

Well Construction Technology Mississippi Curriculum Framework

Program CIP: 46.0504 – Well Drilling/Driller

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The Office of Curriculum and Instruction (OCI) was founded in 2013 under the Division of Workforce, Career, and Technical Education at the Mississippi Community College Board (MCCB). The office is funded through a partnership with The Mississippi Department of Education (MDE), who serves as Mississippi's fiscal agent for state and federal Career and Technical Education (CTE) Funds. The OCI is tasked with developing statewide CTE curriculum, programming, and professional development designed to meet the local and statewide economic demand.

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Adoption of National Certification Standards

The **National Drilling Association** is a nonprofit trade association of contractors, manufacturers and affiliated members from the drilling industry representing the geotechnical, environmental and mineral exploration sectors of this industry. Founded in 1972, NDA has more than 250 international member companies. The NDA mission is to promote the use of professional drilling contractors and their methods. The Well Construction Technology program of study currently has no national standards for adoption, therefore, the Office of Curriculum and Instruction aligned the curriculum to standards offered by the National Drilling Association.

For more information on the National Drilling Association, please contact:

National Drilling Association

4036 Center Road, Suite B, Brunswick, OH 44212

Phone: 877-NDAis4U

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Industry Job Projection Data

A summary of occupational data is available from the Mississippi Department of Employment Security.

<https://mdes.ms.gov/information-center/labor-market-information/>

Articulation

There are no statewide articulation agreements for this program.

Assessment

Colleges should report the following for students who complete the program with a career certificate, technical certificate, or an Associate of Applied Science Degrees for technical skills attainment. To use the approved Alternate Assessment for the following programs of study, colleges should provide a Letter of Notification to the Director of Career Technical Education at the MS Community College Board. Please see the following link for further instructions: <http://www.mccb.edu/wkfEdu/CTDefault.aspx>.

CIP Code	Program of Study
46.0504	Well Construction Technology
Level	Standard Assessment
Technical/AAS	Drilling Safety Certification Exam

Research Abstract

In the fall of 2021 the Office of Curriculum and Instruction (OCI) met with the different industry members who made up the advisory committees for the Well Construction Technology program. An industry questionnaire was used to gather feedback concerning the trends and needs, both current and future, of their field. Program faculty, administrators, and industry members were consulted regarding industry workforce needs and trends.

Industry advisory team members from the college involved with this program were asked to give input related to changes to be made to the curriculum framework. Occupation-specific skills stated include: knowing the fundamental skills pertaining to trucks, heavy equipment or drill/pump rigs; trouble shooting; and being mechanically minded. Safety practices emphasized include practicing all safety rules and wearing the proper safety equipment.

Revision History:

2010, Revised, Research and Curriculum Unit, Mississippi State University

2016, Revised, Office of Curriculum and Instruction, Mississippi Community College Board

2021, Revised, Office of Curriculum and Instruction, Mississippi Community College Board

Program Description

The Well Construction Technology Program provides classroom and laboratory instruction in the use of rotary drilling and related equipment used in drilling for water, petroleum, ecological, and environmental/geotechnical operations. Classroom study covers the rotary rig, power equipment, mechanical maintenance, drilling fluids, hydraulics, and other areas associated with well drilling operations. Laboratory instruction includes hands-on operation of drilling rigs, maintenance of rigs, operation of related equipment, and drilling and completion of various types of wells. Included are basic welding, machine shop operations, hydraulics, and basic industrial electricity.

Well Construction Technology is a 2-year program of study that requires courses in the career–technical core, designated areas of concentration, and the academic core. Students who successfully complete 30 semester hours as outlined in the program of study may be awarded a career certificate. Students who successfully complete 45 semester hours as outlined in the program of study may be awarded a technical certificate. Students who successfully complete 60 semester hours as outlined in the program of study may be awarded an Associate of Applied Science degree. The Associate of Applied Science degree is earned upon successful completion of the Well Construction curriculum, and students are eligible to take the National Drillers Association Drilling Safety Certification. It is the intent of this program to develop rotary drilling technicians or “drillers” who may qualify for entry-level employment. Employment opportunities for technicians may exist in firms specializing in drilling for water, petroleum, ecological, and environmental/geotechnical operations.

Industry standards are based on the *Standards and Guidelines for Well Construction Programs*.

Suggested Course Sequence

Accelerated Integrated Career Pathway

			SCH Breakdown			Contact Hour Breakdown		Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	Lecture	Lab	Certification Name
WCT 1113	Maintenance Mechanics	3	2	2	60	30	30	
WCT 1613	Metal Fabrication for Well Drilling	3	2	2	60	30	30	
	Instructor approved electives	9						
	Total	15						

Career Certificate Required Courses

			SCH Breakdown			Contact Hour Breakdown		Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	Lecture	Lab	Certification Name
WCT 1113	Maintenance Mechanics	3	2	2	60	30	30	
WCT 1135	Rotary Rig and Related Equipment	5	2	6	120	30	90	
WCT 1613	Metal Fabrication for Well Drilling	3	2	2	60	30	30	
WCT 1145	Operation of Rotary Rig and Related Equipment	5	2	6	120	30	90	
WCT 1313	Drilling Fluids	3	2	2	60	30	30	
WCT 1513	Geological Formations	3	2	2	60	30	30	
	Instructor approved electives	8						
	TOTAL	30						

