L-3/T-1/ME **Date : 19/08/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2016-2017

Sub : **IPE 331** (Production Processes)

Full Marks : 280 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) List the advantages and limitations of metal as the pattern material. Discuss the dry sand molds and skin dry molds used in the casting process. **(12)**

   (b) With the help of suitable diagrams discuss the following: **(24)**

   (i) Match plate and sweep pattern

   (ii) Centrifugal casting

   (iii) Squeeze casting

   (c) With the help of suitable sketches, discuss the various design considerations for designing the sand mold castings. Why are risers usually required in permanent mold casting method? **($10\frac{2}{3}$)**

2. (a) With the help of suitable diagrams, describe orthogonal cutting and oblique cutting. State the causes why the direction of the chip flow deviates from orthogonal plane. **(14)**

   (b) Derive, with the help of MCD, a simple expression for the shear plane angle (β) as a function of friction angle (η) and tool rake angle (γ). **(16)**

   (c) A ductile metal rod of 120 mm diameter is turned at speed of 320 rpm, feed of 0.24 mm/rev. and 3.00 mm depth of cut by a tool having tool rake angle 10° and principal cutting edge angle 70°. The following observations were made: Tangential force (P_Z) = 750 N; transverse force (P_y) = 200 N; chip thickness = 0.7 mm. Using MCD, determine the approximate value of (i) Frictional force, (ii) Normal force; (iii) Shear force and (iv) Dynamic yield shear strength of the work material. **($16\frac{2}{3}$)**

3. (a) Sketch the various types of weld joints and welds used in making a joint. Differentiate among autogenous, homogeneous and heterogeneous welding processes. **($10\frac{2}{3}$)**

   (b) With the help of neat sketches, describe briefly the principles of operation and give some suitable industrial application of the following welding processes: **(24)**

   (i) Percussion welding

   (ii) Thermit welding

   (iii) Electron beam welding

   (c) With the help of suitable diagrams, describe the different defects encountered with welding products. What are the benefits of automated welding? **(12)**

Contd P/2

IPE 331 (ME)

4. (a) How the manufacturing processes may be classified: With neat sketches, describe briefly the investment or lost-wax casting method. **(15)**

(b) Classify the types of chips and also state under what conditions of machining those different types of chips form. Deriver an expression, with the help of a diagram, to predict how shear angle is related to chip reduction coefficient and tool rake angle. **($15\frac{2}{3}$)**

(c) What are the similarities and differences between consumable and non-consumable electrodes? With a simplified diagram, describe briefly the principles of operation of laser beam welding process. **(16)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Describe generating and forming method of metal cutting with suitable examples. **($8\frac{2}{3}$)**

(b) What are the factors that affect the selection of manufacturing process? **(8)**

(c) What are the existing methods of taper turning? Describe the method of taper turning using taper turning attachment. **(14)**

(d) Explain with neat diagram the following turning operations: **(16)**

(i) Boring
(ii) Threading
(iii) Knurling

6. (a) Mention briefly the effects of feed per stroke in case of shaping operation? **($8\frac{2}{3}$)**

(b) What are the major wheel defects that occur due to grinding operation? **(10)**

(c) Describe the mechanism of hydraulic shaper with suitable diagram. **(16)**

(d) A shaper is operated at 22,000 mm/min and is used to machine a work piece of 240 mm length and 100 mm width. Use a feed of 0.6 mm per stroke and depth of cut of 3 mm. The forward stroke is completed in 220°. Consider the height to be reduced and clearance to be kept 3 mm and 25 mm respectively. **(12)**

(i) Calculate the time taken for a forward stroke.
(ii) Calculate the time taken for a backward stroke.
(iii) Calculate the total machining time to complete the job.
(iv) Calculate the number of strokes per minute.

Contd P/3

IPE 331 (ME)

7. (a) What is indexing? What are the available methods of indexing? **($8\frac{2}{3}$)**

   (b) What is centerless grinding? Explain with neat diagram. **(10)**

   (c) Describe the properties and functions of the following tools: **(10)**

   (i) Twist drill

   (ii) Core drill

   (d) What is face milling? Explain any four face milling operations with suitable diagram. **(18)**

8. (a) Describe the Mannesmann process with suitable diagram. **($10\frac{2}{3}$)**

   (b) Explain in brief the common extrusion defects. **(10)**

   (c) What is barreling? What are the ways to minimize barreling effect? **(10)**

   (d) What is fullering and edging? What are the stages in forging a connecting rod for an internal combustion engine from a bar stock? **(16)**

L-3/T-1/ME **Date : 15/07/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2016-2017

Sub : **ME 321** (Fluid Mechanics-I)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Symbols used have their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

Assume any data if necessary.

1. (a) Using Reynolds Transfer Theorem, deduce the expression for the integral form of the linear momentum equation for fluids moving through a finite control volume which is fixed in space. **(15)**

   (b) A Tee attached to a pipe end splits an incoming water stream into two free outgoing jets as shown in Fig. for Q. No. 1(b). The exit speed of both streams is 9 m/s. Determine the x and y components of the force that the pipe exerts on the Tee at the Tee joint. Neglect viscous and gravity forces. **(14)**

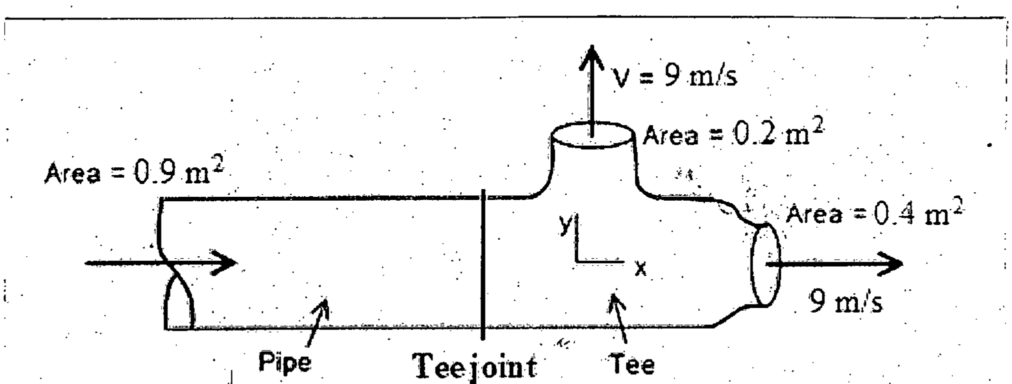

Fig. for Q. No. 1(b)

