ASE) test on front ends and brakes. (S)

II. COURSE GENERAL OBJECTIVES

Upon completion of this course the student will:

A. Diagnose hydraulic and parking brake system problems.
B. Repair brake system problems.
C. Diagnose ABS systems.
D. Repair, replace, and adjust ABS components.
E. Identify worn or defective suspension and steering parts
F. Remove, repair, and/or replace worn or defective steering and suspension parts.
G. Align an automobile steering system.

III. COURSE OUTLINE (LECTURE)

A. Brake Principles and Fundamentals
   1. Friction
   2. Brake Systems
   3. Brake Safety Procedures and Tools

B. Hydraulic System - Component Operation
   1. Brake pedals
   2. Master Cylinders
   3. Hydraulic Tubes and Hoses
   4. Wheel Cylinders and Calipers
   5. Brake Safety Switches and Valves
   6. Brake Fluids
   7. Bleeding and Flushing

C. Drum Brake - Operation and Components (Design)

D. Disc Brake - Disc Brake Components and their function
   1. Fixed Caliper
   2. Floating and Sliding Caliper
E. Parking Brakes - Operation and Components
   1. Integral Parking Brakes
   2. Rear Disc/Drum (Auxiliary Drum) Parking Brake
   3. Rear Disc Parking Brake
   4. Transmission or Drive Shaft Parking Brake

F. Power Brake - Types of Power Units
   1. Auxiliary Vacuum Pumps
   2. Hydraulically Operated Power Brakes
   3. Powermaster Hydraulic Boost
   4. Other Power Booster Units

G. Anti-Lock Brake Systems - Operation and Design
   1. Teves Anti-Skid Brake Systems
   2. Bosch Anti-Lock System
   3. Lucas-Girling Stop Control System

H. Light-Duty Truck Brakes - Operation and Systems
   1. Wheel Hubs and Bearings
   2. Rear Anti-Lock Brakes
   3. Electric Brake Systems

I. Import Vehicle Brakes - Operation and Systems
   1. Fixed Caliper
      a. Girling
      b. ATE
      c. Sumitomo
      d. Teves
   2. Sliding Caliper Disc Brake
   3. Floating Caliper
   4. Rear Disc Brakes
   5. Rear Drum Brakes
   6. Anti-Locking Brake Systems

J. Diagnosing Brake Systems
   1. Service Manual Information
   2. Customer Relations

K. Introduction to Undercar Systems
   1. Tools and Safety
   2. Inspection
   3. Certification (ASE)

L. Front-Suspension Systems and Their Components - Suspension Basics
   1. Components
   2. Independent Front Suspension

M. Rear-Suspension Systems - Live-Axe Rear Suspension
N. Electronic Air or Level Control Systems
   1. Safety and Restrictions
      a. Hoist Lifting
      b. Jacking
      c. Towing
   2. Electronic Suspension Self-Diagnosis
   3. Electronic Level Control
   4. Springless Electronic Suspension Systems

O. Manual Steering Components
   1. Manual Steering Gearbox
   2. Steering Columns and Steering Wheel

P. Power-Steering Components
   2. Electronic Controlled Power-Steering Systems.
   3. Four-Wheel Steering System

Q. Undercar Alignment Procedures
   1. Steering Geometry and Undercoat Alignment Angles
   2. Alignment Procedure
   3. Light Truck Wheel Alignment

R. Seals and Bearings
   1. Types of Seals
   2. Bearings

S. Undercar Four-Wheel Drive Service
   1. Four-Wheel Drive Systems
   2. Four-Wheel Drive Suspension and Steering

T. Tires and Wheels
   1. Tire Construction
      a. Bias
      b. Bias-Belted
      c. Radial
   2. Wheel Construction

U. Undercar Inspection - Routine Inspections

IV. COURSE OUTLINE (LABORATORY)

A. Fundamental Brake Principles
   1. Specialized Brake Tools and Equipment (Identifying)
   2. Safety Procedures in Shop Activities
   3. Identifying Brake Components on the Car
      a. Switches and Valves
      b. Master Cylinders, Wheel Cylinders, Calipers, and Power Units

