BRAINWARE UNIVERSITY

Term End Examination 2020 - 21

Programme – Master of Science in Mathematics

Course Name – Fluid Mechanics

Course Code - MSCME307

Semester / Year - Semester III

Time allotted : 75 Minutes Full Marks : 60

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group-A

(Multiple Choice Type Question) 1 x 60=60

1. *(Answer any Sixty)*

(i) A fluid is a substance that

a) Always expands until it fills any container
b) Has the same shear stress at a point regardless of its motion
c) Cannot remain at rest under action of any shear force
d) Cannot be subjected to shear forces

(ii) Kinematic viscosity is defined as

a) Dynamic viscosity. density
b) Dynamic viscosity/density
c) Dynamic viscosity.pressure
d) Pressure.density

(iii) Poise is the unit of

a) Mass density
b) Kinematic viscosity
c) Dynamic viscosity
d) Velocity gradient

(iv) An ideal fluid

a) Is very viscous
b) Obey Newton's law of viscosity
c) Is assumed in conduit flow
d) Frictionless and incompressible.

(v) Dynamic viscosity of most of the gases with rise in temperature

a) increases
b) decreases

c) Remains same
d) unpredictable

(vi) Viscosity is the most important property in the

a) Travel of a bullet through air
b) Water jet issuing from a fire house
c) Formation of soap bubbles
d) Flow of castor oil through a tube

(vii) The stress-strain relation of the Newtonian fluid is

a) linear
b) parabolic
c) hyperbolic
d) Inverse type

(viii) With increases in pressure the bulk modulus of elasticity

a) increases
b) decreases
c) Remains constant
d) Increases first upto a limit then decreases

(ix) Unit of kinematic viscosity is

a) m2 /sec
b) Kg sec/m2
c) Newton-sec/m2
d) Newton-sec2/m

(x) One poise is equivalent to

a) 360 kg/m-hr
b) 1 dyne sec/cm2
c) 10-1kg/m-sec
d) All of these

(xi) The condition that the surface F(x,y,z,t)=0 may b e bounding surface is

a) DF/Dt=1
b) DF/Dt=0
c) DF/Dt=2
d) None of these

(xii) The stream function is constant along a particular stream line flow

a) False statement
b) True statement
c) Both of these
d) None of these

(xiii) The motion of a inviscid fluid under conservative forces, if once irrational, is always

a) Rotational
b) Irrotational
c) Laminar
d) None of these

(xiv) The motion in which the velocity potential in single-valued is called

a) Laminar
b) Turbulent
c) Cyclic
d) Acyclic

(xv) The result, namely, "when the external forces are conservative and derivable from a single valued potential function and the density is a function of pressure only, then the circulation in any closed circuit moving with the fluid is constant for all time" is due to

a) Stoke's
b) Kelvin
c) Green
d) Lagrange

(xvi) At an internal point in a fluid, vortex lines

a) Can originate
b) Can terminate
c) Can't originate
d) None of these

(xvii) If a rectilinear vortex moves in two dimensions in a fluid bounded by a fixed plane, then a streamline can never coincide with a line of

a) Constant velocity
b) Constant density
c) Constant pressure
d) None of these

(xviii) Which of the following is an intensive thermodynamic property?

a) volume
b) Temperature
c) Mass
d) Energy

(xix) During throttling which of the following quantities does not change?

a) Internal energy
b) entopy

c) pressure

d) enthalpy

(xx) A cycle with constant volume heat addition and constant volume heat rejection is

a) Otto cycle

b) B.diesel cycle

c) Joule cycle

d) Rankine cycle

(xxi) An open system is one which

a) Heat and work cross the boundary of the system, but the mass of the working substance does not.

b) Mass of working substance crosses the boundary of the system but the heat and work do not.

c) Both the heat and work as well as mass of the working substances cross the boundary of the system

d) Neither the heat and work nor the mass of the working substances crosses the boundary of the system

