Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER-1 (NEW) EXAMINATION – WINTER 2016

Subject Code: 2711002 **Date:05/01/2017**

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) Calculate the volume occupied by air by air molecules colliding with a 2 m^2 area of the confining wall per second at 300 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 sources of Back streaming and their prevention. **07**

(b) Explain square scale method of measurement of pressure by the McLeod gauge. Also calculate the change of height (h) of mercury in the capillary by increasing its diameter from 1 mm to 3 mm during measurement of 10^{-3} Pa pressure. The volume of measuring capillary and bulb is 0.7 liter. **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) A gas filled incandescent lamp when cold at 300 K contains a gas under pressure of 100 kPa. What pressure will there be in the lamp, if the filament has raised the filling gas to a mean temperature of 450 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 m^3 and a surface area of 6.23 m^2 is initially at 1.50 Pa. The specific out gassing rate is 2.50 × 10-6 Pa-m/s at 1 hour. The ultimate pressure for system is 0.015 mPa. If the out gassing constant is of 4 hours, determine the system pumping speed required to attain a pressure of 0.150 mPa in 3 hours. **07**

(b) Describe with figure about the Mass Spectrometric Leak Detector. Also write its limitations. **07**

Q.4 **(a)** Write about significance of various non-metallic materials used for vacuum **07**

applications.

(b) Classify the motion seals according to the design. Draw the at least one sketch of the each design of the motion seals. **07**

OR

Q.4 **(a)** Describe the trouble shooting sequence for the Vapour Diffusion vacuum pump. Also justify the need of Cold Trap for this vacuum pump. **07**

(b) Describe construction and working of the Electrical (Ion) Trap with necessary figure showing its components. **07**

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 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 most basic requirements of Vacuum Valves used for the typical vacuum system. **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**

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