

A4 Suspension and Steering

Grades 9-12

Refer to NATEF (National Automotive Technicians Education Foundation) standards.

A4 SUSPENSION AND STEERING

For every task in Suspension and Steering, the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

IV. SUSPENSION AND STEERING	Priority	AYES Pre Intern	AYES YR2	AYES Job Sheet
A. General Suspension and Steering Systems Diagnosis				
1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.	P-1		A4/U2/L2	A4A01
2. Identify and interpret suspension and steering concern; determine necessary action.	P-1		A4/U2/L2	A4A01
3. Research applicable vehicle and service information, such as suspension and steering system operation, vehicle service history, service precautions, and technical service bulletins.	P-1		A4/U2/L3 A4/U4/L1	A4A02
4. Locate and interpret vehicle and major component identification numbers (VIN, vehicle certification labels, calibration decals).	P-1		A4/U8/L1	A4A03
B. Steering Systems Diagnosis and Repair				
1. Disable and enable supplemental restraint system (SRS).	P-1		A4/U6/L2	A4B01
2. Remove and replace steering wheel; center/time supplemental restraint system (SRS) coil (clock spring).	P-1		A4/U6/L2	A4B02

IV. SUSPENSION AND STEERING		Priority	AYES Pre Intern	AYES YR2	AYES Job Sheet
3.	Diagnose steering column noises, looseness, and binding concerns (including tilt mechanisms); determine necessary action.	P-2		A4/U6/L2	A4B03
4.	Diagnose power steering gear (non-rack and pinion) binding, uneven turning effort, looseness, hard steering, noise, and fluid leakage concerns; determine necessary action.	P-3		A4/U2/L3	A4B04
5.	Diagnose power steering gear (rack and pinion) binding, uneven turning effort, looseness, hard steering, noise, and fluid leakage concerns; determine necessary action.	P-3		A4/U2/L3	A4B05
6.	Inspect steering shaft universal-joint(s), flexible coupling(s), collapsible column, lock cylinder mechanism, and steering wheel; perform necessary action.	P-2		A4/U6/L2	A4B06
7.	Adjust manual or power non-rack and pinion worm bearing preload and sector lash.	P-3		A4/U5/L2	A4B07
8.	Remove and replace manual or power rack and pinion steering gear; inspect mounting bushings and brackets.	P-1		A4/U4/L1	A4B08
9.	Inspect and replace manual or power rack and pinion steering gear inner tie rod ends (sockets) and bellows boots.	P-1	A4/U3/L1		A4B09
10.	Determine proper power steering fluid type; inspect fluid level and condition.	P-1	A4/U2/L1		A4B10
11.	Flush, fill, and bleed power steering system.	P-2	A4/U2/L1		A4B11

IV. SUSPENSION AND STEERING	Priority	AYES Pre Intern	AYES YR2	AYES Job Sheet
12. Diagnose power steering fluid leakage; determine necessary action.	P-2		A4/U2/L2	A4B12
13. Remove, inspect, replace, and adjust power steering pump belt.	P-1	A4/U2/L1		A4B13
14. Remove and reinstall power steering pump.	P-3		A4/U2/L2	A4B14
15. Remove and reinstall power steering pump pulley; check pulley and belt alignment.	P-3		A4/U2/L2	A4B15
16. Inspect and replace power steering hoses and fittings.	P-2	A4/U2/L2		A4B16
17. Inspect and replace pitman arm, relay (centerlink/intermediate) rod, idler arm and mountings, and steering linkage damper.	P-2		A4/U3/L1	A4B17
18. Inspect, replace, and adjust tie rod ends (sockets), tie rod sleeves, and clamps.	P-1	A4/U3/L1		A4B18
19. Test and diagnose components of electronically controlled steering systems using a scan tool; determine necessary action.	P-3		A4/U2/L4	A4B19
20. Inspect and test non-hydraulic electric-power assist steering.	P-3		A4/U2/L4	A4B20
21. Identify hybrid vehicle power steering system electrical circuits, service and safety precautions.	P-3		A4/U2/L4	A4B21

