

# Tribology

## Module1: Introduction

**Q.1.** How is tribology useful in the conservation of energy?

**Ans:** The knowledge of tribology is useful in reducing the unnecessary friction and wear between two rubbing surfaces (tribo-pair). Using tribology appropriate lubricant and lubrication mechanism can be adopted to minimize the friction and eliminate wear which would reduce the wastage of energy and enhance working life of tribo-pair.

**Q.2.** How tip based microscopes like Atomic Force Microscope (ATM) and Scanning Tunneling Microscope (STM) help in the study of tribology?

**Ans:** Atomic force microscopy (AFM) and scanning force microscopy (SFM) are high-resolution type of microscopes, having resolution on the order of fractions of a nanometer, more than 1000 times better than the optical diffraction limit. Such high resolution microscopes help in understanding the interaction of asperities between the two rubbing surfaces and the behavior of lubrication on the surface, and therefore the study of tribology.

**Q.3.** What are the science-subjects whose knowledge is required for tribology?

**Ans:** Tribology requires the knowledge of multifaceted disciplines like solid mechanics, fluid mechanics, material science, chemistry etc.

- Solid Mechanics: Focuses on contact stresses and surface temperatures due to sliding.
- Fluid Mechanics: Study of lubricant film formed between various geometric shapes of sliding surfaces.
- Material Science: Focus is on atomic and micro scales mechanisms whereby solid surface degradation or alteration occurs during relative motion.
- Chemistry: Deals with reactivity between lubricants and solid surfaces.

**Q.4.** What is a better method for quantifying surface roughness: average roughness or root mean square roughness and why?

**Ans:** Surface roughness is vertical deviations from nominal surface/line. Often surface roughness is quantified as average and root mean square roughness. Root mean square method is a better measure of quantifying surface roughness as it involves the integration of deviations from the nominal surface.

**Q.5.** How can one utilize tribology knowledge to make a mechanical system much more efficient?

**Ans:** The tribology knowledge can be utilized by lubricating all the joints and moving/rubbing pairs in the mechanical system which would not only reduce friction, wear, corrosion etc. but would also make the system much more efficient and reliable by reducing mechanical wear. Due to reduced friction, wear and corrosion the longevity of the system would improve. The tribology knowledge would also help in identifying the right kind of lubricant and lubrication mechanism for the system.

**Q.6.** Can tribology knowledge be utilized in the initial design of a component / system / product to improve its efficiency?

**Ans:** Tribology knowledge can be very useful during the initial design of the component. The geometry, surface finish and material selection of the component can be done as per the environment and conditions in which the component would be operating.

**Q.7.** Can efficiency of a system be increased to 100% with the use of tribology knowledge?

**Ans:** It is difficult to achieve 100% efficiency for any system but the use of tribology knowledge would definitely help in improving the efficiency level.

**Q.8.** Is the use of tribology only confined to the use of mechanical systems involving two rubbing surfaces?

**Ans:** Tribology is not only confined to two rubbing surfaces in a mechanical system but also covers a broad area of lubricants like magneto rheological lubricants whose viscosity can be varied as per the load requirements. It also covers bio-systems (all joints), electric system (pin-socket joint), hard-disk drive, etc.

**Q.9.** Out of all the lubrication mechanisms which is the best method and why?

**Ans:** Different lubrication mechanisms are used as per different requirements and applications and it would be difficult to categorize as one of them as best. There are different types of lubrication mechanisms like fluid film lubrication, elastohydrodynamic lubrication, boundary lubrication; and each one has different usage. Elastohydrodynamic lubrication provides minimum friction and zero wear, therefore it is preferable compared to other lubrications, but operating regime of EHL is very narrow.

**Q.10.** As per the tribology which are the two best surfaces which produces minimum friction levels?

**Ans:** In general the surfaces which possess very high surface finish and are hard enough to withstand wear are the best surfaces to minimize friction levels.

**Q.11.** Is the scope of tribology only limited to reduce friction levels between two mating surfaces?

**Ans:** No, main aim of tribology is to eliminate wear by controlling friction between tribo-surfaces. Reduction in wear enhances the service life and provides higher returns compared to returns obtained by reducing friction.