DOC. 651

SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

COURSE TITLE: HYDRAULICS

CODE NO.: WTR 330-5 **SEMESTER:** III

PROGRAM: WATER RESOURCES/PULP AND PAPER/CIVIL/ENVIRONMENTAL

AUTHOR: SUBHASH C. VERMA

DATE: JULY 1994 **PREVIOUS OUTLINE DATED:** JULY 199 3

APPROVED:

D^an, School of Sciences &
Natural Resources

HYDRAULICS **WTR 330-5**

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TOTAL CREDIT HOURS: 75

PREREQUISITE: PHYIOO

I. PHILOSOPHY/GOALS:

To introduce the basic principles of fluid mechanics and the application of these principles to practical and applied problems. After completing this course the student should have a firm foundation in the field to continue learning. This course will provide the understanding of basic concepts of fluid mechanics and application of these concepts to solve real world problems in the area of specialization including hydrology, water supply and process control.

II. STUDENT PERFORMANCE OBJECTIVES:

Upon successful completion of this course the student will be able:

- To work with both English and SI Units and modification of mathematical equations from one system of units to the other.
- To have a clear understanding of the properties of fluids, factors affecting, and their role in influencing the hydraulic design.
- To measure and estimate gauge and absolute pressure using gauges and manometers.
- To estimate the forces acting on vertical retaining walls.
- To apply the energy equation to a given hydraulic system to derive the answer for the unknown including head loss and energy added or removed by the machine.
- To apply the principles of fluid mechanics to the computation of energy, power, and pressure within fluid in given system.
- To apply the principles of hydraulics to understand the operation and working principles of flow control and flow measuring devices including orifice, venturi, nozzle, rotameters, pitot tubes for pipe flow and weirs, and flumes for open channel flow.

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II. STUDENT PERFORMANCE OBJECTIVES: (CONT'D)

- To calculate water and power requirements and select such components as pumps and valves.
- To determine head loss due to friction and other accessories, and thus, pressure drop.
- To calculate hydraulic gradients for section of pipes.
- To use flow equations (Darcy, Hazen) to calculate flow in series and parallel pipeline system.
- To analyze open channel and pipe flow to such systems as water supply, water distribution, sanitary and storm sewers.
- To maintain a laboratory notebook.
- To interpret and analyze the data.
- To classify the flow based on Reynold's number and Froude's number.
- To determine the velocities hence flow rate in open channels based on shape of the channel, roughness and hydraulic slope.
- To apply Manning equation for computing flows in sewer systems.

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III. TOPICS TO BE COVERED: NO. OF WEEKS

1. Introduction, units and calculations (1)

2. Properties of fluids (1)

3. * Fluid pressure and its measurement (2)

   - fluid pressure
   - absolute and gauge pressure
   - relationship between pressure and elevation
   - manometers, barometers and pressure gauges

4. Fundcunentals of fluid flow (3)

   - types of flows
   - continuity equation
   - energy and head
   - Bernoulli's equation
   - applications of Bernoulli's equation
   - energy loss and gain
   - general energy equation
   - application of general energy equation

5. * Fluid measurements (2)

   - general methods of local velocity measurements
   - orifices, nozzles and tubes
   - weirs, flumes
   - other methods

6. * Steady flow in pressure conduits (2)

   - laminar and turbulent flow
   - friction formulas for laminar and turbulent flow
   - energy gradient and hydraulic gradient

7. * Minor Losses (1)

   - sources
   - loss coefficient
   - estimation for contraction, expansion, and valves
   - equivalent length technique

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TOPICS TO BE COVERED: (CONT'D) NO^ OF WEEKS

8. Series Pipeline System (2)

- system classification
- Class I,II,III systems
- empirical equations for determining flow capacity (Hazen William)

9. * Pumping Systems (1)

- parameters involved in pump selection
- types of pumps
- static head and dynamic head
- cavitation (NPSH)

10. * Open Channel Flow (2)

- open channel flow defined
- equations of uniform flow (Manning's Equation)
- efficient cross-section
- specific energy and critical flow
- hydraulic jump

Topics marked by asterisk will be supplemented by one or more laboratory experiments to reinforce principles learned; for details consult lab manual and/or instructor.

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IV. EVALUATION METHODS: (INCLUDES ASSIGNMENTS, ATTENDANCE REQUIREMENTS ETC.)

The final grade will be derived from the results of the tests and labwork and assignments, weighted as follows:

Midterm Test	30%
Endterm Test	40%
Lab Reports and Assignments	30%

To pass the course a minimum of 60% is required in the weighted average plus a minimum of 60% in at least one of the tests.

GRADING:

A+	= 90 - 100%
A	= 80 - 89%
B	= 70 - 79%
C	= 60 - 69%

The method of evaluation is subject to change, however students will be notified prior to any change.

V. REQUIRED STUDENT RESOURCES:

Mott, Robert,(1993), Applied Fluid Mechanics, Fourth Edition, Charles E. Merrill Publishing Company, Toronto.

Verma, B.C. (1992), HYDRAULICS LABORATORY MANUAL - WTR330, Sault College

Verma, S.C. (1993), HYDRAULICS - STUDY GUIDE - WTR330, Sault College

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VI. ADDITIONAL RESOURCE MATERIALS AVAILABLE IN THE COLLEGE LIBRARY BOOK SECTION:

Daugherty, R.L., and J.B. Franzini (1977), Fluid Mechanics With Engineering Applications, 7th Edition, McGraw-Hill Book Company, Toronto,

Douglas, J.F. (1980), Solutions to Problems in Fluid Mechanics, Pitman Publishing Company, London, England.

Granet, Irving, (1989), Fluid Mechanics for Engineering Technology, Prentice- Hall Canada Inc., Toronto.

King, H.W., C O . Wisler and J.G. Woodburn (1980), Hydraulics, 5th Edition, Robert E. Krieger Publishing Company, Huntington, New York.

VII. SPECIAL NOTES:

- Eighty percent attendance is reguired for anyone to be considered for supplementary examination.

- Home assignments are due one week after. Late submissions will be penalized.

  Laboratory work is an important component of this course. The concepts discussed in the theory class will be reinforced by performing laboratory experiments.

Students with special needs (e.g. physical limitations, visual impairments, hearing impairments, learning disabilities) are encouraged to discuss required accommodations confidentially with the instructor.

Your instructor reserves the right to modify the course as he/she deems necessary to meet the needs of students .

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