School District of Marshfield Course Syllabus

Course Name: Advanced Automotive Technology Capstone
Length of Course: Year
Credit: 2 Credits

Program Goal:

Empower learners to be college and career ready through standards-based experiences in the classroom and career-based learning experiences with business and industry partners. Learners will engage through technology in design, building, problem-solving, repair or service, in a collaborative environment through theory and hands-on experiences.

Course Description:

This course is an extension of the Automotive Technology Capstone course, designed as a career-based course. Learners will gain valuable leadership skills, be a team leader within the automotive business, and mentor the Automotive Technology Capstone students. Learners will perform advanced level diagnosis and repair of automobiles, while at the same time create a marketable pathway by developing a resume, portfolio, completing a job shadow, and completing ASE (Automotive Service Excellence) Exams. Learners are strongly encouraged to apply for Youth Apprenticeship.

Board approved April 2023

Wisconsin Standards for Technology and Engineering (TE)	
Broad-Based (BB)	
BB1: Students will analyze the core concepts of technology.	
Analyze and use technological systems BB1.a	1.a.5.h: Describe how systems can fail because of design flaws, defect parts, poorly matched parts or they were used beyond their design capabilities. 1.a.6.h: Describe how the outputs of one subsystem are the inputs of another subsystem given a prominent energy, power and transportation system.
Analyze and use tools and materials BB1.b	1.b.5.h: Select appropriate resources and explain how trade-offs between competing values, such as availability, cost, desirability, and waste influenced their decision. 1.b.6.h: Choose and perform the material processing operations of forming (e.g., bending, pressing, drawing, rolling), bonding (e.g., gluing, soldering, brazing, spot welding, gas welding, arc welding), fastening (e.g., screws, nuts & bolts, rivets, clips, pins, nails) and finishing (e.g., surface preparation, cleaning, treatment, coating).
Analyze and use electricity and electronic systems BB1.d	1.d.5.h: Describe the role of thermal, optical, and mechanical transducers in sending electrical control signals to modify how a system performs. 1.d.6.h: Perform a voltage drop test and describe the relationship between voltage, current, and resistance with a multimeter. 1.d.7.h: Inspect and test components such as switches, connectors, relays, and solid state devices and conductors and take appropriate action.
Analyze, explain, and use control systems BB1.e	1.e.6.h: Select and perform appropriate maintenance in order for the product or system to continue functioning properly, to extend its life or to upgrade its capability given a flawed product or system.
Electronics (EL)	
EL1: Students will develop, use, and apply basic electronics and electricity concepts.	
Apply electronic theory to practice EL1.a	1.a.13.h: Calculate current, voltage, or resistance using Ohm's Law and Kirchoff's Voltage Law.
EL2: Students will develop the ability to use symbols, measurements, and schematics to build, test, and troubleshoot electronic circuits and systems.	
Construct and measure a basic circuit using electronic components EL2.a	2.a.10.h: Demonstrate multimeter and usage.
Demonstrate electronic measurement to series, parallel, and combination circuits	2.b.5.h: Explain how a series circuit is used in DC electronic equipment.