(xxii) Spherical shape of droplets of mercury is due to

a) High density

b) High surface tension

c) High adhesion

d) Low vapour pressure

(xxiii) An ideal fluid is the one which is

a) Non-viscous and incompressible

b) Compressible and has low density

c) Elastic and viscous

d) Steady and incompressible

(xxiv) A stagnation point is a point is fluid flow where

a) Pressure is zero

b) Velocity of flow reduces to zero

c) Total energy is zero

d) Total energy is maximum

(xxv) Fluid dynamics deals with the motion of fluid

a) Without considering forces causing flow

b) Considering forces causing flow

c) Both (Without considering forces causing flow) and (Considering forces

d) None of these

causing flow)

(xxvi) A stream line is defined as the line

a) Parallel to central axis flow
b) Parallel to outer surface of pipe
c) Of equal velocity in a flow
d) Along which the pressure drop is uniform

(xxvii) Unsteady uniform flow is a flow through

a) An expanding tube at an increasing rate
b) An expanding tube at an constant rate
c) A long pipe at decreasing rate
d) A long pipe at constant rate

(xxviii) The distance between any two stream lines

a) Is always zero
b) Remains the same
c) Increase along its path
d) Decreases along its path

(xxix) With increase in pressure the bulk modules of elasticity

a) increases
b) decreases
c) Remains constant
d) Increases first upto a limit then decreases

(xxx) For an irreversible process, net entropy change is

a) zero
b) negative
c) positive
d) None of the above

(xxxi) Which of the following is a point function

a) temperature
b) heat
c) work
d) All these

(xxxii)

The units of dynamic or absolute viscosity is

a)
b)

Kg sec/metre

$m^2 / \sec$

c) d)

Newton-sec/m^2

None of these

(xxxiii)

The flow of any fluid, real or ideal satisfies

a) b)

Newton's law of viscosity

Newton second law of motion

c) d)

Continuity equation

$\tau = (\mu + \eta) \frac{du}{dy}$

(xxxiv)

If the motion is irrotational, we have

a) b)

$w = (1/2) \times curlq = 0$

W=curlq=0

c) d)

W=divq=0

None of these

(xxxv)

Differential equations of the path lines are

a) dx/u=dy/v=dz/w

b) dx/dt=u, dy/dt=v, dz/dt=w

c) $dx/\xi = dy/\eta = dz/\varsigma$

d) None of these

(xxxvi)

In usual notations, $\rho \dfrac{\partial(x,y,z)}{\partial(a,b,c)} = \rho_0$, is the equation of continuity in

a) Cartesian coordinates

b) Euler's form

c) Lagrange's form

d) None of these

(xxxvii)

If the fluid be homogeneous and incompressible, then in usual, symbols, the Bernoulli's theorem becomes

a) $\dfrac{q^2}{2} + V + p = c$

b) $q^2 + V + \dfrac{p}{\rho} = c$

c) $q^2/2 + V + p/\rho^2 = c$

d) $q^2/2 + V + p/\rho = c$

(xxxviii)

The relation between ϕ and ψ is

a)

$\partial\phi/\partial x = \partial\psi/\partial y$ and
$\partial\phi/\partial y = \partial\psi/\partial x$

b)

$\partial\phi/\partial x = \partial\psi/\partial y$ and
$\partial\phi/\partial y = -\partial\psi/\partial x$

c)

$\partial\phi/\partial x = \partial\psi/\partial y$ and
$-\partial\phi/\partial y = \partial\psi/\partial x$

d)

None of these

(xxxix)

The velocity q is everywhere tangent to the lines in xy-plane along which

a)

$\phi(x, y) = cons\tan t$

b)

$\psi(x, y) = cons\tan t$

c)

W=constant

d)

None of these

(xl)

