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E-3012

B. E. IV Semester (Main & Re-Exam.) July, 2013

BASIC FLUID MECHANICS AND RATE PROCESSES

Branch : MEE-S 204

Time : Three Hours] *[Maximum Marks : 75/50*
[Minimum Marks : 30/20

Note : Attempt *all* the questions of *Section-A*, *four* questions from *Section-B* and *three* questions from *Section-C*.

SECTION – A

Write down *True* or *False* : 1 × 10 = 10(50)
1.5 × 10 = 15(75)

1. Fourier law is given by, $Q = kA\frac{dT}{dx}$, where all symbols are usual meaning.

2. Distillation is mass transfer phenomena.

3. Convection is two types Natural convection and forced convection.

4. Mass transfer occurs due to temperature difference.

5. Water flow into the pipe due to pressure difference.

6. A fluid, which is incompressible and is having no viscosity is known as an real fluid.

7. Pascal's law states that the pressure or intensity of pressure at a point in a static fluid is equal in all directions.

8. Vacuum pressure is defined as the pressure below the atmospheric pressure.

P.T.O.

9. Total pressure is defined as the force exerted on a surface.

10. Stoke's law is given by $C_D = \frac{24}{Re}$ where C_D drag coefficient, Re Reynolds No.

SECTION – B

Attempt any *four* questions. $4 \times 4 = 16(50)$

$6 \times 4 = 24(75)$

1. Derive an expression for heat transfer rate of a composite wall.

2. Discuss about any mass transfer phenomena with an example.

3. Discuss about different types of fluid as ideal fluid, real fluid, Newtonian fluid, Non Newtonian fluid, ideal plastic fluid.

4. A plate 0.025 mm distant from a fixed plate moves at 60 cm/s and requires a force of 2 N per unit area i.e. 2 N/m^2 to maintain this speed. Determine the fluid viscosity between the plates.

5. The pressure intensity at a point in a fluid is given 3.924 N/cm^2. Find the corresponding height of fluid when the fluid is (a) water and (b) oil of sp. gr. 0.9.

6. State and prove the Pascal's law.

7. Write short notes on :

   (a) Drag coefficient

   (b) Terminal velocity of a body

SECTION – C

Attempt any *three* questions out of *five* questions. $8 \times 3 = 24(50)$

$12 \times 3 = 36(75)$

1. Discuss Newton's law of viscosity, kinematic viscosity, variation of viscosity with temperature.

2. Discuss the types of fluid flow.

3. Derive expression for Bernoulli's equation and explain the application of Bernoulli's equation.

4. Differentiate between steady state heat flow and unsteady state heat flow with suitable example.

5. Write short notes on any *two*

   (a) Orifice meter

   (b) Conduction heat transfer modes

   (c) Fick's law for mass transfer

   (d) Reynold's No.

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E-3423

B. E. IV Semester (Main & Re-Exam), 2014

BASIC FLUID MECHANICS AND RATE PROCESSESS

Branch : ME-IV Sem.

Time : Three Hours]

Max. Marks : 75/50

30

[Min. Marks : 30/20

Note : Attempt ***all*** the questions of ***Section-A***, ***four*** from ***Section-B*** and ***three*** questions from ***Section-C***.

SECTION – A $1 \times 10 = 10$ (50)

(Objective Type Questions) $1.5 \times 10 = 15$ (75)

1. (i) On account of which of the following boundary layer exists :

(a) Surface tension

(b) Gravitational effect

(c) Viscosity of fluid

(d) None of the above

(ii) The boundary layer separation occurs when :

(a) $\frac{dp}{dx} < 0$

(b) $\left(\frac{\partial u}{\partial y}\right)_{y=0} = 0$

(c) $\left(\frac{\delta u}{\delta y}\right)_{y=0} > 0$

(d) None of the above

(iii) Momentum thickness is given by which of the following relations :

(a) $\int_0^{\delta}\left(1-\frac{u}{U}\right)dy$

(b) $\int_0^{\delta}\frac{u}{U}\left(1-\frac{u}{U}\right)dy$

(c) $\int_0^{\delta}\frac{u}{U}\left(1-\frac{u^2}{U^2}\right)dy$

(d) None of the above

P. T. O.

(iv) Sonic velocity (c) for adiabatic process is given by :

(a) $c = \sqrt{\gamma RT^0}$ (b) $c = \sqrt{\gamma RT}$

(c) $c = \sqrt{\gamma^2 RT}$ (d) $c = \sqrt{\gamma R^2 T}$

(v) An Isentropic how is one which is ?

