Mt. San Jacinto College
Integrated Course Outline of Record

Form B

Submitted by: Melita Caldwell-Betties **Date:** 12/17/2020

Department	Subject	Course Number	Title
Water Technology	Water Technology WATR	740	Wells, Pumps and Motors (formerly WATR-140)

Units/Hours

Each lecture unit requires 1 hour per week of class time, and 2 hours per week of study outside of class.
Each laboratory unit requires 3 hours per week of class time.
Each activity unit requires 2 hours per week of class time and 1 hour per week of study outside of class.

Lecture Units	Total Units
3.00	3.00
Lecture Contact Hours	**Total Contact Hours**
48.00 - 54.00	48.00 - 54.00
Lecture Homework Hours	
96.00 - 108.00	

Stand Alone:

Program Applicable

AA/AS Degree General Ed Breadth Area(s):

-none-

General Education Justification:

Maximum Enrollment: 40

Maximum Enrollment Justification: Justification:

Grading Method: Letter Grade or P/NP

TOP code: 0958.00*

Can be Taken 1 **time(s) for credit** (max 4)

- [ ] - Visual or Performing Arts course that is required to meet major requirements for UC/CSU
- [ ] - Intercollegiate athletics course
- [ ] - Academic/vocational competition course

Catalog Description:

(Please do not refer to transferability or degree, certificate, or employment concentration applicability. Please only describe the course).
(**75 words** or less in gray box below).

This course will provide students with a basic knowledge of domestic water wells, water booster pumps, pump theory, electric motor theory and design. Water well design regulations and abandonment will be discussed as well as maintenance procedures in the field and in the shop. The class will cover the various types of pumps used in the water industry and discuss the various uses and maintenance issues for each style of pump.

Schedule Description:

(Please do not refer to transferability or degree, certificate, or employment concentration applicability. Please only describe the course).
(**25 words** or less in gray box below).

The course will provide students with a basic knowledge of domestic water wells water booster pumps pump theory and electric motor theory and design.

Need for the course:

This course provides a basic building block in the water distribution portion of the program. Wells, pumps, and motors are the backbone components of any water system and are an important portion of the knowledge base for a water industry professional. This course is an elective in the Water degree/certificate as well as the Environmental Studies: Water and Soil Technologies/Environmental Engineering Emphasis degree.

Prerequisite(s):

Prerequisites go through a separate approval process. See Forms E1-E6 for details.
(For further clarification, contact the Prerequisite Subcommittee)

-none-

Corequisite(s):

Corequisites go through a separate approval process. See Forms E1-E6 for details.

-none-

Recommend Preparation:

Recommended Preparation goes through a separate approval process. See Forms E1-E6 for details.

- WATR 790

Other Enrollment Criteria:

-none-

Learning Objectives:

(please number each objective and express in behavioral terms)
Upon the completion of the course the student will be able to do the following:

1. Diagram the hydrological cycle and its impact on water sources.
2. Differentiate and identify the components of a water supply well.
3. Compare the use of different types of pumps used in the water industry.

4. Describe pump installation, operating procedures, and trouble-shooting techniques of centrifugal pumps.
5. Classify the variety of pipe, pipe fittings and valves used in the water industry.
6. Inquire why each type of pipe fitting and valve should be used in a particular application and describe the maintenance requirements of valves and piping systems.
7. Explain an electrical circuit, define electrical terms and use electrical formulas for determining power, voltage, amperage and electrical resistance.
8. Explain the electrical principles used in electrical motor design.
9. Estimate the amount of energy necessary to pump water (horsepower) using basic waterworks mathematical formulas.
10. Assess the different types of motor starters, where each is used and their principle of operation.
11. Describe electrical safety procedures for lockout/tagout, arc flash protection and safe use of electrical test equipment.

