QA MTH642 SUBJECTIVE FOR MID TERM
VERIFIED BY I.B.R

Write a linear momentum equation in newton's second law? ***3marks***

Answer:

Newton's second law:

$$F = ma$$

where F is the force acting on an object, m is the mass of the object, and a is the object's acceleration.

We can rewrite this using the definition $a \equiv \frac{\Delta v}{\Delta t}$, where Δv is the change in velocity of the object over some time duration Δt.

$$F = m\frac{\Delta v}{\Delta t}$$

which is equivalent to:

$$F = \frac{\Delta p}{\Delta t}$$

where $\Delta p \equiv m\Delta v$ is change in momentum.

Write the compressible continuity equation in cylindrical coordinates? 2marks

Answer:

Compressible

continuity equation: $\vec{\nabla}\cdot(\rho\vec{V}) = 0$

In Cartesian coordinates, this reduces to

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

In cylindrical coordinates, it reduces to

$$\frac{1}{r}\frac{\partial(r\rho u_r)}{\partial r}+\frac{1}{r}\frac{\partial(\rho u_\theta)}{\partial \theta}+\frac{\partial(\rho u_z)}{\partial z}=0$$

Example of incompressible and study fluid flow? 5marks

Answer:

Compressible

continuity equation: $\vec{\nabla}\cdot(\rho\vec{V})=0$

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$$\frac{1}{r}\frac{\partial(r\rho u_r)}{\partial r}+\frac{1}{r}\frac{\partial(\rho u_\theta)}{\partial \theta}+\frac{\partial(\rho u_z)}{\partial z}=0$$

Incompressible continuity equation: $\vec{\nabla}\cdot\vec{V}=0$

Since $\partial\rho/\partial t \cong 0$

Incompressible continuity equation in Cartesian coordinates:

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

Incompressible continuity equation in cylindrical coordinates:

$$\frac{1}{r}\frac{\partial(ru_r)}{\partial r}+\frac{1}{r}\frac{\partial(u_\theta)}{\partial \theta}+\frac{\partial(u_z)}{\partial z}=0$$

Derive Navier–Stokes equation for incompressible? ***5marks***

Answer:

Incompressible Navier–Stokes equation:

$$\rho\frac{D\vec{V}}{Dt}=-\vec{\nabla}P+\rho\vec{g}+\mu\nabla^2\vec{V}$$

Define Normalized equation? ***2marks***

Answer:

Normalized Equation:

- If the nondimensional terms in the equation are of order unity, the equation is called **normalized**.

State Divergence theorem? 2marks

Answer:

The quickest and most straightforward way to derive the differential form of conservation of mass is to apply the divergence theorem (Gauss's theorem).

Divergence theorem: $$\int_V \vec{\nabla}\cdot\vec{G}\,dV = \oint_A \vec{G}\cdot\vec{n}\,dA$$

Mth 642 Some Imp data From Fluid mechanics Book

(Zain Ahsan)

1–61 If mass, heat, and work are not allowed to cross the boundaries of a system, the system is called
(*a*) Isolated (*b*) Isothermal (*c*) Adiabatic (*d*) Control mass (*e*) Control volume

1–62 The speed of an aircraft is given to be 260 m/s in air. If the speed of sound at that location is 330 m/s, the flight of aircraft is
(*a*) Sonic (*b*) Subsonic (*c*) Supersonic (*d*) Hypersonic

1–63 One J/kg is equal to
(*a*) 1 kPa·m^3 (*b*) 1 kN·m/kg (*c*) 0.001 kJ
(*d*) 1 N·m (*e*) 1 m^2/s^2

1–64 Which is a unit for power?
(*a*) Btu (*b*) kWh (*c*) kcal (*d*) hph (*e*) kW

1–65 The speed of an aircraft is given to be 950 km/h. If the speed of sound at that location is 315 m/s, the Mach number is
(*a*) 0.63 (*b*) 0.84 (*c*) 1.0 (*d*) 1.07 (*e*) 1.20

1–66 The weight of a l0-kg mass at sea level is
(*a*) 9.81 N (*b*) 32.2 kgf (*c*) 98.1 N (*d*) 10 N (*e*) l00 N

