AUTOMOTIVE SERVICE TECHNICIAN - III-12712

DATE:

INDUSTRY SECTOR: Transportation Sector

PATHWAY: Systems Diagnostics, Service and Repair

CALPADS TITLE: Advanced Systems Diagnostics, Service, and Repair (Capstone)

CALPADS CODE: 8532

HOURS:

Total	Classroom	Laboratory/CC/CVE
1080	240	840

JOB TITLE	O*NET CODE	JOB TITLE	O*NET CODE
Tire Repairers and Changers	49-3093.00	Automotive Specialty Technicians	49-3023.02
Recreational Vehicle Service Technicians	49-3092.00	Helpers--Installation, Maintenance, and Repair Workers	49-9098.00
Automotive and Watercraft Service Attendants	53-6031.00		

COURSE DESCRIPTION:

The Automobile Service Technology (AST) course prepares students for entry into Automobile Service Technology (AST). Students study automotive general electrical systems, starting and charging systems, batteries, lighting, and electrical accessories. Upon completing all of the Automobile Service Technology (AST) courses, students may enter the automotive service industry as an ASE Certified AST Technician. Hours earned in Automobile Service Technology (AST) courses may be used toward meeting National Automotive Technicians Education Foundation (NATEF) standards and California Department of Education standards. NATEF requires that 95% of the P-1 tasks, 80% of the P-2 tasks, and 50% of the P-3 tasks will be accomplished. These tasks are notated in these standards.

A-G APPROVAL: No

ARTICULATION: None

DUAL ENROLLMENT: None

PREREQUISITES:

Prerequisite
REQUIRED - Completion of AST I and AST II

METHODS OF INSTRUCTION

- Direct instruction
- Group and individual applied projects
- Multimedia
- Demonstration
- Field trips
- Guest speakers

STUDENT EVALUATION:

- Student projects
- Written work
- Exams
- Observation record of student performance
- Completion of assignment

INDUSTRY CERTIFICATION:

- None

RECOMMENDED TEXTS:

- Duffy, Modern Automotive Technology, 8th ISBN Number 978-1619603707

PROGRAM OF STUDY

Grade	Fall	Spring	Year	Course Type	Course Name
9, 10, 11, 12				Introductory	Automotive Service Technician - I-12713
10, 11, 12				Concentrator	Automotive Service Technician - II-12714
11, 12				Capstone	Automotive Service Technician - III-12712

I.	INTRODUCTION	CR	Lab/ CC	Standards
	Student Learning Objectives: • Identifies the personal qualifications, interests, aptitudes, knowledge, and skills of successful automotive technician assistants and helpers. • Demonstrates an understanding of personal, professional, and educational requirements of this career field. • Demonstrates knowledge of policies, procedures, and regulations related to workplace health and safety.	10	50	**Academic:** RLST: 11-12.3 **CTE Anchor:** Communications: 2.1 **CTE Pathway:** C1.1
II.	**UNDERSTANDING THE MATERIAL SAFETY DATA SHEETS (MSDS)**	**CR**	**Lab/ CC**	**Standards**
	Student Learning Objectives: • Practices safe working habits in the automotive shop/lab. • Locates, reads, and understands Material Safety Data Sheets (MSDSs) in the automotive shop/lab. • Follows fire prevention and control procedures. • Practices appropriate cleanup and maintenance skills. • Demonstrates safe handling of hazardous waste materials and appropriate disposal methods.	10	50	**Academic:** RLST: 11-12.3 **CTE Anchor:** Communications: 2.1 **CTE Pathway:** C1.1
III.	**AUTOMOTIVE SERVICES**	**CR**	**Lab/ CC**	**Standards**
	Student Learning Objectives: • Engine • Cooling • Exhaust Lubrication • Drive Train Electrical/Electronic Fuel • Ignition	10	50	**Academic:** RLST: 11-12.3 **CTE Anchor:** Communications: 2.1 **CTE Pathway:** C1.1
IV.	**HAND TOOLS**	**CR**	**Lab/ CC**	**Standards**
	Student Learning Objectives: • Practices safe working habits in the shop. • Demonstrates proper use of hand tools, power tools, and equipment. • Demonstrates proper use of measuring instruments. • Demonstrates tool and inventory control. • Practices appropriate cleanup and maintenance skills.	10	50	**Academic:** RLST: 11-12.3 **CTE Anchor:** Communications: 2.1 **CTE Pathway:** C1.1
V.	**POWER TOOLS**	**CR**	**Lab/ CC**	**Standards**
	Student Learning Objectives: • Practices safe working habits in the shop. • Demonstrates proper use of hand tools, power tools, and equipment. • Demonstrates tool and inventory control. • Practices appropriate cleanup and maintenance skills. • Uses tools and machines safely and appropriately. Follows directions.	10	50	**Academic:** RLST: 11-12.3 **CTE Anchor:** Communications: 2.1 **CTE Pathway:** C1.1
VI.	**FASTENERS AND SEALANTS**	**CR**	**Lab/ CC**	**Standards**
	Student Learning Objectives: • Practices safe working habits in the shop. • Identifies and utilizes appropriate securing fasteners and sealants. Uses service reference materials. • Practices appropriate cleanup and maintenance skills. • Follows directions.	10	50	**Academic:** RLST: 11-12.3 **CTE Anchor:** Communications: 2.1 **CTE Pathway:** C1.1
VII.	**SHOP AND PERSONAL SAFETY**	**CR**	**Lab/ CC**	**Standards**

