L-3/T-2/NAME **Date : 18/02/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2016-2017

Sub: **MATH 381** (Fourier Analysis, Harmonic Function, Complex Variable and Laplace Transform)

Full Marks: 280 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

1. (a) Prove that, $\sqrt{2}|z| \geq |\mathrm{Re}(z)| + |\mathrm{Im}(z)|$ where z is a non zero complex number. **(13)**

   (b) If $f(z) = x^3 + i(1-y)^3$, then show that $f'(z)$ exists at z =i. **(12 2/3)**

   (c) If the imaginary part of $\frac{(2z+1)}{(iz+1)}$ is – 2, then show that the locus of the points representing in the argand plane is a straight line. **(10)**

   (d) Show that the transformation, $w = \frac{2z+3}{z-4}$ transforms the circle $x^2 + y^2 - 4x = 0$ into the straight line $4u + 3 = 0$. **(11)**

2. (a) If $f(z) = u + iv$ is an analytic function then prove that in polar form Cauchy-Riemann equations are $u_r = \frac{1}{r} v_\theta$ and $v_r = -\frac{1}{r} u_\theta$. **(16 2/3)**

   (b) Find an analytical function $w = u + iv$ given that $u(x,y) = 2xy + 3xy^2 - 2y^3$. **(15)**

   (c) Find all roots of cos z = 2 by equating the real and imaginary parts in the equation. **(15)**

3. (a) Evaluate $\int_c f(z)dz$, where $f(z) = y - x - i3x^2$ and C is the segments one from $z = 0$ to $z = i$ and then from $z = 1$ to $z = 1 + i$. **(16 2/3)**

   (b) Using Cauchy's integral formula evaluate the value of $\oint_c \frac{dz}{z(z-2)^4}$, where C is the circle $|z| = 1$. **(15)**

   (c) Expand $f(z) = \frac{3}{z(2-z-z^2)}$ in a Laurent Series valid in the region. **(15)**

   (i) $|z| > 2$ (ii) $1 < |z| < 2$

4. Evaluate the following integrals using the method of contour integration: **(23+23 2/3)**

   (i) $\int_0^{2\pi} \frac{\sin 2\theta}{5 - 3\cos\theta} d\theta$

   (ii) $\int_0^{2\pi} \frac{x^2}{(x^2+9)(x^2+4)^2} dx$

Contd P/2

MATH 381

SECTION-B

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

5. (a) (i) Find the Fourier coefficients corresponding to the function **(24)**

$$f(x)=\begin{Bmatrix}0, & -5<x<0\\ 3, & 0<x<5\end{Bmatrix}$$

with period = 10

(ii) Also write the above function in corresponding Fourier series.

(iii) How should $f(x)$ be defined at $x=-5,0,5$ in order that the Fourier series will converge to $f(x)$ for $-5\le x\le 5$.

(b) Find the Fourier integral of the function $f(x)=\begin{cases}0, & x<0\\ \frac{1}{2}, & x=0\\ e^{-x} & x>0\end{cases}$ **(22⅔)**

6. (a) Use finite Fourier transform to solve: **(20)**

$$\frac{\partial U}{\partial t}=\frac{\partial^2 U}{\partial x^2},\ U(0,t)=0, U(6,t)=0, U(x,0)=\begin{Bmatrix}1, & 0<x<3\\ 0, & 3<x<6\end{Bmatrix}$$

where $0<x<6,\ t>0$

and interpret physically.

(b) Solve Laplace's equation $\nabla^2 u=0$ in polar co-ordinates (r,θ). **(20⅔)**

7. (a) Find (i) $L\left\{\frac{2}{\sqrt{\pi}}\int_0^{\sqrt{t}} e^{-u^2}du\right\}$ (ii) $L\{\sin\sqrt{t}\}$ **(16)**

(b) State and prove Heaviside Expansion formula. Using this formula find **(16)**

$$L^{-1}\left\{\frac{s^2-3}{(s+2)(s-3)(s^2+2s+5)}\right\}$$

(c) Use Laplace transform to show that $J_0(t)=\frac{1}{\pi}\int_0^{\pi}\cos(t\cos\theta)d\theta$ **(14⅔)**

8. (a) Using Laplace Transform, evaluate $\int_0^{\infty}\cos x^2 dx$ **(13)**

(b) Using convolution theorem, evaluate $L^{-1}\left\{\frac{s}{(s^2+a^2)^2}\right\}$ **(13⅔)**

(c) Solve (using Laplace Transform): $x''(t)+2x'(t)+x(t)=t+\sin t$ **(20)**

Subject to: $x(0)=1,\ x'(0)=-2$. Also verify the result.