   (c) What is 'particle' (total) derivative? Explain how it differentiates the acceleration of a fluid particle with that of a rigid body. **(6)**

2. (a) Show the Energy form, Head form and Pressure form of the Bernoulli's equation and identify the terms. List the assumptions made in the derivation of Bernoulli's equation. **(9)**

   (b) Water is flowing from a large reservoir through a nozzle as shown in Fig. for Q. No. 2(b). Points 1 and 3 are open to atmosphere. The diameter of the pipe at point 2 is 100 mm and at point 3 (the nozzle exit) is 40 mm. Find the water flow-rate and static pressure at point 2. **(14)**

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Contd ... Q. No. 2(b)

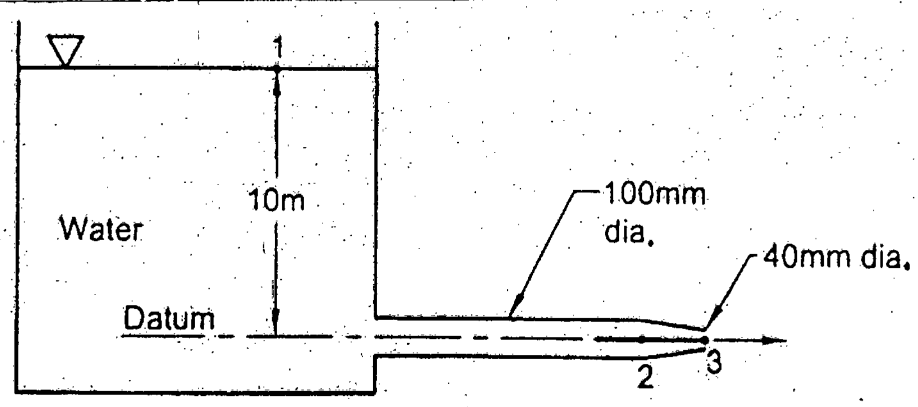

Fig. for Q. No. 2(b)

(c) Derive the most generalized differential form of the continuity equation in Cartesian coordinate system. Reduce it for (i) Steady flow and (ii) incompressible 2D flow. Write down the continuity equation in cylindrical coordinates. **(12)**

3. (a) With neat sketches show how a pitot-static tube can be used to measure the flow-rate of a fluid through a closed channel of known cross-section. **(13)**

(b) A Pitot tube is used to measure the velocity of an aircraft at a certain altitude as shown in Fig. for Q. No. 3(b). At the given altitude, the air density is measured as 1.13 kg/m^3 and the static pressure is measured as 90 kPa. The manometer connected to the Pitot tube records the stagnation pressure as 0.77 m of mercury. What is the aircraft velocity in km/h? **(10)**

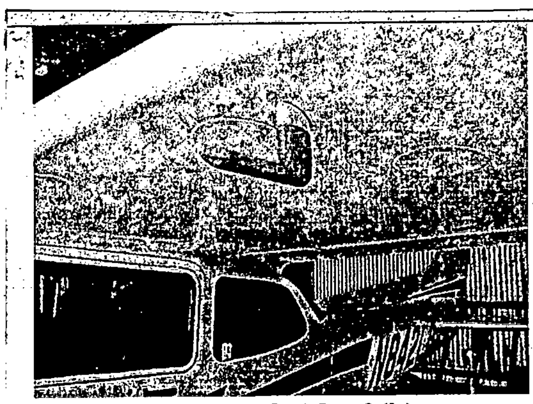

Fig. for Q. No. 3(b)

(c) Write down the most generalized differential form of the momentum equations in Cartesian coordinate system. Identify each term in the equation. Which assumptions are necessary to derive the Navier-Stokes equations from the momentum equations? Write down the Navier-Stokes equations in Cartesian coordinate system. **(12)**

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4. (a) What is incompressible flow? At what condition, the flow of compressible fluids may be treated as incompressible flow? **(6)**

(b) What is irrotational flow? Write down the condition for irrotationality in 2D Cartesian coordinates. **(6)**

(c) What are stream function and velocity potential? Define circulation. **(13)**

(d) Show that for a 2D inviscid irrotational flow, the continuity equation may be expressed as a Laplace equation in velocity potential and the condition of irrotationality may be expressed as a Laplace equation in stream function. **(10)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) A tube of small radius is dipped into water in an open container as shown in Figure for Q. 5(a). Find the diameter of water column required for the capillary rise of 1 mm. Given that surface tension $\sigma = 70$ mN/m and $\theta = 0°$. **(10)**

(b) A velocity field is given by $\vec{V} = ax\hat{i} + by(1+ct)\hat{j}$ where $a = b = c$. Obtain an equation for the stream-line in x-y plane. **(10)**

(c) Show that pressure at a point in a fluid has the same magnitude in all directions. **(15)**

6. (a) Derive the basic equation of fluid statics stating the assumptions used. **(20)**

(b) The inclined tube manometer is filled with oil as shown in Figure for Q. 6(b) has D = 76 mm and d = 8 mm. Calculate the angle θ that gives a 15 cm oil deflection along the inclined tube for the applied pressure of 25 mm of water (gage). Determine the sensitivity of this manometer. **(15)**

7. (a) Deduce the expression for the magnitude and location of the resultant hydrostatic force acting on a plane surface of a completely submerged plate. **(20)**

