INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad - 500 043

AERONAUTICAL ENGINEERING
TUTORIAL QUESTION BANK

Course Name	Fluid Mechanics and Hydraulics
Course Code	AAE003
Class	B. Tech III Semester
Branch	Aeronautical Engineering
Year	2018– 2019
Team of Instructors	Mr. R Sabari Vihar, Assistant Professor, G Satya Dileep, Assistant Professor

OBJECTIVES:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited.

In line with this, faculty of Institute of Aeronautical Engineering, Hyderabad has taken a lead in incorporating philosophy of outcome based education in the process of problem solving and career development. So, all students of the institute should understand the depth and approach of course to be taught through this question bank, which will enhance learner's learning process

COURSE OBJECTIVES:

The course should enable the students to:

S. No	Description
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 LEARNING OUTCOMES:

Students, who complete the course, will be able to demonstrate the ability to do the following

CAAE003.01	Define the properties of fluids and its characteristics, which will be used in aerodynamics, gas dynamics, marine engineering etc.
CAAE003.02	Explain the hydrostatic forces on submerged bodies, variation with temperature and height with respect to different types of surfaces.
CAAE003.03	Define different types of manometers and explain buoyancy force, stability of floating bodies by determining its metacenter height.
CAAE003.04	Define fluid kinematics and classification of flows, concepts of stream function and velocity potential function which provides solution for velocity and acceleration of fluid flow in real time applications.

CAAE003.05	Explain one dimensional, two dimensional flows in wind tunnel with classification of both compressible and in compressible flows in continuity equation.
CAAE003.06	Recognize the surface and body forces required for obtaining momentum equation and energy equation and explain types of derivatives utilized in various flow field conditions.
CAAE003.07	Develop Bernoulli's equation from Euler's equation and explain phenomenological basis of Navier – stokes equation which are widely used in aerodynamics and gas dynamics for real time problems.
CAAE003.08	Demonstrate Buckingham's π theorem and explain similarity parameters used for scale down models and explain flow measurements with dimensionless parameters.
CAAE003.09	Demonstrate for competitive exams, the concepts of boundary layer and qualitative description of boundary layer thickness and velocity profile on a flat plate.
CAAE003.10	Distinguish the pressure drag and skin friction drag and state the relation between the frictions of both the drags.
CAAE003.11	Demonstrate the various types of major and minor losses in pipes and explain flow between parallel plates.
CAAE003.12	Discuss fully developed flow through pipes and variation with friction factor with Reynolds number and sketch the Moody's chart.
CAAE003.13	Describe the concepts of turbo machinery in the field of aerospace engineering and concepts of internal flows through engines.
CAAE003.14	Discuss about stream line, path line, streak line, stream tube, stream surface for classification of flows in fluid mechanics.
CAAE003.15	Explain working principles and overview of turbines, fans, pumps and compressor for its various applications in hydraulic machines.
CAAE003.16	Recognize the importance of velocity triangles used to determine velocities of flow from blades and turbines.
CAAE003.17	Explain Euler turbo machine equation for obtaining torque and angular displacement related functions in hydraulic machines.

TUTORIAL QUESTION BANK

S. No	Question	Blooms Taxonomy Level	Course Learning Outcome
	UNIT-I **FLUID PROPERTIES AND FLUID STATICS**		
Part - A (Short Answer Questions)			
1	Describe how fluids are Classified in ?	Understand	CAAE003.01
2	Define specific volume and specific gravity.	Remember	CAAE003.01
3	Define Newton's laws of viscosity.	Remember	CAAE003.01
4	Explain about surface tension acting over fluids.	Understand	CAAE003.01
5	Define compressibility with respect to fluids.	Remember	CAAE003.01
6	Explain about viscosity of Newtonian and non Newtonian fluids .	Understand	CAAE003.01
7	Define metacenter on a body immersed in fluids.	Remember	CAAE003.01
8	Define atmospheric gauge and vacuum pressure.	Remember	CAAE003.01
9	Define compressible and incompressible fluid.	Remember	CAAE003.01
10	Define and classify the manometers.	Remember	CAAE003.01