L-3/T-2/NAME **Date : 24/02/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2016-2017

Sub : **NAME 347** (Design of Special Ships)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

Assume suitable values where required.

1. Describe the specific concerns and risks associated with High Speed Vessels. What are the different types of High Speed Vessels? **(35)**

2. A guided missile destroyer of 6000 tonf, speed 30 knots and s.h.p 60,000 at full power has an endurance of 5000 miles at 18 knots. **(35)**

   The group weights are

   Hull 2300 tonf

   Machinery 1500 tonf

   Armament 600 tonf

   Fuel 1200 tonf

   Equipment 400 tonf

   Estimate the displacement and group weights of a similar ship with an additional 50 tonf of armament and a full power speed of 28 knots. The endurance is to be 5500 miles at 20 knots.

3. Describe the measures for conceptual switch over from the conventional Cargo vessels to Container vessels and then to Ro-Ro vessels. Discuss the special characteristics of Ro Ro vessels. **(35)**

4. Calculate the Length, Breadth, Depth, Block coefficient, Displacement and draft of a Container Vessel Carrying 1550 Containers of size 6.05m × 2.43m × 2.43m (1150 containers in holds and 400 containers on deck). Service draft = 10 m, service speed = 22 knots. **(35)**

SECTION-B

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

5. (a) With neat sketches discuss the special design features of submarines. **(15)**

   (b) Calculate the effective horsepower (EHP) and the shaft horsepower (SHP) of a nuclear attack submarine travelling at 30 knots in 59 °F seawater. **(20)**

Contd P/2

NAME 347

Contd... Q. No.5(b)

The submarine is 260 ft long, has a maximum diameter of 32 ft, and a submerged displaced of 3400 ton. Assume the total wetted surface of the appendage equals to 20% of the wetted surface of the bare hull and that the average viscous-drag coefficient of the appendage is 1.8 times that of bare hull. Use a roughness (correlation) allowance of 0.0002 and a propulsive coefficient (p.c.) of 0.75.

6. (a) Estimate the dimensions for a VLCC of total deadweight 130,000 tonnes with a speed of 16 knots at a maximum draught of 16.75 m. **(20)**

(b) Briefly discuss the special design features of planning craft and displacement craft. **(15)**

7. (a) Write down the advantages and disadvantages of multihull vessels. **(15)**

(b) calculate the length, breadth, depth, displacement, prismatic coefficient and block coefficient of a Dock Tug having engine power of 1200 KW. Assume suitable values for missing data, if missing. **(20)**

8. (a) Distinguish between distant water trawlers, middle water trawlers and near water trawlers. **(10)**

(b) Draw a typical G.A. plan of a factory stern trawler. **(10)**

(c) For a deep-sea trawler of length 216.75 ft, calculate the probable displacement of the vessel using Posdunine expression assuming a reasonable free running speed. Also calculate the block coefficient and water plane area coefficient. **(15)**

L-3/T-2/NAME **Date : 24/02/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2016-2017

Sub : **NAME 363** (Computational Fluid Dynamics)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

1. (a) What is functional? Show that for a functional F (x, u, u′) **(10)**

$$\delta F = \frac{\partial F}{\partial u}\delta u + \frac{\partial F}{\partial u'}\delta u'$$

(b) Derive the Euler-Lagrange equation for the necessary condition of a functional to have an extreme value. **(25)**

2. (a) Derive the shape function for a two-node line element using generalized co-ordinate system. **(10)**

(b) Discuss how you can solve the momentum equation using SIMPLE algorithm for colocated grid arrangement. **(25)**

3. (a) Using Taylor's series expansion find backward difference formula for $\frac{\partial^2 f}{\partial x^2}$ with equal step size. **(10)**

(b) Solve the following problem by finite element method. **(25)**

$$\frac{d^2u}{dx^2} = -2 \text{ with } 0 < x \leq 1 \text{ and}$$

$$u = 0 \text{ at } x = 0;$$

$$\frac{du}{dx} = 0 \text{ at } x = 1$$

4. (a) Describe how you eliminate the difficulty associated with non equal step sizes used in finite difference equations. **(5)**

(b) How you classify the grid generation techniques? Transform the physical domain shown in Figure for Q. No. 4 (b) defined by L = 4, H_1 = 2, and H_2 = 4 into the computational domain using Algebraic grid generation technique. **(30)**

SECTION-B

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

5. (a) Describe the upwind and central differencing approximation scheme in finite volume method for convection diffusion problem. **(25)**