1–67 The weight of a 1-lbm mass is
(*a*) 1 lbm·ft/s^2 (*b*) 9.81 lbf (*c*) 9.81 N (*d*) 32.2 lbf (*e*) 1 lbf

1–68 A hydroelectric power plant operates at its rated power of 12 MW. If the plant has produced 26 million kWh of electricity in a specified year, the number of hours the plant has operated that year is
(*a*) 2167 h (*b*) 2508 h (*c*) 3086 h (*d*) 3710 h (*e*) 8760 h

1. **How is the Mach number of a flow defined? What does a Mach number of 2 indicate?**

Answer:

Ratio of the speed of flow to the speed of sound is called mach number and mach number 2 indicate flow speed that is twice the speed of flow.

2. **When an airplane is flying at a constant speed relative to the ground, is it correct to say that the Mach number of this airplane is also constant?**

Answer:

NO, because the speed of sound and mach number changes with temperature.

3. **What is the no-slip condition? What causes it?**

Answer:

A fluid in direct contact with a solid surface sticks to the surface and there is no slip is called no slip condition and its due to the viscosity of the fluid.

4. **Explain why the light-year has the dimension of length?**

Answer:

The light year unit is then the product of velocity and time .

5. **What is the net force acting on a car cruising at a constant velocity of 70 km/h (*a*) on a level road and (*b*) on an uphill road?**

Answer:

There is no acceleration , thus net force wii be zero in both cases.

6. **What is the weight, in N, of an object with a mass of 150 kg at a location where $g = 9.6\ m/s^2$?**

Answer:

W=mg putting values you will get 1440N

7. **A 3-kW resistance heater in a water heater runs for 2 hours to raise the water temperature to the desired level. Determine the amount of electric energy used in both kWh?**

Answer:

Total energy = (Energy per unit time)(Time interval)

= 3kw*2h

=6kwh

8. Consider the following steady, two-dimensional velocity field

V › = (u, υ) = (0.66 + 2.1x)i › + (−2.7 − 2.1y) j › Is there a stagnation point in this flow field?

If so, where is it?

Answer:

$$\vec{V} = (u,v) = (0.5+1.2x)\vec{i} + (-2.0-1.2y)\vec{j} \qquad (1)$$

At a stagnation point, both u and v must equal zero. At any point (x,y) in the flow field, the velocity components u and v are obtained from Eq. 1,

Velocity components: $u = 0.5+1.2x \qquad v = -2.0-1.2y \qquad (2)$

Setting these to zero yields

Stagnation point:
$$0 = 0.5+1.2x \qquad x = -0.4167$$
$$0 = -2.0-1.2y \qquad y = -1.667 \qquad (3)$$

So, **yes there is a stagnation point**; its location is $x = -0.417$, $y = -1.67$ (to 3 digits).

9. Consider the following steady, two-dimensional velocity field:

$$\vec{V} = (u, v) = (a^2 - (b - cx)^2)\vec{i} + (-2cby + 2c^2xy)\vec{j}$$

Is there a stagnation point in this flow field? If so, where is it?

Answer:

$$\vec{V} = (u,v) = \left(a^2 - (b-cx)^2\right)\vec{i} + (-2cby + 2c^2xy)\vec{j} \qquad (1)$$

At a stagnation point, both u and v must equal zero. At any point (x,y) in the flow field, the velocity components u and v are obtained from Eq. 1,

Velocity components: $u = a^2 - (b-cx)^2 \qquad v = -2cby + 2c^2xy \qquad (2)$

Setting these to zero and solving simultaneously yields

Stagnation point:
$$0 = a^2 - (b-cx)^2 \qquad x = \frac{b-a}{c}$$
$$v = -2cby + 2c^2xy \qquad y = 0 \qquad (3)$$

So, **yes there is a stagnation point**; its location is $x = (b-a)/c$, $y = 0$.

10. Name and briefly describe the four fundamental types of motion or deformation of fluid particles.

Answer:

- Translation – a fluid particle moves from one location to another.
- Rotation – a fluid particle rotates about an axis drawn through the particle.
- Linear strain or extensional strain – a fluid particle stretches in a direction such that a line segment in that direction is elongated at some later time.