(b) A 5 m high, 5 m wide rectangular gate blocks the end of a 4 m deep freshwater channel as shown in Figure for Q. 7(b). The plate is hinged about a point A and is restrained from opening by a fixed ridge at point B. Determine the force exerted on the plate by the ridge. **(15)**

8. (a) A cylindrical weir as shown in Figure for Q. 8(a) has a diameter of 3 m and a length of 6 m. Find the magnitude and direction of the resultant force acting on the weir from the water. **(20)**

(b) A 60 cm diameter cylindrical tank, as shown in Figure for Q. 8(b) open to the atmosphere contains 30 cm high water. The tank is now rotated about the center-line, and the water level drops at the center while it rises at the edges. Determine the rotational speed at which the bottom of the tank will first be exposed, and the water height at the moment. **(15)**

ME 321

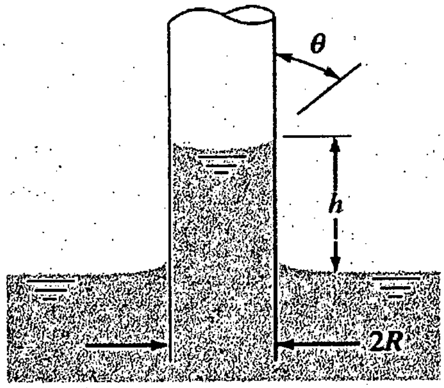


Figure for Q. 5(a)

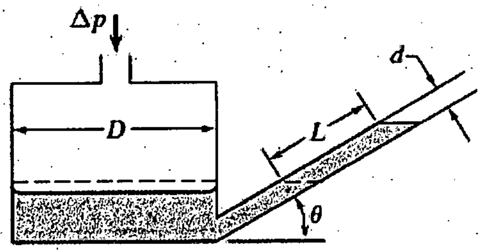


Figure for Q. 6(b)

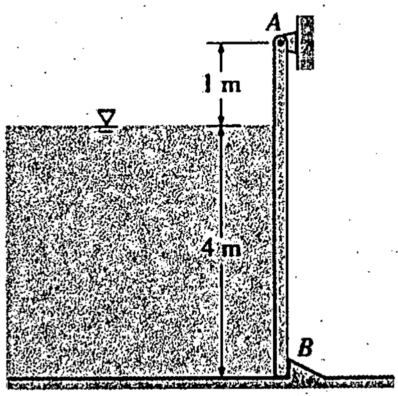


Figure for Q. 7(b)

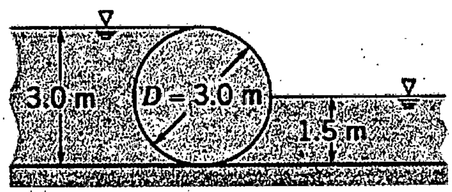


Figure for Q. 8(a)

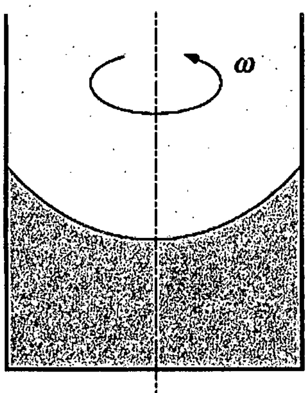


Figure for Q. 8(b)

L-3/T-1/ME **Date : 13/08/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2016-2017

Sub : **ME 349** (Mechanics of Machinery)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Assume any missing data if there is any.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

Symbols indicate their usual meaning.

1. (a) A motor drives a machine through a friction clutch which slips when the torque on it reaches 40 N-m. The moment of inertia of the motor armature is 1.6 kg-m^2 and that of the rotating part of the machine is 3.0 kg-m^2. The torque developed by the motor is 27 N-m assumed constant at all speeds and when the clutch is engaged the steady speed of motor and machine is 500 rev/min. At a given instant, the clutch is disengaged and remains so for 4 s then it is re-engaged. Find the time of slipping after re-engagement and determine how much energy is lost during slipping. **(17)**

   (b) An electric motor on board a ship is arranged with its rotor crosswise the ship. Find the maximum load on its bearings due to gyroscopic action if the ship rolls with S.H.M. 30° on each side of the vertical and the time for one complete roll is 3.4 s; the mass of the rotor is 220 kg, its radius of gyration is 215 mm, the bearings are 1.1 m apart and the speed of the rotor is 3000 rev/min clockwise viewed from the starboard (right) side. Explain precisely with the aid of diagrams the gyroscopic effect on the ship's hull. **(18)**

2. (a) A pinion with 30 involute teeth, of 4 mm module, gears with a rack. If the pressure angle is 20°, and the addenda for pinion and rack are the same, with necessary sketch, determine: (i) the maximum addendum, if interference is to be avoided, (ii) the length of the resulting path of contact. **(17)**

   (b) A compound epicyclic gear is shown in Fig. for Q.2(b). If the shaft R rotates at 1000 rev/min while the annulus A_1 rotates at 1000 rev/min in the opposite direction, determine the speed and direction of rotation of the shaft Q. The numbers of teeth on the wheels are: sun-wheel S_1 = 35, sun-wheel S_2 = 20, annulus A_1 = 105, annulus A_2 = 60. **(18)**

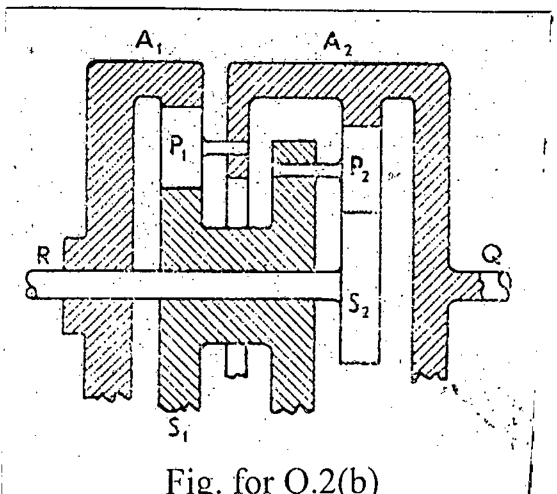


Fig. for Q.2(b)

Contd P/2

ME 349

3. (a) A mass m_1 is suspended from a fixed point by means of a spring of stiffness S_1. Attached to m_1 by means of a second spring of stiffness S_2 is another mass m_2. When the system is set in free vibration, if the inertia of the springs be neglected, show that **(17)**

$$m_1 m_2 \omega^4 - \{m_1 S_2 + m_2 (S_1 + S_2)\}\omega^2 + S_1 S_2 = 0$$

where ω is the phase velocity.