(b) Discuss the parameters to assess the upwind differencing approximation scheme. **(10)**

Contd P/2

NAME 363

6. (a) Formulate the Quadratic upwind differencing scheme (QUICK) in CFD for convection diffusion problem. **(20)**

(b) Explain Crank-Nicolson scheme in CFD for unsteady flows. **(15)**

7. (a) Derive the mathematical expression of the Semi Implicit Method for Pressure Linked Equation (SIMPLE) for pressure-velocity coupling in steady flows. **(25)**

(b) Write the basic governing equations of the flow of compressible Newtonian fluid. **(10)**

8. (a) Mention the differential and integral form of general transport equations. **(10)**

(b) An insulated bar whose ends are maintained at constant temperatures at 200° C and 500° C respectively. The one dimensional problem shown in Figure for Question No. 8 (b) and is governed by one dimensional steady state diffusion equation $\frac{d}{dx}\left(k\frac{dT}{dx}\right)=0$, where k is the thermal conductivity and T is the temperature. Calculate the steady state temperature distribution in the bar. The thermal conductivity k equals 1000 w/m/k cross-sectional area of the bar , A is $10 \times 10^{-3}m^2$. **(25)**

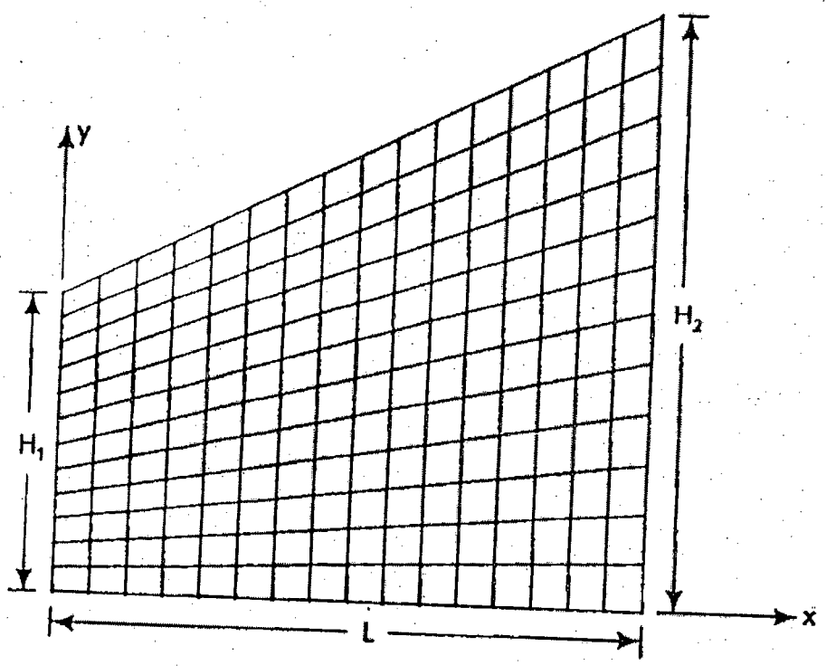


Figure for Q. No. 4(b)

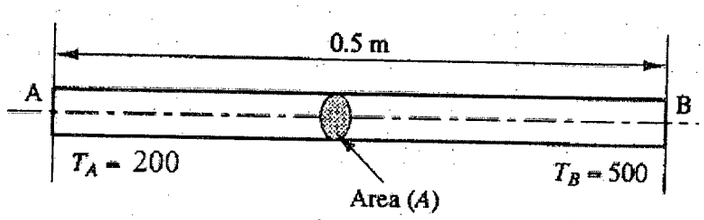


Figure for Question No. 8 (b)

L-3/T-2/NAME **Date : 28/02/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2016-2017

Sub : **NAME 355** (Ship Construction)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

1. (a) What is corrosion? What are the common bimetallic corrosion cell problems in ship hull structure? How are these avoided? Explain briefly. **(12)**

   (b) Mention the advantages and disadvantages of two main types of cathodic protection system used in ship structure. **(16)**

   (c) Write short notes on temporary paint protection during shipbuilding. **(7)**

2. (a) Briefly mention the main features of container ship. **(8)**

   (b) A general cargo ship owner wants to convert his ship from cargo to bulk carrier ship for his company. As a ship designer, what basic structural modification do you suggest for this and why? Justify your answer with necessary sketches of midship section for both ship types. **(17)**

   (c) What is 'Gunwale'? Mention the advantages and disadvantages of rounded 'Gunwale' arrangement. **(5)**

