L-3/T-2/NAME **Date : 17/01/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2013-2014

Sub : **MATH 381** (Fourier Analysis, Harmonic Functions, Complex Variable and Laplace Transforms)

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**.

Symbols used have their usual meaning.

1. (a) Prove the triangle inequality $|z_1+z_2|\le|z_1|+|z_2|$ where z_1, z_2 are nonzero complex numbers. **(10)**

   (b) Describe graphically the region represented by $|z+2-3i|+|z-2+3i|<10$. **(10⅔)**

   (c) Find all roots of $\left(-8-8\sqrt{3}i\right)^{\frac{1}{4}}$ in rectangular coordinates and exhibit the distinct roots graphically. **(11)**

   (d) Find the bilinear transformation which maps the points $z_1=2, z_2=i, z_3=-2$ into the points $w_1=1, w_2=i, w_3=-1$, respectively. **(15)**

2. (a) If $f(z)=e^{\bar{z}}$ then show that $f'(z)$ does not exist at any point. **(10⅔)**

   (b) Show that $Log\left(-1+i\sqrt{3}\right)^2\neq 2Log\left(-1+i\sqrt{3}\right)$. **(10)**

   (c) Find all roots of $\cos z=2$ by equating the real and imaginary parts in the equation. **(10)**

   (d) Evaluate the integral $\int_C \bar{z}dz$ around. **(16)**

   (i) the circle $|z-2|=3$, and (ii) the ellipse $|z-3|+|z+3|=10$.

3. (a) Use Cauchy integral formula to evaluate $\int_C \frac{(z-1)}{(z+1)^2(z-2)}dz$ where C is the circle $C:|z-i|=2$, taken in the positive sense. **(10)**

   (b) Express $f(z)=\frac{z^2-4}{z^2+5z+4}$ in a Laurent series in the region (i) $1<|z|<4$ (ii) $|z|>4$. **(10⅔)**

   (c) Evaluate the following integrals by Cauchy's residue theorem where C is the circle $|z|=3$ taken in the counterclockwise direction: **(13+13)**

   (i) $\int_C \frac{\sin z}{z^2\left(z^2+4\right)}dz$ (ii) $\int_C \frac{1+z^2}{(z-1)^2(z+2i)}dz$

4. Evaluate the following integrals by using the method of contour integration: **(23+23⅔)**

   (i) $\int_0^\infty \frac{1}{x^4+1}dx$ (ii) $\int_0^{2\pi} \frac{\cos 2\theta}{1-2a\cos\theta+a^2}d\theta, a<1$

Contd P/2

MATH 381

SECTION – B

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

5. (a) Find $L\{\sin\sqrt{t}\}$ and hence find $L\left\{\frac{\cos\sqrt{t}}{\sqrt{t}}\right\}$. **(20⅔)**

(b) Express the function $F(t)$ in terms of unit step function where $F(t)=\begin{cases}t-1, & 1<t<2\\ 3-t, & 2<t<3\end{cases}$ and find its Laplace transform. **(12)**

(c) Using Laplace transform prove that $\int_0^\infty J_0(t)dt=1$. **(14)**

6. (a) Use convolution theorem to find $L^{-1}\left\{\frac{s}{(s^2+a^2)^2}\right\}$. **(15)**

(b) Use Laplace transform to solve the following differential equation: **(16)**

$$[tD^2+(1-2t)D-2]y=0\text{; where } y(0)=1,\quad y'(0)=2$$

(c) A particle moves along the x-axis according to the law $\frac{d^2x}{dt^2}+6\frac{dx}{dt}+25x=0$. If the initial position of the particle is at x = 20 and the initial speed is 10, find the displacement of the particle at any time t using Laplace transforms. **(15⅔)**

7. (a) Obtain the Fourier series of the function $f(x)=\begin{cases}0, & -\pi\le x\le 0\\ 1, & 0<x\le\pi\end{cases}$ and verify the result by assuming the complex form of Fourier series. **(28⅔)**

(b) Find the Fourier sine transform of $e^{-x}, x\ge 0$ and using this result show that $\int_0^\infty \frac{x\sin mx}{x^2+1}dx=\frac{\pi}{2}e^{-m}, m>0$. **(18)**

8. (a) Use Fourier transform to solve the following boundary value problem: **(25)**

$$\frac{\partial u}{\partial t}=\frac{\partial^2 u}{\partial x^2},\quad 0<x<4,\quad t>0$$

subject to the conditions $u(0,t)=u(4,t)=0$, $t>0$ and $u(x,0)=2x$, $0<x<4$.