Technical Certificate Required Courses

			SCH Breakdown			Contact Hour Breakdown		Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	Lecture	Lab	Certification Name
WCT 2223	Pump Theory and Installation	3	2	2	60	30	30	National Drilling Association Drilling Safety Certification
WCT 2433	Environmental and Geotechnical Drilling	3	2	2	60	30	30	
WCT 2423	Water Well Construction	3	2	2	60	30	30	
	Instructor approved technical electives	6						
	TOTAL	15						

General Education Core Courses – Well Construction Technology

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 Commission on Colleges (SACSCOC) Section 9 Standard 3 of the *Principles of Accreditation: Foundations for Quality Enhancement*¹ describes the general education core.

Section 9 Standard 3:

3. The institution requires the successful completion of a general education component at the undergraduate level that
- a) is based on a coherent rationale.
 - b) is a substantial component of each undergraduate degree program. For degree completion in associate programs, the component constitutes a minimum of 15 semester hours of the equivalent; for baccalaureate programs, a minimum of 30 semester hours or the equivalent.
 - c) ensures breadth of knowledge. These credit hours include at least one course from each of the following areas: humanities/fine arts, social/behavioral sciences, and natural science/mathematics. These courses do not narrowly focus on those skills, techniques, and procedures specific to a particular occupation or profession.

			SCH Breakdown			Contact Hour Breakdown		Certification Information
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Total Contact Hours	Lecture	Lab	Certification Name
	Humanities/Fine Arts	3						
	Social/Behavioral Sciences	3						
	Math/Science	3						
	Academic electives	6						
	TOTAL	15						

¹ Southern Association of Colleges and Schools Commission on Colleges. (2017). *The Principles of Accreditation: Foundations for Quality Enhancement*. Retrieved from <http://www.sacscoc.org/2017ProposedPrinc/Proposed%20Principles%20Adopted%20by%20BOT.pdf>

Electives

			SCH Breakdown				Contact Hour Breakdown		
Course Number	Course Name	Semester Credit Hours	Lecture	Lab	Externship	Total Contact Hours	Lecture	Lab	Externship
SSP 1003	Smart Start	3	3	0		45			
ELT 1113	Residential Wiring	3	2	2		60	30	30	
WCT 1123	Rotary Drilling Safety	3	2	2		60	30	30	
WCT 2233	Well Testing and Completion	3	1	4		75	15	60	
WCT 2333	Down-Hole Problems	3	2	2		60	30	30	
WCT 291(1-3)	Special Problem in Well Construction Technology	1-3		2-6		30-90		30-90	
WCT 292(1-6)	Supervised Work Experience for Well construction Technology	1-6			3-18	45-270			45-270
WBL 191(1-3) WBL 192(1-3) WBL 193(1-3) WBL 291(1-3) WBL 292(1-3) WBL 293(1-3)	Work-Based Learning	1-3			3-9	45-135			45-135
	All other electives approved by instructor per local community college								

Well Construction Technology Courses

Course Number and Name: WCT 1113 Maintenance Mechanics

Description: This course includes the functions and demonstrates the maintenance of levers, inclined planes, cams, mechanical linkages, pulleys, belts, sprockets, gears, and drives.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Utilize safety procedures in rotary drilling.
 - a. List the major causes of drilling industry accidents. ^{NDA1}
 - b. Describe safety requirements of crew members. ^{NDA2,3}
 - c. Identify safety equipment for crew members. ^{NDA 4}
 - d. List first aid procedures. ^{NDA 23}
2. Apply the function of levers inclined planes, cams, mechanical linkages, pulleys and belts, sprockets, gears, and drives.
3. Demonstrate maintenance of levers inclined planes, cams, mechanical linkages, pulleys and belts, sprockets, gears, and drives.
4. Understand and apply basic mechanical preventative maintenance and mechanical troubleshooting.

Course Number and Name: WCT 1123 Rotary Drilling Safety

Description: This course explores the safety requirements of rotary drilling including rig, shop, welding, and related equipment safety.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Utilize safety procedures in rotary drilling.
 - a. List the major causes of drilling industry accidents. ^{NDA 1}
 - b. Describe safety requirements of crew members. ^{NDA 2,3}
 - c. Identify safety equipment for crew members. ^{NDA 4}
 - d. List first aid procedures. ^{NDA 23}
2. Demonstrate safety procedures on the job.
 - a. Demonstrate electrical safety. ^{NDA 11, 12, 13}
 - b. Employ pump installation safety. ^{NDA 14, 15, 7, 9}
 - c. Demonstrate motor vehicle safety. ^{NDA 19}
 - d. Apply blocking rig safety. ^{NDA 9, 16, 17, 18}
 - e. Practice hand tool safety. ^{NDA 7}
 - f. Demonstrate safe lifting techniques. ^{NDA 20}
 - g. Utilize good housekeeping procedures. ^{NDA 5}
 - h. Examine safety procedures for hazardous well gases. ^{NDA 16, 17, 9}
 - i. Apply trenching safety procedures. ^{NDA 11}
 - j. Identify fire hazards on a rig. ^{NDA 28}
 - k. Demonstrate wire rope safety. ^{NDA 14}
3. Apply welding and cutting safety procedures.
 - a. Demonstrate welding and cutting torch safety. ^{NDA 27}
 - b. Demonstrate and exercise safety in handling oxygen and acetylene cylinders. ^{NDA 27}
4. Examine legal aspects of well drilling.
 - a. Explain the requirements of a driller's license. ^{NDA 2}
 - b. Describe the legal procedures for reporting wells drilled. ^{NDA 2}
 - c. Outline the legal requirements for drilling an environmental sampling well. ^{NDA 2}
 - d. Discuss the legal requirements of obtaining permits for large diameter wells. ^{NDA 2}
 - e. Prepare applications for well drilling permits. ^{NDA 2}
 - f. Complete reports of wells drilled. ^{NDA 2}