EL2.b	2.b.6.h: Calculate an unknown current, voltage, or resistance in a series circuit using Ohm's Law. 2.b.7.h: Explain how a parallel circuit is used in DC electronic equipment. 2.b.8.h: Calculate an unknown current, voltage, or resistance in a parallel circuit using Ohm's Law.
EL7: Demonstrate safe and appropriate use of tools, machines, and materials in electronics technology.	
Demonstrate, apply, and measure electronic safety concepts applied to circuits EL7.a	7.a.6.h: Demonstrate the safe usage of appropriate tools, procedures, and operation of equipment. 7.a.7.h: Describe personal safety precautions for working with electric and electronic devices electrical shock.
Power and Energy (PE)	
PE1: Students will be able to select and use energy and power technologies.	
Analyze, use, and discuss machine and tool use relating to energy and power systems PE1.b	1.b.11.h: Demonstrate and follow proper safety procedures for tools and machines used in power and energy systems. 1.b.12.h: Demonstrate the practical and theoretical applications of test equipment to identify voltage, current, and resistance in energy systems.
Transportation Standards (TR)	
TR1: Students will be able to select and use transportation technologies.	
Analyze and explain transportation systems TR1.a	1.a.7.h: Identify how government regulations and technological trade-offs might influence the transportation modes used to move people and goods from one place to another. 1.8.h: Relate how the current and future design of advanced transportation systems depends on many innovative materials and processes.
Analyze and explain how transportation vehicles and transportation vehicle systems work TR1.b	1.b.7.h: Interpret preventive maintenance schedules and recommended service intervals for vehicles. 1.b.8.h: Define the interdependency of individual systems within a vehicle. 1.b.9.h: Explain that all systems demand specific repair procedures in order to achieve the highest performance and efficiency.
Develop the skill set necessary to diagnose, problem solve and repair transportation vehicles TR1.c	1.c.9.h: Develop measurement skills in electrical/ electronic, mechanical, and hydraulic applications that are necessary to efficiently repair vehicles. 1.c.10.h: Students will perform tasks related directly to current national standards per transportation area (i.e., NATEF). 1.c.11.h: Demonstrate safe and proficient use of specialty tools and equipment related to servicing transportation vehicles. 1.c.12.h: Explain career preparation, career pathways and the importance of on-the-job training

	as well as further education with regard to the transportation field.
Wisconsin Common Career Technical Standards (WCCTS)	
Creativity, Critical Thinking, Communication and Collaboration (4C)	
4C1: Students will think and work creatively to develop innovative solutions to problems and opportunities.	
Develop original solutions, products, and services to meet a given need 4C1.a	1.a.7.h: Develop original ways to solve a given problem. 1.a.8.h: Design a product or service that could fulfill a human need or desire. 1.a.9.h: Apply past experiences to current problems in developing innovative solutions.
Work creatively with others to develop solutions, products, and services 4C1.b	1.b.7.h: Incorporate the skills and experiences of others to develop a new solution to a problem. 1.b.8.h: Work as part of a team to design a product or service that could fulfill a human need or desire. 1.b.9.h: Work as part of a team to improve an existing product or process.
4C2: Students will formulate and defend judgments and decisions by employing critical thinking skills.	
Develop effective resolutions for a given problem, decision or opportunity using available information 4C2.a	2.a.11.h: Determine the information needed to address an identified problem. 2.a.12.h: Contrast the benefits and drawbacks of various proposed resolutions to a given situation. 2.a.13.h: Predict how an action could result in unintended consequences, both positive and negative. 2.a.14.h: Analyze the impact of a decision using a systems thinking model. 2.a.15.h: Determine the best resolution for a problem, decision or opportunity based on given criteria. 2.a.16.h: Defend an action taken or a decision implemented.
Develop and implement a resolution for a new situation using personal knowledge and experience 4C2.b	2.b.5.h: Apply past experience to develop a course of action for a new situation. 2.b.6.h: Use existing knowledge to develop a resolution for a new situation, problem, or opportunity.
4C3: Students will communicate and collaborate with others to accomplish tasks and develop solutions to problems and opportunities.	
Communicate thoughts and feelings with others using verbal and non-verbal language 4C3.a	3.a.9.h: Develop a mutually acceptable response to a question or problem. 3.a.11.h: Communicate effectively in the presence of a language barrier. 3.a.12.h: Utilize effective listening skills in creating consensus in a group.