If m_1 and m_2 are each 225 kg, and S_1 and S_2 are 240 and 120 kN/m respectively, find the frequencies of oscillation and the ratio of the amplitudes of m_1 and m_2.

(b) A uniform beam, of mass 31 kg/m, is simply supported on a span of 3.6 m. Taking EI for the beam as 7 MN-m^2, calculate the frequency of transverse vibrations. This frequency is to be reduced by 40% by fixing three equal masses to the beam, at the mid-point and the quarter points. Calculate how much these masses should be. **(18)**

4. (a) A shaft 50 mm diameter and 1.2 m long carries two flywheels at the end and is driven by a gear wheel fixed to the shaft between the flywheels. The left-hand flywheel has a mass of 350 kg with a radius of gyration of 0.6 m, whilst the right-hand flywheel has a mass 550 kg with a radius of gyration of 0.75 m. The gear wheel, which has a mass of 225 kg with a radius of gyration of 0.4 m, is 0.45 m from the left-hand flywheel. Determine the two frequencies of torsional vibrations which the system may have. Neglect the moment of inertia of the shaft. Use G = 80 GPa. **(17)**

(b) A mass of 50 kg suspended from a spring produces a static deflection of 18.5 mm and when in motion, it experiences a viscous damping force with a value of 720 N at a velocity of 1 m/s. Calculate the periodic time of damped vibration. If the mass is then subjected to a periodic disturbing force, having a maximum value of 180 N and making 2 Hz, find the amplitude of the ultimate motion. **(18)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. A cam is to be designed for a knife edge follower with the following data: **(35)**

(a) Cam lift is 20 mm during 60° of cam rotation with constant acceleration and retardation. The magnitude of retardation is double the acceleration.

(b) Dwell the next 90°.

(c) During the next 60° of cam rotation, the follower returns to its original position with same acceleration and retardation as it was during lift.

(d) Dwell during the remaining rotation.

(e) The follower is offset 10 mm from the radial direction. The radius of the base circle is 35 mm. Draw the cam profile.

Contd P/3

ME 349

6. (a) A three cylinder radial engine driven by a common crank has the cylinders spaced at 120°. The stroke is 130 mm, length of the connecting rod is 250 mm and the mass of the reciprocating parts per cylinder is 2.2 kg. Calculate the primary and the secondary forces at crank shaft speed of 1500 rpm. **(17)**

   (b) The cylinder of a petrol engine is 90 mm in diameter and its stroke is 120 mm. The length of its connecting rod is 240 mm. The piston has a mass of 1 kg and the speed is 1800 rpm. On the explosion stroke with the crank at 30° from top dead centre, the gas pressure is 0.5 N/mm^2. Find: (i) the resultant load on the gudgeon pin, (ii) the thrust on the cylinder walls, (iii) the crank effort at the given position of the crank. **(18)**

7. (a) The reciprocating masses of the first three cylinders of a four cylinder engine are 14, 16 and 17 kg respectively. The centre lines of the three cylinders are 500 mm, 300 mm and 250 mm from the fourth cylinder. If the cranks for all the cylinders are equal, determine the reciprocating mass of the fourth cylinder and the angular position of the cranks such that the system is completely balanced for the primary force and couple. If the cranks are 0.2 m long, the connecting rods are 1.0 m long, and the speed of the engine is 750 rpm; find the maximum unbalanced secondary force and the crank angle at which it occurs. **(18)**

   (b) Two shafts whose centers are 1 m apart are connected by a V-belt drive. The driving pulley is supplied with 100 kW and has an effective diameter of 300 mm. It runs at 1000 rpm, while the driven pulley runs at 375 rpm. The angle of groove on the pulleys is 40°. The permissible tension in 400 mm^2 cross-sectional area belt is 2.1 MPa. The density of the belt is 1100 kg/m^3. The coefficient of friction between the belt and pulley is 0.28. Estimate the number of belts required. **(17)**

8. (a) The equation of the turning moment diagram for the three crank engine is given by: **(17)**

$$T\,(N-m) = 25{,}000 - 75{,}000 \sin 3\theta$$

   where θ radians is the crank angle from inner dead center. The moment of inertia of the flywheel is 400 kg-m^2 and the mean engine speed is 300 rpm. Calculate the power of the engine and the total percentage fluctuation of speed of the flywheel, if (i) the resisting torque is constant and (ii) the resisting torque is (25,000 + 36,000 sinθ) N-m.

   (b) Figure for Q. No. 8(b) shows the particulars of two brake shoes which act on the internal surface of a cylindrical brake drum. The braking forces F_1 and F_2 are applied as shown in the figure and each shoe pivots on its fixed fulcrum O_1 and O_2. The width of the brake lining is 35 mm. The intensity of pressure at any point A is 0.4 sinθ N/mm^2 where θ is measured as shown from either pivot. The coefficient of friction is 0.4. Determine the braking torque and the magnitude of the forces F_1 and F_2. **(18)**

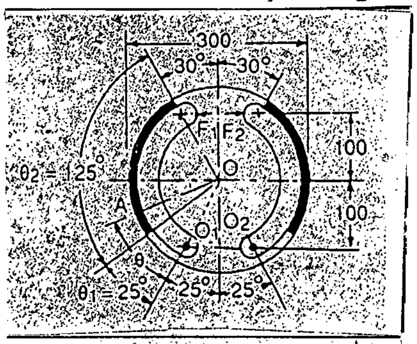


Figure for Q. No. 8(b)

L-3/T-1/ME **Date: 08/08/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2016-2017

Sub: **ME 305** (Heat Transfer)

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks.

