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10MMD/MDE31

Third Semester M.Tech. Degree Examination, December 2012
Tribology and Bearing Design

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Explain with sketches, the regimes of lubrication. **(10 Marks)**

b. State and explain Newton's law of viscous flow. **(05 Marks)**

c. Explain the effect of temperature and pressure on viscosity of lubricating oils **(05 Marks)**

2 a. Derive Hagen Poiseuilli law. State the assumptions made in the derivation. **(10 Marks)**

b. An experiment is conducted to determine the viscosity of a fluid using a rectangular slot with the following dimensions:
Width of slot = 200 mm
Length of slot = 300 mm
Thickness of slot = 0.25 mm
Difference in pressure causing flow = 0.45 MPa.
Rate of flow = 17.28 liter/hr
Temperature = 30°C
Determine the grade of the oil tested. **(05 Marks)**

c. Two rectangular plates 10mm×120mm are separated by a distance of 0.5 mm and the clearance is filled with SAE 40 oil at 30°C. Determine the force required to induce a relative velocity of 0.1 m/s. **(05 Marks)**

3 a. Differentiate between:
i) Hydrodynamic and hydrostatic lubrication
ii) Lightly loaded and heavily loaded bearing. **(04 Marks)**

b. Derive Petroff's equation for the coefficient of friction in a lightly loaded bearing with usual notations. State the assumptions made in the derivation. **(10 Marks)**

c. A full journal bearing of an air compressor has the following specifications:
Journal diameter = 60 mm
Bearing length = 50 mm
Radial clearance = 0.05 mm
Radial load = 900 N
Viscosity = 2.9×10^{-2} N-s/m^2
Coefficient of friction = 0.042
Determine:
i) The speed of te journal which corresponding to the given coefficient of friction.
ii) Power loss at this speed. **(06 Marks)**

4 a. State the assumptions made in the derivation of Reynolds equation in two dimensions. **(05 Marks)**

b. With usual notations, derive Reynolds equation in two dimensions. **(15 Marks)**

5 a. Explain with sketches, formation of continuous oil film in a full journal bearing. **(08 Marks)**

b. Derive an expression for pressure distribution along an idealized slider bearing with fixed shoe. **(12 Marks)**

6 a. Explain the importance of Sommerfeld number in the design of journal bearings. **(05 Marks)**

b. Determine the load carrying capacity, frictional force, coefficient of friction, power loss due to friction and minimum oil film thickness for an ideal full journal bearing having the following specifications:

Diameter of the journal = 5 cm	Length of the bearing = 6.5 cm
Speed of the journal = 1200 rpm	Radial clearance = 0.0025 cm
Average viscosity = 0.011032 Pa-s	Attitude = 0.8.

(15 Marks)

7 a. Derive an expression for the load carrying capacity of hydrostatic step-bearing. **(10 Marks)**

b. Hydrostatic step bearing has the following specifications:

Diameter of shaft = 150 mm	Diameter of pocket = 100 mm
Vertical thrust as bearing = 60 kN	Shaft speed = 1500 rpm
Viscosity of oil = 30 cp	Oil film thickness = 0.125 mm

Determine :

i) Discharge ii) Power loss due to friction iii) Coefficient of friction **(10 Marks)**

8 a. Explain the meaning of elasto-hydrodynamic lubrication giving suitable examples. **(05 Marks)**

b. Write a note on the following :

i) Application of gas lubricated bearings

ii) Fretting phenomenon

iii) Advantages and disadvantages of magnetic bearings. **(15 Marks)**

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10MMD/MDE321

Third Semester M.Tech. Degree Examination, December 2012
Fracture Mechanics

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions.***
2. Missing data may be suitably assumed.
3. Use of SIF data book may be permitted.

1 a. Using Griffith's energy balance approach, for a brittle solid derive an expression for the fracture strength. **(10 Marks)**

b. Explain the Irwin and Orawins modifications to Griffith's criterion. **(04 Marks)**

c. Differentiate clearly between clearage fracture and ductile fracture. **(06 Marks)**

2 a. What are important modes of fractures? Explain with neat sketches. **(08 Marks)**

b. Deduce an expression for theoretical tensile strength (critical cohesive strength) of an ideal solid by first principle. **(08 Marks)**

c. Determine the critical maximum cohesive strength of steel having E = 207 GPa and $\gamma_0 = 1$ J/m^2. Equilibrium separation of two atoms is 2.5 amstrong units (1 amstrong unit = 10^{-10}m) **(04 Marks)**

3 a. Explain the following:
i) Fracture toughness and ii) Critical energy release rate. **(06 Marks)**

b. Determine the energy release rate for a DCB specimen for the following cases with neat sketches:
i) Constant load condition and ii) Constant grip condition. **(10 Marks)**

c. Determine the critical energy release rate of DCB specimen loaded in a tensile testing machine. The thickness of the DCB specimen is 30 mm, depth of each cantilever is 12 mm and crack length is 50 mm. The material is made of hardened steel with modulus of 207 GPa and the crack is about to propagate at 15405 N pulling load. **(04 Marks)**

4 a. Derive an expression for the size of the plastic zone and the correction according to Irwin's approach. State also the significance of it. **(06 Marks)**

b. A large plate of 5 mm thickness made of medium carbon steel $\sigma_{ys} = 350$ MPa with a through thickness centre crack of 2a = 40mm length subjected to a stress of 150 MPa. Find the effective crack length using Irwin's plastic zone correction. **(04 Marks)**

c. Define J-integral. Mention the properties of J-integral. Show that J-integral is path independent. **(10 Marks)**