Work collaboratively with others 4C3.b	3.b.7.h: Participate in group processes to generate consensus. 3.b.8.h: Lead group processes to generate consensus.
Use interpersonal skills to resolve conflicts with others in an ethical manner 4C3.c	3.c.7.h: Resolve conflicts productively with individuals as they arise. 3.c.8.h: Lead a team or group through a conflict resolution process to reach a productive outcome.
Career Development (CD)	
CD1: Students will consider, analyze, and apply an awareness of self, identity and culture to identify skills and talents.	
Identify person strengths, aptitudes and passions CD1.a	1.a.3.h: Evaluate various occupations and career pathways to identify personal, academic and career goals based on personal strengths, aptitudes and passions.
Demonstrate effective decision-making, problem solving and goal setting CD1.b	1.b.5.h: Use a decision-making and problem-solving model. 1.b.6.h: Develop an action plan to set and achieve realistic goals.
CD2: Students will identify the connection between educational achievement and work opportunities in order to reach personal and career goals.	
Assess attitudes and skills that contribute to successful learning in school and across the life span CD2.b	2.b.8.h: Assess education and training opportunities to acquire new skills necessary for career advancement.
CD3: Students will create and manage a flexible and responsive individualized learning plan to meet their career goals.	
Examine and evaluate opportunities that could enhance life and career plans and articulate plans to guide decisions and actions CD3.b	3.b.5.h: Evaluate the relationship between educational achievement and career development.
Employ career management strategies to achieve future career success and satisfaction CD3.c	3.c.6.h: Discuss how adaptability and flexibility, especially when initiating or responding to change, contributes to career success.
CD4: Students will identify and apply employability skills.	
Demonstrate skills related to seeking and applying for employment to find and obtain a desired job CD4.b	4.b.6.h: Prepare a resume, cover letter, employment application.
Identify and exhibit traits for retaining employment CD4.c	4.c.4.h: Model behaviors that demonstrate reliability and dependability. 4.c.5.h: Maintain appropriate dress and behavior for the job to contribute to a safe and effective workplace/jobsite.
Environment, Health, and Safety (EHS)	

EHS1: Students will identify the importance and interrelationships of health, safety and environmental systems and evaluate the impacts of these systems on organizational performance for continuous improvement.	
Implement personal and jobsite safety rules and regulations to maintain and improve safe and healthful working conditions and environments EHS1.d	1.d.8.h: Identify different workplace systems that protect and enhance personal and environmental health and safety.

Automotive Service Excellence (ASE)

I. Engine Repair

A. General

1. Research vehicle service information such as fluid type, internal combustion engine operation, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
3. Verify operation of the instrument panel engine warning indicators.
4. Inspect engine assembly for fuel, oil, coolant, and other leaks.
5. Install engine covers using gaskets, seals, and sealers as required.
6. Demonstrate understanding of the procedure for verifying engine mechanical timing.
8. Identify service precautions related to service of the internal combustion engine of a hybrid electric vehicle.

D. Lubrication and Cooling Systems

1. Identify lubrication and cooling system components and configurations.
2. Perform engine oil and filter change; use proper fluid type per manufacturer specification; reset maintenance reminder as required.
3. Perform colling system pressure and dye tests to identify leaks; check coolant condition and level; inspect and test radiator, pressure cap, coolant recovery tank, heater core, and galley plugs.
5. Inspect, replace, and/or adjust drive belts, tensioners, and pulleys; check pulley and belt alignment.
6. Inspect and test coolant; drain and recover coolant; flush and/or refill colling system; use proper fluid type per manufacturer specification; bleed air as required.
8. Remove, inspect, and replace thermostat and gasket/seal.

II. Automotive Transmission and Transaxle

A. General

1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS).
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.