(b) Find the gravitational potential at any point in space due to a uniform circular disk of mass M and of radius 'a'. **(21⅔)**

L-3/T-2/NAME **Date : 23/01/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2013-2014

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**.

1. (a) Derive the discretized form of five-point finite difference formula for Laplace equation. **(15)**

   (b) The steady-state two-dimensional heat flow in a metal plate is given by **(20)**

$$\frac{\partial^2 T}{\partial x^2}+\frac{\partial^2 T}{\partial y^2}=0$$

   The oundary conditions of the problem are given in Fig. for Q. No. 1(b) and determine the temperatures T_1, T_2, T_3 and T_4.

2. (a) Show that in Boundary Element Method the normal velocity as the i-th panel induced by the j-th panel can be expressed as **(20)**

$$\frac{\lambda_i}{2}+\sum_{\substack{j=1\\ j\neq i}} \frac{\lambda_j}{2\pi} I_{ij}+v_\infty \cos\beta_i=0$$

   where $I_{ij}=\int_j \frac{\partial}{\partial n}\ln\pi_{ij}\, dS_j$ and the symbols have their usual significance.

   (b) Derive the shape functions for the two-dimensional quadrilateral element with respect to natural co-ordinate system. **(15)**

3. (a) Show that the integral of polynomial terms in area co-ordinates of triangulao element can be expressed as **(20)**

$$I=\int_A L_1^m L_2^n L_3^p\, dA=\frac{m!\, n!\, p!}{(n+m+p+2)!}2A$$

   (b) Determine the functional for the boundary value problem $\nabla^2 U=-f(x,y)$ with U=0 on the boundary C of the region R. **(15)**

4. (a) Solve the boundary value problem by finite element and also compare the result with the analytical solution. **(25)**

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

$$U(o)=0;\ \ U'(1)=0$$

   (b) Prove the variational formulae **(10)**

   (i) $\delta\left(\frac{dy}{dx}\right)=\frac{d}{dx}(\delta y)$

   (ii) $\delta\int_a^b y(x)dx=\int_a^b \delta y(x)dx$

Contd P/2

NAME 363

SECTION – B

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

Symbols have there usual meaning. Reasonable value of any missing data can be assumed.

5. (a) Distinguish between conservation form and non-conservation form of governing equations for fluid flow. **(10)**

   (b) Write down the Navier-Stokes equations in non-conservation form. How can you convert those equations in to conservation form? **(15)**

   (c) Make general comments on the conservation form of the governing equations particularly suited for CFD. **(10)**

6. (a) Describe finite volume method for one-dimensional steady state diffusion problem. **(20)**

   (b) How can you extend the method to two and three-dimensional diffusion problems? **(15)**

7. Consider the problem of source-free heat conduction in an insulated rod whose ends are maintained at constant temperature of 150°C and 525°C respectively. Thermal conductivity k equals 1000 W/m/k, cross-sectional area of the rod is $1\text{-}\times 10^{-3} m^3$. If the length of the rod is 0.75 m, calculate the steady state temperature distribution in the rod using finite volume method. **(35)**

8. (a) Describe finite volume method for solving steady one-dimensional convection and diffusion problem using central differencing approximation. **(20)**

   (b) If QUICK scheme is used for above mentioned problem [8(a)], derive the discretised equations in standard form. **(15)**

L-3/T-2/NAME **Date : 23/01/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2013-2014

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.

Assume reasonable values for missing data, if any.

SECTION – A

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

1. (a) Discuss the benefits of Ro-Ro ships over container ships. On what factors the success of Ro-Ro ship depends? **(7½)**

   (b) With figure discuss the following facilities: **(7½×2=15)**

   (i) Slewing ramp (ii) Scissor lift.

