Mansoura University	3D Modeling	Mid Term Exam
Faculty of Engineering	November 2018	Level 300
Biomedical Engineering		Time allowed 1 Hr

1. An idealized incompressible flow has the proposed three-dimensional velocity distribution $V = xy^2i + f(y)j - zy^2k$. Find the appropriate form of the function f (y) that satisfies the continuity relation.

2. Two infinite, parallel plates separated by a distance h. One plate, the bottom one, translates with a constant velocity U in its own plane while the upper plate is kept fixed. Neglecting pressure gradients, the Navier–Stokes equations simplify to

$$\frac{d^2u}{dy^2} = 0$$

where y is a spatial coordinate normal to the plates and u (y) is the velocity distribution. Determine.

i. Integrate the above equation 2 times with respect to y. Write the two boundary conditions required to determine the constants C_1, C_2.

ii. By solving these two equations, obtain the values of constants C_1, C_2.

iii. Why the number of boundary conditions cannot be lower than two.

iv. Why the number of boundary conditions cannot be higher than two.

v. Determine the volumetric flow rate (Q). Take the plate width = b.

vi. Determine the mean velocity (V).

vii. Obtain the velocity distribution equation as a function of the following parameters: the mean velocity (V), the plate height (h), and the y-axis.

viii. Where does the velocity distribution, u(y), equal the mean velocity (V)?

ix. Does the shear stress change with the variation of the y-axis?. Why?

3.i Complete the following sentence:

According to .... law, the energy flow term by conduction in the inlet x direction equals .... This term in the energy equation has the units of ....

3.ii.Define the following: the displacement thickness (δ^*), the momentum thickness (θ), the dimensionless profile shape factor (H).

3.iii. What is the range of the dimensionless profile shape factor (H)? Why?

Good Luck

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