Course Content:

(please number the outline of main topics and subtopics)

1. Water Cycle
2. Water Hydraulics
3. Well location, construction, yield, and terminology
    1. Basic construction of a water production well
    2. Component features of a water production well
    3. Advantages/disadvantages of submersibles vs. conventional wells
    4. Advantages/disadvantages of oil lubricated wells vs. water lubricated wells
    5. Troubleshooting common well problems
    6. Measuring well performance and efficiency
    7. Well house structures and design
    8. Well safety
    9. Domestic vs. agricultural wells
    10. Water well abandonment procedures and regulations
4. Pumps
    1. Common types of pumps and their uses
    2. Pump systems and installation
    3. Basic parts of a centrifugal pump
    4. Types of centrifugal pumps
    5. Fundamental pump hydraulics
    6. Types and applications of centrifugal pump impellers
    7. Pump horsepower and energy mathematics
    8. Cavitation causes and damage
    9. Pump terminology
    10. Net positive suction head
    11. Troubleshooting centrifugal pumps
    12. Types and applications of centrifugal pump impellers
    13. Pump curves
5. Pump Control Valves
    1. Start and stop flow (throttling)
    2. Deep well installations
    3. Pressure reducrtion
    4. Surge protection
6. Pump Drivers (Electric)
    1. Basic components of A.C. electric motors
    2. Basic electrical terms, conversions and symbols
    3. Troubleshooting electric motors
    4. Variable speed motors
    5. Frame designations
    6. Bearings and lubrication
    7. Shaft alignment

8. Electric motor testing
9. Electric motor safety-lock-out/tag-out
10. Friction energy losses

7. Pump Drivers (Internal Combustion Engines)
    1. Natural gas
    2. Diesel
    3. Propane
8. Safety around pumping equipment
    1. NFPA 70E Arc flash protection
    2. Lock-out/Tag-out
    3. Personal Protective Equipmenmt (PPE)
9. Maintenance
    1. Pump rebuilding
    2. Lubrication requirements and procedures
    3. Adjustments
    4. Motor megging
    5. Scheduling: preventive and predictive
    6. Electric panel maintenance
    7. Motor maintenance
10. Recordkeeping

Methods of Instruction:

Methods of instruction may include, but are not limited to the following:

- **Method:** Videos and/or slides
  Integration: Videos and/or slides will be used to familiarize students with the operation and maintenance activities utilized to ensure the safe delivery and treatment of water resources.
- **Method:** Lecture presentation and discussion
  Integration: Presentation and discussion with supporting visual materials (PowerPoints, overheads, or multimedia) of the water topics will be used as an instructional tool to introduce concepts and terminology relevant to mechanical and electric equipment operations throughout the course.
- **Method:** Observation and Demonstration
  Integration: Scenarios will be analyzed as a group to determine the appropriate troubleshooting and testing methods to correctly diagnose the root causes of equipment failure.
- **Method:** Directed Study
  Integration: Assignments will be issued to prepare students in accessing and reviewing the technical resources available to field technicians involved in mechanical and electrical equipment operations.
- **Method:** Group Discussions
  Integration: Small group discussion allows for students to discuss in detail, review, and application of content. This allows for students to put into practice/use terminology in the field of mechanical and electrical equipment maintenance.
- **Method:** Guest Lecturers
  Integration: Guest lecturers will enhance students comprehension by exposing students to industry manufacturers and vendors, as well as, field technicians who build, install, or repair mechanical and electrical equipment utilized in water or wastewater treatment operations.
- **Method:** Activity
  Integration: Supplemental material will include reviews of current news articles concerning water issues such as new technology and process equipment utilized in water or wastewater treatment operations.
- **Method:** Readings
  Integration: Various writing assignments will be given to summarize major concepts discussed relevant to mechanical and electrical equipment operations.
- **Method:** In Class Exercises
  Integration: Various writing assignments will be given to summarize major concepts discussed relevant to mechanical and electrical equipment operations.