Cauchy-Riemann equation in polar form are

a)

$$\frac{\partial\phi}{\partial r} = r\frac{\partial\psi}{\partial\theta}, \frac{\partial\phi}{\partial\theta} = -\frac{1}{r}\frac{\partial\psi}{\partial r}$$

b)

$$\frac{\partial\phi}{\partial r} = \frac{1}{r}\frac{\partial\psi}{\partial\theta}, \frac{1}{r}\frac{\partial\phi}{\partial\theta} = -\frac{\partial\psi}{\partial r}$$

c)

d)

$\frac{\partial \phi}{\partial r} = \frac{1}{r}\frac{\partial \psi}{\partial \theta}, r\frac{\partial \phi}{\partial \theta} = \frac{\partial \psi}{\partial r}$

$\frac{\partial \phi}{\partial r} = -r\frac{\partial \psi}{\partial \theta}, \frac{\partial \phi}{\partial \theta} = \frac{1}{r}\frac{\partial \psi}{\partial r}$

(xli)

Euler's equation of motion in x-direction is

a) $Du/Dt = X - (1/\rho) \times (\partial p/\partial x)$

b) $Du/Dt = X + (1/\rho) \times (\partial p/\partial x)$

c) $\partial u/\partial t = X - (1/\rho) \times (\partial p/\partial x)$

d) $\partial u/\partial t = X + (1/\rho) \times (\partial p/\partial x)$

(xlii)

A stream in a horizontal pipe, after passing a contraction in the pipe at which its sectional area is A is delivered at atmospheric pressure at a place, where the sectional area is B. If a side tube is connected with the pipe at the former place, water will be sucked up through it into the pipe from a reservoir at a depth h below the pipe, s being the delivery per second, where h is given by

a) $(s^2/2g) \times (1/A^2 + 1/B^2)$

b) $(s^2/2g) \times (1/A^2 - 1/B^2)$

c) $(2g/s^2) \times (1/A^2 - 1/B^2)$

d) $(2g/s^2) \times (1/A^2 + 1/B^2)$

(xliii)

When a circular cylinder is in motion with velocity U along x-axis, we have

a) $w = Ua^2/r$

b) $w = Ua^2/z$

c) $w = Uz/a^2$

d) None of these

(xliv)

For circulation about a circular cylinder the complex potential is given by

a) $\left(\frac{ik}{2\pi}\right) logz$

b) $\left(\frac{2\pi}{ik}\right) logz$

c) $\left(\frac{2k}{i\pi}\right) logz$

d) $\left(\frac{2i}{\pi k}\right) logz$

(xlv)

For circulation about a circular cylinder, velocity potential is

a) $k\theta/2\pi$

b) $2\pi/k\theta$

c) $-k\theta/2\pi$

d) $-2\pi/k\theta$

(xlvi)

When an elliptic cylinder moves in an infinite liquid with velocity U parallel to the axial pane through the major axis of the cross-section, then with usual notations, the stream function Ψ is given by

a) $Uce^{\alpha-\xi} sinh\alpha . sin\eta$

b) $Uce^{\alpha-\xi} cosh\alpha . cos\eta$

c) $-Uce^{\alpha-\xi} sinh\alpha . sin\eta$

d) $-Uce^{\alpha-\xi} cosh\alpha . cos\eta$

(xlvii)

Liquid of density ρ is circulating irrotationally between two confocal ellipse $\zeta = \alpha, \boldsymbol{\xi} = \boldsymbol{\beta}$, where $x + iy = c.\cosh(\xi + i\eta)$. If k is the circulation, then the kinetic energy per unit length of the cylinder is

a) $\rho k^2(\beta - \alpha)/8\pi$

b) $\rho k^2(\beta - \alpha)/4\pi$

c) $\rho k^2(\beta - \alpha)/2\pi$

d) None of these

(xlviii)

In usual notations, Stoke's theorem is

a)

b)

$\int_C^{\square} \boldsymbol{q}.\boldsymbol{dr} = \int_S^{\square} curl\boldsymbol{q} \times dS$ $\int_C^{\square} \boldsymbol{q}.\boldsymbol{dr} = \int_S^{\square} curl\boldsymbol{q}.dS$

c)