   (d) What are Mangles and Guillotines? **(5)**

3. (a) Using suitable sketch (if necessary), distinguish the following terms: **(25)**

   (i) Duct keel and Bilge keel

   (ii) Solid plate floor and Bracket floor

   (iii) Superstructure and Deckhouse

   (iv) Center girder and Side girder

   (v) Beam kees and Half beam

   (b) What are the advantages of pre fabrication of ship units? With a block diagram, show the shipbuilding process involved in building a ship using pre fabrication techniques. **(10)**

4. (a) For a general cargo ship adopting longitudinal framing system, discuss the structural arrangement of main deck construction with suitable sketches. Also show the plating arrangement of a deck with hatch opening for this ship. **(15)**

   (b) What is mill scale? Why it is recommended to remove mill scale from steel plates used for fabrication of ship? **(7)**

   (c) Why brackets in a ship structure are called secondary structure members? What is curling? **(5)**

   (d) Mention the advantages and disadvantages of shot blasting. **(8)**

Contd P/2

NAME 355

SECTION-B

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

5. (a) List some renowned classification societies. Briefly discuss their duties to maintain class of a vessel. **(15)**

   (b) Explain the importance of longitudinal strength in ship design. Also list the members which contribute longitudinal strength in a ship structure. **(10)**

   (c) Explain the functions of transverse structural members. Also list the structural members which contribute transverse strength in a ship. **(10)**

6. (a) Mention functions of bulkhead. What are the advantages of corrugated bulkhead over plain bulkhead? **(15)**

   (b) Explain the function of pillars. With neat sketches describe different types of pillar construction. **(12)**

   (c) Why fore end structure is important for a ship? Explain. **(8)**

7. (a) Discuss the potential advantages and disadvantages of using FRP over other materials for small boat building. **(18)**

   (b) 'The fore part of the ship to severe impact from the sea due to heavy pitching assisted by heaving' – Explain how this part is strengthened. **(17)**

8. Write short notes on the following: **(5×7=35)**

   (i) Combined framing system
   (ii) Hogging and Sagging
   (iii) Pounding and Slamming
   (iv) Racking and Torsional strength of ship
   (v) High tensile steel
   (vi) Aluminum alloy as alternative ship building material
   (vii) Swash bulkhead.

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2016-2017

Sub : **NAME 329** (Heat Transfer)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE** questions.
Assume reasonable value for any missing data. The symbols have their usual meanings.

1. (a) Distinguish between the log mean temperature difference (LMTD) method and the effectiveness – NTU method. For a double pipe parallel flow heat exchanger derive the expression of the log mean temperature difference. State any assumption you made in the derivation. **(20)**

   (b) Discuss the selection of heat exchangers based on the following factors: (i) Pumping power (ii) Material (iii) Type and size. **(15)**

2. (a) For two block surfaces A_1 and A_2 arbitrarily located in space prove that the fraction of radiation leaving A_1 that strikes A_2 is: **(25)**

$$F_{A_1-A_2} = \frac{1}{A_1}\int_{A_2}\int_{A_1}\frac{\cos\theta_1 \cos\theta_2}{\pi l^2} dA_1 dA_2$$

   where symbols have their usual meaning.
   Hence derive an expression of view factor of a small area element with respect to a diffuse flat circular disk as shown in Figure for question No. 2(a).

   (b) State two methods you may use to increase the rate of cooling of the hot cup of tea shown in Figure for question No. 2(b). Use your knowledge of convection and Newton's law of cooling to explain why your method would work. **(10)**

3. (a) Two rectangles 50 by 50 cm as shown in Figure for question No. 3(a) are placed perpendicularly with a common edge. One surface has T_1 = 1000 K, ε_1 = 0.6, while the other surface is insulated and in radiant balance with a large surrounding room at 300K. Determine the temperature of the insulated surface and the heat lost by the surface at 1000 K. **(17)**
   Assume $F_{12} = F_{21} = 0.2$
   where symbols have their usual meaning.

   (b) Show that the net rate of radiation heat transfer between two non black bodies is given by: **(18)**

$$Q_{net} = \frac{6T_1^4 - 6T_2^4}{\frac{1-\varepsilon_1}{A_1\varepsilon_1} + \frac{1}{A_1F_{12}} + \frac{1-\varepsilon_2}{A_2\varepsilon_2}}$$

   where symbols have their usual meaning.
   hence for two large parallel plates maintained at uniform temperatures of 800 K and 500 K, with emissivitives 0.2 and 0.7, determine the net rate of radiation heat transfer per unit surface area of the plates.