(a) Isothermal (b) Adiabatic

(c) Adiabatic and Reversible (d) Adiabatic and Irreversible

(vi) Mass Transfer occurs due to temp. difference. *(True/False)*

(vii) Distillation is mass transfer Phenomena *(True/False)*

(viii) Temperature of steam around 550°C can be measured by :

(a) thermopile (b) thermocouple

(c) thermometer (d) radiation pyrometer

(ix) A gray body is one whose absorptivity .....

(a) is equal to its emissivity

(b) varies with temp.

(c) varies with wavelength of the incident ray

(d) none of the above

(x) The inner surface of a phone brick wall is at 50°C and the outer surface is at 25°C. Calculate the rate of heat transfer per m^2 of the surface area of the wall which is 220 mm thick the thermal conductivity of the bricks is 0.51 w/mk :

(a) 20.65 w/m^2 (b) 32.75 w/m^2

(c) 47.62 w/m^2 (d) 57.95 w/m^2

SECTION – B

$4 \times 4 = 16$ (50)

(Short Answer Type Questions)

$6 \times 4 = 24$ (75)

1. A hot plate 1m × 1.5m is maintained at 300°C, Air at 20°C blows over the plate. If the convection heat transfer coefficient is 20 w/m²°C. Calculate the rate of heat transfer.

2. What is the difference between thermodynamics and heat transfer ?

3. Discuss the effects of various parameters on the thermal conductivity of solids.

4. What is boundary layer ? Why does it increase with distance from the up stream edge ?

5. Discuss the high Re-approximation.

6. Write short notes any *three* :

   (i) Wien's law

   (ii) Kirchoff's law

   (iii) Stefan-Boltzmann law

   (iv) Reynold's No.

   (v) Orifice meter

SECTION – C

$8 \times 3 = 24$ (50)

(Long Answer Type Questions)

$12 \times 3 = 36$ (75)

1. A surface having an area of 1.5 m² and maintained at 300°C exchanges heat by radiation with another surface at 40°C. The value of factor due to the geometric location and emissivity is 0.52. Determine :

   (i) Heat lost by radiation,

   (ii) The value of thermal resistance, and

   (iii) The value of equivalent correction coefficient.

2. Derive expression for Bernoullis equation and explain the application of Bernoullis equation.

3. Derive the Navier-stokes equation.

4. Differentiate between steady state heat flow and unsteady state heat flow with suitable examples.

5. Air flow over a plate 0.5 m long and 0.6 m wide with a velocity of 4 m/s. The velocity profile in the form $\frac{u}{U} = \sin\left[\frac{\pi}{2} + \frac{\gamma}{\delta}\right]$ if ϱ = 1.24 Kgn/m^3 and v = 0.15×10^{-4} m^2/s. Calculate.

   (i) Boundary layer thickness at the end of plate,

   (ii) Shear stress at 250 mm from the leading edge, and

   (iii) Drag force on one side of plate.

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E-65

B.E. IV Semester (Main & Re-Exam.)

May 2015

Basic Fluid Mechanism & Rate Processes

Mech. Engg.

Time : Three Hours]

[Maximum Marks : 75

[Minimum Marks : 30

Note : Attempt **all** the questions of Section-A, **four** from Section-B and **three** questions from Section-C.

Section-A

(Objective Type Question)

Note : This section will contain **ten** objective type questions. They may be fill in the blanks, True/False or Multiple Choice Type. 1.5×10=15

1. Navier-Stokes equation represents the equation of :

   (a) Mass (b) Momentum

   (c) Energy (d) Pressure

2. Separation of boundary layer takes place when

   (a) $\left.\frac{\partial u}{\partial y}\right|_{y=0} = 0$ (b) $\left.\frac{\partial u}{\partial y}\right|_{y=\delta} = 0$

   (c) $\left.\frac{\partial u}{\partial y}\right|_{y=0} > 0$ (d) $\left.\frac{\partial^2 u}{\partial y^2}\right|_{y=0} > 0$

P.T.O.

