

Heating, Ventilation, and Air Conditioning Technology Commercial Facility Maintenance and Repair Option

HVAC – Service and Installation (Program CIP: 47.0201 – HVAC & R Maintenance
Technology/Technician)

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**Heating, Ventilation, and Air Conditioning Technology (Commercial Facility
Maintenance and Repair) 16 Hour
ACCELERATED PATHWAY**

Course Number	Course	Credit Hours
ACT 1003	Intro to HVAC	3
ACT 1713	Electrical in HVAC	3
ACT 1124	Basic Compression in Refrigeration	4
ACT 1133	Tools and Piping	3
ACT 1313	Refrigeration System Components	3
	Total Hours	16

**Heating, Ventilation, and Air Conditioning Technology (Commercial Facility
Maintenance and Repair) 30-hour
Career Certificate**

Course Number	Course	Credit Hours
ACT 1003	Intro to HVAC	3
ACT 1713	Electrical in HVAC	3
ACT 1124	Basic Compression in Refrigeration	4
ACT 1133	Tools and Piping	3
ACT 1313	Refrigeration System Components	3
ACT 2433	Refrigeration, Retrofit, and Regulations	3
	Approved Technical Electives*	11
	Total Hours	30

* Electrical, plumbing, carpentry, automation/controls, welding, or other CTE course combinations as determined by current industry needs

30-hour Career Certificate: NCCER Core and EPA Section 608 credentials

**Heating, Ventilation, and Air Conditioning Technology (Commercial Facility
Maintenance and Repair)
45-hour
Technical Certificate**

Course Number	Course	Credit Hours
ACT 2913	OSHA 10 and CPR/First Aid	3
ACT 2323	Commercial Refrigeration	3
	Approved Technical Electives*	9
	Total Hours	15

needs * Electrical, plumbing, carpentry, automation/controls, welding, or other CTE course combinations as determined by current industry

45-hour Career Certificate: 30-hour credentials plus OSHA 10-hour and CPR credentials

GENERAL EDUCATION CORE COURSES

To receive the Associate of Applied Science Degree, a student must complete all of the required coursework found in the Career Certificate option, Technical Certificate option and a minimum of 15 semester hours of General Education Core. The courses in the General Education Core may be spaced out over the entire length of the program so that students complete some academic and Career Technical courses each semester or provided primarily within the last semester. Each community college will specify the actual courses that are required to meet the General Education Core Requirements for the Associate of Applied Science Degree at their college. The Southern Association of Colleges and Schools (SACS) Commission on Colleges Standard 2.7.3 from the Principles of Accreditation: Foundations for Quality Enhancement¹ describes the general education core.

Section 2.7.3 In each undergraduate degree program, the institution requires the successful completion of a general education component at the collegiate level that (1) is substantial component of each undergraduate degree, (2) ensures breadth of knowledge, and (3) is based on a coherent rationale. For degree completion in associate programs, the component constitutes a minimum of 15 semester hours or the equivalent. These credit hours are to be drawn from and include at least one course from the following areas: humanities/fine arts, social/behavioral sciences, and natural science/mathematics. The courses do not narrowly focus on those skills, techniques, and procedures specific to a particular occupation or profession.

General Education Courses

Course Number	Course Name	Semester Credit Hours	SCH Breakdown		Total Contact Hours	Certification Information
			Lecture	Lab		
	Humanities/Fine Arts	3	3		45	
	Social/Behavioral Science	3	3		45	
	Math/Science Elective	3	3		45	
	Other academic courses per local community college requirements for AAS degree.	6				
	Total	15				

¹ Southern Association of Colleges and Schools Commission on Colleges. (2012). *The principles of accreditation: Foundations for quality enhancement*. Retrieved from <http://www.sacscoc.org/pdf/2012PrinciplesOfAccreditation.pdf>

MECHANICAL ENGINEERING COURSES

*Any course not listed as a required course may be used as an elective.