Contd P/2

NAME 329

4. (a) Write short notes on the following: **(15)**

(i) Fouling factor for heat exchangers

(ii) Solid angle, intensity of radiation, radiosity

(iii) Nusselt number and Prandtl number.

(b) Air at 30 °C and at atmospheric pressure flows at a velocity of 2.2 m/s over a flat plate maintained at 90 °C. The length and width of the plates are 900 mm and 450 mm respectively. Using exact solutions, calculate the following: **(20)**

(i) total drag force over the plate (ii) heat transfer rate from first half of the plate (iii) heat transfer rate from full plate (iv) heat transfer rate from last half of the plate.

Also sketch a graph to show the variation of local heat transfer coefficient along the length of the plate. The properties of air at film temperature is:

$\rho = 1.06$ kg/m^3, $\upsilon = 18.97 \times 10^{-6}$ m^2/s

$P_r = 0.696$, $K = 0.02894$ W/m °C.

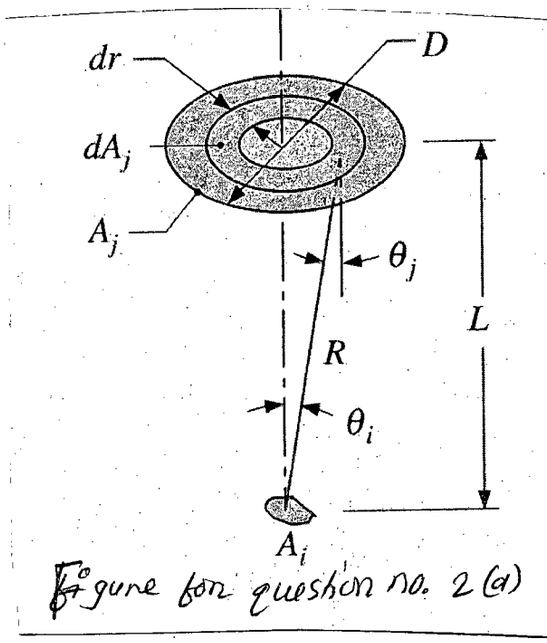


Figure for question no. 2(a)

Figure for question no. 2(b)

SECTION-B

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

Assume reasonable values for missing data (if any).

5. (a) Derive the one dimensional heat conduction equation for heat conduction in a long cylinder. **(20)**

(b) The temperature of a gas stream is to be measured by a thermocouple whose junction can be approximated as a 1-mm-diameter sphere as shown in Fig. for Q. No. 5(b). The properties of the junction are $k = 35$ W/m· °C, $\rho = 8500$ kg/m^3, $C_p = 320$ J/kg. °C, and the convection heat transfer coefficient between the junction and the gas is h = 210 W/m^2· °C. Determine how long will it take for the thermocouple to read 99 percent of the initial temperature difference. (Assume the thermal properties of the junction and the heat transfer coefficients are constant. Also, radiation effects are negligible). **(15)**

Contd P/3

NAME 329

6. (a) A 3-m-high and 5-m-wide wall consists of long 16 cm × 22 cm cross section horizontal bricks (k = 0.72 W/m· °C). There are also 2 cm thick plaster plaster layers on each side of the brick and a 3 cm thick rigid foam (k = 0.026 W/m· °C) on the inner side of the wall (as shown in Fig. for Q. No. 6(a)). The indoor and outdoor temperatures are 20 °C and -10 °C, respectively. Assuming on dimensional heat transfer and disregarding radiation, determine the rate of heat transfer trough the wall. (State necessary assumptions). **(15)**

(b) A 3-m internal diameter spherical tank made of 2-cm-thick stainless steel (k =15 W/m· °C) is used to store iced water at $T_{\infty 1}$ = 0 °C. The tank is located in a room whose temperature is $T_{\infty 2}$ = 22 °C. The walls of the room are also at 22 °C. The outer surface of the tank is black and heat transfer between the outer surface of the tank and the surroundings is by natural convection and radiation. The convection heat transfer coefficients at the inner and outer surfaces of the tank are h_1 = 80 W/m^2· °C and h_2 = 10 W/m^2· °C, respectively. Determine the rate of heat transfer to the iced water in the tank and the amount of ice at 0 °C that melts during a 24-hour period. (State necessary assumptions). **(20)**

7. (a) Define Grashof Number and Rayleigh Number. Use order of magnitude estimates to final an expression for Grashof Number and hence Rayleigh Number. **(15)**

