B.TECH SEM - III (2007 COURSE) (MECHANICAL ENGG.) : SUMMER - 2018

SUBJECT: FLUID MECHANICS

Day: **Friday** | **S-2018-2588** | Time: **02.30 PM TO 05.30 PM**
Date: **25/05/2018** | Max. Marks: 80

N.B.:

1) **Q. No. 1 and Q. No. 5** are **COMPULSORY**. Out of the remaining attempt any **TWO** questions from each section.
2) Figures to the right indicate **FULL** marks.
3) Answers to both the sections should be written in **SEPARATE** answer book.
4) Draw neat diagrams **WHEREVER** necessary.
5) Assume suitable data if necessary.

SECTION - I

Q.1 **a)** Define surface tension and prove $P = \frac{46}{d}$. **(04)**

b) Explain the stability of floating body with reference to its meta-centric height. Give neat sketches. **(05)**

c) Derive Euler's equation of motion. **(05)**

Q.2 **a)** Explain with the help of equations: **(05)**
i) Stream function ii) Potential function

b) If the expression for stream function is described by $\Psi = x^3 - 3xy^2$, determine whether flow is rotational or irrotational. If the flow is irrotatinal then indicate the correct value of the velocity potential. **(08)**

Q.3 **a)** Distinguish between simple manometer and differential manometer. **(05)**

b) A tank contains water upto a height of 0.5m above the base. An immiscible liquid of specific gravity 0.8 is filled on the top of water upto 1m height. Calculate: **(08)**
i) Total pressure on one side of the tank
ii) The position of centre of pressure for one side of the tank.
Which is 2m wide

Q,4 **a)** State Bernoullis theorem. Explain significance of each term in Bernoullis equation. State the assumptions made clearly. **(06)**

b) The following data relate to an orifice meter. Diameter of the pipe = 240 mm. **(07)**
Dia of the orifice = 120 mm
Sp. gravity of oil = 0.88.
Reading of differential manometer = 400mm of mercury, co-efficient of discharge of the meter = 0.65. Determine the rate of flow of oil.

P. T. O.

SECTION-II

Q.5 **a)** Derive a relationship between shear stress and pressure gradient. **(05)**

b) Explain the terms : **(04)**
i) Hydraulic grade line
ii) Total energy line with the help of sketch.

c) What is meant by bounding layer? Define nominal thickness and displacement thickness of the boundary layer. **(05)**

Q.6 **a)** What is Hagen Poiseuille's formula? Derive an expression for Hagen Poiseuille's formula. **(06)**

b) A cylinder rotates at 150rpm with its axis perpendicular in an air stream. Which is having uniform velocity of 25m/s. the cylinder is 1.5m in diameter and 10m long. Assuming ideal fluid theory find: **(07)**
i) The circulation ii) Lift force
iii) Position of stagnation points
Take density of air as 1.25 kg/m^3.

Q.7 **a)** What is siphon? How does it work? State its uses? **(05)**

b) To reservoirs have a constant difference of levels of 70m and are connected by a 250mm diameter pipe which is 4km long. The pipe is tapped mid-way between the reservoirs and water is drawn at the rate of 0.04m^3/s/. Assuming friction factor = 0.04 determine the rate at which water enters the lower reservoir. **(08)**

Q.8 **a)** Derive an expression for prandtl's universal velocity distribution for turbulent flow in pipes. **(05)**

b) A 1:40 model of an ocean tanker is dragged through fresh water at 2 m/s with a total measured drag of 12N. The skin (frictional) drag co-efficient 'f' for model and prototype are 0.03 and 0.002 respectively in the equation $R_f = f.AV^2$. The wetted surface area of the model is 25m^2. Determine the total drag on the prototype and the power required to drive the prototype. Take $\rho_p = 1030\,kg/m^3$ and $\rho_m = 1000kg/m^3$ **(08)**

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