	Student Learning Objectives: • Identify general shop safety rules and procedures. • Utilize safe procedures for the handling of tools and equipment. Identify and use the proper placement of floor jacks and jack stands. Identify and use proper procedures for safe lift operation. • Utilize proper ventilation procedures for working within the lab/shop area. Identify marked safety areas. • 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. Identify the location and use of eyewash stations. Identify the location of the posted evacuation routes. Comply with the required use of safety glasses, ear protection, gloves, and shoes during lab/shop activities. • Identify and wear appropriate clothing for lab/shop activities. Secure hair and jewelry for lab/shop activities. • Demonstrate awareness of the safety aspects of supplemental restraint systems (SRS), electronic brake control systems, and hybrid vehicle high voltage circuits. • Demonstrate awareness of the safety aspects of high voltage circuits (such as high-intensity discharge (HID) lamps, ignition systems, injection systems, etc.). Locate and demonstrate knowledge of material safety data sheets (MSDS).	10	50	**Academic:** RLST: 11-12.3 **CTE Anchor:** Communications: 2.1 **CTE Pathway:** C1.1
VIII.	**LIFTING EQUIPMENT**	**CR**	**Lab/ CC**	**Standards**
	Student Learning Objectives: • Demonstrates safe use of a hoist. • Demonstrates safe use of floor jacks, safety stands, and wheel chocks. • Uses tools and equipment safely and appropriately. • Follows directions.	10	50	**Academic:** RLST: 11-12.3 **CTE Anchor:** Communications: 2.1 **CTE Pathway:** C1.1
IX.	**ENGINE REPAIR**	**CR**	**Lab/ CC**	**Standards**
	Student Learning Objectives: • General Engine Diagnosis; Removal and Reinstallation (R&R) • Cylinder Head and Valve Train Diagnosis and Repair • Engine Block Assembly Diagnosis and Repair • Lubrication and Cooling Systems Diagnosis and Repair **Key Assignments:** 1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction. Research applicable vehicle and service information, such as internal engine operation, vehicle service history, service precautions, and technical service bulletins. Verify operation of the instrument panel engine warning indicators. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action. Install engine covers using gaskets, seals, and sealers as required. Remove and replace timing belt; verify correct camshaft timing. Perform common fastener and thread repair, to include: remove a broken bolt, restore internal and external threads, and repair internal threads with thread insert. Inspect, remove and replace engine mounts. Identify hybrid vehicle internal combustion engine service precautions. Remove and reinstall engine in an OBDII or newer vehicle; reconnect all attaching components and restore the vehicle to running condition. 2. Remove cylinder head; inspect gasket condition; install cylinder head and gasket; tighten according to manufacturer's specifications and procedures. Clean and visually inspect a cylinder head for cracks; check gasket surface areas for warpage and surface finish; check passage condition. Inspect pushrods, rocker arms, rocker arm pivot!! and shafts for wear, bending, cracks, looseness, and blocked oil passages (orifices); determine necessary action. Adjust valves (mechanical or hydraulic lifters). Inspect and replace camshaft and drive belt/chain; includes checking drive gear wear and backlash, end play, sprocket and chain wear, overhead cam drive sprocket(s), drive belt(s), belt tension, tensioners, camshaft reluctor ring/tone-wheel, and valve timing components; verify correct camshaft timing. Establish camshaft position sensor indexing. Remove, inspect, or replace crankshaft vibration damper (harmonic balancer). 3. Perform cooling system pressure and dye tests to identify leaks; check coolant condition and level; inspect and test radiator, pressure cap, coolant recovery tank, and heater core and galley plugs; determine necessary action. Identify the causes of engine overheating. Inspect, replace, and adjust drive belts, tensioners, and pulleys; check pulley and belt alignment. Inspect and test coolant; drain and recover coolant; flush and refill cooling system with recommended coolant; bleed air as required. Inspect, remove, and replace the water pump. Remove and replace the radiator. Remove,	30	70	**Academic:** RLST: 11-12.3 **CTE Anchor:** Communications: 2.1 **CTE Pathway:** C1.1