Assume reasonable value for any missing data. All the symbols have their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Draw the boiling curve and identify the different boiling regimes. Also explain the characteristics of each regime. **(16)**

(b) What is the difference between film and dropwise condensation? Which one is more effective mechanism of heat transfer and why? **(8)**

(c) Sketch and name different boiling regimes in the order they occur in a vertical tube during flow boiling. **(11)**

2. (a) Oil flow in a journal bearing can be treated as parallel flow between two large isothermal plates with one plate moving at a constant velocity of 12 m/s and the other stationary. Consider such a flow with a uniform spacing of 0.7 mm between the plates. The temperature of the upper and the lower plates are 40°C and 15°C, respectively. By simplifying and solving the continuity, momentum and energy equations, determine: **(20)**

(i) the velocity and temperature distributions in the oil.

(ii) the maximum temperature and where it occurs, and

(iii) the heat flux from the oil to each plate.

[Assume the following properties for oil: $k = 0.145$ W/m.K; $\mu = 0.8$ N.s/m^2]

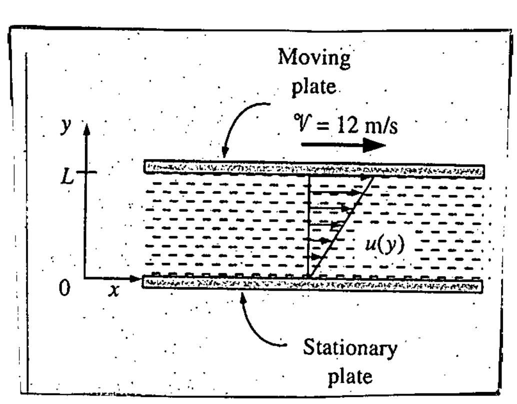


Fig. for Q. No. 2(a)

(b) With a neat sketch show the hydrodynamic and thermal boundary layers for forced air flow over a hot plate and indicate different flow regimes, velocity and temperature profiles and boundary layer thickness. **(15)**

Contd P/2

ME 305

3. (a) Define Prandtl number, Schmidt number and Lewis number. Explain their physical significance. **(9)**

(b) What is the effect of surface roughness on the friction drag coefficient in laminar and turbulent flows? **(6)**

(c) A long 10 cm diameter steam pipe whose external surface temperature is 110°C passes through some open area that is not protected against the winds. Determine the rate of heat loss from the pipe per unit of its length when the air is at 1 atm pressure and 10°C and the wind is blowing across the pipe at a velocity of 8 m/s. Use relation: **(20)**

$$Nu = 0.3 + \frac{0.62\ Re^{1/2}\,Pr^{1/3}}{\left[1+\left(\frac{0.4}{Pr}\right)^{2/3}\right]^{1/4}}\left[1+\left(\frac{Re}{282000}\right)^{5/8}\right]^{4/5}$$

Assume following properties for air

k = 0.02808 W/m°C; Pr = 0.7202

$\nu = 1.896\times 10^{-5}\ m^2/s$

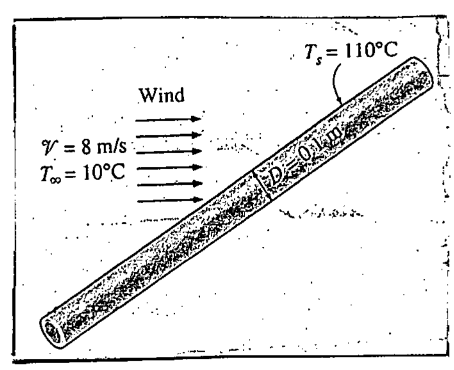


Fig. for Q. No. 3(c)

4. (a) What is hydraulic diameter? How is it defined? Evaluate the hydraulic diameter of a tube of internal diameter D, which has a slowly twisting tape insert of thickness d. **(10)**

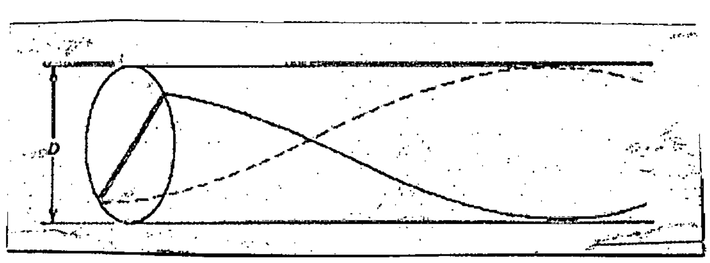


Fig. for Q. No. 4(a)

(b) How does surface roughness affect the pressure drop in a tube if the flow is turbulent? What would be your response if the flow were laminar? **(4)**

(c) How is thermal entry length defined for flow in a tube? With a neat sketch show the hydrodynamic and the thermal entry lengths for a fluid flowing in a tube having Prandtl number 0.7 and 7, respectively. **(5)**

(d) Water enters a 2.5 cm internal diameter thin copper tube of a heat exchanger at 15°C at a rate of 0.3 kg/s, and is heated by steam condensing outside at 120°C. If the average heat transfer coefficient is 800 W/cm^2.°C, determine the length of the tube required in order to heat the water to 115°C. **(16)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) A steam boiler furnace is made of a layer of fireclay 12.5 cm thick and a layer of red brick 50 cm thick. If the wall temperature inside the boiler furnace is 1100°C and that on the outside wall is 50°C, determine the amount of heat loss per square meter of the furnace wall. Consider, k for fireclay = 0.533 W/mK and k for red brick = 0.7 W/mK. **(18)**

   It is desired to reduce the thickness of the red brick layer in this furnace to half by filling in the space between the two layers by diatomite whose k = 0.113 + 0.00023T (W/mK). Calculate the thickness of the filling to ensure an identical loss of heat for the same outside and inside temperatures.

