NORMANDALE COMMUNITY COLLEGE
COMMON COURSE OUTLINE
VACT 2293 and NANO 2293, Vacuum Analysis and Troubleshooting

I. EFFECTIVE DATE OF OUTLINE

Fall Semester, 2012. To be reviewed by the department annually.

II. CATALOG DESCRIPTION

A. VACT 2293 and NANO 2293
B. Vacuum Analysis and Troubleshooting
C. 4 Credits
D. Offered Fall Semester
E. Prerequisites: CHEM 1061 AND ENGC 1101 AND ENGT 1153 or concurrent enrollment AND ENGT 1184 AND VACT 1292 or NANO 1292
F. This course addresses advanced concepts related to the construction, operation, maintenance and repair of vacuum-based systems technologies. An understanding of how materials, mechanical systems and electrical sub-systems interact in a working vacuum system based on operating requirements is developed. Students work with a model vacuum system to complete a variety of lab activities intended to help them understand vacuum system operation and then simulate classic system problems and solutions.

III. RECOMMENDED ENTRY SKILLS/KNOWLEDGE

Students are expected to possess skills in writing (completion of ENGC 1101), algebra (completion of MATH 1100), knowledge of concepts in chemistry related to atomic and electronic structure of elements, properties/behavior of gases and properties/behavior of the physical states of matter (completion of CHEM 1061), basic fluid mechanics (completion of ENGT 1184), knowledge of basic electrical circuit behavior (ENGT 1153 or concurrent enrollment) and a basic understanding about the functions of vacuum-based systems (VACT 1292 or NANO 1292) commensurate with a readiness for this second-year, post-secondary level course. Students should possess intermediate skills in the use of the following Microsoft Office applications: Word and Excel. Examples of intermediate skills in the use of these software applications are creating mathematical functions to analyze data, creating appropriate charts to represent tabled data, adding a chart to a lab report and creating a report according to stated layout criteria. Students should be familiar with the college online course site and be prepared to use the online site to access information about the class including downloads of file-type information, post homework and interact with the instructor and class peers through the online site. Students should also have an intermediate knowledge of how to perform searches for information on the Internet.

IV. OUTLINE OF MAJOR CONTENT AREAS

A. Advanced safety considerations and practices when using vacuum systems technology
B. Ideal Gas Law; common calculations
C. Conductance; common calculations
D. Material properties within the system under vacuum conditions
    a. Outgassing
    b. Metals
    c. Polymers
    d. Glasses and Ceramics
    e. Greases
E. Advanced pressure measurement considerations in vacuum systems
F. Advanced pumping considerations in vacuum systems
G. Mass Flow Controllers
H. Sources of leaks in systems, leak detection
I. Residual Gas Analyzer (RGA)
J. Vacuum system
    a. Construction
    b. Operation and maintenance
    c. Troubleshooting

V. LEARNING OUTCOMES

Upon successful completion of VACT 2293 or NANO 2293, students will have demonstrated ability to:

A. List workplace hazards associated with vacuum-based systems technologies and identify safety practices and techniques to use when operating and maintaining vacuum-based equipment.
B. Apply the ideal gas law and special cases of the ideal gas law to calculate a specified physical quantity.
C. Calculate the conductance for a system of specified physical dimensions.
D. Apply the relationships between throughput, pumping speed, conductance and pressure to calculate one of these physical quantities.
E. Identify the types of outgassing sources present in a vacuum system.
F. Identify the critical vacuum properties associated with metals, polymers, glasses and ceramics and greases and the implications regarding the application of these materials in a vacuum system design.
G. Prepare and interpret graphical representations of vacuum processes.
H. Specify the limits of application for given pressure measurement gauges and select the proper gauge for given vacuum applications.
I. Specify the limits of application for given pumps and select the proper pump for given specifications of basic vacuum system applications.
J. Specify a valve or valves for given specifications based on a given vacuum system application.
K. Explain the function of the mass flow controller (flowmeter) device in a vacuum system design, convert throughput in the flowmeter for a given gas, consider the impact of various physical conditions (ie., temperature, water vapor density, electrical power and others) on the flowmeter operating behavior, differentiate between types of pressure control methods in a vacuum system, and select a flowmeter for given vacuum applications.
L. Identify and describe the sources and causes of leaks in a vacuum system and demonstrate how to locate leaks in the system.
M. Describe how a Residual Gas Analyzer (RGA) device functions to detect leaks in a vacuum system and read, analyze and interpret RGA spectrums.
N. Read and interpret basic symbolic diagrams representing vacuum-based system configurations.
O. Synthesize sub-system components based on given specifications for a basic application to model a vacuum system capable of addressing those functional requirements.
P. Apply basic vacuum system functional knowledge to diagnose root cause issues present in common vacuum system malfunction situations and perform basic corrective actions to make the system operational.
Q. Create advanced lab reports which convey information about lab activities including the purpose and objective, background reference, procedure, summary of results, analysis, conclusion and appendix of data tables and graphs.

VI. METHODS USED FOR EVALUATION OF STUDENT LEARNING

Students will be evaluated on the following categories of course work: (1) assignment work involving both written descriptive answers and mathematical based problem solving; (2) lab reports; (3) demonstration of laboratory competence including but not limited to practices in (a) safety, (b) equipment operation, (c) collecting and documenting data, (d) troubleshooting and analysis techniques, (e) maintaining a lab notebook; and (4) mid-term and final end-of-course exams.

The final grade will be determined by some appropriate weighting of the course assignments, lab work and exam results.

VII. SPECIAL INFORMATION

A. Students will need access to a model vacuum-based system to conduct a variety of lab activities. The vacuum-based system will be available for student use in the classroom.
B. Students will need access to appropriate safety gear. The safety gear will be available for student use in the classroom.