   (c) Distinguish between deadweight carrier, capacity carrier and linear dimension ship. How Ro-Ro ship is categorized by geometry limited ship? **(7½)**

   (d) Mention the special reasons behind the determination of deck heights and design draft or Ro-Ro ships. **(5)**

2. (a) Give an idea about the growth in deadweight capacity of oil tanker after World War II until now. What were the reasons for the rapid increase in tanker size? **(7½)**

   (b) Give a profile sketch of an oil tanker and discuss the important design features of an oil tanker. **(17½)**

   (c) Estimate the length, breadth, block coefficient, displacement (salt water) and dead weight coefficient for a VLCC of total deadweight 150,000 tonne with a speed of 15 knots at a maximum draught of 16.5 m. **(10)**

3. (a) Discuss the fundamental differences between monohull and multihull design concept in terms of weight stabilized monohull and geometry stabilized multihulls. **(15)**

   (b) Mention the advantages and disadvantages of multihulls. **(10)**

   (c) With figure demonstrate the fuel consumption versus speed comparison of monohull and catamarans in displacement mode and planing mode. Mention the causes of their fuel consumption. **(10)**

4. (a) Mention different types of high-speed craft with free-hand sketch. **(10)**

   (b) Write short notes on **(5×3=15)**

   (i) Air cushion vehicle (ACV)

   (ii) Hydrofoils

   (iii) Small waterplane area twin-hull (SWATH)

   (c) Mention the most common types of losses reported with high-speed crafts. **(5)**

   (d) Discuss on the propulsion of high speed craft. **(5)**

Contd P/2

NAME 347

SECTION – B

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

5. (a) Classify tugs according to their duties. What are the basic requirements for each class of tug? **(15)**

   (b) Calculate the length, breadth, draft, prismatic co-efficient and block co-efficient of a Dock Tug having Engine power 1000 k.w. (use suitable formulae) **(20)**

6. (a) Discuss the factors influencing in designing a fishing trawler. Draw a profile of a fishing trawler and locate various items in the profile. **(15)**

   (b) Design a deep sea trawler having length of 216.75 ft. Calculate the probable displacement of the vessel using 'Posdunine expression' and assuming reasonable free running speed. **(20)**

7. (a) List major differences of sub-marine with a surface ship. Draw a diagrammatic arrangement of a conventional sub-marine. **(10)**

   (b) Estimate the EHP and SHP of a nuclear powered sub-marine travelling at 30 knots in $59^{\circ}F$ sea-water. The submarine is 260 ft long, has a maximum dia 32 ft and submerged displacement of 3400 tons. Assume the total wetted surface of the appendages equals 20% of the wetted surface of the bare hull and that the average viscous drag-co-efficient of the appendages is 1.8 times that of the bare hull. Use correlation allowance of 0.0002 and propulsive co-efficient of 0.75. **(25)**

8. Calculate the dimensions of a container vessel to meet the following requirements: **(35)**

   1400 containers $6.05 \times 2.43 \times 2.43$ m.

   Made up by 1000 containers in holds and 400 containers on deck. Loaded draft of 9.0 m and service speed 23 knots.

   Assume the containers are 7 high in each cell with 9 cells across the ship.

L-3/T-2/NAME **Date : 27/01/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2013-2014

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.

Assume reasonable values for any missing data.

SECTION – A

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

1. (a) Define coefficient of restitution. Derive the expression for the loss of Kinetic energy during elastic impact. **(17)**

   (b) A wagon of mass 14 tonnes is hauled up an incline of 1 in 20 by a rope which is parallel to the incline and is being wound round a drum of 1 m diameter. The drum, in turn, is driven through a 40 to 1 reduction gear by an electric motor. The frictional resistance to the movement of the wagon is 1.2 kN, and the efficiency of the gear drive is 85 percent. The bearing friction at the drum and motor shafts may be neglected. The rotating parts of the drum have a mass of 1.25 tonnes with a radius of gyration of 450 mm and the rotating parts on the armature shaft have a mass of 110 kg with a radius of gyration of 125 mm. **(18)**

   At a certain instant the wagon is moving up the slop with a velocity of 1.8 m/s and an acceleration of 0.1 m/s^2. Find the torque on the motor shaft and the power being developed.

