Sem V / mech / 6-6-11 / Fluid mechanics.

AGJ 1st half (q) 4

Con. 3462-11. **RK-2040**

(3 Hours) **[Total Marks : 100**

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **four** questions out of remaining **six** questions.
(3) Assumptions made should be **clearly** stated.
(4) Assume any **suitable** data wherever **required** but **justify** the same.
(5) **Figures** to the **right** indicate marks.
(6) Illustrate answers with sketches wherever **required**.

Q.1.	a)	Write a note on finite volume method in CFD.	(5)
	b)	With the help of examples distinguish between the differential and integral methods of analysis.	(5)
	c)	State and prove Reynolds Transport Theorem.	(5)
	d)	Write a note on Kutta – Joukowski theorem.	(5)
Q.2.	a)	Using the laminar boundary layer velocity distribution : $\frac{u}{U_\infty} = 2\left(\frac{y}{\delta}\right) - 2\left(\frac{y}{\delta}\right)^2 + \left(\frac{y}{\delta}\right)^4$	
		(i) Check if boundary layer separation occurs.	(2)
		In terms of Re determine	
		(ii) Boundary layer thickness.	(8)
		(iii) Shear stress at the surface.	(2)
		(iv) Local Coefficient of drag.	(2)
		(v) Average coefficient of drag.	(2)
	b)	Write a note on stability of floating bodies.	(4)
Q.3.	a)	Consider the uniform flow (6 m/s) flowing over a source and sink pair each of strength $15 m^2/s$. If the source and sink are 1.5 m apart determine :	
		(i) The equation of the streamline $\Psi = 0$	(3)
		(ii) Length and width of the streamline	(4)
		(iii) Location of stagnation points.	(3)
	b)	Starting from the Navier-Stokes equation for an incompressible Newtonian fluid derive Bernoulli's equation stating the assumptions.	(10)

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Q.4.	Using the Reynolds Transport Theorem for the following problem : (i) Derive the expressions for mass flow rate and Forces on water in the bend. (ii) Determine the force erected by the bend on the water. 360 litres per second of water is flowing through a bend of initial diameter 300 mm and final diameter 150 mm. The pipe is bent by 60 degrees. The pressure at the inlet of the bend is 294.3 kPa and friction losses are ten percent of the velocity head at the exit.	(8) (12)
Q.5. a)	For steady incompressible flow verify if the following equations of velocity components are possible: (i) $u = 4xy + y^2$ $v = 6xy + 3x$ (ii) $u = 2x^2 + y^2$ $v = -4xy$ If possible obtain the equation for the streamlines. Check if the flow is irrotational and determine the potential function if it exists.	(2) (2) (2) (4)
b)	Write a note on Prandtl's mixing length theory stating any anamolies and limitations and discuss its relationship with the universal velocity distribution.	(10)
Q.6. a)	In CFD distinguish between (i) Implicit and explicit schemes (ii) Structured and unstructured grid (iii) Aspect ratio and grid independence.	 (3) (3) (3)
b)	A wooden block 1 m long and 0.5 m wide has specific gravity 0.75 and floats in water. If the block is 0.4 m high determine its metacentric height.	(6)
c)	With the help of examples distinguish between streamlined and bluff bodies.	(5)
Q.7. a)	Write a note on Non-Newtonian fluids.	(5)
b)	Water in reservoir A is at a level 6 m above the water level in reservoir B. The reservoirs are connected by a 5 cm diameter horizontal pipe 200 m long. The pressure in reservoir B is 70 kPa gauge while the reservoir A is exposed to atmosphere. Assuming the Darcy friction factor of the pipe is 0.02 and neglecting minor losses determine : (i) Direction of flow (ii) Discharge of water	 (5) (5)
c)	With the help of examples distinguish between the Eulerian and Lagrangian approaches to solutions.	(5)