   (b) A stainless steel rod of outer diameter 1 cm originally at a temperature of 320°C is suddenly immersed in a liquid at 120°C for which the convective heat transfer coefficient is 100 W/m^{2}K. Determine the time required for the rod to reach a temperature of 200°C. Consider, for stainless steel, ρ = 7,800 kg/m^3, c = 460 J/kg.K, k = 40 W/mK. **(17)**

6. (a) A spherical container is subjected to specified temperature on the inner surface (0°C) and convection on the outer surface (h = 18 W/m^2.°C). The rate of heat transfer is to be determined for steady one-dimensional heat transfer. The outer surface temperature is 25°C, the inner radius of the sphere is 2 m and that of outer is 2.1 m, the k for the material is 30 W/m.°C. The mathematical formulation has to be derived here (start from the Fourier law). **(18)**

   (b) A long aluminum cylinder 5.0 cm in diameter and initially at 200°C is suddenly exposed to a convection environment at 70°C and h = 525 W/m^2.°C. Calculate the temperature at a radius of 1.25 cm and the heat lost per unit length 1 min after the cylinder is exposed to the environment. Consider, for aluminum, α = 8.4×10^{-5}m^2/s, k = 215 W/m.°C, ρ = 2,700 kg/m^3, c = 0.9 kJ/kg.°C. **(17)**

7. (a) Derive the mathematical relation between black body emissive power and radiation intensity for a diffusely emitting surface. **(18)**

   (b) A square rod 20 cm by 20 cm is placed along the geometric centerline of a long circular half-cylinder whose diameter is 60 cm as shown in Fig. for Q. No. 7(b). Both are surrounded by a large enclosure. Find F_{12}, F_{13} and F_{11} in accordance with the nomenclature in the figure. **(17)**

Contd P/4

ME 305

Contd... Q. No. 7(b)

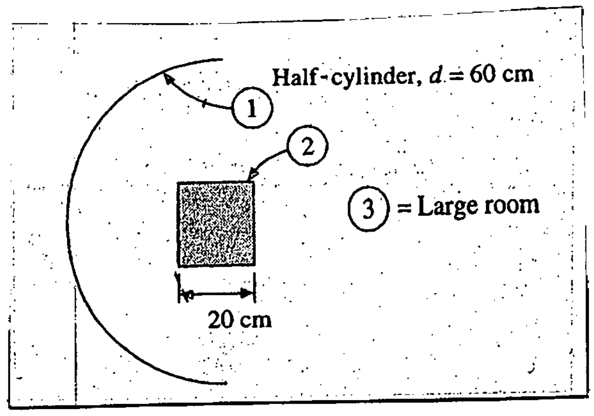
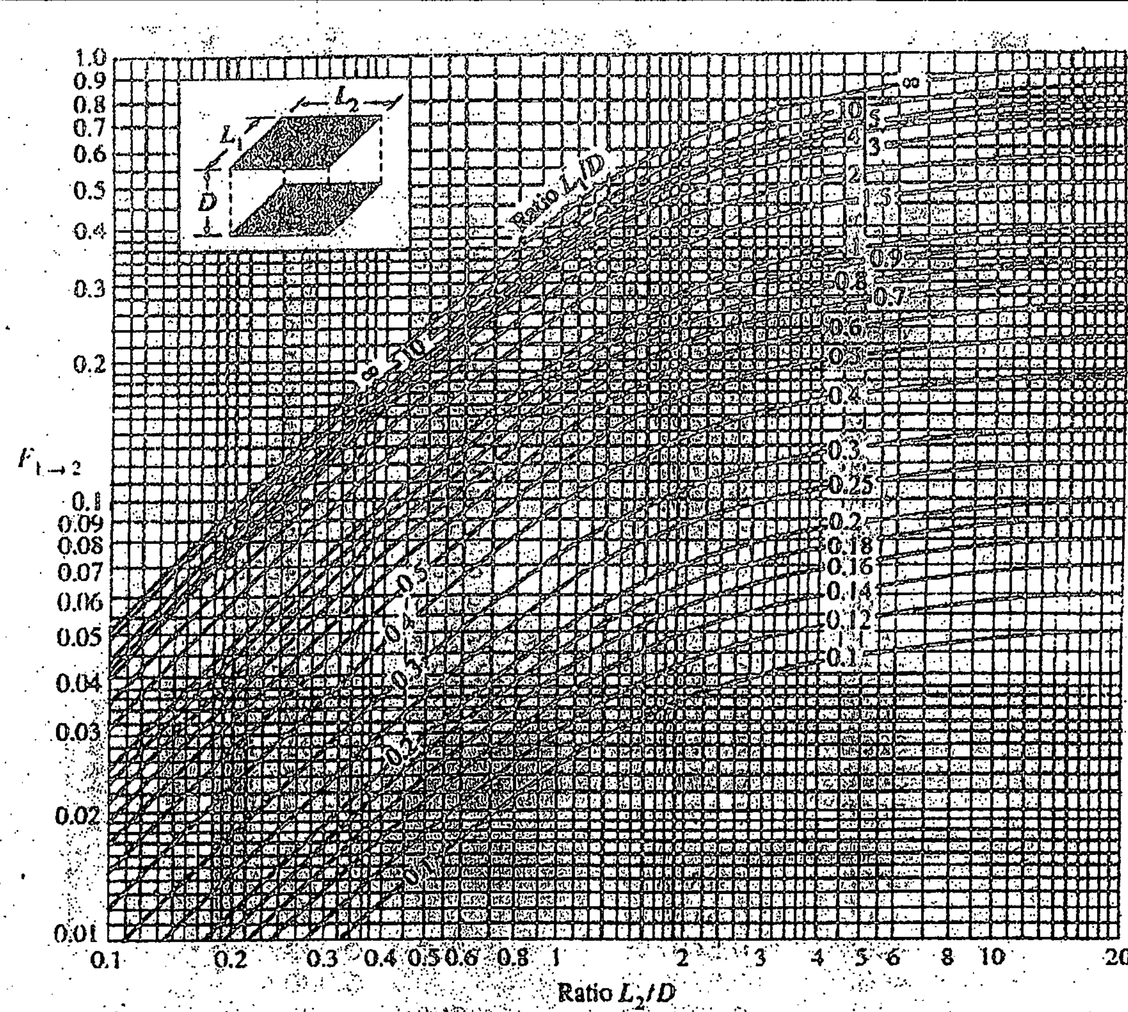