Course Number	Course Name	Semester Credit Hours	SCH Breakdown		Total Contact Hours	Certification Information
			Lecture	Lab		
MNT 1114	Manufacturing Skills Basic	4	2	4	90	NC3
MNT 1123	Industrial Electricity	3	1	4	75	NC3
MNT 1134	Industrial Control Systems	4	2	4	90	NC3
MNT 1142	Mechanical Power Transmission I	2	0	4	60	NC3
MNT 1153	Basic Industrial Robotics	3	2	2	60	NC3
MNT 1213	Programmable Logic Controllers	3	1	4	75	NC3
MNT 1224	Fluid Power	4	2	4	90	NC3
MNT 1233	Electronic Motion Control	3	1	4	75	
MNT 1242	Mechanical Power Transmission II	2	0	4	60	NC3
MNT 2114	Mechatronics Programming I	4	2	4	90	
MNT 2123	Fundamentals of Instrumentation	3	2	2	60	
MNT 2133	Mechatronics Troubleshooting and Repair	3	1	4	75	
MNT 2214	Mechatronics Process Control	4	2	4	90	NC3
MNT 2224	Mechatronics Programming II	4	2	4	90	
MNT 2234	Mechatronics Special Project	4	0	8	120	
MNT 2314	Maintenance Welding and Metals	4	1	6	105	
MNT 2324	Power Tools, Machining and Materials	4	2	4	90	
MNT 2333	Computer Aided Design	3	2	2	60	
MNT 2344	CNC/ Computer Assisted Manufacturing	4	2	4	90	
MNT 2354	Preventative Maintenance	4	2	4	90	
MNT 2364	Industry 4.0 with Data Acquisition	4	2	4	90	NC3
MNT 2373	Servo Control Systems	3	2	2	60	
MNT 2384	Mechatronics Robotics	4	2	4	90	NC3
Others electives may be added pending approval from business/industry representatives						

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COURSE DESCRIPTIONS

Course information can be found: <https://www.mccb.edu/curriculum-download>

- MNT Manufacturing Cluster....Mechatronics Engineering Technology 14.1901
- ACT Architecture and Construction cluster...HVAC 47.0201

APPENDIX A: RECOMMENDED TOOLS & EQUIPMENT

CAPITALIZED ITEMS

Access to some tools and equipment may be provided by Machine Shop, Electrical, Plumbing/Pipefitting, Automotive, and Welding Program facilities.

1. Emergency eyewash station (1)
2. Work bench with heavy duty mechanics vises (5)
3. Oxy-fuel burning table with dross pan and replaceable slats (1)
4. Work area protective screens (1 per welding booth)
5. Exhaust system (1)
6. Compressed air delivery system (compressor, lines and hoses, air regulator, quick connectors and adapters) (1)
7. Refrigerated Air Drying System
8. Shielded metal arc welding machine (AC-DC) with cables and accessories (5)
9. Oxy-fuel welding, brazing, and cutting equipment with regulators, hoses, torch and tips, cart, and accessories (5)
10. Horizontal band saw – 10-in (1)
11. Radial arm drill press – 20-in. with accessories (vise, collets, hold-down clamps) (1)
12. Hydraulic press – 20-ton capacity (1)
13. Pedestal grinders (10- to 12-in.) (2)
14. Taper shank reamer set (1)
15. Adjustable hand reamer set – 1/8 in. – 1/2 in. by 64ths (1)
16. Tap and die set – high-speed steel – 3 by 20 through 13 by 12 (1)
17. Outside micrometer sets (outside) 0–6 in. (10)
18. Depth micrometers (0–6 in.) (2)
19. Vernier calipers (dial) (6-in.) (5)
20. Telescopic gage sets (2)
21. Hand tool sets (wrenches, sockets and socket accessories, screwdrivers, hammers, punches and chisels, pliers, Allen wrenches, feeler gauges, files, etc.) (5)
22. Portable metal cutting band saw (1)
23. Magnetic base drill (1)
24. Pipe threading machine (1)
25. Shop crane and dolly (2)
26. Chain hoist on portable A-frame or overhead trolley (2)
27. Hoisting accessories kit (pulleys, chains, wire rope, clamps, block and tackle, come-alongs, shackles and hooks, etc.) (1)
28. Hydraulic jacks (20-ton) (2)
29. Pipe and tubing bender (1)
30. Abrasive cut-off saw (1)
31. Four-wheel dolly – heavy duty (2)
32. Fiberglass stepladder (6 ft, 8 ft, 10 ft, 12 ft, 14 ft) (1 each)
33. Pipe cutting and beveling machine (1)
34. Mechanical maintenance trainers with accessories (2)
35. Part washing vat (1)
36. Eight-way puller sets (2)
37. Impact wrench with impact socket sets (2)
38. Stationary belt sander (1)
39. Hydro-testing equipment (1)
40. Dry blast parts cleaning cabinet (1)
41. TIG welders with accessories (5)
42. MIG welders with accessories (5)
43. Vertical bank saw, 14-in. (1)