$\int_C^{\square} \boldsymbol{q} \times \boldsymbol{dr} = \int_S^{\square} curl\boldsymbol{q}.dS$

d)

$\int_C^{\square} \boldsymbol{q} \times \boldsymbol{dr} = \int_C^{\square} curl\boldsymbol{q} \times dS$

(xlix)

In usual notations, relation $\Gamma = \int \Omega\,.n\,dS$ holds for

a)

Gauss theorem

b)

Kelvin' theorem

c)

Stoke's theorem

d)

Green's theorem

(l)

With help of transformation $\zeta = z + \frac{a^2}{z}$, the circle transforms into

a)

[redacted]Parabola

b)

Aerofoil

c) d)

[redacted] Circle

[redacted] Ellipse

(li)

The equation of lines of flow relative to a sphere is

a)

$$sin^2\theta = \frac{r^3-a^3}{cr}$$

b)

$$sin^2\theta = \frac{r^3+a^3}{cr}$$

c)

$$sin^2\theta = \frac{cr}{r^3-a^3}$$

d)

$$sin^2\theta = \frac{cr}{r^3+a^3}$$

(lii)

If Ø be the velocity potential due to a simple three dimensional source, then in usual symbols

a)

$$\emptyset = \frac{m}{r}$$

b)

$$\emptyset = -\frac{m}{r}$$

c)

$$\emptyset = \frac{m}{r^2}$$

d)

$$\emptyset = -\frac{m}{r^2}$$

(liii)

In usual notations, the Stoke's stream function for a simple source on the axis of x is

a) $m\ sin\theta$

b) mx

c) $\frac{mx}{r}$

d) $\frac{mx}{r^2}$

(liv)

In usual symbols if $u, v, w = \mu\left(\frac{\partial\phi}{\partial x}, \frac{\partial\phi}{\partial y}, \frac{\partial\phi}{\partial z}\right)$, then the angle θ between the vortex lines and stream lines is

a) $0°$

b) $45°$

c) $90°$

d) None of these

(lv)

In usual notations, complex potential of dipole is

a) $\left(\frac{\mu i}{r}\right) e^{i(\alpha-\theta)}$

b) $\mu r e^{i(\alpha-\theta)}$

c) $\mu e^{i(\alpha-\theta)}$

d) None of these

(lvi)

Rate of dissipation of energy when there is no slip of boundary is

a) $\mu \iiint (\xi^2 + \eta^2 + \xi^2) dv$

b) $2\mu \iiint (\xi^2 + \eta^2 + \xi^2) dv$

c) $3\mu \iiint (\xi^2 + \eta^2 + \xi^2) dv$

d) $4\mu \iiint (\xi^2 + \eta^2 + \xi^2) dv$

(lvii)

The continuity equation for an incompressible fluid is given as

a) $\rho_1 A_1 V_1^2 = \rho_2 A_2 V_2^2$

b) $\rho_1 A_1 V_1 = \rho_2 A_2 V_2$

c) $A_1 V_1 = A_2 V_2$

d) $\rho_1^2 A_1 V_1 = \rho_2^2 A_2 V_2$

(lviii)

The general continuity equation for three dimensional flow of a compressible fluid for steady flow

a)

b)

$$\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}+\frac{\partial w}{\partial z}=0$$

$$\frac{\partial u}{\partial x}=\frac{\partial v}{\partial y}=\frac{\partial w}{\partial z}=0$$

c)

$$\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}+\frac{\partial w}{\partial z}=1$$

d)

$$\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}+\frac{\partial w}{\partial z}=u.v.w$$

(lix)

An ideal fluid

a) Is very viscous

b) Obey Newton's law of viscosity

c) Is assumed in conduit flow

d) Frictionless and incompressible.

(lx)

With usual notations

a) $q=-\nabla\phi$

b) $q=\nabla\phi$

c) $|q|=\nabla^2\phi$

d) None of these