B. In-Vehicle Transmission and Transaxle

1. Inspect 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 and/or align power train mounts.

C. Off-Vehicle Transmission and Transaxle

1. Describe the operational characteristics of a continuously variable transmission (CVT). 2. Describe the operational characteristics of a hybrid vehicle drive train.
III. Manual Drive Train and Axles
A. General
1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS). 2. Identify manual drive train and axle components and configurations. 4. Check fluid condition; check for leaks. 5. Drain and refill manual transmission/transaxle; use proper fluid type per manufacturer specification.
B. Clutch
1. Check and adjust clutch master cylinder fluid level; check for leaks; use proper fluid type per manufacturer specification.
D. Drive Shaft, Half Shafts, Universal Joints and Constant-Velocity (CV) Joints (Front, Rear, All, and Four-Wheel Drive)
1. Inspect and/or remove/replace bearings, hubs, and seals. 2. Inspect and/or service/replace shafts, yokes, boots, and universal/CV joints. 3. Check for leaks at drive assembly and transfer case seals; check vents; check fluid level; use proper fluid type per manufacturer specification.
E. Differential and Drive Axles **E.1** Ring and Pinion Gears and Differential Housing Assembly
1. Inspect differential housing; check for leaks; inspect housing vent. 2. Check and adjust differential housing fluid level; use proper fluid type per manufacturer specification. 3. Drive and refill differential housing; using proper fluid type per manufacturer specification.
E. Differential and Drive Axles **E.2** Drive Axles
1. Inspect and replace drive axle wheel studs.
IV. Suspension and Steering
A. General
1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS). 2. Identify suspension and steering system components and configurations. 4. Disable and enable supplemental restraint system (SRS); verify indicator lamp operation.
B. Steering Systems
1. Inspect rack and pinion steering gear tie rod ends (sockets) and bellows boots. 2. Inspect power steering fluid level and condition. 3. Drain and replace power steering system fluid; use proper fluid type per manufacturer specification. 4. Inspect for power steering fluid leakage. 5. Remove, inspect, replace, and/or adjust power steering pump drive belt. 7. Inspect pitman arm, relay (centerlink/intermediate) rod, idler arm, mountings, and steering linkage damper. 8. Inspect tie rod ends (sockets), tie rod sleeves, and clamps (non-rack and pinions).

C. Suspension Systems
1. Inspect upper and/or lower control arms, bushings, and shafts. 2. Inspect and replace rebound/jounce bumpers. 3. Inspect track bar, strut rods/radius arms, and related mounts and bushings. 4. Inspect upper and/or lower ball joints (with or without wear indicators). 5. Inspect suspension system coil springs and spring insulators. 6. Inspect torsion bars and mounts. 7. Inspect and/or replace front/rear stabilizer bar (sway bar) bushings, brackets, and links. 8. Inspect, remove, and/or replace strut assembly, strut coil spring, insulators, and upper strut bearing mount.
D. Related Suspension and Steering Service
1. Inspect, remove, and/or replace shock absorbers; inspect mounts and bushings. 3. Describe the function of electronically controlled suspension and steering systems and components, (i.e., active suspension and stability control).
E. Wheel Alignment
1. Perform pre-alignment inspection; measure vehicle ride height. 2. Describe four-wheel alignment angles (camber, caster, and toe) and effects on vehicle handling/tire wear.
F. Wheels and Tires
1. Inspect tire condition/age; identify tire wear patterns; check for correct tire size, application (service-class, load, and speed ratings), and air pressure as listed on the tire information placard/label. 2. Rotate tires according to manufacturer's recommendations including vehicles equipped with tire pressure monitoring systems (TPMS). 3. Dismount, inspect, and remount tire on wheel (with/without TPMS); balance wheel and tire assembly. 4. Inspect tire and wheel assembly for air loss; determine needed action. 5. Repair tire following vehicle manufacturer approved procedure. 6. Identify indirect and direct tire pressure monitoring systems (TPMS); calibrate/relearn system; verify operation of instrument panel lamps. 7. Demonstrate knowledge of steps required to remove and replace sensors (per OEM/sensor manufacturer) in a tire pressure monitoring system (TPMS).
V. Brakes
A. General
1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS). 2. Identify brake system components and configurations. 4. Describe procedure for performing a road test to check brake system operation, including an anti-lock brake system (ABS). 5. Install wheel and torque lug nuts.
B. Hydraulic System
2. Describe proper brake pedal height, travel, and feel. 3. Check master cylinder for proper operation. 4. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging, wear, and loose fitting/supports. 5. Select, handle, store, and fill brake fluids to proper level; use proper fluid type per manufacturer specification.