44. Pneumatic oil pump (1)
45. Oil recovery system (1)
46. Plasma cutter (1)
47. Reciprocating saw (1)
48. Hammer drill (1)
49. Power miter, 12-in. (1)
50. Engine lathes, gear drive, (14 in. by 40 in.), with accessories (6)
51. Vertical milling machines, with accessories (3)
52. Surface grinder (1)
53. Vernier height gage (1)
54. Screw pitch gage set (1)
55. Bearing and shaft alignment system with accessories (1)
56. Hydraulic system trainers with accessories (2)
57. Pneumatic system trainers with accessories (2)
58. Mechanical maintenance trainers (2)
59. Machinist precision level (1)
60. Surface plate and stand (1)
61. Student computers with Internet access (10)
62. Printers (10)
63. Oscilloscope (5)
64. Network Analyzer
65. Document Process Calibrator
66. Thermal Imaging Camera
67. AC/DC Electrical Trainer (5)
68. Motor Control Trainers (5)
69. Megaohm Meter
70. Rotation Tester
71. Power Quality Analyzer
72. Shaft Laser Alignment Kit
73. Vibration Analysis Kit
74. Stroboscope (5)
75. Tachometer
76. PLC Trainer with Analog Capability (1 per every 2 students minimum)
77. PLC Programming Software (1 per computer)
78. Variable Frequency Drives with Motor (1 per every 2 students minimum)
79. Electronic Reduced Voltage Starter (1 per every 2 students minimum)
80. Mechatronics Training Systems (to include HMI, robot, vision system, RFID, barcode reader, etc.)
81. Industrial Grade Robotic Arm (1 per every 2 students minimum)
82. CNC Vertical Mill
83. CNC Turning Center
84. CNC Machining Center
85. Process Control Trainer (pressure, temperature, level and flow with both controllers and PLC) (1 per every 2 students minimum)
86. Computer aided design software
87. Large format printer
88. Scissor Lift
89. Ultrasonic Tester
90. Servo Motor Training System

NON-CAPITALIZED ITEMS

1. First aid kit (1)
2. 8-in. C-clamp (1)
3. 4 1/2-in. right angle grinders (2)
4. 9-in. right angle grinder (1 per program)
5. Safety glasses with side shields, safety goggles, and face shields and sanitizing cabinet (1 set including 1 pair of glasses for each student)
6. Leather jacket, cape, sleeves, or apron and leather gloves (4 sets)
7. Welding helmet (2 per welding machine)
8. Welding goggles (2 per oxy-fuel outfit)
9. Drill bit sets (1/16-in. to 12-in. diameter) (2)
10. Set, small hole saws, 3/8-in. to 2-in. sets (2)
11. Combination square set (5)
12. Set precision square set (5)
13. Scales 6-in. 4R graduation (12)
14. Drill point gages (5)
15. Radius gage sets (2)
16. Acme thread gage sets (5)
17. Center gages (10)
18. Spring caliper set – inside, outside, and hermaphrodite – 0 to 12 in. (1)
19. Dividers (10)
20. Torpedo levels (10)
21. Metal scribes (10)
22. Hand hacksaws (5)
23. Hand power drills – 3/8-in. and 1/2-in. (2)
24. Pipe wrench sets (6-in. to 18-in.) (2)
25. Electrical hand tool set (lineman's pliers, wire strippers, screwdrivers, needle-nose pliers, tool pouch, ruler) (5)
26. Drafting kits (T-square, triangles, curves, drafting board) (2)
27. Digital VOM (1)
28. Fiberglass extension ladder, 14 ft (1)
29. Safety harness for ladders (1)
30. Chain pipe vise on tripod (2)
31. Pipe stands (4)
32. Tubing cutter and flaring tool kits (2)
33. Chain-type pipe wrenches (2)
34. Adjustable wrench sets, 6 in. through 12 in. (5)
35. Lockout/Tagout station (1 set)
36. Chipping hammer (1)
37. Wire brushes (5)
38. Fuse puller (1)
39. Clamp-on amp meters (5)
40. Circular saws 73 (5)
41. Jig saw (1)
42. Keyway broach set (1)
43. Dial indicators with magnetic base (2)
44. "V" block set (1)
45. Steel parallel sets (2)
46. Inside micrometer sets (2)
47. Thread micrometers (2)

- 48. Pneumatic chipping hammers (2)
- 49. Sine bars (2)
- 50. 3/8-in. cordless drills with chargers (4)
- 51. Hand pipe cutter, 1/2-in. to 2-in. (1)
- 52. Midget tubing cutter (1)

APPENDIX B: CURRICULUM DEFINITIONS AND TERMS

- Course Name – A common name that will be used by all community colleges in reporting students
- Course Abbreviation – A common abbreviation that will be used by all community and junior colleges in reporting students

Classification – Courses may be classified as the following:

- a. Career Certificate Required Course – A required course for all students completing a career certificate.
 - b. Technical Certificate Required Course – A required course for all students completing a technical certificate.
 - c. Technical Elective – Elective courses that are available for colleges to offer to students. □ Description – A short narrative that includes the major purpose(s) of the
- Prerequisites – A listing of any courses that must be taken prior to or on enrollment in the course
 - Corequisites – A listing of courses that may be taken while enrolled in the course
 - Student Learning Outcomes – A listing of the student outcomes (major concepts and performances) that will enable students to demonstrate mastery of these competencies
 - The following guidelines were used in developing the program(s) in this document and should be considered in compiling and revising course syllabi and daily lesson plans at the local level:
 - The content of the courses in this document reflects approximately 75% of the time allocated to each course. The remaining 25% of each course should be developed at the local district level and may reflect the following:
 - a. Additional competencies and objectives within the course related to topics not found in the state framework, including activities related to specific needs of industries in the community college district
 - b. Activities that develop a higher level of mastery on the existing competencies and suggested objectives
 - c. Activities and instruction related to new technologies and concepts that were not prevalent at the time the current framework was developed or revised

