Tolani Maritime Institute, Induri
Off campus centre of Birla Institute of Technology & Science, Pilani
Question paper
Program: B.Tech(ME) / ~~B.Tech(NT) / MCEC / DNS/OTHERS~~
Form No. **FEX - 2**
Revn. 01

ID No._____

Session: 2015-16 Year: Second Semester: First Examination: Mid Semester - 2
Course: Fluid Mechanics Course Code: METIZC 263 Durn: 1 hour 15 Minutes Max Marks: 40
Date: 7th November 2015

Instructions:
1. This Question paper has two Sections. Section A with 14 Questions and Section B with XX questions All questions are compulsory.
2. All questions are to be answered in the space provided in the Question paper only. All required calculations may be carried out in the space provided for the same
3. Only one additional A4 size paper will be provided if required by the student.

Section A

In following 1 to 14, circle the only ONE correct option (a), (b), (c), or (d) using only ball point pen, ink pen or gel pen. Circle marking must be clear and without ambiguity. Do not over write or erase.

1. Concentrated foam enters at a nozzle at 2.21kg/m3 and 20 m/sec and leaves at 0.762 kg/m3 and 150 m/sec. If mass flow is 0.265 kg/sec, then find the exit area of the nozzle

(a) 23.2 cm2 (b) 46.4 cm2 (c)0.232 m2 (d) 0.464 m2

2. The static and stagnation pressures of a fluid in a pipe are measured by a piezometer and a pitot tube to be 200 kPa and 210 kPa, respectively. If the specific gravity of the fluid is 0.55, then the velocity of the fluid is

(a) 10 m/sec (b) 6.03 m/sec (c) 5.55 m/sec (d) 3.67 m/sec

3. Water is pumped from a lake to a storage tank 18 meter above at a specified rate 70 L/sec. If there is no frictional losses and pump suction and discharge pipe has same diameter, then what is the energy added to the fluid by the pump

(a) 19.6 kW (b) 17.7 kW (c) 12.4 kW (d) 9.81 kW

4. Which statement is true for a fluid flowing in a pipe line

(a) HGL lies above EGL

(b) HGL coincides with EGL

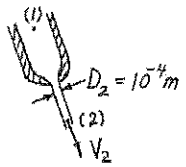
(c) HGL lies below EGL

(d) HGL is independent of EGL

5. While travelling on a dirt road, the bottom of the car hits a sharp rock, and a small hole is developed at the bottom of gasoline tank. If the height of gasoline is 40 cm in the tank, then find the initial velocity of the gasoline at the hole.

(a) 2.43 m/s (b) 5.9 m/s (c) 7.84 m/s (d) 2.8 m/s

6. Small diameter, high pressure liquid jets can be used to cut various material. Estimate the pressure on the stationary liquid at point 1 is needed to produce a 0.10 mm jet at a speed of 700 m/sec. (Consider z1 = z2 and viscosity effects are negligible)



(a) 3.5 bar (b) 24.5 bar (c) 350 bar (d) 2450 bar

7 Refer to fig of Q7

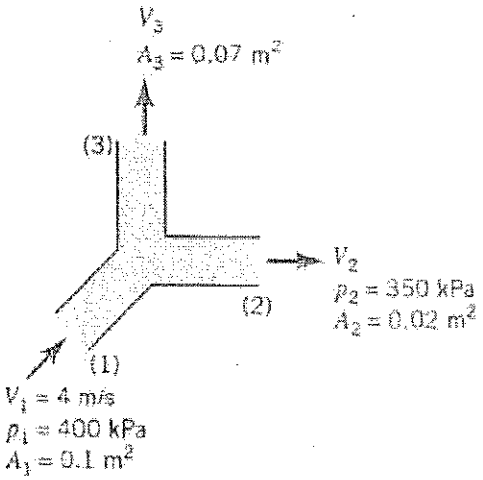


Fig of Q7

What is the value of velocity at (2)