C. Drum Brakes
1. Remove, clean, and inspect brake drum; measure brake drum diameter; determine serviceability. 2. Refinish brake drum and measure final drum diameter; compare with specification. 3. Remove, clean, inspect, and/or replace brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble. 4. Inspect wheel cylinders for leaks and proper operation; remove and replace as needed. 5. Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings; perform final checks and adjustments.
D. Disc Brakes
1. Remove and clean caliper assembly; inspect for leaks and damage, and wear. 2. Inspect caliper mounting and slides/pins for proper operation, wear, and damage. 3. Remove, inspect, and/or replace brake pads and retaining hardware. 4. Lubricate and reinstall caliper, brake pads, and related hardware; seat brake pads against rotor; inspect for leaks. 5. Clean and inspect rotor and mounting surface, measure rotor thickness, thickness variation, and lateral runout. 6. Remove and reinstall/replace rotor. 9. Retract and re-adjust caliper piston on an integrated parking brake system. 10. Describe importance of operating vehicle to burnish/ break-in replacement brake pads according to manufacturer's recommendation.
E. Power-Assist Units
1. Check brake pedal travel with and without engine running to verify proper power booster operation. 2. Identify components of the brake power assist system (vacuum/hydraulic/electric).
F. Related Systems (i.e., Wheel Bearings, Parking Brakes, Electrical)
1. Remove, clean, inspect, repack/replace, and install wheel bearings; remove and install bearing races; replace seals; install hub and adjust bearings. 2. Check parking brake system components for wear, binding, and corrosion; clean, lubricate, adjust and/or replace as needed. 3. Check parking brake operation (including electric parking brakes); check parking brake indicator light system operation. 4. Check operation of brake stop light system. 5. Inspect and replace wheel studs.
G. Electronic Brake Control Systems: Antilock Brake (ABS), Traction Control (TCS) and Electronic Stability Control (ESC) Systems
2. Describe the operation of a regenerative braking system.
VI. Electrical/Electronic Systems
A. General
1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS). 2. Identify electrical/electronic system components and configurations. 4. Demonstrate knowledge of electrical/electronic series, parallel, and series-parallel circuits using principles of electricity (Ohm's Law). 5. Demonstrate proper use of a digital multimeter (DMM) when measuring source voltage, voltage drop (including grounds), current flow, and resistance.

6. Demonstrate knowledge of the causes and effects from shorts, grounds, opens, and resistance problems in electrical/electronic circuits. 7. Describe types of test lights; use appropriate test light to check operation of electrical circuits per service information. 8. Use fused jumper wires to check operation of electrical circuits per service information. 9. Use wiring diagrams to trace electrical/electronic circuits. 10. Measure key-off battery drain (parasitic draw). 11. Inspect and test fusible links, circuit breakers, and fuses. 12. Repair and/or replace connectors, terminal ends, and wiring of electrical/ electronic systems (including solder repair).
B. Batteries (Conventional 12-volt)
1. Perform battery state-of-charge test; determine needed action. 2. Confirm proper battery capacity, size, type, and application for vehicle; perform battery capacity and load test. 3. Maintain or restore electronic memory functions as recommended by manufacturer. 4. Inspect and clean battery; fill battery cells (if applicable); check battery cables, connectors, clamps, and hold-downs. 5. Perform battery charging according to manufacturer's recommendations. 6. Jump-start vehicle using jumper cables and a booster battery or an auxiliary power supply. 7. Identify electrical/ electronic modules, security systems, radios, and other accessories that require reinitialization or code entry after reconnecting vehicle battery.
C. Starting System
1. Perform starter current draw test. 2. Perform starter circuit voltage drop tests. 3. Inspect and test starter relays and solenoids. 4. Remove and install starter in a vehicle. 5. Inspect and test switches, connectors, and wires of starter control circuit.
D. Charging System
1. Perform charging system output test. 2. Inspect, adjust, and/or replace generator (alternator) drive belts; check pulleys and tensioners for wear; check pulley and belt alignment. 3. Remove, inspect, and/or replace generator (alternator). 4. Perform charging circuit voltage drop tests.
E. Lighting Systems
1. Inspect interior and exterior lamps and sockets including headlights and auxiliary lights (fog lights/driving lights); replace as needed. 2. Aim headlights.
F. Instrument Cluster and Driver Information Systems
1. Verify operation of instrument panel gauges and warning/indicator lights; reset maintenance indicators as required.
G. Body Electrical Systems
2. Remove and reinstall door panel. 3. Describe the operation of keyless entry/remote-start systems. 4. Describe disabling and enabling procedures for supplemental restraint system (SRS); verify indicator lamp operation. 5. Verify windshield wiper and washer operation; replace wiper blades.
VII. Heating, Ventilation, and Air Conditioning (HVAC)