	inspect, and replace thermostat and gasket/seal. Inspect and test fan(s) (electrical or mechanical), fan clutch, fan shroud, and air dams. Perform oil pressure tests; determine necessary action. Perform engine oil and filter change. Inspect auxiliary coolers; determine necessary action. Inspect, test, and replace oil temperature and pressure switches and sensors.			
X.	**AUTOMOTIVE TRANSMISSION AND TRANSAXLE**	**CR**	**Lab/ CC**	**Standards**
	Student Learning Objectives: • General Transmission and Transaxle Diagnosis • In-Vehicle Transmission/Transaxle Maintenance and Repair • Off-Vehicle Transmission and Transaxle Repair **Key Assignments:** 1. Identify and interpret transmission/transaxle concern, differentiate between engine performance and transmission/transaxle concerns; determine necessary action. Research applicable vehicle and service information fluid type, vehicle service history, service precautions, and technical service bulletins. Diagnose fluid loss and condition concerns; determine necessary action. Check fluid level in transmission or a transaxle equipped with a dip-stick. Check fluid level in transmission or a transaxle not equipped with a dip-stick. Perform a stall test; determine necessary action. Perform lock-up converter system tests; determine necessary action. Diagnose transmission/transaxle gear reduction/multiplication concerns using driving, driven, and held member (power flow) principles. Diagnose pressure concerns in transmission using hydraulic principles (Pascal's Law). 2. Inspect, adjust, and replace external manual valve shift linkage, transmission range sensor/switch, and park/neutral position switch. Inspect for leakage; replace external seals, gaskets, and bushings. Inspect, test, adjust, repair, or replace electrical/electronic components and circuits including computers, solenoids, sensors, relays, terminal connectors, switches, and harnesses. Drain and replace fluid and filter(s). Inspect, replace and align power train mounts. 3. Remove and reinstall transmission/transaxle and the torque converter; inspect engine core plugs, rear crankshaft seal, dowel pins, dowel pin holes, and mating surfaces. Inspect, leak test, and flush or replace transmission/transaxle oil cooler, lines, and fittings. Inspect converter flex (drive) plate, converter attaching bolts, converter pilot, converter pump drive surfaces, converter end play, and crankshaft pilot bore. Describe the operational characteristics of a continuously variable transmission (CVT). Describe the operational characteristics of a hybrid vehicle drive train.	20	60	**Academic:** RLST: 11-12.3 **CTE Anchor:** Communications: 2.1 **CTE Pathway:** C1.1
XI.	**MANUAL DRIVE TRAIN AND AXLES**	**CR**	**Lab/ CC**	**Standards**
	Student Learning Objectives: • General Drive Train Diagnosis • Clutch Diagnosis and Repair • Transmission/Transaxle Diagnosis and Repair • Drive Shaft and Half Shaft, Universal and Constant-Velocity (CV) Joint Diagnosis and Repair • Drive Axle Diagnosis and Repair; 1 Ring and Pinion Gears and Differential Case Assembly • 2 Drive Axles • Four-wheel Drive/All-wheel Drive Component Diagnosis and Repair **Key Assignments:** 1. Identify and interpret drive train concerns; determine necessary action. Research applicable vehicle and service information, fluid type, vehicle service history, service precautions, and technical service bulletins. Check fluid condition; check for leaks; determine necessary action. Drain and refill manual transmission/transaxle and final drive unit. 2. Diagnose clutch noise, binding, slippage, pulsation, and chatter; determine necessary action. Inspect clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots, and springs; perform necessary action. Inspect and replace clutch pressure plate assembly, clutch disc, release (throw-out) bearing and linkag1 and pilot bearing/bushing (as applicable). Bleed clutch hydraulic system. Check and adjust clutch master cylinder fluid level; check for leaks. Inspect flywheel and ring gear for wear and cracks; determine necessary action. Measure flywheel runout and crankshaft end play; determine necessary action. 3. Inspect, adjust, and reinstall shift linkages, brackets, bushings, cables, pivots, and levers. Describe the operational characteristics of an electronically-controlled manual transmission/transaxle. 4. Diagnose constant-velocity (CV) joint noise and vibration concerns; determine necessary action. Diagnose universal joint noise and vibration concerns; perform necessary action. Inspect, remove, and replace front-wheel drive (FWD) bearings, hubs, and seals. Inspect, service, and replace shafts, yokes, boots, and universal/CV joints. Check shaft balance and phasing; measure shaft runout; measure and adjust driveline angles. 5. Clean and inspect differential housing; check for leaks; inspect the housing vent. Check and adjust the differential housing fluid level. Drain and refill differential housing. Inspect and replace companion flange and pinion seal; measure companion flange runout. Inspect and replace drive	10	50	**Academic:** RLST: 11-12.3 **CTE Anchor:** Communications: 2.1 **CTE Pathway:** C1.1

