

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
THIRD SEMESTER B.TECH DEGREE EXAMINATION(S), MAY 2019

Course Code: ME200

Course Name: FLUID MECHANICS AND MACHINERY

Max. Marks: 100

Duration: 3 Hours

PART A

Answer any three questions, each carries 10 marks.

Marks

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| 1 | a) | Define the following fluid properties | (5) |
| | | i. Mass density | |
| | | ii. Specific weight | |
| | | iii. Specific gravity | |
| | | iv. Specific volume | |
| | b) | A plate 0.025mm apart from a fixed plate moves at 60cm/s and requires a force of 2N per unit area to maintain this speed. Determine fluid viscosity between the plates. | (5) |
| 2 | a) | State Pascal's Law. | (2) |
| | b) | The diameters of a small piston and a large piston of a hydraulic jack are 3cm and 10cm respectively. A force of 80N is applied on the small piston. Find the load lifted by the large piston when | (8) |
| | | i. the pistons are at same level | |
| | | ii. small piston is 40cm above the large piston. | |
| | | The density of liquid in the jack is given as 1000kg/m ³ . | |
| 3 | | A U tube manometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and the contact between water and mercury is in the left limb. Determine the pressure of water in the main line, if the difference in level of mercury in the limbs of U tube is 10cm and the free surface of mercury is in level with the centre of the pipe. If the pressure of water in pipe line is reduced to 9810N/m ² , calculate the new difference in level of mercury. Sketch the arrangement in both cases. | (10) |
| 4 | a) | What are the different modes of equilibrium for a floating body? Explain in detail. | (5) |
| | b) | What do you mean by total pressure and centre of pressure? Derive an expression for total pressure (F) acting on a vertical plane surface submerged in liquid. | (5) |

PART B

Answer any three questions, each carries 10 marks.

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|---|----|---|------|
| 5 | | State and prove Bernoulli's theorem. What are the assumptions made? | (10) |
| 6 | a) | State and explain Hagen-Poiseuille equation. | (5) |
| | | Crude oil of viscosity 0.97poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 100mm and of length 10m. Calculate the difference of pressure at the two ends of the pipe, if 100kg of oil is collected in a tank in 30seconds. | (5) |

- 7 Define the following (10)
- Laminar boundary layer
 - Turbulent boundary layer
 - Boundary layer thickness
- 8 (a) Sketch and label the parts of a venturimeter. (2)
- (b) Find the discharge of water flowing through a pipe of 30cm diameter placed in an inclined position where a venturimeter is inserted. The venturimeter has a throat of diameter 15cm. The difference of pressure between the main and throat is measured by a liquid of specific gravity 0.6 in an inverted U tube which gives a reading of 30cm. The loss of head between the main and throat is 0.2 times the kinetic head of the pipe. (8)

PART C

Answer any four questions, each carries 10 marks.

- 9 a) Compare impulse and reaction turbines. (5)
- b) What is the purpose of draft tube in a reaction turbine? Classify draft tubes. (5)
- 10 a) Derive an expression for force exerted by a jet of water on moving plate. (5)
- b) A jet of water having a velocity of 20m/s strikes a curved vane which is moving with a velocity of 10m/s. The jet makes an angle of 20° with the direction of motion of vane at inlet and leaves at an angle of 130° to the direction of motion of vane at outlet. Calculate the work done per unit weight of water striking the vane per second. (5)
- 11 a) What is the function of spear in Pelton wheel? (2)
- b) A Pelton wheel is to be designed for the following specifications. (8)
- Shaft power-11,772 kW; Head-380m; Speed-750rpm; Overall efficiency-86%; The jet diameter is not to exceed one-sixth the wheel diameter. Determine
- The wheel diameter
 - The number of jets required and
 - Diameter of the jet
- 12 a) What is an air vessel? Why do we use air vessels in reciprocating pumps? (5)
- b) With the help of a neat sketch, explain the working of a double acting reciprocating pump. (5)
- 13 a) Define manometric efficiency of centrifugal pump. (2)
- b) Find the power required to drive a centrifugal pump which delivers $0.04\text{m}^3/\text{s}$ of water to a height of 20m through a 15cm diameter pipe, 100m long. The overall efficiency of the pump is 70% and coefficient of friction $f=0.015$. (8)
- 14 a) Why is it necessary to prime a centrifugal pump? (2)
- b) The internal and external diameters of the impeller of a centrifugal pump are 200mm and 400mm respectively. The pump is running at 1200rpm. The vane angles of the impeller at inlet and outlet are 20° and 30° respectively. Water enters the impeller radially and velocity of flow remains constant. Determine the work done by the impeller per unit weight of water. (8)