B. Hydraulic System-Servicing
   1. Bleeding Procedures
   2. Flushing Hydraulic System
   3. Final Touch Bleeding
4. Brake Pedals and Stoplight
5. Brake Fittings, Lines, and Hoses

C. Drum Brake-Inspecting and Servicing
   1. Drum Shoe and Lining Removal and Inspection
   2. Wheel Cylinder Inspection and Servicing

D. Disc Brake - Inspecting and Servicing
   1. Service Precautions
   2. General Caliper Inspection and Servicing
   3. Rotor Inspection and Servicing
   4. General Rotor Replacement Procedures
   5. Wheel Bearing Repacking and Assembly
   6. Rear Disc Brakes

E. Parking Brake - Operation and Servicing - Servicing Parking Brake
   1. Cable Service and Adjustments
   2. Rear Disc/Drum (Auxiliary Drum) Parking Brake
   3. Driveshaft and Transmission Brake Service

F. Power Brakes - Servicing
   1. Diagnostic Procedures & Testing Power Brake Boosters
   2. Safety Precautions
   3. Powermaster and Hydro-Booster Service

G. Anti-Lock Brake Systems-Servicing
   1. Reading Diagnostic Codes
   2. Component Testing of Sensors and Actuators

H. Light-Duty Truck Brakes - Servicing Hubs and Wheels on Light-Duty Trucks

I. Import Vehicle Brakes
   1. Servicing Fixed Caliper Disc
      a. Girling
   b. ATE
   c. Sumitomo
      d. Teves
   2. Servicing Sliding Caliper Disc
   3. Servicing Floating Caliper Disc

J. Front-Suspension Servicing - General Front Suspension Servicing
   1. Inspection
   2. Component Servicing

K. Rear-Suspension Servicing
   1. Live-Axle Suspension
   2. Semi-Independent

L. Servicing Electronic Air and Level Control Systems
   1. Hoist Lifting and Jacking
      a. Safety Precautions
      b. Service Manual
   2. Servicing Electronic Suspension Components

M. Manual Steering Service
   1. Manual Steering Service Produce
2. Column and Steering Wheel Service

N. Power Steering Service
1. Conventional Power Steering Service
2. Power Steering Diagnosis
3. General Conventional Power Steering Service
4. Four-Wheel Steering Service

O. Undercar Alignment Procedures - Geometry and Undercar Alignment Angles
1. Inspection Procedure
2. Measurement Procedures
   a. Automobile
   b. Light Truck

P. Seal and Bearing Servicing
1. Bearing Cleaning and Inspection Procedures
2. Seal Service

Q. Undercar Four-Wheel Drive Service
1. Four-Wheel Drive Suspension Service
2. Upgrading Four-Wheel Drive Vehicles

R. Tires and Wheel Service
1. Tire and Wheel Inspection
2. Diagnosing Wear Patterns
3. Wheel/Tire Assembly Service

V. UNIT OBJECTIVES (LECTURE)

A. Brake Principles and Fundamentals

The student should be able to:

1. Explain how the principles of friction is involved in braking action.
2. Describe how a hydraulic system transfers foot-pressure into braking power.
3. Identify the factors involved in controlled braking.
4. Explain the development of automotive brake systems.
5. Recognize the two basic types of hydraulic brakes.
6. Name the components used in various brake systems.
7. Explain why most cars made today use a combination brake system.
8. Describe proper brake service and safety techniques.
9. Identify the basic brake tool.

B. Hydraulic System

The student should be able to:

1. Explain the principles of the dual braking system.
2. Identify the difference between a front/rear split system and a diagonally split system.
3. Explain the importance of the dual master cylinder to the hydraulic system, and describe the function of each of its main components.
4. Explain the importance of hydraulic tubes and hoses, wheel cylinders, and calipers to the hydraulic system.
5. Describe the function of the various safety switches and valves, including the
brake.
6. Identify the three basic types of hydraulic brake fluid, as well as the precautions that should be taken to minimize brake fluid contamination.
7. Explain the importance of properly bleeding a hydraulic system.
8. Describe the bleeding sequence and identify common bleeding locations.
9. Explain the various techniques of manual bleeding and identify the difference between them.
10. Explain the techniques of pressure bleeding and surge bleeding.
11. Describe the procedure for bench bleeding a master cylinder.
12. Recognize when it is necessary to flush a hydraulic system, and describe how it is done.
13. Explain the procedure for final touch bleeding.