	axle wheel studs. Remove and replace drive axle shafts. Inspect and replace drive axle shaft seals, bearings, and retainers. Measure drive axle flange runout and shaft end play; determine necessary action. 6. Inspect, adjust, and repair shifting controls (mechanical, electrical, and vacuum), bushings, mounts, levers, and brackets. Inspect front-wheel bearings and locking hubs; perform necessary action(s). Check for leaks at drive assembly seals; check vents; check lube level. Identify concerns related to variations in tire circumference and/or final drive ratios.			
XII.	**SUSPENSION AND STEERING**	**CR**	**Lab/ CC**	**Standards**
	Student Learning Objectives: • General Suspension and Steering Systems • Steering Systems Diagnosis and Repair • Suspension Systems Diagnosis and Repair • Related Suspension and Steering Service • Wheel Alignment Diagnosis, Adjustment, and Repair • Wheels and Tires Diagnosis and Repair **Key Assignments:** 1. Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins. 2. Disable and enable the supplemental restraint system (SRS). Remove and replace steering wheel; center/time supplemental restraint system (SRS) coil (clock spring). Diagnose steering column noises, looseness, and binding concerns (including tilt mechanisms); determine necessary action. 3. Diagnose power steering gear (non-rack and pinion) binding, uneven turning effort, looseness, hard steering, and noise concerns; determine necessary action. Diagnose power steering gear (rack and pinion) binding, uneven turning effort, looseness, hard steering, and noise concerns; determine necessary action. Inspect steering shaft universal-joint(s), flexible coupling(s), collapsible column, lock cylinder mechanism, and steering wheel; perform necessary action. Remove and replace rack and pinion steering gear; inspect mounting bushings and brackets. Inspect rack and pinion steering gear inner tie rod ends (sockets) and bellows boots; replace as needed. Determine proper power steering fluid type; inspect the fluid level and condition. Flush, fill and bleed power steering system. Inspect for power steering fluid leakage; determine necessary action. Remove, inspect, replace, and adjust power steering pump drive belt. Remove and reinstall the power steering pump. Remove and reinstall press-fit power steering pump pulley; check pulley and belt alignment. Inspect and replace power steering hoses and fittings. Inspect and replace pitman arm, relay (center link/intermediate) rod, idler arm and mountings, and steering linkage damper. Inspect, replace, and adjust tie rod ends (sockets), tie rod sleeves, and clamps. Identify hybrid vehicle power steering system electrical circuits and safety precautions. Inspect electric power-assisted steering. 4. Diagnose short and long arm suspension system noises, body sway, and uneven ride height concerns; determine necessary action. Diagnose strut suspension system noises, body sway, and uneven ride height concerns; determine necessary action. Inspect, remove and install upper and lower control arms, bushings, shafts, and rebound bumpers. Inspect, remove and install strut rods and bushings. Inspect, remove and install upper and/or lower ball joints (with or without wear indicators). Inspect, remove and install steering knuckle assemblies. Inspect, remove and install short and long arm suspension system coil springs and spring insulators. Inspect, remove and install torsion bars and mounts. Inspect, remove and install front stabilizer bar (sway bar) bushings, brackets, and links. Inspect, remove and install strut cartridge or assembly, strut coil spring, insulators (silencers), and upper strut bearing mount. Inspect, remove and install track bar, strut rods/radius arms, and related mounts and bushings. Inspect rear suspension system leaf spring(s), bushings, center pins/bolts, and mounts. 5. Inspect, remove, and replace shock absorbers; inspect mounts and bushings. Remove, inspect, and service or replace the front and rear wheel bearings. Describe the function of the power steering pressure switch. 6. Diagnose vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer, and steering return concerns; determine necessary action. Perform pre-alignment inspection and measure vehicle ride height; perform necessary action. Prepare vehicle for wheel alignment on alignment machine; perform four-wheel alignment by checking and adjusting front and rear wheel caster, camber; and toe as required; center steering wheel. Check toe-out-on-turns (turning radius); determine necessary action. Check SAi (steering axis inclination) and included angle; determine necessary action. Check rear wheel thrust angle; determine necessary action. Chee] for front-wheel setback; determine necessary action. Check front and/or rear cradle (subframe) alignment; determine necessary action. Reset steering angle sensor. 7. Inspect tire condition; identify tire wear patterns; check for correct tire size and application (load and speed ratings) and adjust air pressure; determine necessary action Diagnose wheel/tire vibration, shimmy, and noise; determine necessary action. Rotate tires according to manufacturer's recommendations. Measure wheel, tire, axle flange, and hub runout; determine necessary action. Diagnose tire pull problems; determine necessary action. Dismount, inspect, and remount tire on	10	50	**Academic:** RLST: 11-12.3 **CTE Anchor:** Communications: 2.1 **CTE Pathway:** C1.1