Course Number and Name: WCT 1135 Rotary Rig and Related Equipment

Description: This course is a study of all facets of rotary rigs and related equipment.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
5	2	6	120

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Demonstrate safety procedures on the job.
 - a. Demonstrate electrical safety. ^{NDA 11, 12, 13}
 - b. Employ pump installation safety. ^{NDA 14,15}
 - c. Demonstrate motor vehicle safety. ^{NDA 19}
 - d. Apply blocking rig safety. ^{NDA 9, 16, 17, 18}
 - e. Practice hand tool safety. ^{NDA 7}
 - f. Demonstrate safe lifting techniques. ^{NDA 20}
 - g. Utilize safety through good housekeeping procedures. ^{NDA 5}
 - h. Examine safety procedures of hazardous well gases. ^{NDA 16, 17, 18}
 - i. Apply trenching safety. ^{NDA 11}
 - j. Identify fire hazards on a rig. ^{NDA 28}
 - k. Demonstrate wire rope safety. ^{NDA 14}
2. Explain the components of a drilling rig.
 - a. Describe different types of derrick and mast.
 - b. Examine various power systems.
 - c. Describe and operate the components of the hoisting system.
 - d. Identify the components of the rotating system.
 - e. Describe the components of the circulating system.
 - f. Explore the types of well control equipment.
 - g. Describe different auxiliaries.
3. Examine the crew positions.
 - a. Discuss the duties of the tool pusher, driller, derrick person, floorhand, and roustabout.
4. Explain and perform general rig maintenance procedures.
 - a. Inspect rig and related equipment for safety and maintenance requirements. ^{NDA 6}
 - b. Inspect and perform preventative maintenance on rig and related equipment. ^{NDA 6}
5. Operate well drilling and related equipment.
 - a. Demonstrate proper operation of a backhoe.
 - b. Operate a pump hoist.
 - c. Inspect and operate heavy trucks.
6. Explain types of bits used in drilling.
 - a. Identify different roller cone bits, and describe their uses.
 - b. Perform maintenance and care of roller cone bits.
 - c. Relate PDC bits to their uses.
 - d. Classify drag bits, and describe their uses.
 - e. Perform maintenance on drag bits.
 - f. Compare special bits, and describe their uses.
 - g. List maintenance procedures for special bits.

7. Identify and maintain components of the drill string.
 - a. Identify kellys, top drives and maintenance procedures.
 - b. Identify thread design, and inspect drill pipe.
 - c. Perform inspection, and maintenance of tool joints.
 - d. Demonstrate proper transportation and storage of drill pipe.
 - e. Identify and inspect drill collars.
 - f. Compare drill stem auxiliaries.
8. Identify the parts and maintenance of the rotary.
 - a. Identify and maintain the slips, spiders, bushings, and breakouts.
 - b. Operate spinning and torquing devices.
9. Identify and maintain the swivels.
 - a. Describe a power swivel, and demonstrate its operation.
10. Discuss the various blocks of a drilling rig and their maintenance procedures.
 - a. Identify and maintain the traveling blocks.
 - b. Describe and maintain the crown blocks.
11. Discuss, operate, and maintain the various drilling lines.
 - a. Identify, operate, and maintain main hoisting lines.
 - b. Describe, operate, and maintain sand lines.
 - c. Splice wire and braided ropes.
12. Identify and maintain the components of the hoisting system to include brakes, drums, transmissions, clutches, and cathead.
13. Identify and maintain the components of a hydraulic system including hydraulic pumps, motors, cylinders, and valves.

Course Number and Name: WCT 1145 Operation of Rotary Rig and Related Equipment

Description: This course includes the operation of the rotary rig and related equipment.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
5	2	6	120