(b) A glass-door fire screen, used to reduce exfiltration of room air through chimney, has height of 0.71 m and a width of 1.02 m and reaches a temperature of 232 °C. If the room temperature is 23 °C, estimate the convection heat rate from the fireplace to the room. Use the properties - air (T_f = 400 K): K 33.8 × 10^{-3} W/m·K, υ = 26.4 × 10^{-6} m^2/s, α = 38.3 × 10^{-6} m^2/s, P_r = 0.690, $\beta = (1/T_f)$ = 0.0025K^{-1}. (State necessary assumptions). **(20)**

8. (a) Derive the equation of temperature distribution and heat transfer rate of an infinity long fin. Consider that the temperature at the fin tip approaches that of the surrounding fluid. (State necessary assumptions and draw necessary figures). **(25)**

(b) It is required to heat oil to 300 °C for the purpose of frying. A long ladle is used in the frying pan. The section of the ladle is 5 mm × 18 mm. The surrounding air is at 30 °C. The thermal conductivity of the material is 205 W/m·K. If the temperature at a distance of 380 mm from the oil should not exceed 40 °C, determine the convection heat transfer coefficient. (State necessary assumptions). **(10)**

NAME 329 =4=

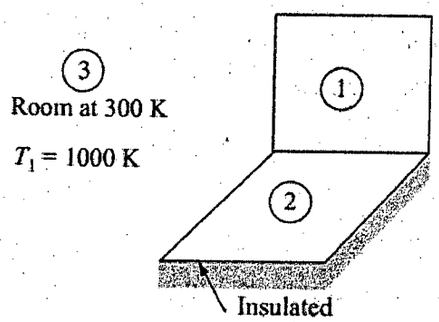


Figure for question no. 3 (a)

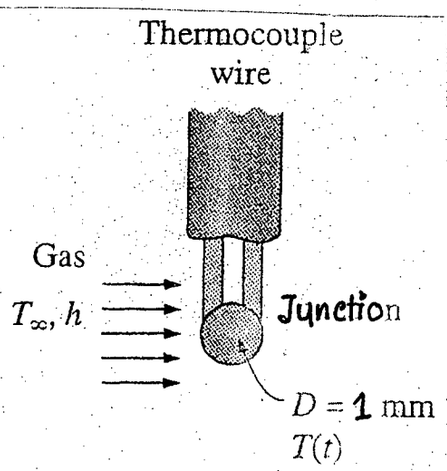


Fig. for Q. No. 5 (b)

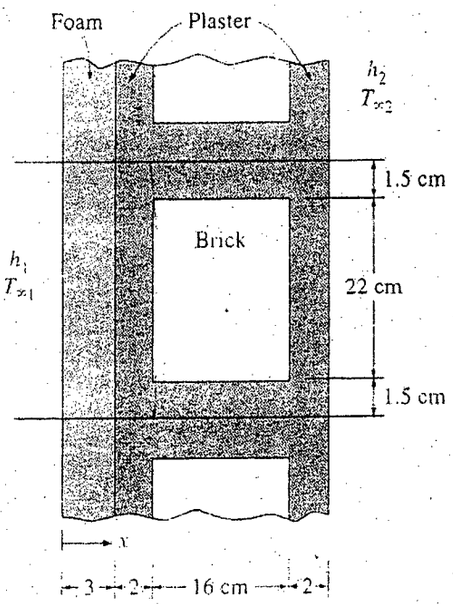


Fig. for Q. No. 6 (a)

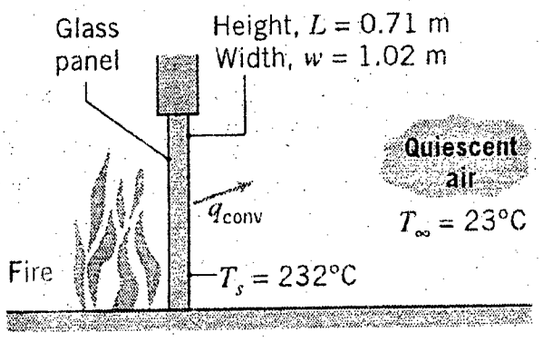


Fig. for Q. No. 7(b)

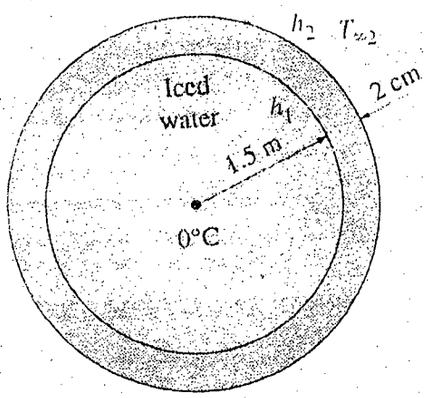


Fig. for Q. No. 6 (b)

