Hall Ticket No | | | | | | | | | | | Question Paper Code: AAEB03

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER - I

B.Tech III Semester End Examinations, November – 2019

Regulations: IARE - R18

FLUID DYNAMICS

(AERONAUTICAL ENGINEERING)

Time: 3 hours **Max. Marks: 70**

Answer ONE Question from each MODULE

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

MODULE– I

1. a) Describe about the hydrostatic forces on submerged bodies and its variation with temperature and height with respect to different surfaces. **[7M]**

   b) A rectangular plate of size 25 cm by 50 cm and weighing 25kgf slides down a 300 inclined surface at a uniform velocity of 2m/sec. If the uniform 2mm gap between the plate and the inclined surface is filled with oil determine the viscosity of the oil. **[7M]**

2. a) Explain why does the viscosity of a gas increases with the increases in temperature while that of a liquid decreases with increase in temperature? **[7M]**

   b) A flat plate weighing 0.45KN has a surface area of 0.1m^2. It slides down an inclined plane at 300 to the horizontal at a constant speed of 3m/s. if the inclined plane is lubricated with an oil of viscosity 0.1Ns/m2. Find the thickness of the oil film. **[7M]**

MODULE – II

3. a) Develop an expression for total pressure on a plane surface submerged in a liquid of specific weight with an inclination an angle θ. **[7M]**

   b) A triangular gate which has a base of 1.5 m and an altitude of 2 m lies in a vertical plane. The vertex of the gate is 1 m below the surface in a tank which contains oil of specific gravity 0.8. Find the force exerted by the oil on the gate and the position of the center of pressure **[7M]**

4. a) Develop the condition for irrotational flow. Prove that for potential flow, both the stream function and velocity potential function must satisfy Laplace equation. **[7M]**

   b) In a free cylindrical vortex flows at a point in the fluid at a radius of 200mm and a height of 100mm.The velocity and pressures are 10m/s and 117.72KN/m^2.find the pressure at a radius of 400mm and at a height of 200mm. the fluid is air having density equal to 1.24kg/m^3. **[7M]**

MODULE – III

5. a) State Bernoulli's theorem for compressible flow. Develop an expression for Bernoulli's equation when the process is (i) Isothermal and (ii) Adiabatic. **[7M]**

   b) A pipe of dia 400mm carries water at a velocity of 25m/s. The pressures at a point are given as 29.43N/cm^2 and 22.563 N/cm^2 while the datum head at A and B are 28m and 30m. Calculate the loss of head between A and B. **[7M]**

6. a) Derive Euler's equation of motion along a stream line for an ideal fluid and clearly mention the assumptions. Mention the situations where Euler's equation is used. **[7M]**

   b) In a 100mm diameter horizontal pipe a Venturimeter of 0.5 contraction ratio has been fixed the head of water on the meter when there is no flow is 3m. Find the rate of flow for which the throat pressure will be 2m of water absolute. Take atmospheric pressure head= 10.3m of water. The coefficient of meter is 0.97. **[7M]**

MODULE – IV

7. a) List the disadvantage of separation in fluid flow and explain how separation of flow can be controlled by (i) acceleration of flow in the boundary layer (ii) suction of flow from the boundary layer. **[7M]**

   b) Air flows at 10m/s past a smooth rectangular flat plate 0.3m wide and 3m long. Assuming that's the turbulence level in the oncoming stream is low and that transition occurs at Re=5x10E5, Calculate the ratio of total drag when the flow is parallel to the length of the plate to the value when the flow is parallel to the width. **[7M]**

8. a) Discuss the development of boundary layer over a flat plate explaining laminar and turbulent boundary layer and establishment length. **[7M]**

   b) A thin plate is moving in still atmospheric air at a velocity of 4m/s. The length of plate is 0.5m and width is 0.4m, calculate the thickness of boundary layer at the end of the plate and drag force on one side of the plate. Take density of air is 1.25kg/m^3 and kinematic viscosity 0.15 stokes. **[7M]**

MODULE – V

9. a) What would be the technical classification of the following turbo machines: (i) a household fan, (ii) a windmill,(iii) an aircraft propeller, (iv) a fuel pump in a car,(v) an eductor, (vi) a fluid-coupling transmission, and (vii)a power plant steam turbine? **[7M]**

   b) A lawn sprinkler can be used as a simple turbine. As shown in Fig., flow enters normal to the paper in the centre and splits evenly into Q/2 and V_{rel} leaving each nozzle. The arms rotate at angular velocity and do work on a shaft. Draw the velocity diagram for this turbine. Neglecting friction, find an expression for the power delivered to the shaft. Find the rotation rate for which the power is a maximum. **[7M]**

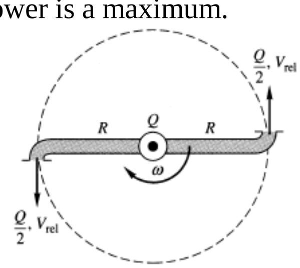

Fig.1

10.	a)	Derive the Euler’s turbo machine equation for simple geometries and state the assumptions made in the derivation.	**[7M]**
	b)	A turbine model test with 250 mm diameter impeller showed an efficiency of 90%. What efficiency could be expected from 1.5m diameter impeller?	**[7M]**

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FLUID DYNAMICS

COURSE OBJECTIVES:

I	Illustrate about the basic properties of a fluid, hydrostatic forces on submerged bodies and different manometers.
II	Derive the basic principles of a fluid-continuity, momentum, Euler and Bernoulli's equations.
III	Explain the concept of boundary layer theory and importance of Prandtl's boundary layer theory.
IV	Understand the flow through pipes and their losses for different geometries.