2. (a) Define bifilar suspension. Derive the expression for the periodic time and frequency of oscillation in case of bifilar suspension. **(15)**

   (b) Show that the center of percussion is below the center of gravity and at a distance k_G^2/h. **(9)**

   (c) In a slider crank mechanism, how can you determine the acceleration of the slider? **(11)**

3. (a) What are the major properties of instantaneous center? Describe the method by which you can locate the instantaneous center in a mechanism. **(12)**

   (b) A mechanism, as shown in Fig. for Q. No. 3(b), has the following dimensions: **(23)**

   O_1A =60 mm; AB = 180 mm; O_2B = 100 mm; O_2C = 180 mm and CD = 270 mm.

   The crank O_1A rotates clockwise at a uniform speed of 120 r.p.m. The block D moves in vertical guides. Find, by instantaneous center method, the velocity of D and the angular velocity of CD.

Contd P/2

NAME 319

4. (a) Using relative velocity method, how can you determine the velocity of a point on a link when the velocity of another point on that link is known? **(10)**

(b) Distinguish between actual and ideal mechanical advantages. **(5)**

(c) The dimensions of the mechanism, as shown in Fig. for Q. No. 4(c), are as follows: **(20)**

AB = 0.45 m; BD = 1.5 m; BC = CD = 0.9 m.

The crank AB turns uniformly at 180 r.p.m. in the clockwise direction and the blocks at D and E are working in frictionless guides.

Draw the velocity diagram for the mechanism and find the velocities of the sliders D and E in their guides. Also determine the turning moment at A if a force of 500 N acts on D in the direction of arrow X and a force of 750 N acts on E in the direction of arrow Y.

SECTION – B

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

5. (a) Derive an expression of a Cross Belt Drive and show that, the length of the belt required remains constant if sum of the radii of the two pulleys be constant. **(20)**

(b) Two parallel shafts 6 meters apart are provided with 300 mm and 400 mm diameter pulleys are connected by means of a cross belt. The direction of rotation of the follower pulley is to be reversed by changing over to an open belt drive. How much length of the belt has to be reduced? **(15)**

6. (a) In a screw jack, the helix angle of thread is α and the angle of friction is ϕ. Show that its maximum efficiency is **(15)**

$$\frac{1-\sin\phi}{1+\sin\phi}, \text{ when } 2\alpha = \left(90^\circ - \phi\right)$$

(b) The mean diameter of the screw jack having pitch of 10 mm is 50 mm. A load of 20 kN is lifted through a distance of 170 mm. Find the work done in lifting the load and efficiency of the screw jack when **(20)**

(i) the load rotates with the screw,

(ii) the load rests on the loose head which does not rotates with the screw.

7. (a) Derive an expression for the friction moment for a flat collar bearing in terms of inner radius r_1, outer radius r_2, axial thrust W and co-efficient of friction μ. **(15)**

Assume uniform intensity of pressure.

Contd P/3

NAME 319

Contd... Q. No. 7

(b) Define angle of Repose. **(5)**

(c) A flat foot step bearing 225 mm in diameter supports a load of 7.5 kN. If the co-efficient of friction is 0.09 and r.p.m is 60, find the power lost in friction, assuming **(15)**

(i) uniform pressure

(ii) uniform wear.

8. (a) Sketch and describe the working procedure of 'The Whitworth quick return motion mechanism'. **(15)**

(b) The Whitworth quick return motion mechanism has the driving crank 150 mm long. The distance between fixed centres is 100 mm. The line of stroke of the ram passes through the centre of rotation of the slotted lever whose free end is connected to the ram by a connecting link. Find the ratio of time of cutting to time of return. **(15)**

(c) Determine the degrees of freedom of the mechanism shown in Fig. 8(c). **(5)**