Part - B (Long Answer Questions)			
1	Discuss Newton's law viscosity and explain how viscosity varies with temperature for liquids and gases.	Understand	CAAE003.01
2	A cube of side floats with one of its axes vertical in a liquid of specific gravity S_L. If the specific gravity of the cube material is S_c, Calculate the values S_L/S_c for the meta-centre height to be zero.	Understand	CAAE003.01
3	A cylindrical log of specific gravity 0.425 is 5m long and 2m in diameter. Calculate to what depth the log will sink in fresh water with its axis being horizontal?	Understand	CAAE003.01
4	Develop an expression for surface tension on a liquid droplet.	Remember	CAAE003.01
5	Discuss how do you measure the pressure by using manometers and mechanical gauges?	Understand	CAAE003.01
6	Prove that volumetric strain of a cylindrical rod which is subjected to an axial tensile load is equal to the strain in the length minus twice the strain if diameter.	Understand	CAAE003.01
7	Explain why does the viscosity of a gas increases with the increases in temperature while that of a liquid decreases with increase in temperature?	Understand	CAAE003.01
8	Calculate density, specific weight and weight of 1 liter of petrol of specific gravity 0.7	Understand	CAAE003.01
9	Determine the meta centric height of the floating body by analytical method.	Remember	CAAE003.02
10	Explain the phenomenon of capillarity. Obtain an expression for capillarity rise of a fluid.	Understand	CAAE003.01
11	Develop the expression for the relation between gauge pressures P inside a droplet of liquid and the surface tension.	Understand	CAAE003.01
Part - C (Problem Solving and Critical Thinking Questions)			
1	A plate of certain oil weighs 40 KN. Calculate the specific weight, mass density and specific gravity of this oil.	Understand	CAAE003.01
2.	What is the intensity of pressure in the ocean at a depth of 1500m, assuming (a) salt water is incompressible with a specific weight of 10050 N/m^3 and (b) salt water is compressible and weighs 10050 N/m^3 at the free surface? E (bulk modulus of elasticity of salt water) = 2070 MN/m^2(constant).	Understand	CAAE003.01
3	A plate 0.0254 mm distant from a fixed plate, moves at 61cm/sec and requires a force of 0.2 kgf/m^2 to maintain this speed. Determine the dynamic viscosity of the fluid between the plates.	Understand	CAAE003.01
4	A rectangular plate of size 25 cm by 50 cm and weighing 25 kgf slides down a 30^0 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.	Remember	CAAE003.01
5	Calculate the capillary effect in mm in a glass tube 3mm in diameter when immersed in (a) water (b) mercury. Both the liquids are at 20^0c and the values of the surface tensions for water and mercury at 20^0c in contact with air are respectively 0.0736 N/m and 0.51 N/m. Contact angle for water = 0^0 and for mercury = 130^0.	Remember	CAAE003.01