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Demonstrate safety procedures on the job.
 - a. Demonstrate electrical safety. ^{NDA 11, 12, 13}
 - b. Employ pump installation safety. ^{NDA 14, 15}
 - c. Demonstrate motor vehicle safety. ^{NDA 19}
 - d. Apply blocking rig safety. ^{NDA 7, 16, 17, 18}
 - e. Practice hand tool safety. ^{NDA 7}
 - f. Demonstrate safe lifting techniques. ^{NDA 20}
 - g. Utilize safety through good housekeeping procedures. ^{NDA 5}
 - h. Examine safety procedures of hazardous well gases. ^{NDA 16, 17, 18}
 - i. Apply trenching safety. ^{NDA 11}
 - j. Identify fire hazards on a rig. ^{NDA 28}
 - k. Demonstrate wire rope safety. ^{NDA 14}
2. Identify and operate prime movers.
 - a. Explain the operation of gasoline and diesel engines.
 - b. Examine the operation of engine cooling systems.
 - c. Describe the functions of engine lubricating systems.
 - d. Identify the different types of governors.
 - e. Examine the operation power transmissions.
 - f. Illustrate the operation of electric drives.
3. Explain the operations of well control equipment.
 - a. Identify ram and annular blow-out preventer.
4. Demonstrate the use of instruments used on rigs.
 - a. Discuss and demonstrate the use of weight indicators and mud pressure gages.
5. Explain basic function and properties of drilling fluids.
 - a. Describe the basic composition of drilling muds.
 - b. Test drilling muds for viscosity, pH, density, specific gravity, and hydrostatic pressure.
 - c. Perform the treatment of drilling muds for maintenance of quality and function.
 - d. Demonstrate safe handling procedures of drilling muds.

Course Number and Name: WCT 1313 Drilling Fluids

Description: This course includes the functions and properties of drilling fluids. Included are the different types of mud and methods of controlling densities and viscosities of muds.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Utilize safety procedures in rotary drilling.
 - a. List the major causes of drilling industry accidents. ^{NDA 1}
 - b. Describe safety requirements of crew members. ^{NDA 2, 3}
 - c. Identify safety equipment for crew members. ^{NDA 4}
 - d. List first aid procedures. ^{NDA 23}
2. Explain the function and properties of drilling muds including fresh water based, salt water based, oil based, and polymer muds.
 - a. Explain the function of drilling muds, including loss circulation, down-hole pressures, suspension of solids, lubrication, buoyancy to drill string, and removal of cuttings.
 - b. Describe the properties of drilling muds, including fresh water mud, salt water mud, natural mud, oil based mud, and polymers.
3. Describe air drilling principles using down-hole hammers.
 - a. Discuss use of surfactants.
4. Perform field test of drilling mud.
 - a. Perform a pH, viscosity, density, and shear test on mud.
 - b. Calculate and measure down-hole pressures mathematically and using a mud balance scale.
5. Explain the use of additives to control mud costs.
 - a. Demonstrate the use of fibrous materials to control mud loss.
6. Describe drilling fluid cleaning equipment.
 - a. Demonstrate the use of shell shakers and the sanders.

Course Number and Name: WCT 1513 Geological Formations

Description: This is a basic course in investigating the occurrence of ground water. Included are basic geology and hydrology and formations related to ground water.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Utilize safety procedures in rotary drilling.
 - a. List the major causes of drilling industry accidents. ^{NDA 1}
 - b. Describe safety requirements of crew members. ^{NDA 2, 3}
 - c. Identify safety equipment for crew members. ^{NDA 4}
 - d. List first aid procedures. ^{NDA 23}
2. Identify and locate geological formations of Mississippi.
3. Explain ground water occurrence and the hydrologic cycle.
 - a. Describe various rock formations.
 - b. Compare aquifers, aquifuges, and aquicludes.
 - c. Explain the importance of salt domes to oil exploration and storage.
 - d. Determine the permeability of formations.
 - e. Perform a sieve analysis test to determine the permeability of a formation.
 - f. Explain well interference, cone of depression.
4. Explain the difference between confined and unconfined aquifers.
 - a. Drill and identify a confined and unconfined aquifer.

Course Number and Name: WCT 1613 Metal Fabrication for Well Drilling

Description: This course includes welding safety, gas and electric welding, and basic machine shop operation as related to well construction operations.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Demonstrate safe operation of oxyfuel welding and cutting equipment and plasma cutter. ^{NDA 27}
 - a. Operate an oxyfuel cutting torch.
 - b. Operate a plasma cutting torch.
 - c. Demonstrate safe operation and transportation of oxyfuel cylinders.
2. Perform safe operation of electric arc welding equipment. ^{NDA 27}
 - a. Set up an electric SMAW and GMAW welding machine.
 - b. Identify and select different types of electrodes.
 - c. Compare different types of construction metals.
 - d. Perform flat, fillet, and butt welds using an electric SMAW and GMAW arc welder.
3. Demonstrate safe operation of metal working tools and equipment. ^{NDA 27}
 - a. Operate drill presses, band saws, and grinders safely.
4. Perform precision measurements.
 - a. Read a rule to 16th of an inch.
 - b. Read a micrometer and vernier caliper to within 1/1000th of an inch.

Course Number and Name: WCT 2223 Pump Theory and Installation

Description: This course includes the selection of pumps for specific applications, installation of pumps, servicing of pumps, and maintenance of pump components.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Size and select a water system for specific applications.
 - a. Install a shallow well and deep well jet pumping system.
 - b. Install a submersible pump.
 - c. Operate and repair a positive displacement pump.
 - d. Install a line shaft turbine pump.
2. Troubleshoot and service pumps and motors.
 - a. Operate pump servicing instruments.
 - b. Service and repair a jet pump and motor.
 - c. Service and repair a submersible pump and motor.
 - d. Install pump electrical supply and lightning protection.
 - e. Service and repair a reciprocating pump and power source.
 - f. Service and repair a line shaft turbine pump and power source.
3. Select and service pressure tanks and water system controls.
 - a. Describe different types of water supply tanks.
 - b. Install and maintain a hydro-pneumatic tank.
 - c. Install and maintain a captive air tank.
 - d. Install and maintain a diaphragm tank.
 - e. Install and maintain tank accessories.
4. Explain principles of water towers.
 - a. Calculate water pressure needed in head in feet from the water well level to height of tower.
 - b. Calculate the pressure of water generated from the tower by head in feet.
 - c. Calculate friction loss in various types of piping.
5. Size and select a variable frequency drive submersible pump.
 - a. Set variable frequency drive pump
 - b. Set up variable frequency drive parameters.