	the wheel; balance wheel and tire assembly (static and dynamic). Dismount, inspect, and remount tire on wheel equipped with tire pressure monitoring system sensor. Inspect tire and wheel assembly for air loss; perform necessary action. Repair tire using an internal patch. Identify and test tire pressure monitoring system (indirect and direct) for operation; verify operation of instrument panel lamps. Demonstrate knowledge of steps required to remove and replace sensors in a tire pressure monitoring system.			
XIII.	**BRAKES**	**CR**	**Lab/ CC**	**Standards**
	Student Learning Objectives: • General Brake Systems Diagnosis • Hydraulic System Diagnosis and Repair • Drum Brake Diagnosis and Repair • Disc Brake Diagnosis and Repair • Power-Assist Units Diagnosis and Repair • Miscellaneous (Wheel Bearings, Parking Brakes, Electrical, Etc.) Diagnosis and Repair • Electronic Brake, Traction and Stability Control Systems Diagnosis and Repair **Key Assignments:** 1. Identify and interpret brake system concerns; determine necessary action. Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins. Describe the procedure for performing a road test to check brake system operation; including an anti-lock brake system (ABS). Install wheel and torque lug nuts. 2. Diagnose pressure concerns in the brake system using hydraulic principles (Pascal's Law). Measure brake pedal height, travel, and free play (as applicable); determine necessary action. Check master cylinder for internal/external leaks and proper operation; determine necessary action. Remove, bench bleed, and reinstall master cylinder. Diagnose poor stopping, pulling or dragging concerns caused by malfunctions in the hydraulic system; determine necessary action. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging, and wear; check for loose fittings and supports; determine necessary action. Replace brake lines, hoses, fittings, and supports. Fabricate brake lines using proper material and flaring procedures (double flare and ISO types). Select, handle, store, and fill brake fluids to the proper level. Inspect, test, and/or replace components of brake warning light system. Identify components of the brake warning light system. Bleed and/or flush brake system Test brake fluid for contamination. 3. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging or pedal pulsation concerns; determine necessary action. Remove, clean, inspect, and measure brak, drum diameter; determine necessary action. Refinish brake drum and measure final drum diameter; compare with specifications. Remove, clean, and inspect brake shoe: springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble. Inspect wheel cylinders for a leak: and proper operation; remove and replace as needed. 4. Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings; perform final checks and adjustments. 5. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging, or pulsation concerns; determine necessary action. Remove and clean caliper assembly; inspect for leaks and damage/wear to caliper housing; determine necessary action. Clean and inspect caliper mounting and slides/pins for proper operation, wear, and damage; determine necessary action. Remove, inspect, and replace pads and retaining hardware; determine necessary action. Lubricate and reinstall caliper, pads, and related hardware; seat pads and inspect for leaks. Clean and inspect rotor; measure rotor thickness, thickness variation, and lateral runout; determine necessary action. Remove and reinstall rotor. Refinish rotor on the vehicle; measure final rotor thickness and compare with specifications. Refinish rotor off the vehicle; measure final rotor thickness and compare with specifications. Retract and re-adjust caliper piston on an integrated parking brake system. Check brake pad wear indicator; determine necessary action. Describe the importance of operating vehicle to burnish/break-in replacement brake pads according to the manufacturer's recommendations. 6. Check brake pedal travel with, and without, engine running to verify proper power booster operation. Check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster. Inspect vacuum-type power booster unit for leaks; inspect the check-valve for proper operation; determine necessary action. Inspect and test the hydraulically-assisted power brake system for leaks and proper operation; determine necessary action. Measure and adjust master cylinder pushrod length. 7. Diagnose wheel bearing noises, wheel shimmy, and vibration concerns; determine necessary action. Remove, clean, inspect, repack, and install wheel bearings; replace seals; install hub and adjust bearings. Check parking brake cables and components for wear, binding, and corrosion; clean, lubricate, adjust or replace as needed. Check parking brake operation and parking brake indicator light system operation; determine necessary action. Check operation of brake stop light system. Replace wheel bearing and race. Inspect and replace wheel studs. Remove and reinstall sealed wheel bearing assembly.	10	50	**Academic:** RLST: 11-12.3 **CTE Anchor:** Communications: 2.1 **CTE Pathway:** C1.1