A. General
1. Research vehicle service information, including refrigerant/oil/fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS). 2. Identify heating, ventilation, and air conditioning (HVAC) components and configurations.
B. Refrigeration System Components
1. Inspect and/or replace A/C compressor drive belts, pulleys, tensioners. 2. Inspect for proper A/C condenser airflow.
C. Heating, Ventilation, and Engine Cooling Systems
1. Inspect engine colling and heater systems hoses and pipes.
D. Operating Systems and Related Controls
1. Inspect A/C-heater ducts, doors, hoses, cabin filters, and outlets.
VIII. Engine Performance
A. General
1. Research vehicle service information such as fluid type, vehicle service history, service precautions, technical service bulletins, and recalls including vehicles equipped with advanced driver assistance systems (ADAS). 2. Retrieve and record DTCs, OBD monitor status, and freeze frame data; clear codes and data when directed.
C. Ignition System
2. Remove and replace spark plugs; inspect secondary ignition components for wear and damage.
D. Fuel, Air Induction, and Exhaust Systems
2. Replace fuel filter(s) where applicable. 3. Inspect, service, or replace air filters, filter housings, and intake duct work. 4. Inspect integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shields. 5. Inspect condition of exhaust system hangers, brackets, clamps, and heat shields. 6. Check and refill diesel exhaust fluid (DEF).
E. Emissions Control Systems
2. Inspect, test, and service, and/or replace positive crankcase ventilation (PCV) filter/breather, valve, tubes, orifices, and hoses.

Key Vocabulary:			
Acronyms:	OBD	Impeller	Technical Service Bulletin
ABS	Direct Injection	Misfire	Thrust
BCM	Electromagnetism	Propeller	Transaxle
DLC	Fuel injection	Radiator	Voltage Regulator
ECM	Helical	Schematic	Voltmeter
EFI	Hemispherical	Solenoid	Wheel Cylinder

Topics/Content Outline- Units and Themes:

Quarter 1: Safety and Vehicle Inspection

- Careers and Professionalism in the Industry
- Safety in the Lab and Around the Vehicle
- Vehicle Identification and Service Information

Quarter 2: Vehicle Maintenance and Care

- Buying, Owning, and Selling a Vehicle
- Preventative Maintenance
- Welding and Soldering
- Wheels and Tires
- Automotive Engine Design and Technology

Quarter 3: Basic Vehicle Systems

- Lubrication and Cooling Systems
- Battery Service
- Starting and Charging Systems
- Electrical and Lighting Systems

Quarter 4: Basic Vehicle Systems

- Electronic Fuel Injection Systems
- Ignition Systems
- Scan Tool Hook-Up
- Disc and Drum Brakes
- Steering and Suspension Systems

Primary Resource(s):

Automotive Technology: A Systems Approach, 6th Edition
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