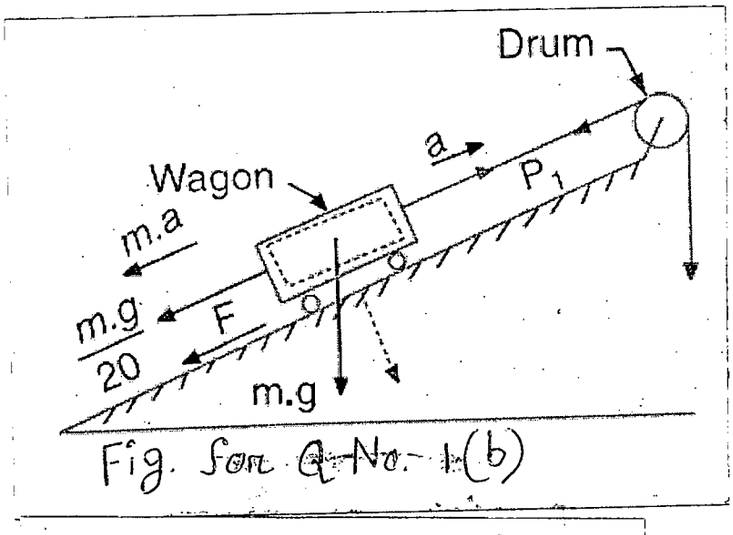

Fig. for Q. No. 1(b)

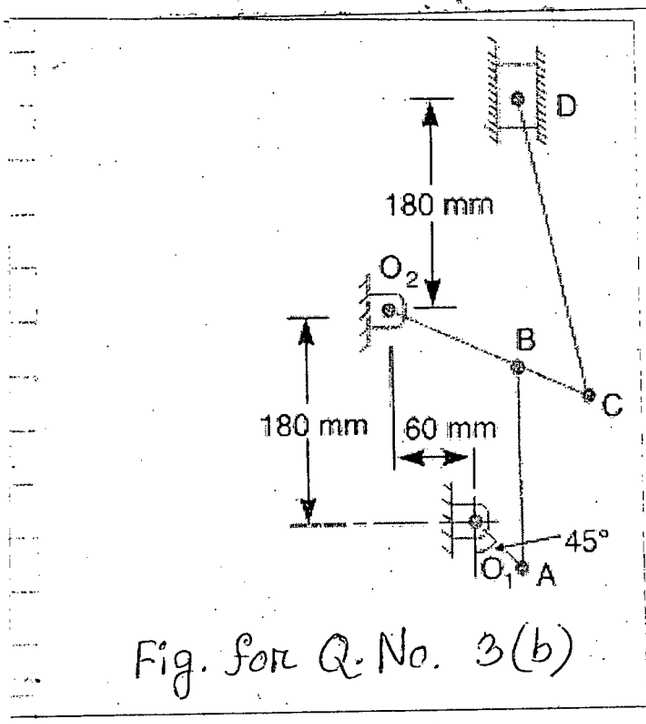

Fig. for Q. No. 3(b)

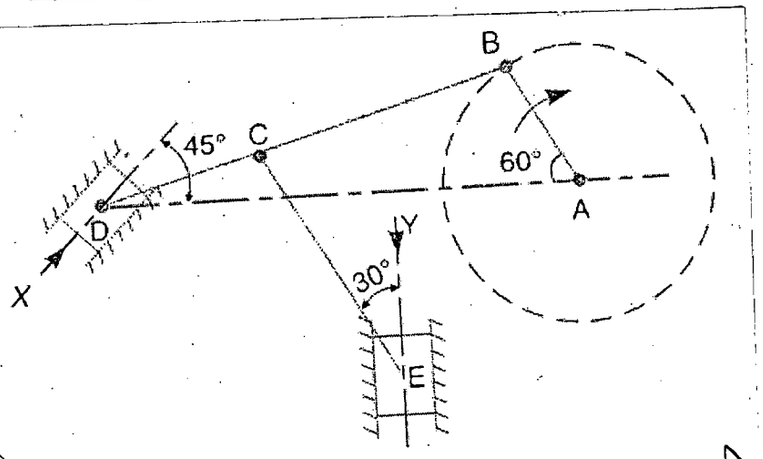

Fig. for Q. No. 4(c)

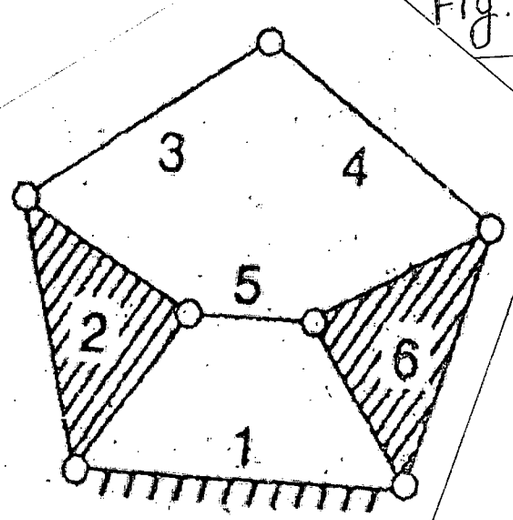

Fig. 8(c)

L-3/T-2/NAME **Date : 31/01/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2013-2014

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**.