Fig. for Q. No. 7(b)

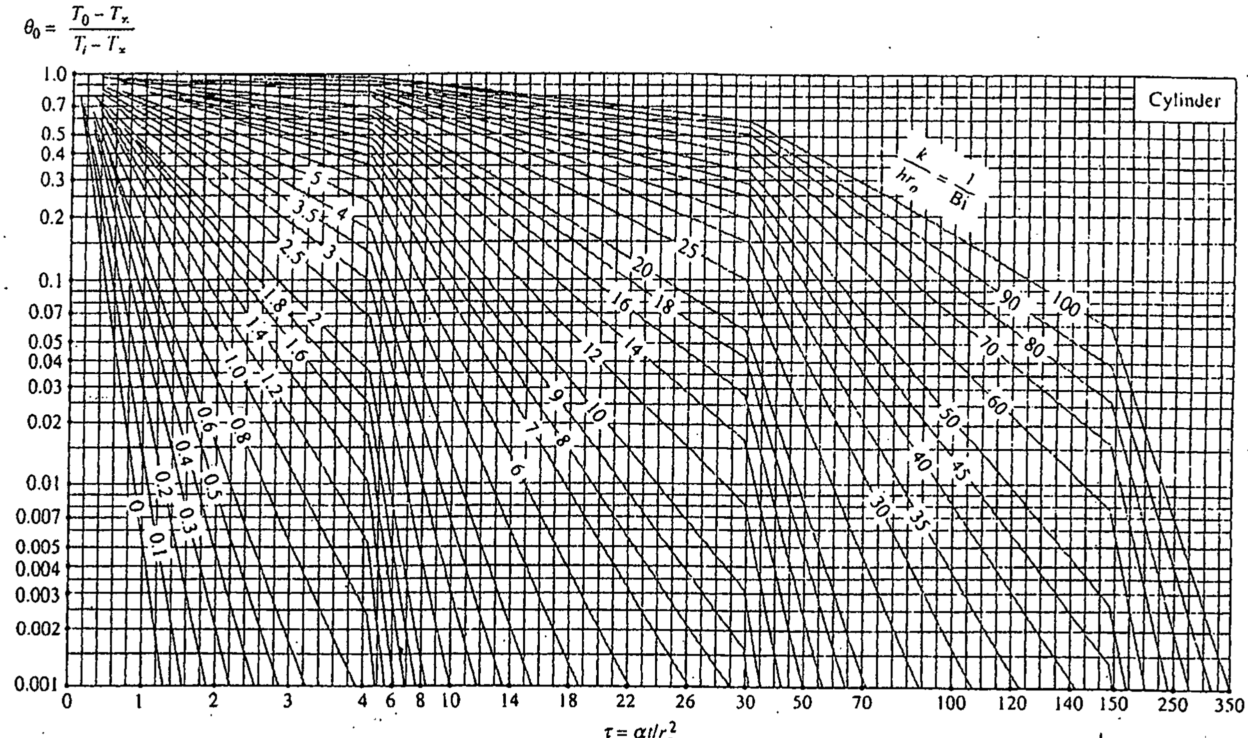
8. (a) Show that the total hemispherical emissivity of a surface at temperature T is equal to its hemispherical absorptivity for radiation coming from a blackbody at the same temperature. **(18)**

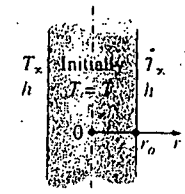
(b) Two parallel plates of size 1.0 m by 1.0 m spaced 0.5 m apart are located in a very large room, the walls of which are maintained at a temperature of 27°C. One plate is maintained at a temperature of 900°C and the other at 400°C. Their emissivities are 0.2 and 0.5 respectively. If the plates exchange heat between themselves and surroundings, find the net heat transfer to each plate and to the room. Consider only the plate surfaces facing each other. **(17)**



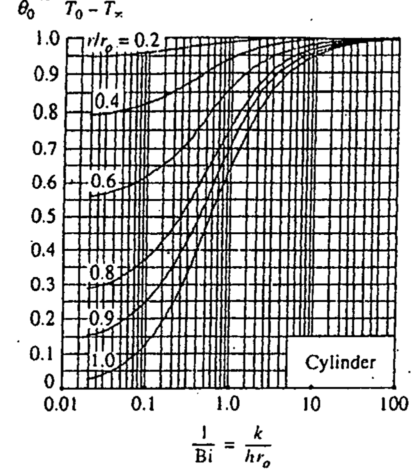
Graph 1: View factor between two aligned parallel rectangles of equal size.

