BACHELOR 'S PROGRAMME
2nd YEAR OF STUDY, 2nd SEMESTER

COURSE TITLE	VACUUM PHYSICS AND TECHNOLOGY
COURSE CODE	
COURSE TYPE	full attendance
COURSE LEVEL	1st cycle (bachelor's degree)
YEAR OF STUDY, SEMESTER	2nd year of study, 2nd semester
NUMBER OF ECTS CREDITS	5
NUMBER OF HOURS PER WEEK	4 (2 lecture hours + 2 seminar hours)
NAME OF LECTURE HOLDER	Lect.univ. dr. Alina Silvia CHIPER
NAME OF SEMINAR HOLDER	Lect.univ. dr. Alina Silvia CHIPER
PREREQUISITES	Advanced level of English

A GENERAL AND COURSE-SPECIFIC COMPETENCES

General competences:

→ Application of efficient work techniques in a multi-disciplinary team, on various hierarchical levels.(1 credit).

Course-specific competences:

→ Identification and proper use of the main laws and physical principles of vacuum technology.

→ Application of Physics knowledge both in given situations in related fields and in experiments, using standard laboratory equipment.1 credit).

→ Explanation and interpretation of physical phenomena by formulating assumptions and operationalizing key concepts and proper use of laboratory equipment.

B LEARNING OUTCOMES

On successful completion of this subject, students will be able to:

- Understand and explain physical phenomena specific to vacuum physics.
- Describe the operation mode of different vacuum devices.
- To work with vacuum pumps and containers.
- To apply their knowledge in fields that require work in clean environment and work with vacuum components.

C LECTURE CONTENT

- Vacuum Nomenclature and Definitions. Basic terms and concepts in vacuum technology. Pressure Regions of Vacuum.
- Gas Laws and Kinetic Theory of Gases. Gas Flow. Throughput, Pumping Speed, Evacuation Rate, Outgassing Rate and Leak Rate. Flow Conductance.
- Gas Release from Solids. Surface Physics and Its Relation to Vacuum Science.
- Measurement of Total Pressure in Vacuum Systems. Pressure Ranges and Corresponding Measurement Techniques. Manometers. Thermal Conductivity Gauges. Ionization Gauges. Combined Vacuum Gauges. Placement and Calibration of Gauges
- Partial Pressure Vacuum Gauges and Leak Detectors. Partial Pressure Analysis by Mass Spectrometry. Partial Pressure Measurement Using Optical Methods. Leak Detectors.
- Production of High Vacuum. Overview and Formulation of General Requirements. Fore-Vacuum Pumps. Diffusion Pumps. Other High Vacuum Pumps.
- Production of Ultrahigh Vacuum. Fundamental Concepts in the Production of Ultrahigh Vacuum. Getter and Ion Pumps. Cryogenic Pumping. Turbomolecular Vacuum Pumps.
- Design of High Vacuum Systems. Operating and Maintaining High Vacuum Systems. Design and Performance of Bakeable Ultrahigh Vacuum Systems
- Special Requirements in the Design, Operation, and Maintenance of Ultrahigh Vacuum Systems
- The Fine Art of Leak Detection and Repair. Types of Leaks. Leak rate, leak size, mass flow. Leak detection methods. Special Techniques and Problems. Repair Techniques
- Applications of vacuum technology. High-Vacuum-Based Processes: Sputtering. Plasma Etching. Ion Beam Technology. Pulsed Laser Deposition. Plasma-Enhanced Chemical Vapor Deposition. Common Analytical Methods for Surface and Thin Film
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D RECOMMENDED READING FOR LECTURES

1. Vacuum Physics and Technology, Edited by G. L. Weissler and R.W. Carlson, Academic Press, 1st Edition, 1979.
2. Handbook of Vacuum Science and Technology, Edited by Dorothy M. Hoffman, Bawa Singh, John H. Thomas, III; Academic Press, 1998.
3. Handbook of Vacuum Technology, Editor: Karl Jousten, Wiley-VCH Verlag GmbH & Co., 2016.
4. Fundamentals of Vacuum Technology revised and compiled by Dr. Walter Umrath,1998.

	5. A User's Guide to Vacuum Technology, Third Edition, John F. O'Hanlon, John Wiley & Sons Inc., 2003. 6. A. Roth, Vacuum Technology, 3rd Edition, Elsevier, 1996.
E	SEMINAR CONTENT
	• Basics of Vacuum. Vacuum Nomenclature and Definitions. • Gases in Vacuum Systems. Gaseous Flow and Mean Free Path. • Production of Vacuum. Maintenance of a High-Vacuum System. Vacuum Components. • Vacuum Measurement Devices. • Partial Pressure Measurements by Mass Spectrometry. • Vacuum Pumps. Methods used for Pumping Speed Calculation of Vacuum Pumps. • Pumping Speed Determination by Constant Volume Method. • Design and Construct of an Experimental Set up to measure Conductance of Different Piping. • Calibrating a Needle Valve. • Overview of Vacuum Technologies. Application: Vacuum and Vapor Deposition Procedures. • Presentation of reports.
F	RECOMMENDED READING FOR SEMINARS
	1. Laboratory Notes (.pdf, print) 2. Ultrahigh Vacuum Practice, G.F. Weston (Philips Research Laboratories), Butterworths & Co., London, 1985. 3. http://web.physics.ucsb.edu/~phys128/experiments/vacuum/VacuumRev07.pdf 4. Design of rotary, turbo-molecular and cryosorption pumping systems for Vacuum Laboratory, Shihabudeen P.S., Master of Technology in Mechanical engineering, National Institute of Technology, Rourkela, India, 2014 5. Design and modelling of vacuum experimental set-ups, Trilochan Penthia, Master of technology in Mechanical Engineering, National Institute of Technology, Rourkela, India, 2014
G	EDUCATION STYLE
LEARNING AND TEACHING METHODS	problematization, explanation, debate, laboratory experiment, observation, lecture
ASSESSMENT METHODS	• Formative assessment (during the semester)
LANGUAGE OF INSTRUCTION	English