3. At the point of boundary layer separation -

(a) Shear stress is maximum (b) Shear stress is zero

(c) Velocity is negative (d) Density variation is maximum

4. If x is the distance measured from leading edge of a flat plate, the wall shear stress for laminar boundary layer varies as -

(a) x (b) $x^{1/2}$

(c) $x^{-1/2}$ (d) $x^{-4/5}$

5. In case of one dimensional heat conduction in a medium with constant properties, T is a temperature at position x, at time t. Then, $\partial T / \partial t$ is proportional to -

(a) T/x (b) $\partial T / \partial x$

(c) $\partial^2 T / \partial x \, . \, \partial t$ (d) $\partial^2 T / \partial x^2$

6. The value of Biot number is very small (less than 0.01) when -

(a) the convective resistance of the fluid is negligible

(b) the conductive resistance of the fluid is negligible

(c) the conductive resistance of the solid is negligible

(d) none of these

7. The thickness of thermal and hydrodynamic boundary layers are equal if :

(a) $Pr = 1$ (b) $Pr > 1$

(c) $Pr < 1$ (d) $Pr = Nu$

8. A streamline and an equipotential line in a flow field -

(a) are identical

(b) are parallel to each other

(c) are perpendicular to each other

(d) intersect at an acute angle

9. Mass transfer occurs due to temperature difference. (True/False)

10. The concept of LMTD will not work when outlet Temperature of both the fluids are not known. (True/False)

Section-B

(Short Answer Type)

Note : This section will contain **six** questions. Students will ask to attempt any **four** questions out of **six** questions.

6×4=24

1. Define and give significance of following dimensionless numbers.

   (a) Reynold number

   (b) Weber number

   (c) Mach number

   (d) Euler number

2. What do you mean by similitude and what are the different types similarities that must exist between model and a prototype?

3. Discuss the high Re-approximation.

4. Show that the temperature profile for the heat conduction through wall of constant thermal conductivity is a straight line.

5. Discuss critical radius and economical thickness of insulation on cylinders.

6. Define mass fraction, mole fraction, molar concentration, mass flux and molar flux.

Section-C

(Long Answer Type)

Note : This section will contain **five** questions. Students will ask to attempt any **three** questions out of **five** questions. $12 \times 3 = 36$

1. Derive the Navier Stokes equation.

2. Starting from steady flow energy equation, show how Bernoulli's equation for an inviscid incompressible fluid can be obtained. List out the assumptions and limitations.

3. Following are the three velocity profiles over a stationary surface -

   (a) $\frac{u}{U_\infty} = \frac{3}{2}\frac{y}{\delta} - \frac{1}{2}\left(\frac{y}{\delta}\right)^3$

   (b) $\frac{u}{U_\infty} = \frac{-3}{2}\frac{y}{\delta} + \frac{1}{2}\left(\frac{y}{\delta}\right)^3 + \left(\frac{y}{\delta}\right)^4$

   (c) $\frac{u}{U_\infty} = 2\left(\frac{y}{\delta}\right)^2 + \left(\frac{y}{\delta}\right)^3 - \frac{4}{2}\left(\frac{y}{\delta}\right)^4$

   Check whether the flow adheres to or detaches from the surface.

4. A hollow cylinder with inner radius 30mm and outer radius 50mm is heated at the inner surface at a rate of 10^5 W/m^2 and dissipated heat by convection from outer surface into fluid at 80°C with heat transfer co-efficient of 400 W/m^{2}k. There is no heat generation and thermal conductivity of the material is constant at 15 W/mk. Calculate the temperatures of in side and outside surfaces of Cylinder.

5. Derive the 3-D Heat conduction eq. in Cartesian formo.

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E-226

B. E. IV Semester (Main & Re-Exam) Examination – May, 2016

BASIC FLUID MECHANICS & RATE PROCESS

(Mech. Engg.)

Time : Three Hours]

[Maximum Marks : 75

[Minimum Marks : 30

Note : Attempt ***all*** questions from **Section - A** (Objective type questions), ***four*** questions from **Section – B** (Short answer type questions) and ***three*** questions from **Section – C** (Long/Essay type questions).

SECTION – A [Marks : 1.5 × 10 = 15

Note : Attempt ***all*** questions.

1. The viscosity of liquids ..... with increase in temperature.

(a) Decrease (b) Increase

(c) First decrease than increase (d) No effect on viscosity

2. The pressure of a liquid on a surface will always act ..... to the surface.

(a) Parallel (b) Normal

(c) 45° (d) 60°

3. An ice-cube is floating in glass of water. As the cube melts the water level.

(a) remain constant (b) falls

(c) rises (d) none of the above

P. T. O.

4. If the Reynold's number is less than 2000, the flow in pipe is :

(a) laminar flow
(b) turbulent flow
(c) transition flow
(d) none of the above

5. The path followed by fluid particle in motion is called a :

(a) streamline
(b) path line
(c) streak line
(d) none of the above

6. Dynamic similarity between the model and prototype is the :

(a) similarity of motion
(b) similarity of lengths
(c) similarity of forces
(d) None of the above

