University Deptt. of Mathematics
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M. Sc : 4th semester
Paper code : ECMATH 403 A
Paper : Boundary Layer theory.
(B.L.T)

SET : B

Answer form all the section as directed.
Q. No. 1 is compulsory.
The figures in the right-hand margin indicate marks.
Candidate are required to give their answers in their own words as far as practicable.

SECTION-I
(compulsory)

1. choose the correct option of the following : 1×10

(a) The shear stress (τ) can be defined as

(i) $\tau = \mu \frac{dy}{dy}$

(ii) $\tau = \mu / \left(\frac{dy}{dy}\right)$

(iii) $\tau = \mu \left(\frac{dy}{dy}\right)^2$

(iv) None.

(b) In a plane - couette flow, the velocity distribution is

(i) constant
(ii) linear
(iii) Quadratic
(iv) cubic.

(c) '_____' thickness is the distance through which the total loss of momentum per second be equal to if it were passing a stationary plate.

(i) Displacement
(ii) momentum
(iii) Energy
(iv) None.

(d) The boundary layer separation occurs when

(i) $\frac{dp}{dx} < 0$
(ii) $\left(\frac{\partial u}{\partial y}\right)_{y=0} = 0$
(iii) $\left(\frac{\partial u}{\partial y}\right)_{y=0} > 0$
(iv) None.

(e) The momentum thickness (θ) is given by

(i) $\int_0^\infty \frac{u}{U}\left(1 - \frac{u}{U}\right) dy$
(ii) $\int_0^\delta \left(1 - \frac{u}{U}\right) dy$

iii) $\int_0^{\delta} \frac{u}{U^2}\left(1-\frac{u}{U}\right)dy$ iv) None

(f) The boundary layer exists in which of the following ?

i) Flow of real fluid

ii) Flow of ideal fluid

iii) Flow over flat surfaces only

iv) None

(g) Boundary layer means .....

i) a thin plane layer of fluid anywhere in fluid.

ii) a thin layer of fluid in the nbd. of the body.

iii) None.

(h) The force of attraction bet^n the molecules of a fluid and the molecules of a solid boundary surface in contact with the liquid is _____.

i) cohessive

ii) adhessive

iii) frictional force

iv) none.

i) The boundary layer thickness on a flat plate is given by

(i) $\delta = \frac{5x}{\sqrt{Re_x}}$ (ii) $\delta = \frac{x}{\sqrt{Re_x}}$

(iii) $\delta = 5x\sqrt{Re_x}$ (iv) $\delta = x\sqrt{Re_x}$

where Re denotes Reynold's number.

(j) Relationship between shear stress and pressure gradient is

(i) $\frac{\partial \tau}{\partial y} = \frac{\partial p}{\partial x}$

(ii) $\frac{\partial \tau}{\partial x} = \frac{\partial p}{\partial y}$

(iii) $\frac{\partial \tau}{\partial x} = \frac{\partial p}{\partial x}$

(iv) None.

SECTION – II

Answer any four questions (15×4)

(2) Derive Navier-stokes equations of motion of viscous incompressible fluid with constant viscosity.

(3) Prove that the stress matrix is diagonally symmetric and contains only six unknowns.

(4) Discuss flow of an incompressible fluid in a convergent channel.

(5) The Prandtl's velocity distribution is given by

$$\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - 2\left(\frac{y}{\delta}\right)^3 + \left(\frac{y}{\delta}\right)^4$$

Determine the following

(a) Displacement thickness (δ^*)

(b) Momentum thickness (θ)

(c) Energy thickness (δ_e)

(6) Derive plane poiseuille flow equations between two infinite parallel plates separated by a distance h and introduce the theory of lubrication.

(7) Explain the principal of dynamical similarity. Define Reynolds no. and indicates its significance.

(8) Discuss the flow between two concentric rotating cylinders.

Answer key

Paper code : ECMATH403A

Paper : Boundary Layer Theory (B.L.T)

Answer key

SET : B

Q. No.	corresponding ans.
1.	
(a)	(i)
(b)	(iii)
(c)	(iii)
(d)	(ii)
(e)	(i)
(f)	(i)
(g)	(iii)
(h)	(ii)
(k)	(i)
(j)	(i)