IV. SUSPENSION AND STEERING		Priority	AYES Pre Intern	AYES YR2	AYES Job Sheet
C. Suspension Systems Diagnosis and Repair					
1. Front Suspension					
1.	Diagnose short and long arm suspension system noises, body sway, and uneven riding height concerns; determine necessary action.	P-1		A4/U8/L1	A4C1.1
2.	Diagnose strut suspension system noises, body sway, and uneven riding height concerns; determine necessary action.	P-1		A4/U9/L1	A4C1.2
3.	Remove, inspect, and install upper and lower control arms, bushings, shafts, and rebound bumpers.	P-3		A4/U8/L2	A4C1.3
4.	Remove, inspect and install strut rods (compression/tension) and bushings.	P-2		A4/U8/L2	A4C1.4
5.	Remove, inspect, and install upper and/or lower ball joints.	P-1		A4/U8/L3	A4C1.5
6.	Remove, inspect, and install steering knuckle assemblies.	P-2		A4/U8/L3	A4C1.6
7.	Remove, inspect, and install short and long arm suspension system coil springs and spring insulators.	P-3		A4/U8/L3	A4C1.7
8.	Remove, inspect, install, and adjust suspension system torsion bars; inspect mounts.	P-3		A4/U8/L3	A4C1.7
9.	Remove, inspect, and install stabilizer bar bushings, brackets, and links.	P-2		A4/U8/L2	A4C1.9

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10.	Remove, inspect, and install strut cartridge or assembly, strut coil spring, insulators (silencers), and upper strut bearing mount.	P-1	A4/U9/L1		A4C1.10
11.	Lubricate suspension and steering systems.	P-2	A0/U10/L1		A4C1.11
2. Rear Suspension					
1.	Remove, inspect, and install coil springs and spring insulators.	P-2		A4/U11/L2	A4C2.1
2.	Remove, inspect, and install transverse links, control arms, bushings, and mounts.	P-2		A4/U11/L2	A4C2.2
3.	Remove, inspect, and install leaf springs, leaf spring insulators (silencers), shackles, brackets, bushings, and mounts.	P-3		A4/U11/L2	A4C2.3
4.	Remove, inspect, and install strut cartridge or assembly, strut coil spring, and insulators (silencers).	P-2		A4/U11/L2	A4C2.4
3. Miscellaneous Service					
1.	Inspect, remove, and replace shock absorbers.	P-1	A4/U8/L2		A4C3.1
2.	Remove, inspect, and service or replace front and rear wheel bearings.	P-1	A4/U10/L1		A4C3.2
3.	Test and diagnose components of electronically controlled suspension systems using a scan tool; determine necessary action.	P-3		A4/U12/L2	A4C3.3

IV. SUSPENSION AND STEERING		Priority	AYES Pre Intern	AYES YR2	AYES Job Sheet
D. Wheel Alignment Diagnosis, Adjustment, and Repair					
1.	Diagnose vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer, and steering return concerns; determine necessary action.	P-1		A4/U14/L2	A4D02
2.	Perform prealignment inspection; perform necessary action.	P-1		A4/U14/L3	A4D03
3.	Measure vehicle riding height; determine necessary action.	P-1		A4/U14/L3	A4D04
4.	Check and adjust front and rear wheel camber; perform necessary action.	P-1		A4/U14/L3	A4D05
5.	Check and adjust caster; perform necessary action.	P-1		A4/U14/L3	A4D05
6.	Check and adjust front wheel toe and center steering wheel.	P-1		A4/U14/L3	A4D05
7.	Check toe-out-on-turns (turning radius); determine necessary action.	P-2		A4/U14/L3	A4D05
8.	Check SAI (steering axis inclination) and included angle; determine necessary action.	P-2		A4/U14/L3	A4D05

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9.	Check and adjust rear wheel toe.	P-2		A4/U14/L3	A4D05
10.	Check rear wheel thrust angle; determine necessary action.	P-2		A4/U14/L3	A4D05
11.	Check for front wheel setback; determine necessary action.	P-2		A4/U14/L3	A4D05
12.	Check front cradle (subframe) alignment; determine necessary action.	P-3		A4/U14/L3	A4D14
E. Wheel and Tire Diagnosis and Repair					
1.	Diagnose tire wear patterns; determine necessary action.	P-1		A4/U13/L2	A4E01
2.	Inspect tires; check and adjust air pressure.	P-1	A4/U13/L1		A4E02
3.	Diagnose wheel/tire vibration, shimmy, and noise; determine necessary action.	P-2		A4/U13/L3	A4E03
4.	Rotate tires according to manufacturer's recommendations.	P-1	A4/U13/L2		A4E04
5.	Measure wheel, tire, axle, and hub runout; determine necessary action.	P-2		A4/U13/L3	A4E05
6.	Diagnose tire pull (lead) problem; determine necessary action.	P-2	A4/U13/L2		A4E06
7.	Balance wheel and tire assembly (static and dynamic).	P-1	A4/U13/L3		A4E07