	8. Identify and inspect electronic brake control system components; determine necessary action. Identify traction control/vehicle stability control system components. Describe the operation of a regenerative braking system.			
XIV.	**ELECTRICAL/ELECTRONIC SYSTEMS**	**CR**	**Lab/ CC**	**Standards**
	Student Learning Objectives: • General Electrical System Diagnosis • Battery Diagnosis and Service • Starting System Diagnosis and Repair • Charging System Diagnosis and Repair • Lighting Systems Diagnosis and Repair • Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair • Horn and Wiper/Washer Diagnosis and Repair • Accessories Diagnosis and Repair **Key Assignments:** 1. Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins. Demonstrate knowledge of electrical/electronic series, parallel, and series-parallel circuits using principles of electricity (Ohm's Law). Demonstrate proper use of a digital multimeter (DMM) when measuring source voltage, voltage drop (including grounds), current flow and resistance. Demonstrate knowledge of the causes and effects from shorts, grounds, opens, and resistance problems in electrical/electronic circuits. Check operation of electrical circuits with a test light. Check operation of electrical circuits with fused jumper wires. Use wiring diagrams during the diagnosis (troubleshooting) of electrical/electronic circuit problems. Diagnose the cause(s) of excessive key-off battery drain (parasitic draw); determine necessary action. Inspect and test fusible links, circuit breakers, and fuses; determine necessary action. Inspect and test switches, connectors, relays, solenoid solid-state devices, and wires of electrical/electronic circuits; determine necessary action. Replace electrical connectors and terminal ends. Repair wiring harness. Perform solder repair of electrical wiring. 2. Perform a battery state-of-charge test; determine necessary action. Confirm proper battery capacity for vehicle application; perform battery capacity test; determine necessary action. Maintain or restore electronic memory functions. Inspect and clean battery; fill battery cells; check battery cables, connectors, clamps, and hold-downs Perform slow/fast battery charge according to manufacturer's recommendations. Jump-start vehicle using jumper cables and a booster battery or an auxiliary power supply. Identify high-voltage circuits of electric or hybrid electric vehicle and related safety precautions. Identify electronic modules, security systems, radios, and other accessories that require re-initialization or code entry after reconnecting vehicle battery. Identify hybrid vehicle auxiliary (12v) battery service, repair, and test procedures. 3. Perform starter current draw tests; determine necessary action. Perform starter circuit voltage drop tests; determine necessary action. Inspect and test starter relays and solenoids; determine necessary action. Remove and install starter in a vehicle. Inspect and test switches, connectors, and wires of starter control circuits; determine necessary action. Differentiate between electrical and engine mechanical problems that cause a slow-crank or a no-crank condition. Perform charging system output test; determine necessary action. Diagnose (troubleshoot) charging system for causes of undercharging, no-charge, or overcharge condition Inspect, adjust, or replace generator (alternator) drive belts; check pulleys and tensioners for wear; check pulley and belt alignment. Remove, inspect, and re-install generator (alternator). Perform charging circuit voltage drop tests; determine necessary action. 4. Diagnose (troubleshoot) the causes of brighter-than-normal, intermittent, dim, or no light operation; determine necessary action. Inspect interior and exterior lamps and sockets including headlights and auxiliary lights (fog lights/driving lights); replace as needed. Aim headlights. Identify system voltage and safety precautions associated with high-intensity discharge headlights. 5. Inspect and test gauges and gauge sending units for causes of abnormal gauge readings; determine necessary action. Diagnose (troubleshoot) the causes of incorrect operation of warning devices and other driver information systems; determine necessary action. 6. Diagnose (troubleshoot) causes of incorrect horn operation; perform necessary action. Diagnose (troubleshoot) causes of incorrect wiper operation; diagnose wiper speed control and park problems; perform necessary action. Diagnose (troubleshoot) windshield washer problems; perform necessary action. 7. Diagnose (troubleshoot) incorrect operation of motor-driven accessory circuits; determine necessary action. Diagnose (troubleshoot) incorrect electric lock operation (including remote keyless entry); determine necessary action. Diagnose (troubleshoot) incorrect operation of cruise control systems; determine necessary action. Diagnose (troubleshoot) supplemental restraint system (SRS) problems; determine necessary action. Disable and enable an airbag system for vehicle service; verify indicator lamp operation. Remove and reinstall door panel. Check for module communication errors (including CAN/BUS systems) using a scan tool. Describe the operation of keyless entry/remote-start systems. Verify operation of instrument panel gauges and	20	60	**Academic:** RLST: 11-12.3 **CTE Anchor:** Communications: 2.1 **CTE Pathway:** C1.1

