

KADI SARVA VISHWVIDHYALAYA

M.E.(Thermal Engineering) SEMESTER: IV EXAMINATION [OCT/2015]

Subject Code: ME406

Date: 30/10/2015

Subject Name: Fluid Mechanics

Time: 10:30 A.M.-01:30 P.M.

Total Marks: 70

Instructions:

1. Attempt all questions as directed and answer each section in separate main answer sheets.
2. Figures to the right indicate full marks.
3. Make suitable assumptions.
4. Indicate Clearly, the option you attempt along with its respective question number.
5. Use the last page of main supplementary for rough work.
6. Use of scientific calculator is permitted.
7. Please don't write anything on this question paper except your Enrollment and ID Number.
8. Please keep your Identity Cards and Hall Tickets on your desk during the examination.
9. Please follow all the instructions provided by authorized university and institute personnel.

SECTION - I

Q. 1

Total: 15

- A. State the Newton's law of viscosity and give examples of its application. 05
B. Define Newtonian and Non-Newtonian fluids. 05

C. A body with gravity force of 500 N with a flat surface area 0.2 m^2 slides down a lubricated inclined plane making a 30° angle with the horizontal. For viscosity of 0.1 kg m/s and body speed of 1 m/s . Determine the lubricant film thickness. 05

OR

- C. Prove that "Intensity of pressure at any point in a fluid at rest is same in all direction" 05

Q. 2

Total :10

- A. What is manometer ? How are they classified ? 05
B. The barometric pressure at sea level is 76 cm of Hg. While that on a mountain top is 73.5 cm. If the density of air is assumed to be constant as 1.2 kg/m^3 , prove that the elevation of the mountain top is 284.4 meter 05

OR

Q. 2

Total :10

- A. A solid cube of sides 0.5 m each is made of material of relative density 0.5. The cube floats in a liquid of relative density 0.95 with two of its faces horizontal. Examine its stability. 05

B. Explain the terms 'meta-centre' and 'meta-centric height'. 05

Q. 3

Total: 10

- A. What is Euler's equation of motion ? How will you obtain Bernoulli's equation from it ? 05
B. A venturimeter has an area ratio 9:1, the large diameter being 30 cm. During the flow, the recorded pressure head in the large section is 7.75 m and that at the throat is 5.5 m. Find the discharge through the meter if $C_d=0.98$ 05

OR

Q. 3

- A. Distinguish between (1) Compressible and Incompressible flow (2) Steady flow and Un-steady flow. **Total: 10** 05
- B. State the characteristics of Laminar flow and Turbulent flow 05

SECTION - II

Q. 4

- A. Derive Darcy-Weisbach equation with usual notations. **Total: 15** 05
- B. The rate of flow of water through a horizontal pipe is $0.25\text{m}^3/\text{s}$. The diameter of the pipe which is 0.2 meter is suddenly enlarged to 0.4 meter. The pressure intensity in the smaller pipe is $11.772 \times 10^4 \text{ N/m}^2$. Determine (i) Loss of head due to sudden enlargement (ii) Pressure intensity in the large pipe (iii) Power lost due to enlargement 05
- C. Show, using Buckingham's $_$ -theorem, that the resistance (F) to the motion of a sphere of diameter (D) moving with a uniform velocity (V) through a real fluid of density (ρ) and viscosity (μ) is given by: 05

$$F = D^2 V^2 \rho \emptyset \left[\frac{\mu}{\rho V D} \right]$$

OR

- C. Derive an expression for Hagen Poiseuille's theorem. 05

Q. 5

- A. The velocity of a flow is given by $\vec{v} = -xi + 2y j + (5-z) k$. Derive the equation of streamline passing through a point (2, 1, 1). **Total: 10** 05
- B. Define the equation of continuity. Obtain an expression for continuity equation for a three-dimensional flow. 05

OR

Q. 5

- A. What are the methods of dimensional analysis ? Describe the Ray-leigh's method for dimensional analysis. **Total: 10** 05
- B. Differentiate between forced vortex flow and free vortex flow. 05

Q. 6

- A. Prove that velocity of sound wave in a compressible fluid is given by $C = \sqrt{k/\rho}$ Where k = Bulk modulus of fluid and ρ = Density of fluid. **Total: 10** 05
- B. A flying object is flying at a speed 1100 km/ hour at sea level at a temperature of 20°C . Take $K=1.4$ and $R = 287 \text{ J/Kg K}$. Find the Mach number at a point on this flying object 05

OR

Q. 6

- A. Define Mach number. What is the significance of Mach number in compressible fluid flows ? **Total: 10** 05
- B. What is the difference between dynamic viscosity and kinematic viscosity? State their units. 05

Our best wishes are always with you...