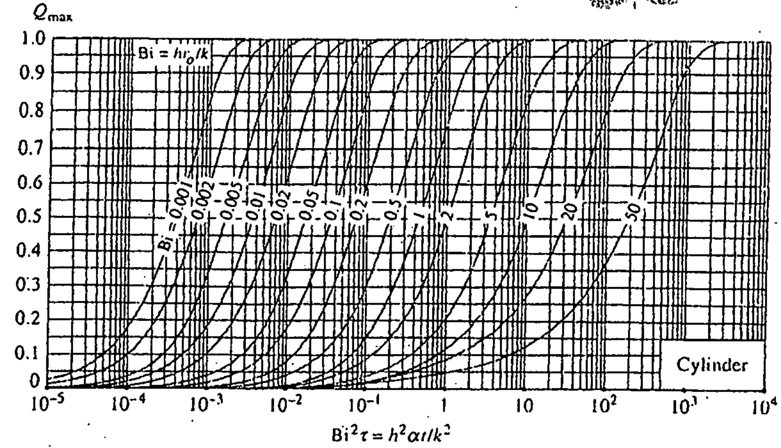
Chart for Q. No. 8(b)





(a) Centerline temperature (from M. P. Heisler, "Temperature Charts for Induction and Constant Temperature Heating," *Trans. ASME 69*, 1947, pp. 227–36. Reprinted by permission of ASME International.)





(b) Temperature distribution (from M. P. Heisler, "Temperature Charts for Induction and Constant Temperature Heating," *Trans. ASME 69*, 1947, pp. 227–36. Reprinted by permission of ASME International.)

(c) Heat transfer (from H. Gröber et al.)

FIGURE 4–17
Transient temperature and heat transfer charts for a long cylinder of radius r_o initially at a uniform temperature T_i subjected to convection from all sides to an environment at temperature T_∞ with a convection coefficient of h.

Chart for Question no. 6(b)

L-3/T-1/ME **Date : 02/08/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2016-2017

Sub : **ME 361** (Instrumentation and Measurement)

Full Marks: 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Name some common temperature sensing techniques with neat sketches and briefly describe. **(20)**

   (b) What are the differences between thermopiles and thermocouples connected in parallel? **(4)**

   (c) What do you mean by RTD and thermister? Describe their competitive advantages and applications. **(3)**

   (d) What do you mean by 'thermal imaging'? Describe its characteristics and specific application. **(4)**

   (e) Write short note on slug type heat-flux sensor. **(4)**

2. (a) What are the differences between a sensor and a transducer? **(3)**

   (b) Name some basic pressure measuring methods generally used in industrial practice. **(20)**

   (c) Describe with sketches at least two low pressure measurement devices in a process industry. **(7)**

   (d) Mention the factors that one should consider during selection of pressure measuring devices for a specific purpose. **(5)**

3. (a) Briefly describe the working principle of a turbine type flow meter. How does it differ from a magnetic type flow meter? Mention their applications. **(12)**

   (b) What are the differences between flow nozzles and orifices? Mention their competitive advantages and applications. **(10)**

   (c) What do you mean by flow visualization? Describe its importance in modern science and technology innovation. **(7)**

   (d) Describe with a neat sketch the working principle of water flow meter. **(6)**

4. (a) What do you mean by Arduino? What are its applications? Describe. **(10)**

   (b) Write short notes on any **five** of the following: **(25)**

   (i) The discrete Fourier transform.
   (ii) Vibrometer and accelerometer.
   (iii) Gauge factor.
   (iv) Mechanical and Hydraulic dynamometer.
   (v) Piezoelectric sensor.
   (vi) Total radiation pyrometer.

Contd P/2

ME 361

SECTION-B

There are **FOUR** questions in this section. Answer any **THREE** questions.
Assume any data if necessary. Symbols used have their usual meaning and interpretation.

5. (a) Differentiate between the following measurement specifications with proper illustrations: (i) Resolution, (ii) Accuracy, (iii) Repeatability. **(15)**

   (b) The resistance of a certain size of copper wire is given as $R = R_0[1+\alpha(T-20)]$, where $R_0 = 6\Omega \pm 0.3\%$ is the resistance at 20°C, $\alpha = 0.004^0C^{-1} \pm 1\%$ is the temperature coefficient of resistance, and the temperature of the wire is $T = 30^0C \pm 1^0C$. Calculate the nominal value of the resistance of the wire and its uncertainty. **(20)**

6. (a) A certain 4-Band resistor has the band color of Gray, Blue and Orange. Calculate the resistance value of the resistor. **(5)**

   (b) Describe the working principle of Hall Effect Sensor using proper diagram. **(10)**

   (c) Prove De Morgan's Theorem regarding digital logic circuits using truth table. Simplify the following logic gate circuit and show your final findings using logic gates. **(10+10)**

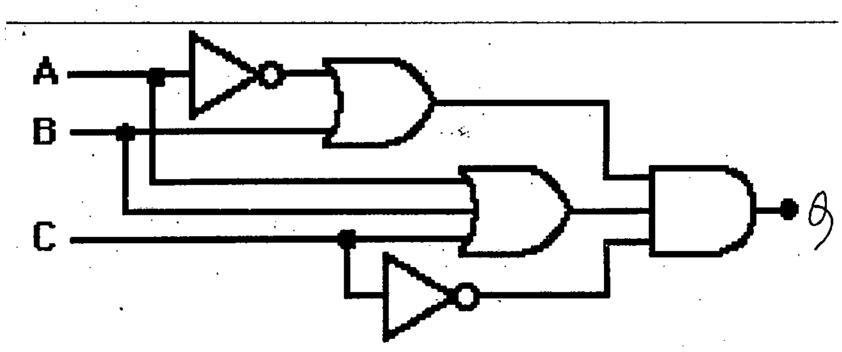


Figure for Q. No. 6(c)

7. (a) Describe the following types of DACs with proper diagrams: **(20)**

   (i) Binary Weighted Resistor type.

   (ii) R-2R Ladder type.

   Also mention their advantages and disadvantages.

   (b) What do you mean by LVDT? Describe its principle with advantages and disadvantages. **(15)**

8. (a) With proper circuit diagrams, discuss the following types of Op-Amps: **(20)**

   (i) Integrator.

   (ii) Instrumentation Amplifier.

   (iii) Comparator.

   (iv) Summing Amplifier.

   (b) Find out the expression for cutoff frequency and phase shift of the **(15)**

   (i) RC high pass filter,

   (ii) RL low pass filter.
