

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

Department of Mechanical Engineering

B. Sc. Engineering 4th year 2nd Term Examination, 2014

ME 4059

(Engineering Tribology)

Time: 3 Hours.

Total Marks: 210

- N.B. i) Answer any THREE questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.
iii) Necessary Charts may be supplied on request.
iv) Assume reasonable data if any missing.

SECTION - A

- 1(a) Define the term tribology. Explain the industrial importance of tribology. 10
- 1(b) Describe the methods of solution of tribological problems with neat sketch. 15
- (c) What is meant by running-in and planned obsolescence? 04
- 1(d) Define atomic packing factor. Calculate the atomic packing factor of FCC structure of material. 06
- 2(a) Draw the peak, valley, ordinate and slope distribution of a typical surface profile. 05
- 2(b) What is theoretical density? Sketch the pressure and stress distribution patterns when a flat, cylindrical and spherical body rubbing over a flat surface. 10
- 2(c) What is unit cell and lattice. Prove that the atomic packing of a solid is higher when it has FCC structure than that of a BCC structure. 14
- 2(d) Explain the different properties of surfaces. 06
- 3(a) What is meant by friction? State and briefly explain the laws of friction. 10
- 3(b) What are the factors of influencing adhesion? Describe the simple adhesion theory. 12
- 3(c) What is rolling friction? Classify the types of rolling contact. Describe about rolling subjected to tractions. 15
- 4(a) Explain the following terms: 08
(i) Crystalline material (ii) Fretting
(iii) Delamination (iv) Mutual solubility in contact interface.
- 4(b) State the laws of adhesive wear. Explain the mechanism of corrosive wear. 11
- 4(c) Briefly explain the factors that affecting wear behaviour. 05
- 4(d) What are the methods of measuring wear. Explain with neat sketch the methodology of measuring wear using 4-ball wear tester. 11

SECTION - B

- 5(a) What is lubrication? What are the purposes of lubrication? 07
- 5(b) How lubricant can be classified? What are the important properties of lubricant? 10
- 5(c) Describe the effect of temperature and pressure on viscosity. 12
- 5(d) How viscosity can be measured by capillary tube viscometers? 06

- 6(a) What is meant by lubrication regimes. Explain the mechanism behind hydrodynamic lubrication and boundary lubrication. 12
- 6(b) Shortly explain the mechanism of elastohydrodynamic lubrication (EHL). Show the lubrication regimes with the help of Stribeck Curve. 17
- 6(c) What are the purpose of additives? Give some examples of additives. 06
- 7(a) What are the different types of bearing? Explain the operating methods of a journal bearing with neat sketch. 12
- 7(b) What are the requirements of lubrication for open gears and enclosed gears? 08
- 7(c) What is meant by pitting and fretting in gear wear? 06
- 7(d) Write short note on micro and nano tribology. 09
- 8(a) Deduce Reynolds Fluid Film Lubrication equation. 10
- 8(b) Explain various basic seal types. What are the design considerations of sealing systems? 15
- 8(c) What are the essential elements and requirements of a mechanical seal? 05
- 8(c) What are the future aspects of tribological research in Bangladesh? 05

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KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

Department of Mechanical Engineering

B. Sc. Engineering 4th year 2nd Term Examination, 2014

ME 4213

(Fluid Mechanics-III)

Time: 3 Hours.

Total Marks: 210

- N.B. i) Answer any THREE questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.
iii) Assume reasonable data if any missing.
iv) Charts or graphs may be supplied on request.

SECTION - A

- 1(a) How air vessels minimize the fluctuation of flow in suction side of a reciprocating pump? 05
- 1(b) Show that work saved against friction by fitting an air vessel in a single acting reciprocating pump is 84.8%. 15
- (c) A single acting reciprocating pump runs at 75 rpm. The diameter of the plunger is 25 cm and crank radius is 0.18 m. The suction pipe is 10 cm in diameter and 7.0 m long. Calculate the maximum permissible value of suction lift, if the separation takes place at 2.4 m of water absolute. 15
- 2(a) Define the followings for centrifugal pump. 08
(i) Static head (ii) Manometric head
(iii) Manometric efficiency (iv) Volumetric efficiency
- 2(b) Why priming is necessary in centrifugal pump? What is specific speed of centrifugal pump? 09
- 2(c) A centrifugal pump works against a static head of 20 m of which delivery head is 15 m. Both suction and delivery pipes are of same diameter 100 mm; the head losses in the suction and delivery lines are 1.5 m and 5 m respectively. The impeller is 400 mm in diameter and 20 mm wide at the mouth; it revolves at 1400 rpm with an effective vane angle at exit is 40%. If $\eta_o = 75\%$ and $\eta_{mano} = 80\%$, determine the discharge delivered by the pump and the power required to drive the pump. 18
- 3(a) Distinguish between impulse and reaction turbine. 04
- 3(b) What is meant by governing of a water turbine? 08
- 3(c) Describe the function of surge tank. 06
- 3(d) A double jet pelton wheel has a specific speed of 14 and is required to deliver 1000 kW. The turbine is supplied through a pipeline from a reservoir whose level is 400 m above the nozzles. Allowing 5% for friction loss in the pipe calculate (i) speed in rpm, (ii) diameter of jet and (iii) mean diameter of bucket circle. Take $C_v = 0.98$, speed ratio = 0.46 and overall efficiency = 85%. 17
- 4(a) What is reaction turbine? Deduce the expression for efficiency of a reaction turbine. 18
- 4(b) Show that in a turbine with radial vanes at inlet and outlet, operating under head 'h', if the velocity of flow at outlet is 'C' times that at inlet, the efficiency is –
$$\eta_h = \frac{2}{2+C^2 \tan^2 \alpha}$$
, where the symbols have their usual meanings. 17

SECTION – B

- 5(a) Show that for irrotational flow vorticity is zero. 10
- 5(b) What is flow net? Write its physical significance. 10
- 5(c) Derive the equation of stream function for source and sink of equal strength is combined with uniform flow and show its graphical representation. 12.15
- 6(a) Show the effect of superimposition of uniform flow and a doublet. 17
- 6(b) Why and how a spin bowler can swing ball in cricket? 05
- 6(c) A circular cylinder of diameter 400 mm is rotated about its own axis in a stream of water having uniform velocity of 8 m/sec. Determine the rotational speed for which both the stagnation points will coincide just at the bottom of the cylinder and also the lift force on the cylinder. Assume $\rho_{\text{water}} = 1000 \text{ kg/m}^3$. 13
- 7(a) What is economic section of an open channel flow? Deduce the expression of economic section for a trapezoidal channel. 18
- 7(b) A trapezoidal channel having bottom width 7 m and side slopes 3 horizontal to 2 vertical is laid on a bottom slope of 1 in 2000. If it carries a uniform flow of water at the rate of $9.5 \text{ m}^3/\text{sec}$, determine (i) the normal depth and (ii) the mean velocity of flow. Take Manning's n as 0.03. 17
- 8(a) Define (i) Specific energy, (ii) Critical depth and (iii) Critical velocity. 06
- 8(b) Deriving specific energy equation show the rapid and tranquil flow for constant discharge graphically and also find the condition for critical depth. 15
- 8(c) A trapezoidal channel carries a discharge of $3.5 \text{ m}^3/\text{sec}$ per meter of bottom width. If a hydraulic jump occurs and losses energy of 3.0 m, determine the depth before and after the jump. 14

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