(a) 10. 8 m/s (b) 7.4 m/s (c) 4 m/s (d) 2 m/s

8 What the total mechanical energy carried by unit mass of liquid at point (3) as mentioned in fig of Q7

(a) It is half of the energy carried by liquid / kg mass at point 1

(b) It is same as the energy carried by liquid / kg mass at point 1

(c) It is more than the energy carried by liquid / kg mass at point 1

(d) It is less than the energy carried by liquid / kg mass at point 1

9 Refer to fig of Q9 find theoretical velocity of liquid flowing from the orifice. Consider specific gravity is 0.624,

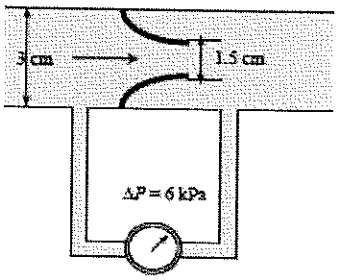


Fig of Q9

(a) 7.68 m/s (b) 4.5 m/s (c) 1.09 m/s (d) none of these

10 Refer to fig of Q10 fresh water is flowing through the venture;

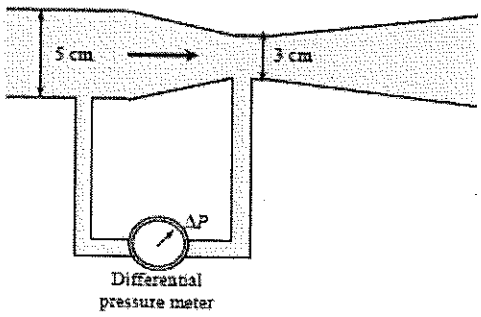


fig of Q10

If differential pressure meter shows a drop = 10 kPa find the velocity of fluid at the throat

(a) 3.4 m/s (b) 4.8 m/s (c) 6.0 m/s (d) 7.2 m/s

11 Energy line along the flow ———————— with respect to the flow line, if there are no losses.

(a) Will increase by a step

(b) Will slope upwards

(c) Will remain horizontal

(d) Will slope downwards

12 In a steady flow, if the diameter of pipe is halved, then the kinetic energy

(a) Is doubled

(b) Increases by 4 times

(c) Increases by 8 times

(d) Increases by 16 times

13 In a vertical upward flow of incompressible fluid along a constant pipe section under steady conditions, the mass flow in the flow direction will

(a) Increase (b) decrease (c) remain constant (d) increase or decrease depending on the fluid.

14 Statement 1 - If velocity increases, the hydraulic grade line will dip along the flow direction.

Statement 2 – Free flow will take place along energy gradient line.

(a) Both statements are correct

(b) Only statement 1 is correct

(c) Only statement 2 is correct

(d) Both statements are wrong

Section B

	Question:1 (6 Marks)
1.0	A steady two dimensional incompressible flow has the X component of the velocity as: $U = a\,x\,y + b\,y + c\,x^2 - d\,x\,y$
1.1	Obtain the simplest form of the Y component of this velocity field.
1.2	Obtain the Stream Function ψ for this two dimensional flow.

1.3	Write the equation of the stream line passing through from point (1, 1) from above Stream function. Take numerical values as a = c = 1 and b = d = 2
	Question:2 (6 Marks)
2.0	A velocity vector for a two dimensional fluid flow is given as: $\boldsymbol{V} = (y^4 - yx^3 + x^2y^2 - yx)\,\mathrm{i} + \left(\frac{3x^2y^2}{2} - \frac{2y^3x}{3} + \frac{y^2}{2} - x^4\right)\mathbf{j}$
2.1	Check if this flow is compressible or incompressible.
2.2	Check if this flow is rotational or irrotational.

2.3	Obtain the stream function for this velocity field.
	Question:3 (8 Marks)
3.0	Two dimensional velocity field is given by: $V = k(x^2 - y^2)\,\mathbf{i} - (2k\,xy)\,\mathbf{j}$
3.1	Obtain the radial component of the acceleration at the point (2, 4)

	Question:4 (6 Marks)
4.0	A two dimensional unsteady flow is given by:
	$$u = u_0 \sin\omega\left(t - \frac{y}{v_0}\right)$$ $$v = v_0$$ **u_0, v_0 and ω are constants.**
4.1	Find the Acceleration field for this flow field.

4.2	Comment about the nature of the acceleration field.
4.3	Obtain the equation of the stream line passing through the origin at time, $t = \frac{\pi}{2\omega}$ seconds