	warning/indicator lights; reset maintenance indicators. Verify windshield wiper and washer operation, replace wiper blades.			
XV.	**HEATING AND AIR CONDITIONING**	**CR**	**Lab/ CC**	**Standards**
	Student Learning Objectives: • General NC System Diagnosis and Repair • Refrigeration System Component Diagnosis and Repair • Heating, Ventilation, and Engine Cooling Systems Diagnosis and Repair • Operating Systems and Related Controls Diagnosis and Repair • Refrigerant Recovery, Recycling, and Handling **Key Assignments:** 1. Identify and interpret heating and air conditioning problems; determine necessary action. Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins. Performance test A/C system; identify problems. Identify abnormal operating noises in the A/C system; determine necessary action. Identify refrigerant type; select and connect proper gauge set; record temperature and pressure readings. Leak test A/C system; determine necessary action. Inspect condition of refrigerant oil removed from A/C system; determine necessary action. Determine the recommended oil and oil capacity for system application. Using a scan tool, observe and record-related HV AC data and trouble codes. Inspect and replace A/C compressor drive belts, pulleys, and tensioners; determine necessary action. Inspect, test, service or replace A/C compressor clutch components and/or assembly; check compressor clutch air gap; adjust as needed. Remove, inspect, and reinstall A/C compressor and mountings; determine recommended oil quantit} Identify hybrid vehicle A/C system electrical circuits and service/safety precautions. Determine need for an additional A/C system filter; perform necessary action. Remove and inspect A/C system mufflers, hoses, lines, fittings, 0-rings, seals, and service valves; perform necessary action. Inspect A/C condenser for airflow restrictions perform necessary action. Remove, inspect, and reinstall receiver/drier or accumulator/drier; determine recommended oil quantity. Remove, inspect, and install expansion valve or orifice (expansion) tube. Inspect evaporator housing water drain; perform necessary action. Determine procedure to remove and reinstall evaporator; determine the required oil quantity. 2. Inspect engine cooling and heater systems hoses; perform necessary action. Inspect and test heater control valve(s); perform necessary action. Determine procedure to remove inspect, and reinstall heater core. 3. Inspect and test A/C-heater blower motors, resistors, switches, relays, wiring, and protection devices; perform necessary action. Diagnose A/C compressor clutch control systems; determine necessary action. Diagnose malfunctions in the vacuum, mechanical, and electrical components and controls of the heating, ventilation, and A/C (HV AC) system; determine necessary action. Inspect and test A/C-heater control panel assembly; determine necessary action. Inspect and test A/C-heater control cables, motors, and linkages; perform necessary action. Inspect A/C-heater ducts, doors, hoses, cabin filters, and outlets; perform necessary action. Identify the source of A/C system odors. Check operation of automatic or semi-automatic heating, ventilation, and air-conditioning (HV AC) control systems; determine necessary action. 4. Perform correct use and maintenance of refrigerant handling equipment according to equipment manufacturer's standards. Identify and recover A/C system refrigerant. Recycle, label, and store refrigerant. Evacuate and charge A/C system; add refrigerant oil as required.	20	50	**Academic:** RLST: 11-12.3 **CTE Anchor:** Communications: 2.1 **CTE Pathway:** C1.1
XVI.	**ENGINE PERFORMANCE**	**CR**	**Lab/ CC**	**Standards**
	Student Learning Objectives: • General Engine Diagnosis • Computerized Controls Diagnosis and Repair • Ignition System Diagnosis and Repair • Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair • Emissions Control Systems Diagnosis and Repair **Key Assignments:** 1. Identify and interpret engine performance concerns; determine necessary action. Research applicable vehicle and service information, vehicle service history, service precautions, and technical service bulletins. Diagnose abnormal engine noises or vibration concerns; determine necessary action. Diagnose the cause of excessive oil consumption coolant consumption, unusual exhaust color, odor, and sound; determine necessary action. Perform engine absolute (vacuum/boost) manifold pressure tests; determine necessary action. Perform cylinder power balance test; determine necessary action. Perform cylinder cranking and running compression tests; determine necessary action. Perform cylinder leakage test; determine necessary action. Diagnose engine mechanical, electrical, electronic, fuel, and ignition concerns; determine	10	50	**Academic:** RLST: 11-12.3 **CTE Anchor:** Communications: 2.1 **CTE Pathway:** C1.1