KADI SARVA VISHWAVIDYALAYA
B.E. SEMESTER IV EXAMINATION MAY 2014

Subject Code: ME 406

DATE: 17/05/2014

TIME: 10:30 to 1:30

Subject: FLUID MECHANICS

TOTAL MARKS: 70

Instructions:

1. Answer each section in separate answer sheet.
2. Use of scientific calculator is permitted.
3. All questions are compulsory.
4. Indicate clearly the options you attempted along with its respective question number.
5. Use the last page of main supplementary for rough work.
6. Make suitable assumption wherever needed and clearly state the assumptions.

Section-1

- Q.1** All compulsory
- A Define continuity Equation and derive an expression for a three dimensional flow for Cartesian co-ordinates. 05
- B Explain the phenomenon of capillarity. Obtain an expression for capillary rise of a liquid. 05
- C Explain with neat sketch Water Hammer. Also list the factors affecting water hammer in pipes. 05
- OR
- C Explain with neat sketch Say bolt Viscometer. 05
- Q.2** Answer the following question
- A Derive Darcy-Weisbach equation for the loss of head due to friction in pipes. 05
- B The right limb of a simple U-tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of sp.gr 0.9 is flowing. The centre of the pipe is 12 cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20 cm. Take Sp.Gr of mercury = 13.6. 05
- OR
- A Define surface tension. Prove that the relationship between surface tension and pressure inside a droplet of liquid in excess of outside pressure is given by $p = \frac{4\sigma}{d}$. 05
- B Explain with neat sketch U- Tube manometer for gauge pressure. 05
- Q.3** Answer the following question
- A Derive and sketch the velocity distribution for the viscous flow through a circular pipe. Using that prove that the ratio of maximum velocity to the average velocity is 2. 05

- B Derive Bernoulli's equation from Euler's equation for streamline flow. List assumptions made while equation derivation. 05

OR

- A Define the following terms: (1) Laminar flow (2) Turbulent flow (3) Newtonian fluid (4) Stream line flow (5) Vortex Flow 05
B State and explain Pascal's Law. 05

Section-2

Q.4 All compulsory

- A Define following terms:(1) Centre of Buoyancy (2) Meta Centre (3) Meta centric height (4) Homogenous equation (5) Centre of pressure 05
B What are the conditions of equilibrium of a floating body and a sub-merged body? 05
C Explain with a sketch the construction, operation and use of Pitot- Static tube. 05

OR

- C Find an expression for a discharge over a rectangular notch. 05

Q.5 Answer the following question

- A List the dimensionless numbers. Explain any two of them in detail. 05
B The resisting force R of a supersonic plane during flight can be considered as dependent upon the length of the aircraft ℓ , velocity V, air viscosity μ , air density ρ , and bulk modulus of Elasticity K. Express the functional relationship between variables and resisting force R using Buckingham's π theorem. 05

OR

- A Explain the construction and working of a venturimeter and also derive an expression for the discharge through it. 05
B A solid cylinder of diameter 4.0 m has a height of 4.0 m. find the meta-centric height of the cylinder if the specific gravity of cylinder = 0.6 and it is floating in water with its axis vertical. State whether the equilibrium is stable or unstable. 05

Q.6 Answer the following question

- A Discuss different types of similarities that must exist between a prototype and its model. 05
B Define Sonic flow, Sub-sonic flow, Supersonic flow, Mach angle and Mach cone. 05

OR

- A What do you mean by Displacement thickness? Derive an expression for displacement thickness. 05
B The discharge through a weir is $1.5 \text{ m}^3/\text{s}$. Find the discharge through the model of the weir if the horizontal dimension of the model = $1/50$ the horizontal dimension of the prototype and vertical dimension of the model = $1/10$ the vertical dimension of the prototype. 05