1. (a) 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. **(20)**

   (b) What are the functions of docking plugs and air pipes in double bottom tank construction? Describe in brief with neat sketches. **(7)**

   (c) A ship has a draft of 4 m having breadth 14 m and length 78 m. Calculate the thickness of depth of centre girder. **(8)**

2. (a) Discuss the potential advantages and disadvantages of using FRP over other materials for small craft construction. **(18)**

   (b) What is pillar? What are its types and functions? Discuss the spacings and construction of different kinds of pillars used in ship construction with neat sketches. **(17)**

3. (a) List down the points to be considered during planning a new shipyard or re-planning an existing one. Also draw a typical layout of a modern shipyard based on production flow. **(20)**

   (b) Using suitable sketch; define different kinds of brackets used in ship construction. **(15)**

4. Write short notes on the following: **(35)**

   (i) Hatch coaming

   (ii) Bulwarks

   (iii) Strength deck

   (iv) Combined Framing System

Contd P/2

NAME 355

SECTION – B

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

5. (a) Discuss different ship design stages with design spiral. **(17)**

   (b) sing suitable sketch, distinguish the following: **(10)**

   (i) Bar keel and duct keel

   (ii) Bilge keel and flat keel

   (c) Mention advantages and disadvantages of aluminum as shipbuilding materials. **(8)**

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

   (b) Make a neat sketch of a double bottom structure with both longitudinal and transverse framing system of a ship (in the way of plate floor and bracket floor) and mention the various structural members in it. **(20)**

7. (a) What are the advantages of double bottom construction? What are its design considerations? **(10)**

   (b) Mention in general the longitudinal and transverse strength members of a ship. **(10)**

   (c) With reference to Fore End structural members mention the function of the following items: **(15)**

   (i) Stem bar

   (ii) Breast hooks

   (iii) Panting stringers

   (iv) Perforated bulkhead

8. Write short notes on: **(35)**

   (i) Stern construction

   (ii) Shipbuilding steels

   (iii) Mould lofts

   (iv) Local stresses

   (v) Ship contract.

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2013-2014

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

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Assume suitable value for any missing data, 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) The simplified form of the energy equation of the boundary layer is: **(6)**

$$u\frac{\partial T}{\partial x}+v\frac{\partial T}{\partial y}=\alpha\frac{\partial^2 T}{\partial y^2}$$

State the assumptions used in the above form of energy equation.

(b) If for a flat plate, the thermal boundary layer thickness is $\delta_t = \dfrac{\sqrt{\dfrac{3\alpha x}{U\infty}}}{\sqrt{\dfrac{3}{20}\varphi-\dfrac{3}{280}\phi^3}}$

and the velocity boundary layer thickness is $\delta=\dfrac{4.64x}{\sqrt{Re_x}}$ where $\varphi=\dfrac{\delta t}{\delta}$

Show that $\dfrac{\delta t}{\delta}\approx\dfrac{1}{1.025}(Pr)^{-1/3}$. Use the definition of Prandtl number to justify this formula. **(12+5)**

(c) A thin walled metal tank containing fluid at 40°C cools in air at 14°C; h is very large inside the tank. If the sides are 0.4 m high, compute $\bar{h}$, $\bar{q}$ δ at the top. At 27°C,

$P_r = 0.711$, $\nu = 1.566\times10^{-5}$, $\alpha = 2.203\times10^{-5}$ $\overline{N}_{u_L} = 0.678\ R_{a_L}^{1/4}\left(\dfrac{Pr}{0.952+Pr}\right)^{1/4}$ **(12)**

2. (a) Define a Gray body. How does it differ from a black body? **(5)**

(b) Define intensity of radiation and solid angle with the help of a figure. **(5)**

(c) Derive the expression for net heat exchange by radiation between two finite block surfaces A_1 and A_2 arbitrarily located in space. **(15)**

