**PH 522: Measurement Techniques and Cryogenics (3-0-0:3)**

**Kinetic Theory of Gases**: Behaviour of gases, pressure of gases, Maxwell’s law, gas transport phenomenon; viscous, molecular and transition flow regimes. **[4L]**

**Vacuum Generation**: Measurement of pressure, residual gas analyses; production of vacuum - mechanical pumps, rotary vane pumps, diffusion pump, cryopumps, turbo-molecular pumps, getter and ion pumps, choice of pumping process. **[8L]**

**Vacuum Measurement**: Fundamentals of low-pressure measurement, vacuum gauges- McLeod gauge, pirani gauge, penning gauge, thermal conductivity gauges - cold cathode and hot cathode ionisation gauges, materials in vacuum; high vacuum, and ultra high vacuum systems, leak detection.

 **[10L]**

**Noise Control:** Basics of sound and noise, noise sources; types and measurement, noise screening, principles of noise control, silencers and their types. **[4L]**

**Cryogenics:** Properties of engineering materials at low temperature, cryogenic fluids and their physical properties, super-fluidity, refrigeration; pomeranchuk cooling, thermoelectric coolers, closed cycle refrigeration, single and double cycle He3 refrigerator, He4 refrigerator, cryostat design; cryogenic level sensors, handling of cryogenic liquids; cryogenic fluid storage*,* insulations, cryogenic fluid transfer systems*,* cryogenic thermometry. **[10L]**

**Textbooks and References**

1. D. M. Hoffman, B. Singh and J. H. Thomas, “Handbook of Vacuum Science and Technology”, Academic Press Limited.
2. J. M. Lafferty, “Foundations of Vacuum Science and Technology”, Wiley-Blackwell.
3. V. V. Kostionk, “A Text Book Of Cryogenics”, Discovery Publishing House.
4. T. M. Flynn, “Cryogenic Engineering”, Marcel Dekker.
5. P. V. E McClintock, D. J. Meredith and J. K. Wigmore, *“*Low-temperature Physics: An Introduction for Scientists and Engineers”*,* Springer Science.