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8.	Dismount, inspect, and remount tire on wheel.	P-2	A4/U13/L2		A4E09
9.	Dismount, inspect, and remount tire on wheel equipped with tire pressure sensor.	P-3	A4/U13/L2		A4E09
10.	Reinstall wheel; torque lug nuts.	P-1	A4/U13/L2		A4E04
11.	Inspect tire and wheel assembly for air loss; perform necessary action.	P-1	A4/U13/L2		A4E11
12.	Repair tire using internal patch.	P-1	A4/U13/L2		A4E11
13.	Inspect, diagnose, and calibrate tire pressure monitoring system.	P-3	A4/U13/L2		AEE13

National Automotive Student Skills Standards Assessment
Test Specifications and Task List

SUSPENSION AND STEERING

Content Area	Questions In Test
A. General Steering Systems Diagnosis and Repair	11
B. Suspension Systems Diagnosis and Repair	11
C. Wheel Alignment Diagnosis, Adjustment, and Repair	12
D. Wheel and Tire Diagnosis and Repair	6
Required To Pass: 20 of 40	TOTAL 40

A. General Steering Systems Diagnosis and Repair

1. Disable and enable supplemental restraint system (SRS).
2. Remove and replace steering wheel; center/time supplemental restraint system (SRS) coil (clock spring).
3. Diagnose steering column noises, looseness, and binding concerns (including tilt mechanisms); determine necessary action.
4. Diagnose power steering gear (non-rack and pinion) binding, uneven turning effort, looseness, hard steering, and noise concerns; determine necessary action.
5. Diagnose power steering gear (rack and pinion) binding, uneven turning effort, looseness, hard steering, and noise concerns; determine necessary action.
6. Inspect steering shaft universal-joint(s), flexible coupling(s), collapsible column, lock cylinder mechanism, and steering wheel; perform necessary action.
7. Adjust non-rack and pinion worm bearing preload and sector lash.
8. Remove and replace rack and pinion steering gear; inspect mounting bushings and brackets.
9. Inspect and replace rack and pinion steering gear inner tie rod ends (sockets) and bellows boots.
10. Determine proper power steering fluid type; inspect fluid level and condition.
11. Flush, fill, and bleed power steering system.
12. Diagnose power steering fluid leakage; determine necessary action.
13. Remove, inspect, replace, and adjust power steering pump belt.
14. Remove and reinstall power steering pump.
15. Remove and reinstall press fit power steering pump pulley; check pulley and belt alignment.
16. Inspect and replace power steering hoses and fittings.
17. Inspect and replace pitman arm, relay (centerlink/intermediate) rod, idler arm and mountings, and steering linkage damper.
18. Inspect, replace, and adjust tie rod ends (sockets), tie rod sleeves, and clamps.
19. Test and diagnose components of electronically controlled steering systems using a scan tool; determine necessary action.

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20. Inspect and test electric power assist steering.
21. Identify hybrid vehicle power steering system electrical circuits, service and safety precautions.

B. Suspension Systems Diagnosis and Repair

1. Diagnose short and long arm suspension system noises, body sway, and uneven ride height concerns; determine necessary action.
2. Diagnose strut suspension system noises, body sway, and uneven ride height concerns; determine necessary action.
3. Remove, inspect, and install upper and lower control arms, bushings, shafts, and rebound bumpers.
4. Remove, inspect and install strut rods and bushings.
5. Remove, inspect, and install upper and/or lower ball joints.
6. Remove, inspect, and install steering knuckle assemblies.
7. Remove, inspect, and install short and long arm suspension system coil springs and spring insulators.
8. Remove, inspect, install, and adjust suspension system torsion bars; inspect mounts.
9. Remove, inspect, and install stabilizer bar bushings, brackets, and links.
10. Remove, inspect, and install strut cartridge or assembly, strut coil spring, insulators (silencers), and upper strut bearing mount.
11. Remove, inspect, and install leaf springs, leaf spring insulators (silencers), shackles, brackets, bushings, and mounts.
12. Inspect, remove, and replace shock absorbers.
13. Remove, inspect, and service or replace front and rear wheel bearings.
14. Test and diagnose components of electronically controlled suspension systems using a scan tool; determine necessary action.
15. Diagnose, inspect, adjust, repair or replace components of electronically controlled steering systems (including sensors, switches, and actuators); initialize system as required.
16. Describe the function of the idle speed compensation switch.
17. Lubricate suspension and steering systems.

C. Wheel Alignment Diagnosis, Adjustment, and Repair

1. Diagnose vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer, and steering return concerns; determine necessary action.
2. Perform prealignment inspection and measure vehicle ride height; perform necessary action.