Methods of Evaluation:

A student's grade shall be determined by the instructor using multiple measures of performance related to the course objectives. Methods of evaluation may include but are not limited to the following:

- **Method:** Quizzes
  Integration: Periodic short objective tests of course concepts such as systems operation and correct identification of equipment related process control variables. The final written work product will be graded for accuracy, completeness, and demonstrated mastery of the subject matter.
- **Method:** Exams/Tests
  Integration: Periodic testing at the midpoint and final week of the semester will be utilized to determine content understanding of terminology, knowledge of subject matter, and test of content understanding of terminology. The final written work product will be graded for accuracy, completeness, and demonstrated mastery of the subject matter.
- **Method:** Homework
  Integration: Written out of the classroom assignments will be issued to determine understanding of content, terminology and knowledge. The final written work product will be graded for accuracy, completeness, and demonstrated mastery of the subject matter.
- **Method:** Class Work
  Integration: Class assignments will be administered to determine understanding of content, terminology and knowledge. The final written work product will be graded for accuracy, completeness, and demonstrated mastery of the subject matter.
- **Method:** Special Projects and Case Studies
  Integration: Students will conduct research related to concepts and skills developed throughout the course. Students will compare and contrast a variety of water pumping and motor equipment installations as well as operational costs. The final written work product will be graded for completeness and demonstrated mastery of the subject matter.
- **Method:** Simulation
  Integration: Simulations will be used to familiarize students with the operation and maintenance activities utilized to ensure the safe delivery and treatment of water resources. The final work product will be graded for accuracy and demonstrated mastery of the subject matter.

Examples of Assignments:

Students will be expected to understand and critique college level texts or the equivalent. Reading and writing, as well as out of class assignments are required. These assignments may include but are not limited to the following:

1. Research the design specifications and replacement costs for a failed motor in a booster station application.
2. Read and evaluate a pump performance curve for a filter influent pump.
3. Troubleshoot the premature failure of domestic well pump, based on a given set of operational symptoms.
4. Identify the internal components of a pump volute and the purpose of each in creating "suction lift" conditions.
5. Outline the advantages and disadvantages of a submersible wet-well pump versus a dry-well installation.
6. Calculate the distibution storage needed for both equalizing demand and fire reserve based on hourly demands on a specific date of maximum water consumption.
7. Research the use of centrifugal and positive dispalcement pumps. Write a brief report on the applications and limitations of each pump type.
8. Briefly describe the basic requirements for an acceptable meter installation.

Textbooks:

- Manning, N. (2013). *Fluid Power Pumps and Motors: Analysis, Design and Control 1st Edit* McGraw-Hill Education. ISBN: 978-0071812207
- Inc. Metcalf & Eddy; Tchobanoglous, George; Stensel, H. David; Tsuchihashi, Ryujiro; Burton, Franklin (2013). *Wastewater Engineering: Treatment and Resource Recovery, 5th ed* McGraw-Hill Education. ISBN: 978-

0073401188
- Chin, David A. (2012). *Water Resources Engineering, 3rd Edition* Prentice Hall . ISBN: 978-0132833219
- Perez, R.X., Conkey, A. P. (2016). *Troubleshooting Rotating Machinery: Including Centrifugal Pumps and Compressors, Reciprocating Pumps and Compressors, Fans, Steam Turbines, Electric Motors, and More* Wiley-Blackwell. ISBN: 978-1-119-29413-9
- Volk, M. (2013). *Pump Characteristics and Applications, Third Edition (Mechanical Engineering)* CRC Press . ISBN: 978-1466563087
- Shammas, N. K., Wang, L. K. (2015). *Water Engineering: Hydraulics, Distribution and Treatment, ed.* Wiley, John & Son Inc.. ISBN: 978-0-470-39098-6

Other Resources:

- Arasmith, S.. Pumps and Pumping, 10th ed.. ACR Publications , 01-01-2010.

Minimum Qualification

- Environmental Technologies