All the best

KADI SARVA VISHWVIDHYALAYA
B.E.SEMESTER IV EXAMINATION NOVEMBER 2014

Subject Code: ME406

Date: 10/11/2014

Subject Name: FLUID MECHANICS

Time: 10:30: TO 01:30

Total Marks: 70

Instructions:

1. Attempt all questions as directed and answer each section in separate main answer sheets.
2. Figures to the right indicate full marks.
3. All questions are compulsory
4. Indicate Clearly , the option you attempt along with its respective question number.
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SECTION - I

Q. 1

- A. Define fluid and discuss how fluids are classified **Total: 15** 05
- B. Define viscosity and differentiate between kinematic and dynamic viscosity
- C. A pipe carrying water at pressure at 162 KN/m^2 is connected by differential manometer to another pipe 1.1 m lower than first pipe and conveying water at high pressure. If the differences in height of mercury in two limbs of manometer is equal to 70 mm. What is the pressure in lower pipe.(Sp. Gravity of mercury = 13.6) 05
- OR
- C. Describe the terms atmospheric, absolute, gauge and vacuum pressure with a sketch. 05

Q. 2

- A. Explain the terms meta centre and meta centric height **Total: 10** 05
- B. A uniform rectangular body of size 2 m long, 1 m wide and 1 m deep floats in sea water. The depth of immersion is 0.8 m What is the weight of the body. Is body in stable equilibrium ? Specific gravity of sea water = 1.025 05

OR

Q. 2

- A. Differentiate between the Eulerian and Langrangian method of describing fluid motion. **Total: 10** 05
- B. Describe various types of fluid flows with example of each. 05

Q. 3

- A. What is Euler's equation of motion? How will you obtain Bernoulli's equation from it. **Total: 10** 05
- B. What is pitot-tube ?How the velocity at any point is determined with the help of 05

pitot-tube?

OR

Q. 3

Total: 10

- A. / The actual velocity in the contracted section of a jet of liquid issuing from a 5 cm diameter orifice is 7.5 m/sec under the head of 4 m. Calculate the coefficient of velocity. If the measured discharge is 8 lit/sec, determine the coefficient of contraction and discharge for this orifice. 05
- B. / Discuss relative merits and demerits of venturimeter with respect to orifice meter. 05

SECTION - II

Q. 4

Total: 15

- A. Define continuity equation. Derive an expression of continuity equation for a three-dimensional flow 10
- B. Define clearly stream line , path line and streak line 05
- C. Define velocity potential function and stream function 05
- OR**
- C Prove that flow can be said irrotational, If the curl of velocity vector is zero. 05

Q. 5

Total: 10

- A. What is dimensionless number ? State and explain them. 05
- B. The efficiency η of a fan depends on the density ρ , the dynamic viscosity μ of the fluid, the angular velocity ω , diameter D of the rotor and the discharge Q . Express η in terms of dimensionless parameters. 05

OR

Q. 5

Total: 10

- A. What is meant by geometric ,kinematic and dynamic similarities.? 05
- B. Explain viscous flow. 05

Q. 6

Total: 10

- A. / State Bernoulli's equation for compressible flow. Derive Bernoulli's equation for adiabatic process. 05
- B. / Derive the expression of velocity of sound wave in a fluid. 05

OR

Q. 6

Total: 10

- A. / Define: (1) Mach Number (2) Mach Cone (3)Zone of action (4) Mach angle (5) Zone of silence 05
- B. / What is venturi meter. Derive an expression for the discharge through a venturi meter. 05

Our best wishes are always with you...

KADI SARVA VISHWVIDHYALAYA

B.E.(Mechanical Engineering) Semester: IV

Subject Code: ME406

Subject Name: Fluid Mechanics

Date: 09/05/2014

Time: 10:30 A.M.-01:30 P.M.