7. On account of which of the following boundary layer exists ?

(a) Surface tension
(b) Gravitational force
(c) Viscosity of fluid
(d) None of the above

8. The flow is said to be subsonic when Mach number is :

(a) equal to unity
(b) less than unity
(c) greater than unity
(d) none of the above

9. Which of the following equations is known as momentum principle :

(a) $F = \frac{d(m^2v)}{dt}$ (b) $F = \frac{dv}{dt}$ (c) $F = \frac{d(mv)}{dt}$ (d) $F = \frac{d(mv)}{dt^2}$

10. A streamline is one :

(a) In which the flow cannot cross the boundary surface
(b) Which has constant area throughout its length
(c) In which stream function does not change
(d) None of these

SECTION – B

[Marks : 4 × 6 = 24

Note : Attempt any *four* questions.

1. What is capillarity ? Derive expression for height of capillary rise.

2. Derive the 3-D continuity equation in Cartesian co-ordinates.

3. State the momentum equation. How will you apply momentum equation for determining the force exerted by a flowing liquid on a pipe bend.

4. What do you mean by separation of boundary layer ? What is the effect of pressure gradient on boundary layer separation.

5. Derive the expression for general heat conduction equation in Cartesian co-ordinates.

6. Explain briefly the term 'mass transfer' and enumerate application of mass transfer.

SECTION – C

[Marks : 12 × 3 = 36

Note : Attempt any *three* questions.

1. (a) A plate 0.025 mm distant from a fixed plate, moves at 60 cm/s and requires a force of 2N per unit area to maintain this speed. Determine the fluid viscosity between the plates.

   (b) Differentiate between :

   (i) Steady and Un-steady flow

   (ii) Uniform and Non-uniform flow

2. Explain the different types of hydraulic similarities that must exist between a prototype and its model.

3. A man weighing 90 kgt descends to the ground from an aeroplane with the help of a parachute against the resistance of air. The velocity with which the parachute , which is hemispherical in shape, comes down is 20 m/s. Find the diameter of the parachute. Assume C_D= 0.5 and density of air = 1.25 kg/m^3.

4. State the Bernoulli's theorem for incompressible flow and compressible flow. Derive the expression for Bernoulli's equation for incompressible flow.

5. Write short notes on any *four* :

   (a) Molar concentration

   (b) Drag and lift

   (c) Conduction of heat

   (d) Mach Number

   (e) An aerofoil

   (f) Laminar boundary layer

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E-437

B.E.VI Semester Examination, May 2017

(Main & Re-Exam)

Basic Fluid Mechanics & Rate Process

(ME)

Time : Three Hours] *[Maximum Marks : 75*

[Minimum Marks : 30

Note : Attempt **all** the questions of Section-A, **four** from Section-B and **three** questions from Section-C.

Section-A

(Objective Type Question)

Note : This Section will contain **ten** objective type questions. They may be fill in the blanks. True/False or multiple choice type. 1.5×10=15

1. Wet cloths are hung on the clothesline outdoor in sub-zero weather. After a day the cloths are brought into the house and observed to be dry. The process of drying is best explained as
   (a) Vaporization
   (b) Sublimation
   (c) Melting
   (d) Condensation
2. The wavelength of the radiation emitted by a body depends upon.
   (a) The nature of its surface
   (b) The temperature of its surface
   (c) The area of its surface
   (d) All of the above factor
3. The ratio of energy transferred by convection to that by conduction is called.
   (a) Stauton (b) Nussit Number
   (c) Biot Number (d) Preclet Number

P.T.O.