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Test Specifications and Task List

3. Prepare vehicle for wheel alignment on the alignment machine; perform four wheel alignment by checking and adjusting front and rear wheel caster, camber; and toe as required; center steering wheel.
4. Check toe-out-on-turns (turning radius); determine necessary action.
5. Check SAI (steering axis inclination) and included angle; determine necessary action.
6. Check rear wheel thrust angle; determine necessary action.
7. Check for front wheel setback; determine necessary action.
8. Check front and/or rear cradle (subframe) alignment; determine necessary action.

D. Wheel and Tire Diagnosis and Repair

1. Inspect tire condition; identify tire wear patterns; check and adjust air pressure; determine necessary action.
2. Diagnose wheel/tire vibration, shimmy, and noise; determine necessary action.
3. Rotate tires according to manufacturer's recommendations.
4. Measure wheel, tire, axle flange, and hub runout; determine necessary action.
5. Diagnose tire pull problems; determine necessary action.
6. Dismount, inspect, and remount tire on wheel; Balance wheel and tire assembly (static and dynamic).
7. Dismount, inspect, and remount tire on wheel equipped with tire pressure monitoring system sensor.
8. Reinstall wheel; torque lug nuts.
9. Inspect tire and wheel assembly for air loss; perform necessary action.
10. Repair tire using internal patch.
11. Inspect, diagnose, and calibrate tire pressure monitoring system.

GUIDE TO BHS AUTOMOTIVE CLASSES

The Bemidji High School Automotive Technologies Program is accredited by the National Technicians Education Foundation (NATEF) and is partnering with Automotive Youth Education Systems (AYES). This affiliation ensures that students are working through a curriculum that meets National Standards for Automotive Technology. It also provides students the opportunity for a paid Automotive Youth Apprenticeship with participating dealerships during their senior year. Students completing the prescribed curriculum will be prepared to take the Automotive Service Excellence (ASE) certification exams the fall following their graduation.

Students who successfully complete the sequence of course in BHS's Automotive Technologies Program and pass the ASE exams in all four of the areas offered are eligible to earn up to 16 college credits towards a degree in Automotive related fields at MNSCU colleges and NATEF accredited technical colleges. Students are required to maintain a minimum of a "B" average and excellent attendance in all courses.

INTRO. TO INDUSTRIAL TECHNOLOGY

Open to: 9-10 1 term, ½ credit

Prerequisite: None This class is designed for students new to the industrial technology program. Through hands-on activities in several technology lab areas, students will gain knowledge of tool usage, safety in shop areas, basic measurements, and how to construct, create and complete a project. This course provides basic experience for future technology classes and also presents the subject of technology in an enthusiastic and less-intimidating manner. Technology areas may include several of the following: woodworking, drafting, metal technology, video production, electronics, and/or construction technology.

AUTOMOTIVE TECHNOLOGY 1

Open to: 9-12 1 term, ½ credit

Prerequisite: None Auto Tech 1 implements NATEF and AYES guidelines for high school automotive programs in the areas of hand/power tools, general shop safety, basic vehicle systems and maintenance, and electrical systems including general electrical, battery, starting, charging, and lighting. Students will read and apply technical information from a variety of documents and online service manuals to obtain the high level of excellence and professionalism. There is a \$15.00 lab fee.

BRAKE SYSTEMS

Open to: 10-12 1 term, ½ credit

Prerequisite: Auto Tech 1

This course implements NATEF and AYES guidelines for high school automotive programs in the area of A5-Braking and Hydraulic Systems used in automobile and light trucks. The course also addresses Traction Control, ABS, and related systems as prescribes by ASE area A5. There is a \$15.00 lab fee.

STEERING AND SUSPENSION

Open to: 10-12 1 term, ½ credit

Prerequisite: Auto Tech 1

This course implements NATEF and AYES guidelines for high school automotive programs in the areas of area A4-Steering and Suspension Systems. This includes parallelogram and rake-n-pinion steering systems, coil, leaf, torsion bar, air, and all current suspension systems. This course will also explore future steering and suspension systems prescribed by ASE area A-4. There is a \$15.00 lab fee.

AUTOMOTIVE ELECTRICAL

Open to: 10-12 1 term, ½ credit

Prerequisite: Auto Tech 1

This is part one of a two part sequence introducing area A6-Automotive Electrical and Electronics. This course Implements NATEF and AYES guidelines for high school automotive programs in the areas of Automotive Electrical. This course will focus on the basic electricity, electrical properties, and diagnosis as prescribed by ASE area A6. There is a \$15.00 lab fee.

AUTOMOTIVE ELECTRONICS

Open to: 10-12 1 term, ½ credit

Prerequisite: Auto Tech 1 and Auto Electrical

This is part two of a two part sequence continuing area A6-Automotive Electrical and Electronics. . This course Implements NATEF and AYES guidelines for high school automotive programs in the areas of Automotive Electronics. This course will focus on semi-conductor, solid state components, relays, computer components, switches, accessories, and electronic controls on automobiles and light trucks as prescribed by ASE area A6. There is a \$15.00 lab fee.