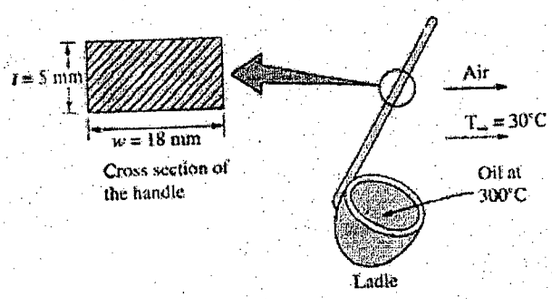


Fig. for Q. No. 8(b)

—X—

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2016-2017

Sub : **NAME 319** (Theory of Machines)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

Symbols have their usual meanings. Assume reasonable values for any missing data.

1. (a) What is inversion of mechanism? Differentiate between a machine and a structure. **(10)**

   (b) Figure for Q. No. 1(b) shows the layout of a quick return mechanism of the oscillating link type. The driving crank BC is 30 mm long and time ratio of the working stroke to the return stroke is to be 1.7. If AC = 75 mm and AP = 150 mm, determine the length of the working stroke of R. **(15)**

   (c) What do you mean by degrees of freedom of a mechanism? Determine the degrees of freedom of the mechanism shown in Figure for Q. No. 1(c). **(10)**

2. (a) Explain the term 'interference' when it is applied to gears. Two mating gears have 20 and 40 involute teeth of module 10 mm and 20° pressure angles. The addendum on each wheel is to be made of such a length that the line of contact on each side of the pitch point has half the maximum possible length. Determine the addendum height for each gear wheel, length of the path of contact, arc of contact and contact ratio. **(20)**

   (b) Derive an expression for the magnitude and direction of coriolis component of acceleration. **(15)**

3. (a) Illustrate Grashof's law and explain its importance in designing mechanism. **(10)**

   (b) The length of various links of a mechanism shown in Fig. for Q. No. 3(b) are: **(25)**

   OA = 0.3 m, AB = 1 m, CD = 0.8 m and AC = CB.

   Determine, for the given configuration, the velocity of the slider D if the crank OA rotates at 60 rpm in the clockwise direction. Also find the angular velocity of the link CD. Use instantaneous centre method.

4. A mechanism of a crank and slotted lever quick return motion is shown in Fig. for Q. No. 4. If the crank rotates counter clockwise at 100 rpm, determine for the configuration shown, the velocity and acceleration of the ram D. Also determine the angular acceleration of the slotted lever. Where Crank, AB = 150 mm; slotted arm, OC = 700 mm, and link, CD = 200 mm. **(35)**

Contd P/2

NAME 319

SECTION-B

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

5. (a) A road roller has a total mass of 12 tonnes. The front roller has a mass of 2 tonnes, a radius of gyration of 0.4 m and a diameter of 1.2 m. The rear axle, together with its wheels, has a mass of 2.5 tonnes, a radius of gyration of 0.6 m and a diameter of 1.5 m. Calculate: **(25)**

(i) Kinetic energy of rotation of the wheels and axles at a speed of 9 km/h.

(ii) Total energy of road roller.

(iii) Braking force required to bring the roller to rest from 9 km/h in 6 m on the level.

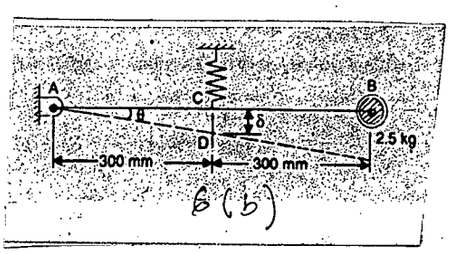
(b) Define the term "co-efficient of restitution". **(10)**

6. (a) Show that the minimum periodic time of a compound pendulum is **(20)**

$$t_p(\min) = 2\pi\sqrt{\frac{2K_G}{g}}$$

where K_G is the radius of gyration on about the centre of gravity.