Course Number and Name: WCT 2233 Well Testing and Completion

Description: This course is a detailed study of different well completion methods and their applications.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	1	4	75

Prerequisite: Instructor approved

Student Learning Outcomes:

1. Demonstrate safety procedures on the job.
 - a. Demonstrate electrical safety. ^{NDA 11}
 - b. Employ pump installation safety. ^{NDA 14, 15, 29}
 - c. Demonstrate motor vehicle safety. ^{NDA 19}
 - d. Apply blocking rig safety. ^{NDA 9, 16, 17, 18}
 - e. Practice hand tool safety. ^{NDA 7}
 - f. Demonstrate safe lifting techniques. ^{NDA 20}
 - g. Utilize good housekeeping procedures. ^{NDA 5}
 - h. Examine safety procedures for hazardous well gases. ^{NDA 16, 17, 18}
 - i. Apply trenching safety procedures. ^{NDA 11}
 - j. Identify fire hazards on a rig. ^{NDA 28}
 - k. Demonstrate wire rope safety. ^{NDA 14}
2. Identify reservoir characteristics.
 - a. Determine the capacity and peak demand periods of a well.
 - b. Investigate the legal aspects required.
 - c. Size and select appropriate well screen.
3. Explain how to evaluate formations.
 - a. Describe and evaluate the use of a spontaneous potential log.
 - b. Describe and evaluate the use of a gamma log.
4. Perform various pump tests on wells.
 - a. Discuss and perform procedures for a 24-hr pump test.
 - b. Demonstrate a pump test using the weir method.
 - c. Perform a test using a time-measured method.
5. Perform various well development methods.
 - a. Describe the use of completion tools.
 - b. Perform an airlift completion test.
 - c. Back wash a well.
 - d. Develop a well using a surge block.
 - e. Bail a well using a dart valve bailer.
6. Size, select, and install casing.
 - a. Select appropriate well casing to meet requirements.
 - b. Determine down-hole pressure in the well.
 - c. Install various types of casings.
7. Demonstrate cementing procedures.
 - a. Determine volume requirements.
 - b. Describe cement additives and special types of cements.
 - c. Describe and perform different cementing methods.

- d. Operate and clean a grouting machine.

Course Number and Name: WCT 2333 Down-Hole Problems

Description: This course addresses problems of maintaining a straight hole when drilling. Included are fishing for lost tools, lost circulation zones, and other down-hole problems.

Hour Breakdown:	Semester Credit Hours	Lecture	Lab	Contact Hours
	3	2	2	60

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Utilize safety procedures in rotary drilling.
 - a. List the major causes of drilling industry accidents. ^{NDA 1}
 - b. Describe safety requirements of crew members. ^{NDA 2, 3}
 - c. Identify safety equipment for crew members. ^{NDA 4}
 - d. List first aid procedures. ^{NDA 23}
2. Perform procedures for preventing down-hole problems.
 - a. Identify factors creating hole deviation.
 - b. Apply methods of controlling hole deviation.
3. Control zones of lost circulation.
 - a. Utilize the squeeze method, pull-back method, and fluid density control method.
4. Perform different fishing techniques.
 - a. Use a tapered tap, slip die overshot, and impression block.
 - b. Identify and use miscellaneous fishing tools.
5. Identify and describe induced, natural, and intrinsic fractures.
6. Identify and describe key seating.
 - a. Demonstrate methods of correcting key seating.
7. Determine the causes of mud balling.
 - a. Apply methods of removing and preventing mud balling.
8. Recognize and prevent differential pressure sticking.
 - a. Describe and apply methods of eliminating differential pressure sticking through correct mud management.

Course Number and Name: WCT 2423 Water Well Construction

Description: This course is a detailed study of the drilling, development, and production of water supply wells. Objectives included are the legal responsibilities of a drilling contractor and investigation of the sanitary aspects of a well.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Demonstrate safety procedures on the job.
 - a. Demonstrate electrical safety. NDA 11, 12, 13
 - b. Employ pump installation safety. NDA 14, 15, 29
 - c. Demonstrate motor vehicle safety. NDA 19
 - d. Apply blocking rig safety. NDA 9, 16, 17, 18
 - e. Practice hand tool safety. NDA 7
 - f. Demonstrate safe lifting techniques. NDA 20
 - g. Utilize safety through good housekeeping procedures. NDA 5
 - h. Examine safety procedures of hazardous well gases. NDA 16, 17, 18
 - i. Apply trenching safety. NDA 11
 - j. Identify fire hazards on a rig. NDA 28
 - k. Demonstrate wire rope safety. NDA 14
2. Design a water well.
 - a. Devise a plan for well construction according to demand and geological formation.
 - b. Size and select a water well screen and casing.
3. Perform development methods of wells.
 - a. Develop a well using natural formations.
 - b. Install an artificial gravel pack.
4. Perform well sterilization techniques including chlorinating, pH control, and water sampling tests.
5. Analyze well cost.
 - a. Calculate cost of materials.
 - b. Calculate cost of labor.
 - c. Calculate equipment cost.
 - d. Determine fixed overhead and maintenance costs.
6. Demonstrate procedures for well abandonment.
 - a. Perform procedures for abandonment of hollow stem auger hole and mud rotary drilled hole.
 - b. Demonstrate abandonment of cased drilled well.

