BIRLA INSTITUTE OF TECHNOLOGY
MESRA – 835215, RANCHI, INDIA

UG

Name: …… Roll No.: ……..

Branch: …… Signature of Invigilator: ……

Semester: VIth Date: 28/04/2022 (MORNING)

Subject with Code: **ME367 INDUSTRIAL TRIBOLOGY**

	Section A (30)	Section B (20)	Total Marks (50)
Marks Obtained			

INSTRUCTION TO CANDIDATE

1. The booklet (question paper cum answer sheet) consists of two sections. First section consists of MCQs of 30 marks. Candidates may mark the correct answer in the space provided / may also write answers in the answer sheet provided. The Second section of question paper consists of subjective questions of 20 marks. The candidates may write the answers for these questions in the answer sheets provided with the question booklet.
2. The booklet will be distributed to the candidates before 05 minutes of the examination. **Candidates should write their roll no. in each page of the booklet.**
3. Place the Student ID card, Registration Slip and No Dues Clearance (if applicable) on your desk. All the entries on the cover page must be filled at the specified space.
4. Carrying or using of mobile phone / any electronic gadgets (except regular scientific calculator)/chits are strictly prohibited inside the examination hall as it comes under the category of unfair means.
5. No candidate should be allowed to enter the examination hall later than 10 minutes after the commencement of examination. Candidates are not allowed to go out of the examination hall/room during the first 30 minutes and last 10 minutes of the examination.
6. Write on both side of the leaf and use pens with same ink.
7. The medium of examination is English. Answer book written in language other than English is liable to be rejected.
8. All attached sheets such as graph papers, drawing sheets etc. should be properly folded to the size of the answer book and tagged with the answer book by the candidate at least 05 minutes before the end of examination.
9. The door of examination hall will be closed 10 minutes before the end of examination. Do not leave the examination hall until the invigilators instruct you to do so.
10. Always maintain the highest level of integrity. Remember you are a BITian.
11. Candidates need to **submit the question paper cum answer sheets before leaving the examination hall**.

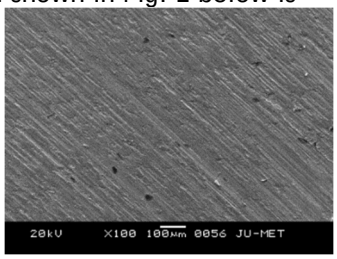
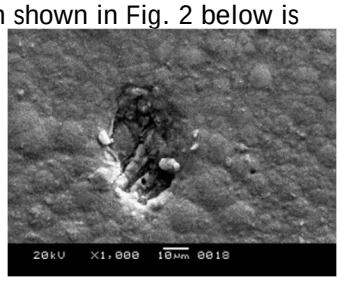
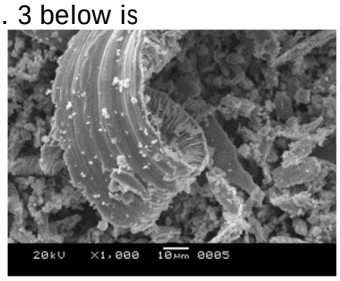
BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI				
(END SEMESTER EXAMINATION)				
CLASS:	**B. Tech**			**SEMESTER: VI**
BRANCH:	**ME**			**SESSION: SP/2022**
SUBJECT: ME367 INDUSTRIAL TRIBOLOGY				
TIME:	**2 HOURS**			**FULL MARKS: 50**

INSTRUCTIONS:

1. The total marks of the questions are 50.
2. Q1 carries 30 marks and consists of multiple-choice questions. **For question 1, you are required to write down the complete correct option rather than only the option number.**
3. Q2 to Q6 carries 5 marks. **You may attempt any four amongst the five questions i.e. 20 Marks.**
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. The missing data, if any, may be assumed suitably. All symbols have their usual meanings.