	necessary action. 2. Verify engine operating temperature; determine necessary action. Verify correct camshaft timing. Retrieve and record diagnostic trouble codes, OBD monitor status, and freeze frame data; clear codes when applicable. Access and use service information to perform step-by-step (troubleshooting) diagnosis. Perform active tests of actuators using a scan tool; determine necessary action. Describe the importance of running all OBDII monitors for repair verification. 3. Diagnose (troubleshoot) ignition system-related problems such as no-starting, hard starting, engine misfire, poor driveability, spark knock, power loss, poor mileage, and emissions concerns; determine necessary action. Inspect and test crankshaft and camshaft position sensor(s); perform necessary action. Inspect, test, and/or replace ignition control module, powertrain/engine control module; reprogram as necessary. Remove and replace spark plugs; inspect secondary ignition components for wear a11 damage. 4. Check fuel for contaminants; determine necessary action. Inspect and test fuel pumps and pump control systems for pressure, regulation, and volume; perform necessary action. Replace fuel filter(s). Inspect, service, or replace air filters, filter housings, and intake ductwork. Inspect throttle body, air induction system, intake manifold and gaskets for vacuum leaks and/or unmetered air. Inspect and test fuel injectors. Verify idle control operation. Inspect the integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tailpipe(s), and heat shields; perform necessary action. Inspect condition of exhaust system hangers, brackets, clamps, and heat shields; repair or replace as needed. Perform exhaust system back-pressure test; determine necessary action. Check and refill diesel exhaust fluid (DEF). Diagnose oil leaks, emissions, and drivability concerns caused by the positive crankcase ventilation (PCV) system; determine necessary action. Inspect, test, and service positive crankcase ventilation (PCV) filter/breather cap, valve, tubes, orifices, and hoses; perform necessary action. Diagnose emissions and drivability concerns caused b: the exhaust gas recirculation (EGR) system; determine necessary action. Inspect, test, service, and replace components of the EGR system including tubing, exhaust passages, vacuum/pressure controls, filters, and hoses; perform necessary action. Inspect and test electricaVelectronically-operated components and circuits of air injection systems; perform necessary action. Inspect and test catalytic converter efficiency. Inspect and test components and hoses of the evaporative emissions control system; perform necessary action. Interpret diagnostic trouble codes (DTCs) and scan tool data related to the emissions control systems; determine necessary action.			
XVII.	**CAREER PLANNING**	**CR**	**Lab/ CC**	**Standards**
	Student Learning Objectives: • Identifies personal qualifications, interests, aptitudes, information, and skills necessary to succeed in this career field. • Demonstrates an understanding of the importance of ethics, values, and laws as related to the workplace. • Develops a career plan that is designed to reflect career interest, pathways, and post-secondary educational options. • Identifies important strategies for self-promotion in the hiring process such as job applications, resume writing, interviewing skills and preparation of a portfolio.	10	0	**Academic:** RLST: 11-12.3 **CTE Anchor:** Communications: 2.1 **CTE Pathway:** C1.1
XVIII.	**WORK READINESS**	**CR**	**Lab/ CC**	**Standards**
	Student Learning Objectives: • Demonstrate basic math, written and verbal language skills appropriate to the workplace. • Demonstrate competency in the 21st Century Soft & Interpersonal Skills • Demonstrates the ability to problem solve and think critically. • Demonstrates Dependability, Reliability, and Flexibility. • Demonstrates time management, organizational, and customer service skills. • Consistently act in an honest and ethical manner. • Demonstrate the ability to both works cooperatively and independently. • Demonstrates articulate verbal communication skills. • Demonstrates a willingness to accept constructive feedback.	10	0	**Academic:** RLST: 11-12.3 **CTE Anchor:** Communications: 2.1 **CTE Pathway:** C1.1
XIX.	**INTEGRATED MATHEMATICAL COMPONENTS; INTEGRATED LANGUAGE ARTS COMPONENTS**	**CR**	**Lab/ CC**	**Standards**
	Student Learning Objectives: • Demonstrate effective integrated math applications appropriate and commensurate with employment in this industry sector. • Demonstrate effective integrated Language Arts applications appropriate and commensurate with employment in this industry sector.	10	0	**Academic:** RLST: 11-12.3 **CTE Anchor:** Communications: 2.1 **CTE Pathway:** C1.1

XX.	COURSE NOTES:	CR	Lab/ CC	Standards
	Course Notes: 7/31/19 – Added to new SCOE format. – John Bruestle	0	0	**Academic:** RLST: 11-12.3 **CTE Anchor:** Communications: 2.1 **CTE Pathway:** C1.1

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