Course Number and Name: WCT 2433 Environmental and Geotechnical Drilling

Description: This is a detailed course covering all aspects of environmental drilling. The objectives included are hazardous materials recognition, identification, and safe handling and a study of the various methods of soil sampling used in geological and environmental investigations.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
3	2	2	60

Prerequisite: Instructor Approved

Student Learning Outcomes:

- Utilize safety procedures in rotary drilling.
 - List the major causes of drilling industry accidents. ^{NDA 1}
 - Describe safety requirements of crew members. ^{NDA 2, 3}
 - Identify safety equipment for crew members. ^{NDA 4}
 - List first aid procedures. ^{NDA 23}
- Examine legal aspects of well drilling.
 - Explain the requirements of a driller's license.
 - Describe the legal procedures for reporting wells drilled.
 - Outline the legal requirements for drilling an environmental sampling well.
 - Discuss the legal requirements of obtaining permits for large diameter wells.
 - Prepare applications for well drilling permits.
 - Complete reports of wells drilled.
- Demonstrate procedures for managing hazardous materials.
 - Recognize hazardous zones.
 - Identify hazardous materials.
 - Interpret possible paths of contamination by toxic products.
 - Provide sources of information for managing hazardous materials.
- Explain the levels of hazmat protection, including levels A, B, C, and D.
 - Perform work in hazmat protection gear.
- Identify the types monitoring well testing instruments.
 - Demonstrate use of a H₂S meter.
 - Demonstrate the use of a combustible gas monitor.
- Explain the influences of geology, groundwater, and contaminant movement on monitoring system design.
 - Drill and locate contaminants.
 - Drill and map plume of migration.
 - Report migration data.
- Explain and demonstrate drilling methods used in monitoring wells.
 - Demonstrate mud rotary method for monitoring wells.
 - Demonstrate hollow stem and continuous flight auger methods of drilling monitoring wells.
- Demonstrate monitoring well development methods.
 - Develop a well using the air lift, surge, pump development, and bailing method.
- Explain and demonstrate monitoring and sampling in the vadoze zone.

- a. Drill well in an unsaturated zone.
 - b. Take samples using a combustible gas monitor.
 - c. Report findings of monitoring.
- 10. Perform sampling using a hollow stem auger.
 - a. Collect a Shelby tube soil sample using the hollow stem method.
 - b. Perform a standard penetration test using the hollow stem auguring method.
 - c. Collect a split-spoon soil sample using the hollow stem auguring method.
- 11. Identify methods of soil sampling with a mud rotary rig.
 - a. Collect Shelby tube soil samples using the mud rotary method.
 - b. Perform a standard penetration soil samples using the mud rotary method.
 - c. Collect a split-spoon soil sample using the mud rotary method.
- 12. Perform other soil sampling methods.
 - a. Demonstrate hand auger sampling.
 - b. Extrapolate a sample using a continuous flight auger.
 - c. Demonstrate continuous core barrel sampling.

Course Number and Name: WCT 291(1-3) Special Problem in Well Construction Technology

Description: This course provides students with an opportunity to utilize skills and knowledge gained in other Well Construction Technology courses. The instructor and student work closely together to select a topic and establish criteria for completion of the project.

Hour Breakdown:

Semester Credit Hours	Lecture	Lab	Contact Hours
1		2	30
2		4	60
3		6	90

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Develop a written plan that details the activities and projects to be completed.
 - a. Utilize a written plan that details the activities and projects to be completed.
 - b. Perform written occupational objectives in the special project.
2. Assess accomplishment of objectives.
 - a. Prepare daily written assessment of accomplishment of objectives.
 - b. Present weekly written reports of activities performed and objectives accomplished to the instructor.
3. Utilize a set of written guidelines for the special problem.
4. Develop and follow a set of written guidelines for the special problem.

Course Number and Name: WCT 292(1-6) Supervised Work Experience for Well Construction Technology

Description: This cooperative program between industry and education is designed to integrate the student's technical studies with industrial experience. Variable credit is awarded on the basis of 1 semester hour per 45 industrial contact hours.