Mth 642 mid solve paper

1. Define internal flow with example?

Answer:

Internal flow is defined as a flow where in the fluid is completely confined by inner surface of an item. **For example** Flows through pipes ducts, nozzles, diffusers, valves and fittings.

2. Difference between Viscous and inviscid flow?

Answer:

Viscous Flow	Inviscid Flow
Flows in which the frictional effects are significant are called viscous flows.	.inviscid flow is the flow of an inviscid fluid in which the viscosity of the fluid is equal to zero.
A flow where viscosity is important.	A flow where viscosity is not important

3. If $V = x^2 + 2x - y$ then find flow is rotational or irrational?

Answer:

As we know

$\Delta \times \vec{V} = 0$ ----------(1) (it also called curl of V)

if $\Delta \times \vec{V} = 0$ Then it will irrotational

if $\Delta \times \vec{V} \neq 0$ then it will rotational.

In order to find curl of v first we have to do

$$V = \Delta\phi$$

here we will put value of V and $\Delta\phi$

$$x^2 + 2x - y = \frac{\delta\phi}{\delta x}\vec{i} + \frac{\delta\phi}{\delta y}\vec{j} + \frac{\delta\phi}{\delta z}\vec{k}$$

$$=(2x+2)\vec{i} - \vec{j} + 0\ \vec{k}$$

Now put value in eq 1

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$$\Delta \times \vec{V} = 0$$

$$\begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ \frac{\delta}{\delta x} & \frac{\delta}{\delta y} & \frac{\delta}{\delta z} \\ 2x+2 & -1 & 0 \end{vmatrix} = \vec{i}(0-0) - \vec{j}(0-0) + (0-0)\vec{k} = 0$$

So it is irrotational Hence Proved....

Note:

If value of u and v is given then you can check irrational and incompressible by following formulas

you can use following formula

1) for finding irrotational flow

$$\omega = \frac{1}{2}\left(\frac{\delta v}{\delta x} - \frac{\delta u}{\delta y}\right) = 0$$

And

2) For finding incompress flow

$$\frac{\delta u}{\delta x} + \frac{\delta v}{\delta y} = 0$$

MTH 642 Mid Paper (10-01-2022)

1. Define Flow Separation?

Answer:

When a fluid is forced to flow over a curved surface, such as the back side of the cylinder at sufficiently high velocity the boundary layer can no longer remain attached to the surface and at same point it separates from the surface- a process called flow separation.

2. Application of fluid mechanics in medicine?

Answer:

Fluid mechanics is also going through your body. For example chemotherapy and blood thinner etc

3. The rate of translation vector in Cartesian coordinates?

Answer:

$$\vec{V} = u\vec{i} + v\vec{j} + w\vec{k}$$

4. The rate of rotation vectorin Cartesian coordinates

Answer:

$$\omega = \frac{1}{2}\left(\frac{\delta w}{\delta y} - \frac{\delta v}{\delta z}\right)\vec{i} + \frac{1}{2}\left(\frac{\delta u}{\delta z} - \frac{\delta w}{\delta x}\right)\vec{j} + \frac{1}{2}\left(\frac{\delta v}{\delta x} - \frac{\delta u}{\delta y}\right)\vec{k}$$

5. Difference between solid and fluid?

Answer:

Solid	Liquid
Definite shape and volume	Volume but no definite shape
Intermolecular force Is strong	Intermolecular force is weak
Have high density	low density
Solid cannot be compressed	Liquids can be compressed

Some define

VISCOSITY

The frictional effect between different layers of a flowing fluid is called viscosity .Viscosity measures how much force is required to slide one layer of the liquid over another layer.

DRAG FORCE

An object moving through a fluid experiences a retarding force called a drag force. The drag force increases as the speed of the object increases.

FLUID

Anything that can flow is called fluid. Liquids and gases are the examples of fluids.

LAMINAR / STREAMLINE / REGULAR FLOW

The flow is said to be streamline or laminar if every particle that passes a particular point moves along exactly the same path as followed by particles which pass that points earlier.

TURBULENT / IRREGULAR / UNSTEADY FLOW

The regular or unsteady flow of the fluid is called turbulent flow.