(b) A uniform thin rod as shown in Fig. 6(b), has a mass of 1 kg and carries a concentrated mass of 2.5 kg at B. The rod is hinged at A and is maintained in the horizontal position by a spring of stiffness 1.8 kN/m at C. Find the frequency of oscillation, neglecting the effect of the mass of the spring. **(15)**



7. (a) Compare between over hauling and self locking screws. **(8)**

(b) Show that the efficiency of self-locking screw is less than 50%. **(10)**

(c) A load of 10 KN is raised by means of screw jack, having a square threaded screw of 12 mm pitch and of diameter 50 mm. If a force of 100 N is applied at the end of a lever to raise the load, **(17)**

(i) What should be the length of the lever used?

(ii) What is the mechanical advantage obtained? [Take co-efficient of friction=0.15].

(iii) State whether the screw is self-locking or not.

Contd P/3

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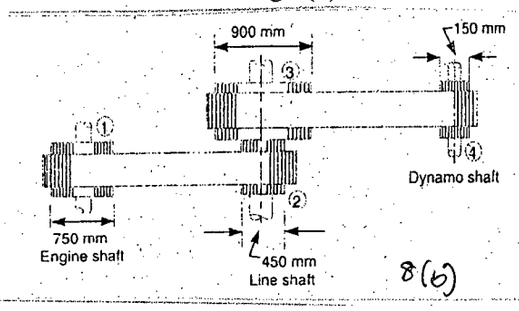
8. (a) Determine the width of 9.75 mm thick leather belt required to transmit 15 KW from a motor running at 900 rpm. The diameter of the driving pulley of the motor is 300 mm. The driven pulley runs at 300 rpm and the distance between the centre of two pulleys is 3 metres. The density of the leather is 1000 kg/m^3. The maximum allowable stress in the leather is 2.5 MPa. The co-efficient of friction between the leather and pulley is 0.3. Assume open belt drive and neglect the sag and slip of the belt. **(20)**

(b) An engine, running at 150 r.p.m., drives a line shaft by means of a belt. The engine pulley is 750 mm diameter and the pulley on the line shaft being 450 mm. A 900 mm diameter pulley on the line shaft drives a 150 mm diameters pulley keyed to a dynamo shaft. Find the speed of the dynamo shaft, when **(15)**

(i) there is no slip

(ii) there is a slip of 2% at each drive.

Arrangement of the shafts are shown in Fig 8(b).



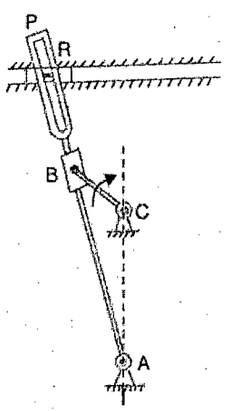


Figure For Q. No. 1(b)

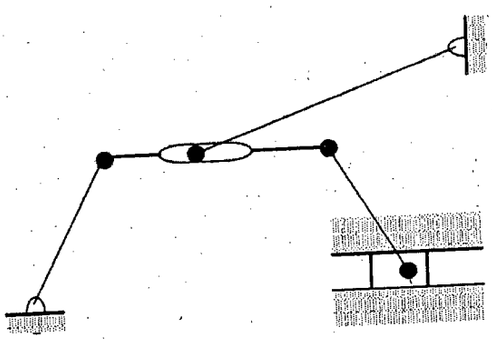


Figure For Q. No. 1(c)

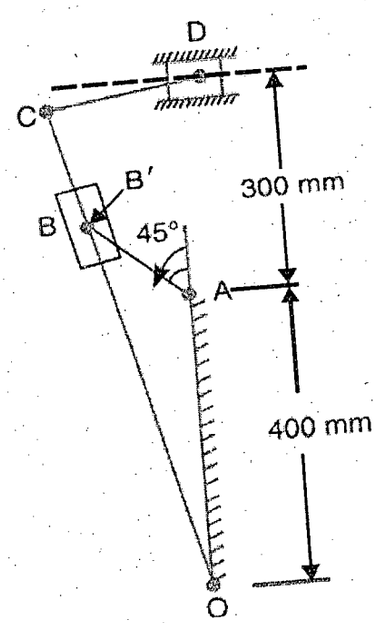


Figure For Q. No. 4

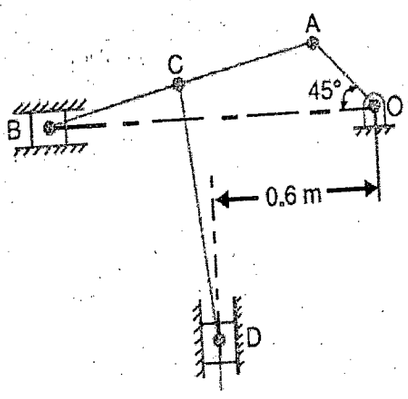


Figure For Q. No. 3(b)