(d) Determine the view factors from the base of a pyramid to each of its four side surfaces. The base of pyramid is a square and its side surfaces are isosceles triangles. State any assumption used. **(10)**

Contd P/2

NAME 329

3. (a) Using electric analogy draw the radiation network for three non black surfaces which see each other only. **(3)**

(b) A 30 cm diameter hemisphere is maintained at a constant temperature of 500°C and insulated on its back side. The surface emissivity is 0.4, the opening exchanges radiant energy with a large enclosure at 30°C. Calculate the net radiant exchange. **(10)**

(c) Use electric analogy to draw radiation network for two parallel plates separated by one radiation shield. Hence show that in case of N shields placed between two infinite parallel plates, $(\text{heatflow})_{\text{with shield}} = \frac{1}{N+1}(heatflow)_{without\ shield}$. Assume emissivities of all surfaces are same. **(10)**

(d) Two large parallel planes having emissivities of 0.3 and 0.5 are maintained at temperatures of 900k and 400k, respectively. A radiation shield having an emissivity of 0.05 on both sides is placed between the planes. Calculate: **(12)**

(i) The heat transfer rate per unit area if the shield were not present (ii) The heat transfer rate per unit area with the shield present and (iii) the temperature of the shield.

4. (a) Describe various types of heat exchanger. **(8)**

(b) For a double pipe parallel flow heat exchanger, derive the expression for log mean temperature difference (LMTD). State two assumptions of the LMTD method. **(15+2)**

(c) State an advantage of double pipe counter flow heat exchanger over parallel flow heat exchanger. Water at the rate of 68 kg/min is heated from 35°C to 75°C by an oil having specific heat of 1.9 kJ/kg°C. The fluids are used in a counterflow double pipe heat exchanger and the oil enters the exchanger at 110°C and leaves at 75°C. The overall heat transfer coefficient is 320 $W/m^2°C$. Calculate the heat exchanger area. Assume specific heat of water = 4.18 J/g°C **(1+9)**

SECTION – B

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

5. (a) Derive the expressions of heat transfer for a Cylinder without heat sources. **(15)**

(b) A steel pipe with 5-cm OD is covered with 6.4 mm asbestos insulation [k = 0.096 Btu/ h.ft.°F] followed by a 2.5 cm layer of fiberglass insulation [k= 0.028 BTu/h.ft°F]. The pipe wall temperature is 315°C, and the outside insulation temperature is 38°C. Construct the thermal resistance model of the system. Hence calculate the interface temperature between the asbestos and fiber glass, overall heat transfer co-efficient for the pipe neglecting convection heat transfer, R value, heat loss per unit length of the pipe. **(20)**

Contd P/3

NAME 329

6. (a) Derive an expression for heat transfer through a rectangular fin if the end of the fin is insulated. **(20)**

   (b) Compare the temperature distribution in a straight cylindrical rod having a diameter of 2 cm and a length of 10 cm and exposed to a convection environment with h = 25 $W/m^2°C$ for three fin materials: copper [k = 385 W/m°C]; stainless steel [k = 17 W/m°C]; and glass [k = 0.8 W/m°C]. Also compare the relative heat flows and fin efficiencies. **(15)**

7. (a) A Slab mode up of carbon steel is initially at a temperature of 500°C and it is suddenly exposed to air at 30°C. The thickness of the slab is 1 cm. What will be the temperature of the slab after one minute? Assume that the convective heat transfer co-efficient (h) on the surface of the slab is 40 W/m^2k. The properties of carbon steel are: $\rho = 7833\ kg/m^3$, C = 0.465 kJ/kgk, k = 38.5 W/mk, $\alpha = 1.474 \times 10^{-5}\ m^2/s$. **(15)**

   (b) Deduce an expression for transfer heat flow using Lumped heat capacity analysis. **(15)**

   (c) What are the significance of Biot number and Fourier number? **(5)**

8. (a) State Buckingham π-theorem. With the help of Buckingham π-theorem show that for forced convection Nusselt number is a function of Renolds number and Prandtle number. **(20)**

   (b) What do you mean by thermal boundary layer? How does the ratio $\delta/\delta t$ vary with Prandtle number? **(10)**

   (c) What is meant by Nusselt number? **(5)**