C. Drum Brake

The student should be able to:

1. Explain how a drum brake operates.
2. Identify the major components of a typical drum brake and describe the function of each component.
3. Describe the three functions of primary and secondary brake shoes.
4. Explain the function of brake lining and describe the importance of its proper location-the shoe.
5. Describe the installation process for mechanical components such as the shoe return springs, shoe hold downs, and shoe anchors.
6. Explain the difference between duo-servo and non-servo drum brakes.
7. Identify the various types of automatically adjusted servo brakes.
8. Explain the difference between Lockheed manual and the adjustable strut type of non-servo adjuster designs.
9. Identify the various types of automatically adjusted non-servo brakes.

D. Disc Brake

The student should be able to:

1. Explain the advantages of disc brakes over drum brakes.
2. Recognize the difference between a floating and a sliding caliper.
3. Explain how a disc brake hub and rotor assembly, caliper assembly, and brake pad assembly operates.
4. Describe the basic operation and applications of fixed caliper disc brakes.
5. Describe the basic operation and application of floating and sliding caliper disc brakes.
6. Explain how a rear disc/park brake system operates.

E. Parking Brakes

1. Explain the function of the parking brake.
2. Identify the types of parking brakes.
3. Explain the methods for adjusting and servicing parking brakes.
4. Explain the procedure for testing parking brakes.
F. Power Brake

The student should be able to:

1. Describe the basic types of power assist mechanisms.
2. Explain the four basic phases of braking action involved.
3. Describe the procedure for bleeding a power unit.
4. Explain the function and operation of a vacuum pump.

G. Anti-Lock Brake Systems

The student should be able to:

1. Identify the advantages of the principal anti-lock brake system.
2. Recognize and explain the functions of the major components of typical anti-lock systems.
3. Describe a control cycle in the operation of the anti-lock brake.
4. Explain the procedure for brake system bleeding.
5. Explain the three basic steps in diagnosing anti-lock malfunctions.

H. Light-Duty Truck Brakes

The student should be able to:

1. Describe light-duty truck brake systems.
2. Explain the procedure for replacing rotors in front-wheel, rear-wheel, and four-wheel drive models.
3. Explain the procedure for replacing brake drums.
4. Recognize electric and air brake systems.

I. Import Vehicle Brakes

The student should be able to:

1. Recognize special features on import brake systems not found on domestic vehicles.
2. Explain the function and design of rear disc brakes. (Akebono, Girling, ATE).
3. Explain the design of non-service drum brakes (European and Japanese cars).

J. Introduction to the Undercar System.

The student should be able to:

1. Explain the function and importance of suspension and steering systems.
2. Explain the importance of tires and wheel alignment.
3. Identify suspension safety rules, proper tools, and caution.
K. Front-Suspension Systems and their Components

The student should be able to:

1. Explain the difference between conventional frame and unibody construction.
2. Describe how the suspension system has evolved through the years.
3. Identify the function of shock absorbers and struts, and describe their basic construction.
4. Describe the differences between shock-assist, lever-type, and gas-charged shock absorbers.
5. Explain shock-absorber ratio.
6. Explain how the torsion back suspension system differs from the coil spring type.
7. Describe the basic operation of the MacPherson strut suspension system.

L. Electronic Air or Level Control Systems

The student should be able to:

1. Explain how EAS and ELC systems work.
2. Describe the function of the basic EAS/ELC components, including the compressor assemble, height sensor, air lines and fittings, and computer module.
3. Identify basic hoist lifting, jacking, and towing restrictions for vehicles with electronic suspension systems.
4. Explain the ways an electronic suspension carries out self-diagnosis.
5. Describe how a springless electronic suspension system works.