Hour Breakdown:

Semester Credit Hours	Lecture	Externship	Contact Hours
1	0	3	45
2	0	6	90
3	0	9	135
4	0	12	180
5	0	15	225
6	0	18	270

Prerequisite: Instructor Approved

Student Learning Outcomes:

1. Apply technical skills needed to be a viable member of the workforce.
 - a. Prepare a description of technical skills to be developed in the supervised work experience program.
 - b. Develop technical skills needed to be a viable member of the workforce.
2. Apply skills developed in other program area courses.
 - a. Perform skills developed in other program area courses in the supervised work experience program.
3. Apply human relationship skills.
 - a. Practice human relationship skills in the supervised work experience program.
4. Apply and practice positive work habits and responsibilities.
 - a. Perform assignments to develop positive work habits and responsibilities.
5. Work with the instructor and employer to develop written occupational objectives to be accomplished.
 - a. Perform written occupational objectives in the supervised occupational experience program.
6. Assess accomplishment of objectives.
 - a. Prepare daily written assessment of accomplishment of objectives.
 - b. Present weekly written reports of activities performed and objectives accomplished to the instructor.
7. Utilize a set of written guidelines for the supervised work experience.
 - a. Develop and follow a set of written guidelines for the supervised work experience.

Appendix A: Recommended Tools and Equipment

CAPITALIZED ITEMS

1. Air compressor, portable (250 cfm) (1)*
2. Arbor press (1)*
3. Shielded metal arc welder, stationary (2)*
4. Shielded metal arc welder, portable (1)*
5. Gas metal arc welder, stationary (2)*
6. Plasma Cutting Torch (1)
7. Auger, hollow stem (8 in.) with center rod (100 ft)*
8. Auger, continuous flight (6 in. diameter) (200 ft)*
9. Backhoe, front end loader (1)*
10. Computer with SVGA monitor and access to CD-ROM and telecommunications (2)
11. Drill press (1)*
12. Generator, portable AC (2,500 W) (1)*
13. Hammer, safety (140 lb) (1)*
14. Jack, floor (20 T) (1)*
15. Machine, grouter (1)*
16. Monitor, combustible gas (1)
17. Power unit for line shaft turbine (1)*
18. Printer, with cables (1)
19. Pump, line shaft turbine with 300 ft capacity at 300 gpm (1)*
20. Rig, hollow stem auger with accessories (capacity 25,000-ft lb torque) (1)*
21. Rig, mud rotary with accessories (1,500 ft capacity) (1)*
22. Steam cleaner/pressure washer (2 gpm, 1,000 psi, and 1½ hp) (1)*
23. Tank, water (2,000 gal.) (1)*
24. Tool hand set (3/8 in., ½ in., and ¾ in. drive) (1 each)
25. Trailer, equipment (1)*
26. Trailer, utility (1)*
27. Truck, service with pump hoist (5 T capacity) (1)*
28. Truck, 3/4 - 1 T, (equipped with tool boxes) (1)*
29. Truck, 2½ T (equipped to carry water tank) (1)*
30. Sonic water level indicator (1)*

NON-CAPITALIZED ITEMS

1. Amp meter (1)
2. Anvil (1)*
3. Band saw, metal cutting (1)*
4. Bits (6 in., 8 in., & 10 in. drag) (2 each)
5. Cabinet, safety glass with glasses and goggles (1)
6. Chain hoist (1)*
7. Charger, battery (1)
8. Chop saw (1)*
9. Eye wash and shower, portable (to meet EPA anticipated requirements) (1)
10. First-Aid kit
11. Grinder, bench (1)*
12. Grinder, hand (7") (1)*
13. Instrument, water level indicator (100')
14. Instrument, water level indicator (300')
15. Jackstands (20 ton) (2 pr)
16. Meter, pH/litmus paper (1)
17. Meter, volt-ohm (2)
18. Perzometer for pump test (1)*

19. Soil sampler (split stem, Shelby tube) (2 each)
20. Transit level with Philadelphia rods (1)
21. Vise, bench (2)*
22. Welder/torch, oxyfuel (2)
23. Workstation, computer with hutches (2)
24. Wrenches, pipe (18 in., 24 in., 36 in., and 48 in.) (4 each)

*Used equipment is acceptable provided it is available, and it is in satisfactory condition.

RECOMMENDED INSTRUCTIONAL AIDS

It is recommended that instructors have access to the following items:

1. VCR/DVD player
2. Data projector
3. Access to copier
4. Access to overhead

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:
 - Career Certificate Required Course – A required course for all students completing a career certificate.
 - Technical Certificate Required Course – A required course for all students completing a technical certificate.
 - 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 course
- 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:
 - 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
 - Activities that develop a higher level of mastery on the existing competencies and suggested objectives
 - Activities and instruction related to new technologies and concepts that were not prevalent at the time the current framework was developed or revised
 - 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
 - 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 Well Construction Technology CIP 46.0504 – Well Drilling/Driller					
<i>Note: Courses that have been added or changed in the 2016 curriculum are highlighted.</i>					
Existing			Revised		
2009 MS Curriculum Framework			2016 MS Curriculum Framework		
Course Number	Course Title	Hours	Course Number	Course Title	Hours
WCT 1113	Maintenance Mechanics	3	WCT 1113	Maintenance Mechanics	3
WCT 1123	Rotary Drilling Safety	3	WCT 1123	Rotary Drilling Safety	3
WCT 1136	Rotary Rig and Related Equipment	6	WCT 1135	Rotary Rig and Related Equipment	5
WCT 1146	Operation of Rotary Rig and Related Equipment	6	WCT 1145	Operation of Rotary Rig and Related Equipment	5
WCT 1314	Drilling Fluids	4	WCT 1313	Drilling Fluids	3
WCT 1513	Geological Formations	3	WCT 1513	Geological Formations	3
WCT 1613	Metal Fabrication for Well Drilling	3	WCT 1613	Metal Fabrication for Well Drilling	3
WCT 2223	Pump Theory and Installation	3	WCT 2223	Pump Theory and Installation	3
WCT 2233	Well Testing and Completion	3	WCT 2233	Well Testing and Completion	3
WCT 2333	Down-hole Problems	3	WCT 2333	Down-hole Problems	3
WCT 2423	Water Well Construction	3	WCT 2423	Water Well Construction	3
WCT 2433	Environmental and Geotechnical Drilling	3	WCT 2433	Environmental and Geotechnical Drilling	3
WCT 291(1-3)	Special Problem in Well Construction Technology	1-3	WCT 291(1-3)	Special Problem in Well Construction Technology	1-3
WCT 292(1-6)	Supervised Work Experience in Well Construction Technology	1-6	WCT 292(1-6)	Supervised Work Experience in Well Construction Technology	1-6