ENGINE PERFORMANCE 1

Open to: 10-12 1 term, ½ credit

Prerequisite: Auto Tech 1, Auto Electrical, Auto Electronics

This is one of a two part sequence in area A8-Engine Performance. This course will focus on engine diagnosis, computer engine controls, and ignition systems. This course will use specialized tools such as computerized scan tool and code readers to analyze and diagnose problems on automobiles and light trucks as prescribed by ASE area A8. There is a \$15.00 lab fee.

ENGINE PERFORMANCE 2

Open to: 10-12 1 term, ½ credit

Prerequisite: Auto Tech 1, Auto Electrical, Auto Electronics, Engine Performance 1

This is part two of the sequence in area A8-Engine Performance. This course will continue where Engine Performance 1 left off and train students in advanced diagnosis and repair of computer controlled systems, sensors, emissions, fuel systems, EVAP, and integrated accessories on automobiles and light trucks as prescribed by ASE area A8. The course will also explore systems of the future such as Hybrid and Fuel Cell technology. There is a \$15.00 lab fee.

ENGINE PERFORMANCE 3

Open to: 12 1 term, ½ credit

Prerequisite: All Auto courses and Inst. Approval.

This course is the final step in the BHS Automotive Technologies Program. This is a paid apprenticeship with a Master Technician that has been trained as a mentor at a local dealership. The student will work under the direct supervision of a Master Technical on real customer vehicles in a real work environment. The apprenticeship follows the guidelines of the NATEF and AYES program.

DRAFTING I

Open to: 9-12 1 term, ½ credit

Prerequisite: None

Drafting I follows a step-by-step approach to the study of drafting and the mastery of special techniques that produce clear and concise drawings. Each step of work is based on objectives that must be satisfactorily performed to a level comparable to the student's capabilities and aspirations. Basic principles of the course include: (1) introduction to drafting and safety, (2) design process, (3) multi-view/pictorial sketching, (4) computer aided drafting, (5) freehand lettering, (6) drafting tools and supplies, (7) shape description, (8) size description, (9) pictorial drafting, (10) architectural drawing.

DRAFTING II

Open to: 9-12 1 term, ½ credit

Prerequisite: Drafting I

Drafting II is essential for students interested in becoming an architect, or attending a vocational school for drafting or a related trade such as carpentry. It is required in college for a technical or technology education degree. It is very helpful and valuable to students from a vocational standpoint and for those interested in design and interior design. Drafting II will cover everything from selection of site and financing of a home to detailed and complete house plans done by each student. Students will find this especially beneficial when planning, remodeling, or furnishing a home of their own. It is of great practical value because all students are potential homeowners and many modern techniques and materials for building are studied. Topics include: (1) review and safety, (2) room planning and single line floor plans, (3) double line floor plans, (4) door and window schedule, and (5) wall section.

DRAFTING III

Open to: 9-12 1 term, ½ credit

Prerequisite: Drafting I and II

This course is a continuation of Drafting II. Topics include: (1) elevations and model of home built to scale, (2) foundation plans, (3) computer foundation, (4) electrical plan, (5) plot plan, (6) details, (7) cost estimation, and (8) interior perspective (rough and trace).

COMPUTER AIDED DRAFTING/DESIGN I

Open to: 9-12 1 term, ½ credit

Prerequisite: Drafting I

Computer Aided Drafting/Design is essential for students interested in becoming an architect, mechanical designer or engineer. Any student wanting to attend vocational school for drafting or a related trade such as carpentry will also find this class beneficial. This class is great for those interested in design and problem solving, and provides basic working familiarity with CAD. It will introduce students to Computer Aided Drafting and Design using Auto CAD programs plus other computer graphic systems and software, such as digitizing tablets, printers, and plotter. Current computer technology and programs will be studied as related to drafting and design. Topics include: (1) review and safety, (2) geometric drawing, (3) line drawing, (4) title box and computer multi-view drawing, (5) multi-view pictorial drawing and dimension, (6) duplication drawing, (7) designing patterns on computers, (8) sectional drawings, (9) automobile designs, and (10) 3-d solids.

ADVANCED COMPUTER AIDED DRAFTING/DESIGN

Open to: 10-12 1 term, ½ credit

Prerequisite: Drafting I, and Computer Aided Drafting/Design I

This is an activity-based class with in-depth design and problem solving activities for critical thinkers. Students will learn and apply the concepts of CADD. This class is designed for students considering a career in technology, mechanical design, engineering, architecture or education. Topics include: (1) review and safety, (2) multi-view bridge, (3) pictorial of bridge, (4) model of bridge, (5) 3-d drawing, (6) commercial project.

