

GUJARAT TECHNOLOGICAL UNIVERSITY
ME - SEMESTER–I(New course)• EXAMINATION – WINTER- 2015

Subject Code: 2711002**Date: 02/01/2016****Subject Name: Vacuum Engineering****Time: 2:30 pm to 5:00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Use of scientific calculators and gas properties charts/tables permitted.

- Q.1** (a) Explain resistance and conductance of an arbitrary vacuum pipe work. Also derive the fundamental equation of the vacuum system and give your explanations for calling it as fundamental equation. **07**
- (b) (i) Define different ranges of degree of vacuum. **07**
(ii) A gas filled incandescent lamp when cold at 300 K contains a gas under pressure of 90 kPa. What pressure will there be in the lamp, if the filament has raised the filling gas to a mean temperature of 500 K?

- Q.2** (a) Explain with a neat sketch construction and working of a fractioning type oil-vapor diffusion pump. Explain Back streaming and Back migration including the two main source of Back streaming and their prevention. **07**
- (b) Classify vacuum gauges based on their operating principle. Also write down the range of operation and general application of the gauges. **07**

OR

- (b) Classify vacuum pumps based on the principles of operation. Also write their operating limits of pressure and applications. **07**
- Q.3** (a) (i) Determine the root mean square speed of hydrogen molecules at 200 K. **07**
(ii) Calculate the volume occupied by air by air molecules colliding with a 2 m² area of the confining wall per second at 300 K.
- (b) Explain the laboratory procedure for measurement of the pump speed (S_p) for mechanical vacuum pump with necessary figure. **07**

OR

- Q.3** (a) A vacuum system having a volume of 1.250 m³ and a surface area of 6.23 m² is initially at 1.50 Pa. The specific outgassing rate is 2.50×10^{-6} Pa-m/s at 1 hour. The ultimate pressure for system is 0.015 mPa. If the outgassing constant is of 4 hours, determine the system pumping speed required to attain a pressure of 0.150 mPa in 3 hours. **07**
- (b) Classify the motion seals according to the design. Draw the at least one sketch of the each design of the motion seals. **07**

- Q.4** (a) Write about significance of various non-metallic materials used for vacuum applications. **07**
- (b) Explain the use of helium as search gas in MSLD and calibration of MSLD. **07**

OR

- Q.4** (a) State the principle of measurement of vacuum by a McLeod gauge. Explain with the help of sketch linear and square scale methods of measurement of vacuum. **07**
- (b) Describe the role of Trap used in vacuum pump. Also explain working of the Electrical (Ion) Trap with necessary figure showing its components. **07**
- Q.5** (a) Explain in brief the principle of operation of thermal conductivity gauges. Discuss the factors which limit its upper and lower values of measurement of pressures. **07**
- (b) Describe working of Cold-Cathode Sputter-Ion gauge with figure. Also give its equation for electrical discharge current (I_d) in terms of relational parameters. **07**

OR

- Q.5** (a) Describe the trouble shooting sequence for the oil sealed Rotary Vanes vacuum pump. Also justify the need of Gas-ballast device for this vacuum pump. **07**
- (b) Describe construction and characteristics of Hot Cathode Getter-Ion Pump with neat figure. Also draw and explain its speed curve with and without backed by diffusion pump. **07**