- d. Activities that include integration of academic and career–technical skills and course work, school-to-work transition activities, and articulation of secondary and postsecondary career– technical programs
 - e. Individualized learning activities, including work-site learning activities, to better prepare individuals in the courses for their chosen occupational areas
- Sequencing of the course within a program is left to the discretion of the local college. Naturally, foundation courses related to topics such as safety, tool and equipment usage, and other fundamental skills should be taught first. Other courses related to specific skill areas and related academics, however, may be sequenced to take advantage of seasonal and climatic conditions, resources located outside of the school, and other factors. Programs that offer an Associate of Applied Science Degree must include all of the required Career Certificate courses, Technical Certificate courses **AND** a minimum of 15 semester hours of General Education Core Courses. The courses in the General Education Core may be spaced out over the entire length of the program so that students complete some academic and Career Technical courses each semester. Each community college specifies the actual courses that are required to meet the General Education Core Requirements for the Associate of Applied Science Degree at their college.
- In order to provide flexibility within the districts, individual courses within a framework may be customized by doing the following:
 - Adding new student learning outcomes to complement the existing competencies and suggested objectives in the program framework.
 - Revising or extending the student learning outcomes
 - Adjusting the semester credit hours of a course to be up 1 hour or down 1 hour (after informing the Mississippi Community College Board [MCCB] of the change)

APPENDIX C: COURSE CROSSWALK

COURSE CROSSWALK					
Mechatronics Engineering Technology CIP: 14.1901-Mechanical Engineering					
<i>Note: Courses that have been added or changed in the 2018 curriculum are highlighted.</i>					
Existing			Revised		
2017 MS Curriculum Framework			2018 MS Curriculum Framework		
Course Number	Course Title	Hours	Course Number	Course Title	Hours
DDT 1313	Computer Aided Design I	3	MNT 2333	Computer Aided Design	
IMM 1474	Fluid Power	4	MNT 1224	Fluid Power	
IMM 1734	Maintenance Welding and Metals	4	MNT 2314	Maintenance Welding and Metals	
IMM 1934	Manufacturing Basic Skills	4	MNT 1114	Manufacturing Basic Skills	
IMM 1935	Manufacturing Skills Basic	5	MNT 1114	Manufacturing Basic Skills	
IMM 2124	Power Tools, Machining & Materials	4	MNT 2324	Power Tools, Machining and Materials	
IMM 2714	CNC Computer Assisted Manufacturing	4	MNT 2344	CNC/ Computer Assisted Manufacturing	
			MNT 1123	Industrial Electricity	
			MNT 1134	Industrial Control Systems	
			MNT 1142	Mechanical Power Transmission I	
			MNT 1153	Basic Industrial Robotics	
			MNT 1213	Programmable Logic Controllers	
			MNT 1233	Electronic Motion Control	
			MNT 1242	Mechanical Power Transmission II	
			MNT 2114	Mechatronics Programming I	
			MNT 2123	Fundamentals of Instrumentation	
			MNT 2133	Mechatronics Troubleshooting and Repair	

			MNT 2214	Mechatronics Process Control	
			MNT 2224	Mechatronics Programming II	
			MNT 2234	Mechatronics Special Project	
			MNT 2354	Preventative Maintenance	
			MNT 2364	Industry 4.0 with Data Acquisition	
			MNT 2373	Servo Control Systems	
			MNT 2384	Mechatronics Robotics	

APPENDIX D: RECOMMENDED TEXTBOOK LIST

Recommended Textbook List		
CIP: 14.1901 Mechanical Engineering		
Book Title	Author(s)	ISBN
Fluid Power Hydraulics and Pneumatics 2 nd edition	James R. Daines	9781605259314
High Performance Manufacturing 1 st edition	MSSC	9780078614873
Electrical Motor Control for Integrated Systems 5 th edition	Gary Rockis & Glen Mazur	9780826912268
Programmable Logic Controllers 5 th edition	Frank Petruzella	9780073373843
Delmar's Standard Textbook of Electricity 6 th edition	Steven L. Herman	9781285852706
Instrumentation and Process Control 6 th edition	Franklyn W. Kirk	9780826934420
NCCER Welding Level 1 5 th edition or AWS equivalent	NCCER	9780134163116