IDEAL FLUID

A fluid is called ideal fluid if it has following characters ,

- The fluid is non viscous I. e, there is no internal frictional force between adjacent layers of fluid.
- The fluid is incompressible I. e, its density is constant.
- The fluid motion is steady.

EQUATION OF CONTINUITY

The product of cross sectional area of the pipe and the fluid speed at any point along the pipe is a constant. This constant equals the volume flow per second of the fluid or simply flow rate.

- Recall from physics that a substance exists in three primary phases.
- Solid, liquid and gas.
- A substance in the liquid or gas phase is referred to as a **fluid**.
- Distinction between a solid and a fluid is made on the basis of the substances ability to resist an applied shear (or tangential) stress that tends to change its shape.
- A solid can resist an applied shear stress by deforming, whereas a fluid deforms continuously under the influence of the shear stress no matter how small. In solids stress is proportional to strain, but in fluids stress is proportional to strain rate.
- **Stress** is defined as force per unit area and is determined by dividing the force by the area upon which it acts.
- The normal component of the acting on a surface per unit area is called the **normal stress**.
- The tangential component of force acting on a surface per unit area is called the **shear stress**.
- In a fluid at rest, the normal stress is called **Pressure**.
- A fluid at rest is at a state of zero shear stress.

$$\text{Ma} = \frac{v}{c} = \frac{\text{Speed of flow}}{\text{Speed of sound}}$$

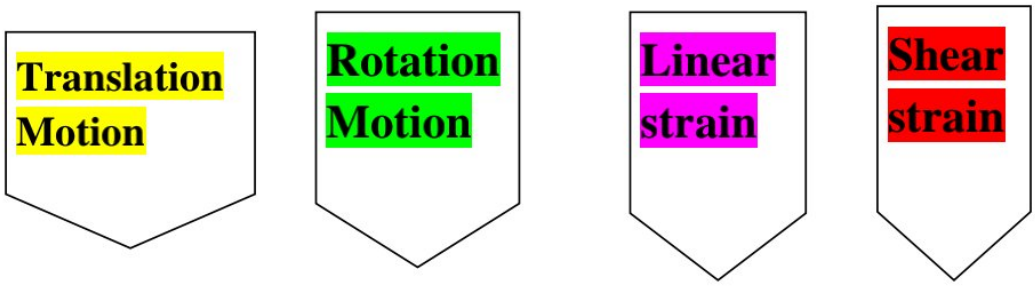
where c is the **speed of sound** whose value is 346 m/s in air at room temperature at sea level. A flow is called **sonic** when Ma = 1, **subsonic** when Ma < 1, **supersonic** when Ma > 1, and **hypersonic** when Ma $\gg$ 1.

Mth 642 Imp Coordinates

Four types of motion

Zain Ahsan

Follow Color pattern to memorize easily



Cartesian coordinate of these motion

Translation motion

$$\vec{v} = u\hat{i} + v\,j + uk$$

Rotation

$$\vec{\omega} = \frac{1}{2}\left(\frac{\partial w}{\partial y} - \frac{\partial v}{\partial z}\right)\hat{i} + \frac{1}{2}\left(\frac{\partial u}{\partial z} - \frac{\partial w}{\partial x}\right)j + \frac{1}{2}\left(\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\right)k$$

Linear Strain

$$\in_{xx} = \frac{\partial u}{\partial x}$$

$$\in_{yy} = \frac{\partial v}{\partial y}$$

$$\in_{zz} = \frac{\partial w}{\partial z}$$

Shear Strain:

$$\in_{xy} \frac{1}{2}\left(\frac{\partial u}{\partial y} - \frac{\partial v}{\partial x}\right)$$

$$\in_{zx} = \frac{1}{2}\left(\frac{\partial w}{\partial x} - \frac{\partial u}{\partial z}\right)$$

$$\in_{yz} = \frac{1}{2}\left(\frac{\partial v}{\partial z} - \frac{\partial w}{\partial y}\right)$$

1. Flow seperation
2. Applications of fluid mech. in medicine
3. Basis on which fluid and solid are distinguished
4. Rate of rotation vector in cartesian coordinates.