M. Manual Steering Components

The student should be able to:

1. Describe the similarities and differences between parallelogram and rack-and-pinion steering.
2. Name the five basic types of steering linkage systems found on passenger cars, trucks, and vans.
3. Identify the components in a parallelogram steering linkage arrangement.
4. Identify the components in a manual rack-and-pinion steering linkage arrangement.
5. Describe the function and operation of the manual steering gearbox and the steering column.

N. Power Steering Components

The student should be able to:

1. Explain the benefits of accurate undercar alignment.
2. Explain the importance of correct wheel angles.
3. Describe the different functions of camber and caster with regard to a vehicle's suspension.
4. Identify the purposes of steering axis inclination.
5. Explain why toe is the most critical tire wear factor of all alignment angles.
6. Identify the purposes of turning radius or toe-out.
7. Explain the condition known as tracking.
8. Explain the condition known as setback.

O. Seal and Bearing
The student should be able to:

1. Explain the function of a bearing and each of its four basic working parts.
2. Identify and explain the types of bearings used in vehicles.
3. Explain the purpose of the two types of seal-dynamic and static.

P. Undercar Four-Wheel Drive

The student should be able to explain how a four-wheel drive system operates, and identify its advantages.

Q. Tires and Wheels

The student should be able to:

1. Recognize the basic parts of a tubeless tire.
2. Explain the difference between the three types of tire construction in use today.
3. Explain the tire ratings and designations in use today.
4. Explain why certain factors affect tire performance, including inflation pressure, tire rotation and tread wear.
5. Describe the difference between static and dynamic balance.

VI. UNIT OBJECTIVES (LABORATORY)

A. Brake Principles and Fundamentals

The student should be able to use vehicle manuals and aftermarket literature.

B. Hydraulic System-Servicing

The student should be able to:

1. Perform a complete inspection of the basic components of a hydraulic brake system.
2. Inspect a brake pedal for free height and travel, and remove a typical brake pedal assembly.
3. Service stoplight switches, brake fittings, lines, and hoses.
4. Recognize conditions that are considered normal for a master cylinder and therefore do not require servicing.
5. Perform basic test on a master cylinder, including testing for trapped air, check for external leaks, testing for bypass, testing for open replenishing ports, and checking for brake pedal reserves.
6. Service the various types of master cylinders.
7. Inspect the various safety valves and switches to determine if they are operating properly, and replace as needed.

C. Drum Brakes-Inspecting and Servicing

The student should be able to:

1. Remove a wheel and tire assembly, including anti-theft wheel lug nuts, in order to inspect and service the drum brake.
2. Perform a cleaning and inspection of a drum brake and its related parts.
3. Recognize conditions that adversely affect the structure strength of a drum,
including scoring, hard spots, and heat checks.

4. Measure a drum using a drum micrometer.
5. Identify the general rules of drum matching.
6. Assemble a typical duo-service drum brake.
7. Assemble a typical non-service drum brake.
8. Recondition and replace a wheel cylinder.

D. Disc Brakes-Inspecting and Servicing

The student should be able to:

1. Identify general service precautions when working on disc brakes.
2. Inspect and service brake calipers.
3. Remove and install brake pads.
4. Identify and rectify malfunctions in rotors using inspecting, replacing, and machining procedures.
5. Clean and repack wheel bearings.
6. Service front and rear disc brakes (domestic cars).

E. Parking Brake Servicing

The student should be able to:

1. Identify the types of parking brakes.
2. Adjust and service parking brakes.
3. Test parking brake operations.

F. Power Brake Servicing

1. Identify and rectify problems in any power brake system.
2. Bleed a power unit system.
3. Service a vacuum pump and components, including vacuum pump, controller, and piston assembly.

G. Anti-Lock Brake Systems Servicing

The student should be able to:

1. Follow the basic steps in diagnosing anti-lock brake system malfunction.
2. Service and repair anti-skid brake systems.

H. Light-Duty Truck Brakes Service

The student should be able to:

1. Recognize light-duty brake systems.
2. Remove, service and replace hub locks.
3. Service disc and drum light-duty truck brake systems.
I. Import Vehicle Brake Service

The student should be able to:

1. Recognize special features on import brake systems not found on domestic vehicles.
2. Perform road tests, recognizing problems relating to brake systems, weather condition, and driver, that could be blamed on shoddy work or defective parts.