4. Free convection flow depends on all the following Except :
   (a) Density
   (b) Coefficient of viscosity
   (c) Gravitational force
   (d) Velocity
5. Which **one** of the following is the correct statement?
   (a) The match number is less than I at a point while the entropy is maximum wheather it is Rayleigh or Fennoline.
   (b) A normal shock can appear in subsonic flow.
   (c) The downstream match number across a normal shock is more than one
   (d) The stagnation pressure across a normal shock decreases.
6. Stability of freely falling object is assured of its centre of :
   (a) Buoyancy lies below its centre of gravity
   (b) Gravity coincides with centre of buoyancy
   (c) Gravity lies below its metacenter
   (d) Buoyancy lies below its metacenter
7. If a piece of metal having a specific gravity of 13.6 is placed in mercury of specific gravity 13.6, then :
   (a) The metal piece will be sink to the bottom
   (b) The metal piece will simply flot over the mercury with no immersion
   (c) The metal piece will be immersed in mercury by half.
   (d) The whole of the metal piece will be immeresed with its top surface just at mercury level.
8. A pipe is connected in series to another pipe whose diameter is twice and length is 32 times that of first pipe. The ratio of frictional head losses for the first pipe to those for the Second pipe is (both the pipes have the same frictional constant).
   (a) 8 (b) 4
   (c) 2 (d) 1
9. Separation of fluids is caused by :
   (a) Reduction of pressure in the direction of flow
   (b) Reduction of the boundry layer thickness
   (c) Presence of adverse pressure gradient.
   (d) Presence of favrable pressure gradient.

10. A right circular cylinder is filled with a liquid upto its top level. It is related about its vertical axis at such a speed that half the liquid spills out, then the pressure at the point of intersection of the axis and bottom surface is :
    (a) Same a before rotation
    (b) Half of the value before rotation
    (c) Quater of the value before rotation
    (d) Equal to atmosphere pressure

Section-B

(Short Answer Type)

Note : This section will contain **six** questions. Students will ask to attempt any **four** questions out of **six** questions. 6×4=24

1. Discuss the Neutonion & Non-Neutonion fluids with suitable example and also discuss the different pressures?
2. Classify the different types of fluids flows and derive the differential equations of continuity?
3. Derive the Bernaullie's theorem and also discuss one Instrument based on it with neat sketch?
4. Discuss the effect of drag & lift on an airfoil?
5. Derive the effect of Biot number on temperature distribution in a slab with neat generations?
6. Derive the expression for neat & mass transfer for different types of extend surfaces.

Section-C

(Long Answer Type)

Note : This section will contain **five** questions. Students will ask to attempt any **three** questions out of **five** questions. 12×3=36

1. A cylinder whose axis is perpendicular to the stream of air having a velocity of 20 m/s, rotates at 300 rpm. The Cylinder is 2m in diameter and 10 m long. Find,
    (i) The circulation
    (ii) The theoretical lift force per unit length
    (iii) The position stagnation points and.
    (iv) The actual lift, drag and directions of resultant force or determining actual

drag & lift, assume,

$U_C / U_0 = 1.57$; $C_L = 3.4$ and $C_D = 0.65$.

2. Consider a flat plate 8m wide × 1.8m long placed in an air stream having a velocity of 160 Km/hr.

   (i) Assuming that a laminar boundry layers exists over the entire length of plate, what is the skin friction drag & how thick is the boundary layer 1.2m aft of the leading edge? How would these values changes if a turbulent boundary layer develops from the vary start of the leading edge of the plate?

   (ii) If critical Reynolds number for transition from laminar to turbulent flow is 1×10^6, how far aft of the plate leading edge will be transition point be? If an immidiate transition from laminar to turbulant flow is assumed, what is the skin friction drag on a plate?

3. A model of an aeroplane built to one-tenth scale is to tested in a wind tunnel which operates at a pressure of 20 atmosphere. At what speed should be wind tunnel operates to give dynamic similarity between the model tested in the compressed air tunnel and the aeroplane which is expected to fly at a speed of 600 Km/hr at high altitudes. If measured drag on the model is 350 N, what power will be needed to propell the aircraft at 600 Km/hr.

4. A steam main of 8cm inside diameter and 9.5 an outside diameter is lagged with two successive layer of insulation. The layer in contact with pipe is 3.75 cm asbestos with K=0.11 W/m^{0}K and the asbestos layer is covered with 1.5 cm thick mangnesia insulation with K=0.067 W/m^{0}K. The inside film heat transfer co-efficient is 290W/m^{0}k and the outside film heat transfer co-efficient is 7.0 W/m^{0}k conductivity of pipe material is 45 W/m^{0}K. Calculate the steady heat loss from the steam of 50 m length if the steam passing is at 350^{0}C and the ambient temperature is 30^{0}C.

5. Exhaust gases flowing through the tubler heat exchange at the rate of 20kg/ min are cooled from 450^{0}C to 150^{0}C by water initially at 20^{0}C. The specific heat of gases may be taken as 1.13 Kj/Kg^{0}k and overall heat transfer coefficient may be taken as 140 W/m^2. Calculate the surface area needed if the water flow is 2.5 kg/min for :

   (a) Parallel flow &

   (b) Counter flow