ELECTRICITY AND ELECTRONICS I

Open to: 9-12 1 term, ½ credit

Prerequisite: None

This is a beginning course in Electricity and Electronics. Study will include the fundamentals of electricity with an introduction into electronics. Emphasis will be on bread boarding numerous electronic circuits such as series, parallel and ohm's law. There will be two take home kits: continuity tester and strobe light.

ROBOTICS

Open to: 10-12 1 term, ½ credit

Prerequisite: None

Robotics is an exciting phase of modern high technology. This course deals with fundamentals of robotics. Students will learn the many functions of robots and the role that robots play in society today and in the future. Students will learn how to program robots and interface with the Robotus System.

MACHINE TOOL TECHNOLOGY I

Open to: 9-12 1 term, ½ credit

Prerequisite: None

Machine Tool Technology I is an introduction to the machining of metals. Areas of study will include safety in the machine shop, measurements, and the operation of the following machines: metal lathe, power hack saw, drill press, vertical and horizontal milling machines, shaper and band saw. Various projects will be made by the student to utilize the equipment listed above.

ADVANCED MACHINE TOOL TECHNOLOGY

Open to: 9-12 1 term, ½ credit

Prerequisite: Machine Tool Technology I

This is a continuation of Machine Tool Technology I with an introduction to heat treatment of metals, use of taps and dies and career exploration. Additional time will be spent on both the vertical and horizontal milling machine. Each student will be required to program and run the computer

numerical controlled lathe. Projects will be the basis for evaluation.

*Code to repeat for credit: TAMTT2***SMALL ENGINES 1**

Open to: 9-12 1 term, ½ credit

Prerequisite: None

This course will acquaint the student with simple one-cylinder engines such as the type commonly found on lawn mowers. Each student is expected to furnish their own engine, which they will disassemble, inspect, repair, and reassemble. Approximately one day per week will be spent in the classroom studying related information and theory of operation.

ADVANCED SMALL ENGINES

Open to: 9-12 1 term, ½ credit

Prerequisite: Small Engines I

Advanced Small Engines is a continuation of the prerequisite. The students are expected to furnish their own engines, but in this case, they may also use foreign-built engines such as the type used on snowmobiles, motorcycles, and chain saws. Approximately one day per week is spent in the classroom on ignition systems, carburetion, lubrication, and other systems.

*Course may not be repeated without instructor approval. *Code to repeat for credit: TASME2*

BASIC WELDING

Open to: 9-12 1 term, ½ credit

Prerequisite: None

This is an introductory course. Basic knowledge and skills related to welding will be covered. Proper use of tools, equipment and materials and safe laboratory practices will be studied in detail. Techniques of electric arc welding and oxy-acetylene welding will be taught including welding in the flat and horizontal positions and MIG.

ADVANCED WELDING

Open to: 9-12 1 term, ½ credit

Prerequisite: Basic Welding

Advanced Welding will consist of perfecting everything learned in Basic Welding. Vertical and overhead welding will be explained and demonstrated. MIG and TIG welding and cast iron welding will also be introduced and studied on a broader scale. The student will also learn fabrication techniques and how to compute cost estimates. Extensive welding exercises will be required using the TIG and MIG welders. Selected projects are required.

Code to repeat for credit: TAWEL2

WOODWORKING TECHNOLOGY I

Open to: 9-12 1 term, ½ credit

Prerequisite: None

This is a beginning woodworking course, which is exploratory in nature. The course provides an introduction to the basic properties and nature of woods, fundamental operations of hand tools and machines, safety, design, basic construction principles, finishing techniques and problem solving. The student will construct an appropriate project or projects to carry out the objectives of the course.

WOODWORKING TECHNOLOGY II

Open to: 9-12 1 term, ½ credit

Prerequisite: Woodworking Technology I

This course is exploratory in nature. It provides for advanced study in the properties and nature of woods, hand tool skills, machines, safety, design and construction principles, and finishing. Additional activities will include: veneering, plastic laminates, wood laminates, bending woods, and pattern making. The primary project of this course will be a cabinet that the students design. Other appropriate exercises and projects will be selected by students to carry out the course objectives. Through project building, students will use proper construction techniques, develop an appreciation and understanding of related materials, develop problem solving techniques and an appreciation of craftsmanship.