Q1	(a)	The deformed layer on a surface is formed due to (i) Adsorption of lubricant (ii) Machining (iii) Chemical reaction with oxygen in air (iv) Formation of strong chemical bonds with adsorption species	[1]
	(b)	Surface irregularity of longer wavelength is called (i) Lays (ii) Flaws (iii) Waviness (iv) Micro-roughness	[1]
	(c)	Separation of highest peak and lowest valley is called (i) Mean to valley height (ii) Peak to valley height (iii) Peak to mean height (iv) Average peak to mean height	[1]
	(d)	Separation of average of five highest asperities and mean line is called (i) Mean to valley height (ii) Peak to valley height (iii) Peak to mean height (iv) Average peak to mean height	[1]
	(e)	The spacing of asperities on a surface produced due to machining is given by (i) Mean to valley height (ii) Peak to valley height (iii) Mean line peak spacing (iv) Average peak to mean height	[1]
	(f)	The skewness is given as (i) $R_{sk} = \frac{1}{nR_q^3}\sum_{i=1}^{n} y_i^3$ (ii) $R_{sk} = \frac{1}{nR_q^3}\sum_{i=1}^{n} y_i^2$ (iii) $R_{sk} = \frac{1}{R_q^3}\sum_{i=1}^{n} y_i^3$ (iv) $R_{sk} = \frac{1}{nR_a^3}\sum_{i=1}^{n} y_i^3$	[1]
	(g)	The Kurtosis is given as (i) $R_{ku} = \frac{1}{R_q^3}\sum_{i=1}^{n} y_i^3$ (ii) $R_{ku} = \frac{1}{nR_q^3}\sum_{i=1}^{n} y_i^3$	[1]

		(iii) $R_{ku} = \frac{1}{nR_q^4}\sum_{i=1}^{n} y_i^4$ (iv) $R_{ku} = \frac{1}{R_q^4}\sum_{i=1}^{n} y_i^4$	
	(h)	Oils and greases reduces friction between sliding surfaces by (i) Filling the surfaces cavities (ii) Removing contamination from surface (iii) Increasing contact area of the surfaces (iv) Oxidizing the surface	[1]
	(i)	Which of the following statement is false (i) Lubrication results in reduced surface failures (ii) Lubrication results in increased surface failures (iii) Lubrication results in decreased fatigue failures (iv) Lubrication reduces stress concentration	[1]
	(j)	Natural oils include (i) Animal fats (ii) Synthetic hydrocarbons (iii) Chlorinated hydrocarbons (iv) Silicones	[1]
	(k)	Synthetic oils include (i) Animal fats (ii) Vegetable oils (iii) Paraffins (iv) Silicones	[1]
	(l)	The following parameter is a measure of fire hazard related to a lubricant (i) Pour point (ii) Flash point (iii) Acidity (iv) Alkalinity	[1]
	(m)	The following parameter determines suitability of a lubricant for use at low temperatures (i) Pour point (ii) Flash point (iii) Acidity (iv) Alkalinity	[1]
	(n)	The Barus relationship of variation of viscosity with pressure is given as (symbols have their usual meaning) (i) $\mu = \mu_0 \exp(\alpha \cdot p^2)$ (ii) $\mu = \mu_0 \exp(\alpha \cdot p^{0.5})$ (iii) $\mu = \mu_0 \exp(\alpha^2 \cdot p)$ (iv) $\mu = \mu_0 \exp(\alpha \cdot p)$	[1]
	(o)	The variation of viscosity with temperature and pressure is given as (symbols have their usual meaning) (i) $\mu = \mu_0 exp\left[\alpha T + \beta\left(\frac{1}{P} - \frac{1}{P_0}\right)\right]$ (ii) $\mu = \mu_0 exp[\alpha p + \beta(T - T_0)]$ (iii) $\mu = \mu_0 exp\left[\alpha p + \beta\left(\frac{1}{T} - \frac{1}{T_0}\right)\right]$ (iv) $\mu = \mu_0 exp[\alpha T + \beta(P - P_0)]$	[1]
	(p)	Friction and wear are (i) Mechanical properties of a material (ii) System response (iii) Both (i) and (ii) (iv) None of the above	[1]
	(q)	Corrosive wear is (i) Combination of adhesive and abrasive wear (ii) Combination of chemical attack and wear	[1]