5 a. Describe the test procedure for determining fracture toughness using 3-point bent specimen (SENB). **(12 Marks)**

b. Discuss the effect of thickness on fracture toughness. **(04 Marks)**

c. Discuss the effect of temperature and yield stress on fracture toughness. **(04 Marks)**

6 a. List and explain the important factors that influence the fatigue crack growth. **(08 Marks)**

b. Obtain an expression for number os cycles required for the crack to propagate from an initial length of 'a_i' to a final length of 'a_f' for the case of m = 2.0. **(08 Marks)**

c. Draw the shapes of plastic zone for plane stress and plane strain according to Von-Mises and Tresca criterion. **(04 Marks)**

7 a. Explain the principle of crack arrest and with neat sketch explain any two techniques for arresting the propagating crack. **(10 Marks)**

b. List the various NDT methods used in fracture mechanics. With neat sketch, explain any two NDT methods of testing. **(10 Marks)**

8 Explain the following :

a. Damage tolerance approach

b. Sources of micro and macro cracks

c. R-curve and its importance

d. Fail safe and safe life approach to design **(20 Marks)**

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10MMD/MDE333

Third Semester M.Tech. Degree Examination, December 2012

Design for Manufacture

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions.***
2. ***Use of approved data band book allowed.***

1 a. Explain the following:
i) Interference fits
ii) Bilateral tolerance
iii) Compound tolerance **(08 Marks)**

b. Explain the effect of manufacturing process on design. **(06 Marks)**

c. The material for a solid, cylindrical tie rod of cross sectional area 'A' and length 'L' is to be selected for carrying tensile force of 'P' with factor of safety 'S'. Explain the process of material selection to minimize weight. **(06 Marks)**

2 a. Explain geometric tolerance with symbols. **(10 Marks)**

b. Find the resultant 'X' for the Fig.Q2(b). **(10 Marks)**

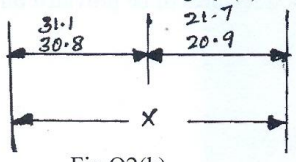

Fig.Q2(b)

3 a. Explain with a sketch, selective assembly of model – 11 with ($t_s = g_s$). **(10 Marks)**

b. It is desired that an end assembly of four equal parts have a tolerance u_a equal to 0.200 mm. Find the piece-part tolerance that should be specified by i) arithmetic rule, ii) normal law, iii) normal law with a truncation of one standard deviation. **(10 Marks)**

4 a. For the component shown in Fig.Q4(a). Identify the functional and manufacturing datum and suggest suitable manufacturing dimensions and give the modified manufacturing drawing. **(10 Marks)**

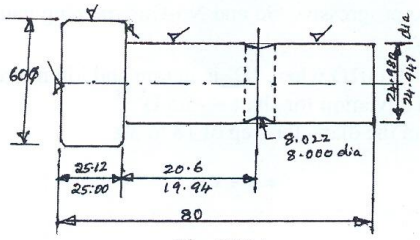

Fig.Q4(a)

b. The suitable operational sequence layout, explain :
i) Falling, turning, part off by using capstan lathe
ii) Machining groove with the help of horizontal or vertical milling machine. **(10 Marks)**

5 a. Explain the following with suitable examples:
   i) Cast holes
   ii) Cored holes
   iii) Machined holes **(10 Marks)**

   b. With sketches of a lever made of cast-iron Fig.Q5(b), give the different possible parting line for casting a lever-cast iron. What is the most suitable parting line for lever cast iron? **(10 Marks)**

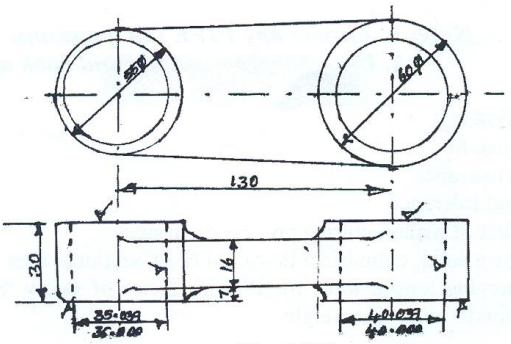

Fig.Q5(b)

6 a. Explain with sketches the specification features of be provided on the following for the case of machining:
   i) Internal screw thread
   ii) Blind bored holes. **(10 Marks)**

   b. Explain the following with examples:
   i) Dowells and dowelling procedures
   ii) Simplification by separation **(10 Marks)**

7 a. Explain zero positional tolerance at maximum material condition along with an example. **(10 Marks)**

   b. With an example, explain fixed fastener and floating fastener methods of calculating true position tolerances. **(10 Marks)**

8 a. With a neat sketch, explain briefly the following:
   i) Double ended plug gauge
   ii) Double ended snap gauge **(05 Marks)**

   b. Design a workshop type progressive Go and No-Go type plug gauge for checking a 30 H7/f8 hole and shaft assembly.

   Take: i) $i = 0.45\sqrt[3]{D} + 0.001D$ where 'D' is in mm and i in microns.
   ii) Fundamental deviation for shaft = $-5.5\ D^{0.41}$.
   iii) 30 mm falls in the diameter step of 18 to 30. **(15 Marks)**

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