ADVANCED WOODWORKING TECHNOLOGY

Open to: 10-12 1 term, ½ credit

Prerequisite: Woodworking Technology II

This course provides students showing special woodworking interest an opportunity to develop advanced skills with machines related to woodworking, construction techniques, safety, problem solving, craftsmanship, shop maintenance and machine care. There will be minimal equipment demonstrations. Most instruction will be individual in nature but will be shared with the class if it would benefit the other students. Each student will design and develop plans and a bill of materials for an individual project. Then the student will construct a wood product from the plans using the appropriate formulas for lumber measurement and measurement accuracy. This course may be repeated for credit
Code to repeat for credit: TAWOO2

CONSTRUCTION TECHNOLOGY I

Open to: 10-12 1 term, ½ credit

Prerequisite: None

This course is designed to give each student a variety of hands-on experiences in construction-related areas. Upon completion of the course, a student should have a broad understanding of construction techniques and apply them as a future homeowner and consumer. This course also has application for the student who is interested in exploring a career in construction. Completion of Woodworking Technology I class would be helpful to the student, but not required.

ADVANCED CONSTRUCTION TECHNOLOGY II

Open to: 10-12 2 terms, 1 credit

Prerequisite: Construction Technology I**TACO1—1st semester****TACO2—2nd semester**

This is a two-term vocational building construction course designed to introduce the student to a wide spectrum of residential building construction trades. Students may elect to take this course both semesters in a school year. The student will be introduced to cement, masonry, carpentry, electrical, plumbing, shingling, insulation, heating, sheet rocking, taping, millwork, painting, remodeling, and repair. The main project will include the building of a home.

INTRO TO VIDEO COMMUNICATIONS

Open to: 10-12 1 term, ½ credit

Prerequisite: None

Students will be introduced to and become familiar with the technologies needed to plan, create, and edit a video project. This course counts toward required art credit for graduation.

ADVANCED VIDEO COMMUNICATIONS

Open to: 10-12 1 term, ½ credit

Prerequisite: Intro to Video Communications

Students in this course will put together weekly productions for the entire school. Students will plan, record, edit and playback these productions using a variety of technologies and thought processes. This course counts toward required art credit for graduation.

Code to repeat for credit: TAVIC2

INTRODUCTION TO ENGINEERING DESIGN

Open to: 9-12 2 terms, 1 credit

Prerequisites: None

Using computer modeling software, students learn the design process. They solve design problems as they develop, create and analyze product models.

This course is part of Project Lead the Way.

PRINCIPLES OF ENGINEERING

Open to: 9-12 2 terms, 1 credit

Prerequisites: Algebra 2 or Accelerated Alg. 2 or concurrent enrollment (Intro. to Engineering Design recommended)

Students explore technology systems and engineering processes to find out how math, science and technology help people. *This course is part of Project Lead the Way.*

CIVIL ENGINEERING AND ARCHITECTURE

Open to: 10-12 2 terms, 1 credit

Prerequisite: None

This course is intended to serve as a specialization course within the Project Lead The Way sequence. The course is structured to enable all students to have a variety of experiences that will provide an overview of both fields. Students work in teams, exploring hands-on projects and activities to learn the characteristics of civil engineering and architecture. Students will use Rivet, which is a state of the art 3D design software package.

This course is part of Project Lead The Way

COMPUTER INTEGRATED MANUFACTURING

Open to: 10-12 2 terms, 1 credit

Prerequisite: Introduction to Engineering Design

Students learn concepts of robotics and automated manufacturing by creating three-dimensional designs with modeling software and producing models of their designs. *This course is part of Project Lead The Way*

DIGITAL ELECTRONICS

Open to: 9-12 2 terms, 1 credit

Prerequisite: Electricity and Electronics | recommended

Students use computer simulation to learn about the logic of electronics and they design, test, and actually construct circuits and devices. This class will cover the fundamentals of electronics, logic devices, flip-flops, and micro-controllers. *This course is part of Project Lead The Way.*

ENGINEERING DESIGN & DEVELOPMENT

Open to: 11-12 2 terms, 1 credit

Prerequisite: 4 of the following: Introduction to Engineering Design, Principles of Engineering, Digital Electronics, Civil Engineering, Computer Integrated Manufacturing

An engineering research course in which students work in teams to research, design and construct a solution to an open-ended engineering problem.

Students apply principles developed in the four preceding courses and are guided by a community mentor. *This is the capstone course in Project Lead the Way*

TECHNOLOGY EDUCATION

Technology Education courses have a lab fee. Scholarships are available for qualified students upon request from teacher or counselor.

