

BSP802T Vacuum Science and Cryogenics

Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory		Internal	Term Work	Practical/Viva	Total Marks
					MS	ES				
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Course Objective:

1. To outline and define the concepts of vacuum science.
2. To illustrate and show different techniques for vacuum science and engineering.
3. To establish foundations of cryogenics.
4. To appraise and illustrate the applications and handling of cryogenics and technology.

Unit-1

15 hrs

Behavior of Gases, Gas Transport Phenomenon, Viscous, molecular and transition flow regimes Production of Vacuum, Mechanical Pumps(rotary, turbo molecular pumps), Diffusion pump, Getter and Ion pumps, Cryopumps, Materials in Vacuum; High Vacuum, and Ultra High Vacuum Systems; Leak Detection;

Unit 2

15 hrs

Measurement of Pressure, Pirani gauge, penning gauge, Measurement systems for low temperatures:-Temperature measurements, pressure measurements, Properties of engineering materials at cryogenic temperatures, mechanical properties ,thermal properties, electric & magnetic properties, super conducting materials ,thermo electric materials, composite materials, properties of cryogenic fluids

Unit 3

15 hrs

Refrigeration and Liquefaction, Recuperative Cycles, Liquefaction of Gases, Refrigerator Efficiency, Cryogenic insulation:- various types such as expanded foams, gas filled& fibrous insulation, vacuum insulation, evacuated powder& fibrous insulation ,opacified powder insulation, multi-layer insulation

Unit 4

15 hrs

Applications of cryogenic systems Super conductive devices such as bearings, motors, cryotrons, magnets, D.C. transformers, tunnel diodes, space technology, space simulation, cryogenics in biology and medicine, food preservation and industrial applications, nuclear propulsions, chemical propulsions.

Hazards and Safety in handling of cryogenics:-Physical hazards, Chemical hazards, Physiological hazards, combustion hazards, oxygen hazards, accidents in cryogenic plants & prevention, care for storage of gaseous cylinders, familiarization with regulations of department of explosives.

Total: 60 Hrs

Learning outcomes:

On completion of the course, students will

1. Be able to associate the knowledge of vacuum science and various techniques to obtain it.
2. Be able to differentiate and choose the suitable pressure and temperature measurement methods.
3. Be able to employ the concepts of thermodynamics and phase transition to construct an appropriate refrigeration or liquefaction cycle.
4. Be able to translate the knowledge of physical properties into choosing the insulating materials for cryogenic application.
5. Be able to identify the venues of application of cryogenic and vacuum science.
6. Be able to appraise and propose the hazards and safety measurement required in handling cryogenics and vacuum science instruments.

Reference Books:

1. *James M. Lafferty, Foundations of Vacuum Science and Technology*
2. *J.F. O'Hanlon, A User's Guide to Vacuum Science and Technology*
3. *Rao, Ghosh and Chopra, Vacuum Science and Technology*
4. *Cryogenic systems-Baron, McGraw-Hill book*
5. *Cryogenic fundamentals-Haselden, Academic press New York*
6. *Cryogenic technology –Vance*
7. *Advance cryogenic –bailey, plenum press*

