

GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (CRYOGENIC ENGINEERING) (10)

VACUUM ENGINEERING

SUBJECT CODE: 2711002

SEMESTER: I

Type of course: Core subject

Prerequisite: Basic knowledge of rotary equipments

Rationale:

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	PA (V)		PA (I)			
					ESE	OEP	PA	RP		
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1.	Equation of state for ideal gases ,real gases ,velocity and speed of gas molecules ,the mean free path ,volume occupied by gas molecules.	2	5
2.	Basic theory of pumping: Basic definitions, resistance and conductance of arbitrary vacuum pipe work, fundamental equation of vacuum technique, regions of gas flow in pipes, calculation of pump down time.	4	10
3.	Interaction of gases with solid-taking up and evolution of gases by solids, adsorption and desorption of gases.	2	5
4	Production of vacuum: classification of vacuum pump-Calculation, operating limits of vacuum pump, their ranges, Types of vacuum pumps-oil sealed rotary, roots blower, ejector, diffusion, turbo molecular, sorption, getter pumps, cold cathode & cryogenic pumps principles, construction, operation of pump and their salient features.	12	35
5	Vacuum gauges: classification –ranges of vacuum gauges, McLeod, mechanical, thermal conductivity gauges, hot cathode and cold cathode ionization gauges, ionization gauges with upper range-principle, construction and salient features.	9	20
6	Metered leak measurement. Leak hunting: Tightness of vacuum system, leak detection methods, halide leak detector, and mass spectrometer leak detector.	7	15
7	Vacuum system components: demountable vacuum joints, electrical lead, introduction to vacuum valves, various types, their selection.	2	5
8	Vacuum materials:-basic requirements, metals & their alloys, nonmetals, pump fluids.	2	5
9	Selection of pumping facilities –determination of intrinsic speed-	2	5

	matching pumps operating in series and in parallel, calculation of fire vacuum cylinders.		
10	Application of vacuum – vacuum systems for space simulation chamber,	2	5

Reference Books:

1. Fundamentals Of Vacuum Techniques-A Pipko
2. Vacuum technology: Andrew Gutheries.
3. Vacuum technology :A.roth
4. Hand book of high vacuum engg .:Steinherz

Course Outcome:

After learning the course the students should be able to know

Fundamental concepts of gas theory, Basic theory of pumping, Fundamental equation of vacuum techniques, Adsorption and desorption of gases, Production of vacuum, Calculations of operating limits of vacuum pump, their ranges, Types of vacuum pumps-oil sealed rotary, roots blower, ejector, diffusion, turbo molecular, sorption, getter pumps, cold cathode & cryogenic pumps. Vacuum gauges, Leak detection and measurements. Vacuum system components-Vacuum joints, electrical leads and valves, Vacuum material and vacuum applications

List of Experiments:

1. Study of mechanical oil sealed double vane type vacuum pump
2. Study of simple and fractionating type oil diffusion pump
3. Study and operation of vacuum module
4. Study of vacuum gauges – Pirani and Penning gauges
5. Study of turbo molecular pump
6. Study of water ring pump
7. Study of roots blower vacuum pump
8. Study of Helium mass spectrometer leak detector.

Design based Problems (DP)/Open Ended Problem:

In depth study of different applications of vacuum and recent development in that area

Major Equipments:

Diffusion pump, Rotary pump, Helium mass spectrometer leak detector