		(iii) A form of erosive wear (iv) A result of chemical bonding between two nominally clean surfaces	
	(r)	Erosive wear is a function of (i) Particle Velocity (ii) Impact angle (iii) size of abrasive (iv) none of the above (v) all of the above	[1]
	(s)	In adhesive wear, k = 0.1 denotes (i) Every junction involved in the friction process produces a wear fragment (ii) One in ten million junctions produces a wear fragment (iii) One tenth of the friction junctions produce wear fragments (iv) One fifth of the friction junctions produce wear fragments	[1]
	(t)	Archard's equation of adhesive wear is given as (symbols have their usual meanings) (i) $v = (Wx)/kH$ (ii) $v = (kWx)/H$ (iii) $v = (kW)/xH$ (iv) $v = W/H$	[1]
	(u)	The primary wear mechanism shown in Fig. 1 below is  **Fig. 1.** (i) Adhesive wear (ii) Abrasive wear (iii) Fatigue wear (iv) Fretting wear	[2]
	(v)	The primary wear mechanism shown in Fig. 2 below is  **Fig. 2.** (i) Adhesive wear (ii) Abrasive wear (iii) Fatigue wear (iv) Fretting wear	[2]
	(w)	The wear debris shown in Fig. 3 below is  **Fig. 3.** (i) Plate shaped (ii) Ribbon shaped (iii) Spherical shaped (iv) Irregular shaped	[2]

	(x)	The real area of contact is (i) Equal to apparent area of contact (ii) Less than apparent area of contact (iii) Greater than apparent area of contact (iv) None of the above	[1]
	(y)	Which statement amongst the following is true? (i) As per the simple adhesion theory, the coefficient of friction is dependent on material properties of softer material (ii) As per the simple adhesion theory, the coefficient of friction is dependent on material properties of harder material (iii) As per the simple adhesion theory, the coefficient of friction is dependent on material properties of both softer and harder material (iv) As per the simple adhesion theory, the coefficient of friction is dependent on geometry of asperities of softer material	[1]
	(z)	As per the junction growth theory of friction (i) Similar pair of materials must be chosen to reduce friction (ii) Dissimilar material pairs must be chosen to reduce friction (iii) A low shear strength oxide film compared to bulk material reduces friction (iv) Both (ii) and (iii) (v) Both (i) and (iii)	[2]
Q2	(a)	Differentiate between lays and flaws in a surface.	[2]
Q2	(b)	What is a better method for quantifying surface roughness: average roughness or root mean square roughness and why?	[3]
Q3	(a)	Consider a hard ball sliding against a soft and flat surface at two different loads. At one situation, friction coefficient is 0.25 and the groove width is 1 mm. At another load situation, the corresponding values of friction coefficient and groove width are 0.22 and 0.6 mm respectively. Assuming friction due to adhesion and ploughing in additive mode, calculate the radius of the ball and the adhesive component of friction coefficient.	[3]
Q3	(b)	What are the differences between simple adhesion theory given by Bowden and Tabor and Junction Growth Theory?	[2]
Q4	(a)	What are the main criteria for classification of wear and what are the types of wear?	[3]
Q4	(b)	State the significance of non-dimensional wear coefficient *k* in adhesive wear?	[2]
Q5	(a)	Distinguish between hydrostatic and hydrodynamic lubrication.	[2]
Q5	(b)	Comment on the mechanism of pressure build-up in case of hydrodynamic lubrication.	[3]
Q6	(a)	What is seizure and what causes it in a tribological system?	[3]
Q6	(b)	Why are foam inhibitors used in lubricants?	[2]

:::::: 28/04/2022 ::::::