

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)**

**CLASS: B. TECH
BRANCH: MECHANICAL**

**SEMESTER : V
SESSION : MO/2025**

SUBJECT: ME367 INDUSTRIAL TRIBOLOGY

TIME: 3 Hours

FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
 2. Attempt all questions.
 3. The missing data, if any, may be assumed suitably.
 4. Before attempting the question paper, be sure that you have got the correct question paper.
 5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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|--|-------------------------|---------|----|
| Q.1(a) There are 4 surface roughness parameters, namely center line average roughness (R_a), root mean square roughness (R_q), Skewness and Kurtosis. Show that all these parameters in combination are important for characterizing a surface rather than considering any one parameter alone. | [5] | 1 | 3 |
| Q.1(b) A surface with a triangular sawtooth roughness pattern has a peak-to-valley height of 4 μm . Find the R_a and R_q values. | [5] | 1 | 3 |
| Q.2(a) For a hard conical asperity, establish the relationship between the ploughing component of friction and geometry of asperity. A hard metal surface having conical asperities with the roughness angle of α slides over a soft metal surface. With α increasing from 75° to 80° , the coefficient of friction decreased by 15%. Assuming the friction has resulted from adhesion and plowing, determine the adhesion component of the coefficient of friction. If the shear strength of softer material is 300 MPa, find out the interfacial shear stress. | [5] | 1,
2 | 3 |
| Q.2(b) Explain the stick-slip phenomenon. Illustrate a simplistic model which can be used to formulate a mathematical relationship of the forces during stick and slip phases. | [5] | 1,
2 | 3 |
| Q.3(a) State the physical significance of the wear coefficient k in Archard's equation of adhesive wear. A journal bearing in a dam gate moves slowly and operates under a high load. The entire bearing is made of AISI 1040 steel. To increase the bearing life, a material change is considered for one of the surfaces. Which of the following materials will give the longest life: brass, lead, polytetrafluoroethylene (PTFE), or polyethylene? The hardness for brass is 225 MPa, for lead it is 30 MPa, for PTFE it is 50 MPa, and for polyethylene it is 70 MPa. The wear coefficients are given in Table 1. | [5] | 2,
3 | 4 |
| Table 1 | | | |
| Material pairs | Wear coefficient | | |
| Brass on steel | 10^{-3} | | |
| Lead on steel | 2×10^{-5} | | |
| Polytetrafluoroethylene on steel | 2×10^{-5} | | |
| Polyethylene on steel | 5×10^{-8} | | |
| Q.3(b) Differentiate between two-body and three body abrasion with a neat sketch. A hard steel surface ploughs a soft lead surface having hardness 74 MPa. The hard surface has conical asperities with 60° semi-angle. The applied normal load is 15 N. Find out the volume of material worn out per unit sliding distance. If failure is considered for a wear volume of 10^{-6} m^3 when the k_{abr} is 4.1×10^{-3} , find out the sliding distance at which failure takes place. | [5] | 2,
3 | 3 |

- Q.4(a) Explain the importance of Tower's experiment in lubrication. What are some of the performance parameters of a sliding contact bearing? [5] 1, 2
3
- Q.4(b) How can viscosity of a lubricant be measured by a capillary type viscometer? The viscosity of a fluid is to be measured by a viscometer constructed of two 40-cm-long concentric cylinders. The outer diameter of the inner cylinder is 12 cm, and the gap between the two cylinders is 0.15 cm. The inner cylinder is rotated at 300 rpm, and the torque is measured to be 1.8 N·m. Determine the viscosity of the fluid. [5] 1, 3
3
- Q.5(a) In case of two meshing gears, state the surface failure modes. In this regard, what are the tribological requirements and associated materials of a gear. [5] 4 3
- Q.5(b) State the tribological challenges encountered in a metal cutting tool and factors that determine tool life. What are the common tool materials and coatings with higher wear resistance? Also state how cutting fluids reduces tribological challenges. [5] 4 4

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