J. Front Suspension System Components

The student should be able to:

1. Identify the different types of springs and how they operate, including coil, torsion bar, multiple leaf, and monoleaf.
2. Name the advantages of ball joint suspension.

K. Front-Suspension Servicing

The student should be able to:

1. Determine the cause of front-suspension problems through proper and accurate inspections.
2. Service the parts and assemblies causing the problem.
3. Safely install new coil springs and coil spring stabilizers.
4. Service ball joints, control arms, bushings, stabilizer assemblies, steering knuckles, kingpins, and shock absorbers.
5. Use specialized tools needed to measure and check components.
6. Determine which components must be removed in order to service the problem part or assembly.
7. Determine if components that can be replaced individually have to be replaced or repaired as a set.
8. Determine if components can be replaced individually or only as an assembly.
9. Diagnose suspension problems through road testing.
10. Inspect, diagnose, and service MacPherson strut suspension systems.

L. Rear-Suspension Service

The student should be able to:

1. Service both leaf-spring and coil-spring live-axle suspension systems.
2. Remove and install springs and shock absorbers.
3. Service semi-independent rear suspension systems.
4. Remove and install stabilizer bars, springs and insulators, control arm bushings, hub/bearing assemblies, and rear axle assembly.
5. Service independent rear suspension systems with and without struts.
6. Perform all the necessary servicing safely with no personal injury or damage to the vehicle.

M. Electronic Air or Level Control System Service

The student should be able to:

1. Measure body or ride height on vehicle with an electronic suspension system.
2. Make a component performance test on an ELC system.
N. Manual Steering Service

The student should be able to:

1. Identify the typical manual steering system components and their functions.
2. Identify parallelogram and rack-and-pinion steering arrangements.
3. Make various manual steering system adjustments, including worm bearing preload, and backlash.

O. Power Steering Service

The student should be able to diagnose and correct power steering system checks for belt condition and tension turning effort, tie-rod articulate effort, air in the system, adequate pressure, fluid contamination and deteriorated hoses.

P. Undercar Alignment Procedure

The student should be able to:

1. Diagnose common wheel alignment problems, and identify the equipment used to check wheel alignment.
2. Perform complete alignment procedures on two and four wheel drive vehicles.
3. Perform adjustments on steering angle components.
4. Perform a four-wheel alignment

Q. Seal and Bearing Service

The student should be able to:

1. Diagnose problems with bearings.
2. Service bearings and seals, including removal, cleaning, installation, lubrication, mounting, and replacement.

R. Undercar Four-Wheel Drive Service

The student should be able to:

1. Replace a wheel lock hub on a four-wheel drive vehicle.
2. Perform spring and radius arm service on four-wheel drive vehicles.

S. Tire and Wheel Service

The student should be able to:

1. Repair an air leak due to wheel damage.
2. Remove and install a wheel and tire assembly.
3. Dismount and remount a tire.
4. Repair a damaged tire.
5. Balance a wheel and tire assembly.
T. Undercar Inspection

The student should be able to:

1. Perform a complete undercar inspection procedure.
2. Determine the cause of noise, vibration, and harshness problems.

VII. METHOD OF INSTRUCTION

A. Lecture
B. Demonstration
C. Laboratory

VIII. REQUIRED TEXTBOOKS


IX. REQUIRED MATERIALS

Safety Glasses

X. SUPPLEMENTAL REFERENCES

B. James G. Hughes, Brakes, Harcourt, Brace, Jovanovich, Publishers
D. Sheldon L. Abbott, Automotive Brakes, Bruce
E. Thomas W. Birch, Automotive suspension and Steering Systems, Harcourt, Brace, Jovanovich, Publishers
F. David A. Coghlan, Automotive chassis Systems, Breton Publishers
G. E. Miles Bacon, Principles of Wheel Alignment, McGraw Hill

XI. METHOD OF EVALUATION

A. Tests
B. Quizzes
C. Laboratory Performance
D. Comprehensive Final Exam