Course Crosswalk
Well Construction Technology
CIP 46.0504 – Well Drilling/Driller

Note: Courses that have been added or changed in the 2021 curriculum are highlighted.

Existing			Revised		
2016 MS Curriculum Framework			2021 MS Curriculum Framework		
Course Number	Course Title	Hours	Course Number	Course Title	Hours
WCT 1113	Maintenance Mechanics	3	WCT 1113	Maintenance Mechanics	3
WCT 1123	Rotary Drilling Safety	3	WCT 1123	Rotary Drilling Safety	3
WCT 1135	Rotary Rig and Related Equipment	5	WCT 1135	Rotary Rig and Related Equipment	5
WCT 1145	Operation of Rotary Rig and Related Equipment	5	WCT 1145	Operation of Rotary Rig and Related Equipment	5
WCT 1313	Drilling Fluids	3	WCT 1313	Drilling Fluids	3
WCT 1513	Geological Formations	3	WCT 1513	Geological Formations	3
WCT 1613	Metal Fabrication for Well Drilling	3	WCT 1613	Metal Fabrication for Well Drilling	3
WCT 2223	Pump Theory and Installation	3	WCT 2223	Pump Theory and Installation	3
WCT 2233	Well Testing and Completion	3	WCT 2233	Well Testing and Completion	3
WCT 2333	Down-hole Problems	3	WCT 2333	Down-hole Problems	3
WCT 2423	Water Well Construction	3	WCT 2423	Water Well Construction	3
WCT 2433	Environmental and Geotechnical Drilling	3	WCT 2433	Environmental and Geotechnical Drilling	3
WCT 291(1-3)	Special Problem in Well Construction Technology	1-3	WCT 291(1-3)	Special Problem in Well Construction Technology	1-3
WCT 292(1-6)	Supervised Work Experience in Well Construction Technology	1-6	WCT 292(1-6)	Supervised Work Experience in Well Construction Technology	1-6

Appendix D: Textbook List

Recommended Well Construction Text Book List

CIP 46.0504 – (Well Drilling/Driller)

Book Title	Author (s)	ISBN
Groundwater & Wells	Robert Sterrett	978-0-9787793-0-6
The Pump Book	Bob Pelikan	978-0-6151-8509-5
Water Systems Handbook	Water Systems Council	

Appendix E: Drilling Safety Certification Exam Guide



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Brunswick, OH 44212
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November 9, 2021

RE: Drilling Safety Certification Exam

To whom it may concern:

Please see below the topics covered within the Drilling Safety Guide that is the manual for this exam. This guide contains suggested safety procedures in reference to the following areas.

- | | |
|---|--------------------------------------|
| 1. Introduction to Drilling Safety | 15. Cathead & Rope Hoists |
| 2. Governmental Regulations | 16. Auger Drilling |
| 3. Safety Supervision | 17. Rotary & Core Drilling |
| 4. Personal Protective Equipment | 18. Air Drilling |
| 5. Housekeeping on the Drill Rig | 19. Transporting a Drill Rig |
| 6. Maintenance | 20. Loading & Unloading |
| 7. Hand Tools | 21. Off-Road Movement |
| 8. Cleaning the Work Area | 22. Tires, Batteries & Fuel |
| 9. Start Up | 23. First Aid |
| 10. Drilling Operations | 24. Drill Rig Utilization |
| 11. Overhead & Buried Utilities | 25. Drill Rig Alterations |
| 12. Supplying Power to the Job Site | 26. Shut Down |
| 13. Contact with Electricity | 27. Welding and Cutting Torch Safety |
| 14. Wire Line Hoists, Wire Rope & Hoisting Hardware | 28. Fire on the Rig |
| | 29. Drilling Equipment Safety Labels |

The Drilling Safety Guide has been prepared through the combined efforts of the Diamond Core Drill Manufacturers Association (DCDMA), the National Drilling Association (NDA), and the National Groundwater Association (NGWA).

This document cannot cover all aspects of drilling safety, nor can safe drilling be accomplished only by mechanical means, systems or processes. This manual is to be used as a guideline for safe operation of drilling equipment.

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