Total Marks: 70

Instructions:

1. Attempt all questions as directed and answer each section in separate main answer sheets.
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SECTION - I

Q. 1

Total: 15

- A. What is the difference between dynamic viscosity and kinematic viscosity? State their units. 05
- B. Determine the density, specific weight and specific volume of oxygen at 40°C and 100 KPa absolute. Also find the temperature and pressure of oxygen , If it were compressed isentropically to 40 percent of its original volume. What will be the pressure and temperature if the process is isothermal. Molecular weight of oxygen is 32. 05
- C. Prove that "Intensity of pressure at any point in a fluid at rest is same in all direction" 05

OR

- C. What do you understand by continuum concept of a fluid? 05

Q. 2

Total: 10

- A. Describe vertical single column manometer? How will you measure the fluid pressure with it ? 05
- B. A rectangular plate 30 cm x 40 cm having a centrally located circular hole of 10 cm diameter is immersed vertically , in an oil of specific gravity 0.9 The oil surface is 80 cm above top of plane. Find total force and locate C.P. 05

OR

Q. 2

Total :10

- A. A solid cylinder of diameter 4 m has a height of 3 m. Find the metacentric height of the cylinder when it is floating in water with its axis vertical. Take specific gravity of the cylinder as 0.6 05

- B. Derive continuity equation in 3 dimensional co-ordinate system. 05
- Q. 3**
- A. Derive an expression for the discharge through a venturimeter. 05
- B. A venturimeter 100 mm x 50 mm size is used to measure the flow of liquid of specific gravity 0.8 If the mercury differential manometer head is 200 mm. Find discharge through the venturimeter. Find also absolute pressure at the neck if the pressure at the enlarged end is 0.5 kg/cm². Take C_d = 0.98
OR
- Q. 3**
- A. Define: - (i) path line (ii) stream line (iii) stream tube 05
- B. State the characteristics of Laminar flow and Turbulent flow 05
- SECTION - II**
- Q. 4**
- A. What do you understand by the terms major energy loss and minor energy losses in pipe? Derive Darcy-Weisbach equation with usual notations. 05
- B. A 60 mm diameter pipe has a discharge of 450 litre/min. At a section the pipe has a sudden expansion to a size of 90 mm diameter. If the pressure just upstream of the expansion is 20 kPa, calculate the pressure just after the expansion. Assume the pipe to be horizontal at the expansion region. 05
- C. Show, using Buckingham's π -theorem, that the resistance (F) to the motion of a sphere of diameter (D) moving with a uniform velocity (V) through a real fluid of density (ρ) and viscosity (μ) is given by: 05
- $$F = D^2 V^2 \rho \phi \left[\frac{\mu}{\rho V D} \right]$$
- OR**
- C. Derive an expression for Hagen Poiseuille's theorem. 05
- Q. 5**
- A. Velocity components of a fluid flow are given as 05
 $u = (6xyz + t)$, $v = (3yz + t^2 + 5)$, $w = (z + 3ty)$, where x, y, z are given in meters and time t in seconds. Determine velocity vector at point P (4, 1, 2) at time t = 4 seconds. Also determine the magnitude of velocity and acceleration of the flow for given location and time.
- B. Explain in brief about velocity potential function and stream function 05
- OR**
- Q. 5**
- A. What is meant by geometric, kinematic , and dynamic similarities? 05
- B. Differentiate between forced vortex flow and free vortex flow. 05
- Q. 6**
- A. Prove that velocity of sound wave in a compressible fluid is given by 05
 $C = \sqrt{k/\rho}$ Where k= Bulk modulus of fluid and ρ = Density of fluid.
- B. An aviation unit is flying at 1100 Km/hour in a still air having a pressure of 7 N/cm² and temperature -5° C . Wind velocity may be taken as zero. Take R=287.14 J/Kg K and find the Mach Number. Also calculate the pressure, temperatre and density of air at stagnation point on the nose of unit. Take $\gamma=1.4$ 05
- OR**
- Q. 6**
- A. Explain: Mach cone, Zone of silence, stagnation pressure, adiabatic process. 05
- B. 300 litres of water flowing through a pipe having diameter 350 mm right angle bend in a horizontal plane. Find the force acting on bend, If the pressure on inlet and outlet of the bend are 30 N/cm² and 27 N/cm² respectively 05