Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME SEMESTER – I EXAMINATION – SUMMER 2017

Subject Code: 2711002 **Date:10/05/2017**

Subject Name: Vacuum Engineering

Time:02:30 p.m. to 05:00 p.m. **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Classify vacuum pumps based on the principle of operation. State their operating limits of pressure and applications.	**07**
	(b)	Classify vacuum gauges based on their operating principle and state the range of operation and general application of the same.	**07**
Q.2	**(a)**	Answer the following. (i) Determine the root mean square speed of hydrogen molecules at 180 K. (ii) Calculate the volume occupied by air, due to air molecules colliding with a 2 m^2 area of the confining wall per second at 273 K.	**07**
	(b)	Define conductance of the conduit. Explain different gas flow mechanisms to be considered for evaluating the conductance of the system.	**07**
		OR	
	(b)	Determine throughput and mass flow rate through a vacuum system consisting of a 500 mm long section of 50 mm ID tube connected in series to a 375 mm long section of a 25 mm ID tube. The 50 mm tube is connected at a large vessel in which the pressure is 100 mPa, and the pressure at the exit of the 25 mm tube is 5 mPa. The temperature of the air flowing through the system is 300 K. Take the viscosity of air as 18.47 μPa-s.	**07**
Q.3	**(a)**	Which types of traps are used in vacuum pumping systems? Also explain working of any one of the traps with necessary figure showing its components.	**07**
	(b)	Describe working of Cold-Cathode Sputter-Ion gauge with figure. Also give its equation for electrical discharge current (*Id*) in terms of relational parameters.	**07**
		OR	
Q.3	**(a)**	Give classification of the motion seals used for vacuum systems. Draw at least one sketch of the each design of the motion seals.	**07**
	(b)	Derive the fundamental equation of vacuum system in terms of speed of exhaust, pump speed and pipe work conductance. Give your remarks pertaining to the equation derived.	**07**
Q.4	**(a)**	Describe construction and characteristics of Hot Cathode Getter-Ion Pump in context to backing with neat figure.	**07**
	(b)	Enlist different types of vacuum valves being used for the vacuum systems. Explain working of the butterfly vacuum valve with figure.	**07**
		OR	
Q.4	**(a)**	Describe the trouble shooting sequence for the oil sealed Rotary Vanes vacuum pump. Also write down phenomenon of Gas-ballast device for this vacuum pump.	**07**
	(b)	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**

Q.5	**(a)**	Write the important requirements to be met by materials used in vacuum systems. Also write the use of ceramics and polymers in vacuum system.	**07**
	(b)	Describe various leak detection methods with their limitations.	**07**

OR

Q.5	**(a)**	Justify the need of matching of intrinsic speeds, when pumps are operating in series and in parallel for the vacuum system.	**07**
	(b)	Explain the laboratory procedure for measurement of the pump speed (S_p) for mechanical vacuum pump with necessary figure.	**07**

****