2 questions yad nahn

Mth642 4PM (10-01-2022)

5:16 PM

Mth642

Material derivative ka formula
Drag force
Material derivative with pressure P and Velocity D (formula and explain)

5 sy 6 quiz mega file main sy thy. Steady flow devices wala quetion tha. System,surrounding aur boundary ko explain krna tha. Ek question linear strain rate aur shear strain rate ko define krna tha. Significant digit ko define krna tha with example. Materal derivative wala ek question tha. Baki yad ni abi.

★ 6:08 PM

[redacted]

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5 sy 6 quiz mega file main sy thy. Steady flow devices wala quetion tha. System,surrounding aur boundary ko ex...

Mth-642 8:30am today paper.

Objective Kafi confusing Hota. Files ka pata nahi but handouts me se hi tha objt sara but conceptual. Subjective b full handouts se.

★ 12:47 PM

[redacted]

⭕Long m 1 transient flow and unsteady flow ka difference btana tha .5 marks

⭕1 rate of rotation ka question tha v given tha .5 marks

⭕Error m difference tha .3 marks

⭕ Or 1 m v given tha uss ka pta NHI kya find krna tha .3 marks

⭕ Bernolli eq. Likhna the .2 marks

★ 12:51 PM

[redacted]

> ⭕Long m 1 transient flow and unsteady flow ka difference btana tha .5 marks
> ⭕1 rate of rotation ka question tha v giv...

Mth642 today paper

★ 12:54 PM

Super sonic subsonic 3 number ka ma number

★ 3:03

Water temperature wla 2 marks ka

Aik 3 dimensions wla aya velocity distribution

★ 3:04

Mth642 ★ 3:04 PM

Mth 642 today's paper 4:00pm
Mcqs ak b file main sa ni aya totally handouts sa Ur subjective main
1.internal flue with example
2.viscous nd inviscid flow difference
3.if v=x`+2x-y then flue is rotational or not?
4.ak example the hose garden wali g=0.7 etc the us main mass Ur density find krni the
5.ak Ur tha 30l buket Wala questions tha us main average velocity Ur mass find Krna tha

2:35 PM

Bernouli equation ; adective acceleration ; do questions thay jin main aik main mass flow rate find karna tha or aik main presaure pascle main find karna tha yh dono 5 marks kay thay or aik ka formula likhna tha

★ 9:48 AM

Or aik basic vonsept wlaa tha

★ 9:48 AM

Kah jb do chezon ko phnaiko to ohlay kon si pahunchi gi apni destiny oh

★ 9:48 AM

Handsout say hi mcqs aay thay or aik file sy mcqs aya tha

★ 9:48 AM

P = p atm + pgh ko derive karna tha

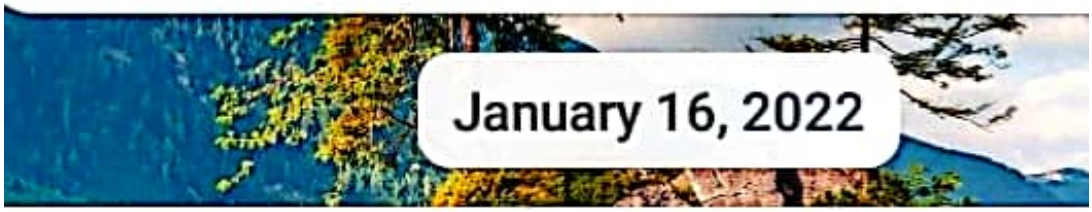
★ 9:48 AM

Mth642

★ 9:48 AM

Difference between steady and unsteady flow.
Bernoli equation di thi us me btana tha teen factors kon kon se hain
Pehka flow energy second kinetic energy and third gz wala momentum likh ata hon pta ni usko kia kehty
h1 and h2 ki values di thin or pocha tha pressure difference P1-P2 find krain

★ 9:09 P



MTH 642 (15-01-2022) 7 pm
1) define steady and unsteady flow
2) define specific gravity
3) bernoli equation was given Btana tha k dP/q + V^2/2 + gz = constant kia hain ???
4)value of h1 and h2 were given difference between pressure 1 and pressure 2 btana tha
5) material derivative ki equation se related question tha
6) volume k bary tha expression b likhni thi