CREDIT	COURSE CODE	COURSE TITLE	DURATION	PREREQUISITE	GRADES
½ credit	TINIT	INTRO. TO INDUSTRIAL TECHNOLOGY	1 term	None	9-10
½ credit	TAUT1	AUTOMOTIVE TECHNOLOGY 1 ☼	1 term	None	9-12
½ credit	TBSY	BRAKE SYSTEMS ☼◆	1 term	Auto Tech 1	10-12
½ credit	TSTSS	STEERING & SUSPENSION SYSTEMS ☼◆	1 term	Auto Tech 1	10-12
½ credit	TAUEL	AUTOMOTIVE ELECTRICAL ☼◆	1 term	Auto Tech 1	10-12
½ credit	TAUEN	AUTOMOTIVE ELECTRONICS ☼◆	1 term	Auto Tech 1 & Auto Electrical	10-12
½ credit	TENP1	ENGINE PERFORMANCE 1 ☼◆	1 term	Auto Tech 1, Auto Electrical, & Auto Electronics	10-12
½ credit	TENP2	ENGINE PERFORMANCE 2 ☼◆	1 term	Auto Tech 1, Auto Electrical, Auto Electronics, & Eng. Perf. 1	10-12
½ credit	TENP3	ENGINE PERFORMANCE 3 ☼	1 term	All Automotive courses & Instructor Approval	12
½ credit	TDRA1	DRAFTING I ◆	1 term	None	9-12
½ credit	TDRA2	DRAFTING II ◆	1 term	Drafting I	9-12
½ credit	TDRA3	DRAFTING III	1 term	Drafting I & II	9-12
½ credit	TCADI	COMPUTER AIDED DRAFTING/DESIGN I	1 term	Drafting I	9-12
½ credit	TACAD	ADVANCED COMPUTER AIDED DRAFTING/DESIGN *	1 term	Drafting I and Computer Aided Draft/Design I	10-12
½ credit	TELE1	ELECTRICITY AND ELECTRONICS I ◆	1 term	None	9-12
½ credit	TROBO	ROBOTICS	1 term	None	10-12
½ credit	TMATT	MACHINE TOOL TECHNOLOGY I	1 term	None	9-12
½ credit	TAMTT	ADVANCED MACHINE TOOL TECHNOLOGY *◆	1 term	Machine Tool Technology I	9-12
½ credit	TSMEN	SMALL ENGINES I	1 term	None	9-12
½ credit	TASME	ADVANCED SMALL ENGINES *	1 term	Small Engines I	9-12
½ credit	TWELD	BASIC WELDING ◆	1 term	None	9-12
½ credit	TAWEL	ADVANCED WELDING *◆	1 term	Basic Welding	9-12
½ credit	TWOOD	WOODWORKING TECHNOLOGY I	1 term	None	9-12
½ credit	TWO02	WOODWORKING TECHNOLOGY II ◆	1 term	Woodworking Technology I	9-12
½ credit	TAW00	ADVANCED WOODWORKING TECHNOLOGY*◆	1 term	Woodworking Technology II	10-12
½ credit	TCONT	CONSTRUCTION TECHNOLOGY I	1 term	None	10-12
1 credit	TACO1	ADVANCED CONSTRUCTION TECHNOLOGY II (1 st semester) *◆	2 terms	Construction Technology I	11-12
1 credit	TACO2	ADVANCED CONSTRUCTION TECHNOLOGY II (2 nd semester) *◆	2 terms	Construction Technology I	11-12
½ credit	TVIC0	INTRO TO VIDEO COMMUNICATIONS	1 term	None	10-12
½ credit	TAVIC	ADVANCED VIDEO COMMUNICATIONS *	1 term	Intro to Video Communications	10-12
1 credit	TIEND	INTRODUCTION TO ENGINEERING DESIGN ■+	2 terms	None	9-12
1 credit	TPENG	PRINCIPLES OF ENGINEERING ■+	2 terms	Algebra 2 or Accelerated Alg. 2 or concurrent enrollment (Intro. to Engineering Design recommended)	9-12
1 credit	TCENA	CIVIL ENGINEERING AND ARCHITECTURE ■+	2 terms	None	10-12
1 credit	TCOIM	COMPUTER INTEGRATED MANUFACTUR. ■+	2 terms	Intro Engineering Design	10-12
1 credit	TDELE	DIGITAL ELECTRONICS ■◆+	2 terms	Electricity and Electronics I	9-12
1 credit	TENDD	ENGINEERING DESIGN & DEVELOPMENT +■	2 terms	4 of these: Intro. to Eng. Des., Prin. of Eng., Digital Electronics, Civil Eng., Comp. Int. Manufac.	11-12

+ Weighted grade point system * May be repeated for credit ◆ Advanced Standing/Tech Prep Credit at NTC
 ■ Project Lead the Way ☼ Articulation Agreement with MNSCU colleges and all NATEF accredited technical colleges.