COURSE OUTCOMES (COs):

CO 1	Understand the basic fluid properties and fluid dynamic concepts with its applications of fluid statics to determine forces of buoyancy and stability; and to fluids in rigid-body motion.
CO 2	Use of conservation laws in differential forms and Understand the dimensional methods and kinematics of fluid particles.
CO 3	Use Euler's and Bernoulli's equations and the conservation of mass to determine velocities, pressures, and accelerations for incompressible and inviscid fluids.
CO 4	Understand the concepts of viscous boundary layers, mechanics of viscous flow effects on immersed bodies and its forces.
CO 5	Apply principles of fluid mechanics to the operation, design, and selection of fluid machinery and to understand the ethical issues associated with decision making.

COURSE LEARNING OUTCOMES (CLOs):

AAEB03.01	Define the properties of fluids and its characteristics, which will be used in aerodynamics, gas dynamics, marine engineering etc.
AAEB03.02	Explain the hydrostatic forces on submerged bodies, variation with temperature and height with respect to different types of surfaces.
AAEB03.03	Define different types of manometers and explain buoyancy force, stability of floating bodies by determining its metacentre height.
AAEB03.04	Dimensional similarity and prediction of flow behaviour using dimensionless numbers.
AAEB03.05	Classification of fluid flows and governing equations of inviscid fluid flows.
AAEB03.06	Conceptual analysis of fluid flow and exact solutions of navier stokes equations for coquette flow and poiseuille flow.
AAEB03.07	Define Fluid forces and describe the motion of a fluid particle with fluid deformation;
AAEB03.08	Determine the Euler's and Bernoulli's equation and obtain its phenomenological basis of Naviers-stokes equation.
AAEB03.09	Describe about the flow measurements using different equipments of fluid flows.
AAEB03.10	Understand the Concept of boundary layer flows and control of flow separation.
AAEB03.11	Determine the flows over streamlined and bluff bodies to predict the drag and lift forces.
AAEB03.12	Understand the thickness factor with respect to Displacement, momentum and energy thickness.
AAEB03.13	Explain about the turbo machinery systems and working.
AAEB03.14	Describe the concepts of turbo machinery in the field of aerospace engineering and concepts of internal flows through engines.
AAEB03.15	Demonstrate the knowledge gained from the working of compressors, fans and pumps

MAPPING OF SEE – COURSE OUTCOMES

SEE Question No.		Course Outcomes		Course Outcomes	Blooms' Taxonomy Level
1	a	AAEB03.01	Define the properties of fluids and its characteristics, which will be used in aerodynamics, gas dynamics, marine engineering etc.	CO1	Remember
	b	AAEB03.01	Define the properties of fluids and its characteristics, which will be used in aerodynamics, gas dynamics, marine engineering etc.	CO1	Remember
2	a	AAEB03.03	Classification of fluid flows and governing equations of inviscid fluid flows.	CO1	Remember
	b	AAEB03.02	Explain the hydrostatic forces on submerged bodies, variation with temperature and height with respect to different types of surfaces.	CO1	Understand
3	a	AAEB03.03	Define different types of manometers and explain buoyancy force, stability of floating bodies by determining its meta-centre height.	CO1	Remember
	b	AAEB03.04	Dimensional similarity and prediction of flow behaviour using dimensionless numbers.	CO2	Remember
4	a	AAEB03.04	Dimensional similarity and prediction of flow behaviour using dimensionless numbers.	CO2	Remember
	b	AAEB03.05	Classification of fluid flows and governing equations of inviscid fluid flows.	CO2	Remember
5	a	AAEB03.07	Define Fluid forces and describe the motion of a fluid particle with fluid deformation.	CO3	Understand
	b	AAEB03.06	Conceptual analysis of fluid flow and exact solutions of navier stokes equations for coquette flow and poiseuille flow.	CO2	Remember
6	a	AAEB03.08	Determine the Euler's and Bernoulli's equation and obtain its phenomenological basis of Naviers-stokes equation.	CO3	Understand
	b	AAEB03.08	Determine the Euler's and Bernoulli's equation and obtain its phenomenological basis of Naviers-stokes equation.	CO3	Understand
7	a	AAEB03.10	Understand the Concept of boundary layer flows and control of flow separation.	CO4	Understand
	b	AAEB03.11	Determine the flows over streamlined and bluff bodies to predict the drag and lift forces.	CO4	Remember
8	a	AAEB03.12	Understand the thickness factor with respect to Displacement, momentum and energy thickness.	CO4	Understand
	b	AAEB03.12	Understand the thickness factor with respect to Displacement, momentum and energy thickness.	CO4	Understand
9	a	AAEB03.13	Explain about the turbo machinery systems and working.	CO5	Remember
	b	AAEB03.14	Describe the concepts of turbo machinery in the field of aerospace engineering and concepts of internal flows through engines.	CO5	Understand
10	a	AAEB03.13	Explain about the turbo machinery systems and working.	CO5	Remember
	b	AAEB03.15	Demonstrate the knowledge gained from the working of compressors, fans and pumps.	CO5	Remember

Signature of Course Coordinator **HOD, AE**