6	What is the pressure within a droplet of water 0.05 mm in diameter at 20^0c, if the pressure outside the droplet is standard atmospheric pressure of 1.03 kg (f) / cm^2. Given σ = 0.0075 kg (f)/m for water at 20^0 C.	Understand	CAAE003.01
7	If the equation of a velocity profile over a plate is $V=2y^{2/3}$ in which V is the velocity in m/sec at a distance of y meters above the plate. Determine the shear stress at y=0 and y=0.075m given H = 0.835N.S/m^2.	Understand	CAAE003.02
8	Convert a pressure head of 100m of water to a) Kerosene of specific gravity 0.81 b) Carbon tetra chloride of specific gravity 1.6	Understand	CAAE003.02
9	A trapezoidal channel 2m wide at the bottom and 1m deep has side slopes 1:1. Determine: thetotal pressure and the center pressure on the vertical gate closing the channel when it is full of water.	Remember	CAAE003.01
10	A flat plate weighing 0.45KN has a surface area of 0.1m^2. It slides down an inclined plane at 30^0 to the horizontal at a constant speed of 3m/s. if the inclined plane is lubricated with an oil of viscosity 0.1Ns/m^2. Find the thickness of the oil film.	Understand	CAAE003.02
11	A rectangular plane surface 3m wide and 4m deep lies in water in such a way that its plane making an angle of 30^0 with the surface of water. Determine the total pressure force and position of center of pressure, when upper edge is 2m below the free surface.	Understand	CAAE003.02
UNIT-II FLUID KINEMATICS AND BASIC EQUATIONS OF FLUID FLOW ANALYSIS			
Part - A (Short Answer Questions)			
1	What are the methods of describing fluid flow?	Understand	CAAE003.14
2	What arrangements should be adopted to find the velocity at any point in a pipe by a pitot tube?	Understand	CAAE003.04
3	What is flow net in understanding fluid properties?	Understand	CAAE003.04
4	Define uniform and non-uniform flows.	Remember	CAAE003.04
5	Define and state the applications of momentum equation.	Remember	CAAE003.06
6	What is three dimensional flow?	Understand	CAAE003.05
7	Define compressible and incompressible flows.	Remember	CAAE003.05
8	Define the equation of continuity.	Remember	CAAE003.05
9	Define the terms velocity potential and stream functions.	Remember	CAAE003.04
10	Define the terms vertex, free vortex flows and forced vortex flows.	Remember	CAAE003.04
Part - B (Long Answer Questions)			
1	Sketch the flow pattern of an ideal fluid past a cylinder with circulation.	Understand	CAAE003.04
2	Develop the condition for irrotational flow. Prove that for potential flow, both the stream function and velocity potential function must satisfy Laplace equation.	Remember	CAAE003.04
3	Develop an expression for total pressure on a plane surface submerged in a liquid of specific weight with an inclination an angle θ.	Remember	CAAE003.02
4	Obtain an expression for continuity equation for a 3-D Flow.	Remember	CAAE003.05
5	List out the mathematical and physical distinction between rotational and irrotational flows.	Remember	CAAE003.04
6	Describe the use and limitations of flow nets	Remember	CAAE003.04
7	Develop an expression for continuity equation for a 1-D Flow	Understand	CAAE003.05

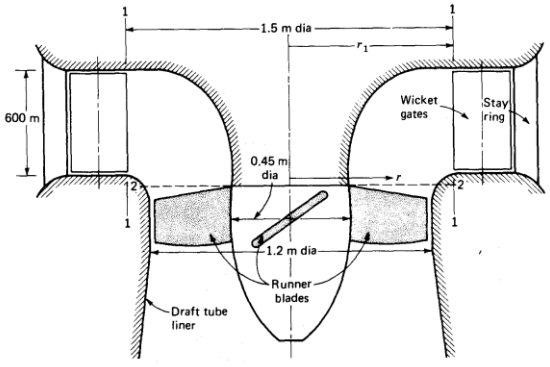
8	Define path line, stream line, and streak line.	Remember	CAAE003.14
9	Describe the properties of stream function and prove each one of them.	Remember	CAAE003.04
10	What is a stream tube and explain are its characteristics.	Remember	CAAE003.04
Part - C (Problem Solving and Critical Thinking Questions)			
1	An open circular cylinder of 15cm diameter and 100cm long contains water up to a height of 70cm. Calculate the speed at which the cylinder is to be rotated about its vertical axis so that the axial depth becomes zero.	Remember	CAAE003.04
2	A vessel cylindrical in shape and closed at the bottom contains water up to a height of 80cm.the diameter of the vessel is 20cm and length of vessel is 120cm. the vessel is rotated at a speed of 400r.p.m about its vertical axis. Calculate the height of parabolic formed.	Remember	CAAE003.04
3	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.	Remember	CAAE003.03
4	A uniform flow with a velocity of 20m/s is flowing over a source of strength 10m^2/s. The uniform flow and source flow are in the same plane	Understand	CAAE003.03
5	A vessel cylindrical in shape and closed at the bottom and the top contains water at a height of 700mm. The dia of the vessel is 200mm and length of the vessel is 1.1m. Find the speed of rotation of the vessel if the axial depth of the water is Zero.	Understand	CAAE003.04
6	An open circular cylinder of 20cm dia and 100cm long contains water up to a height of 80cm. It is rotated about its vertical axis. Find the speed of rotation when there is no water spills and axial depth is Zero.	Understand	CAAE003.04
7	In a free cylindrical vortex flow of water at a point at a radius of 150mm the velocity and pressure are 5m/s and 14.715N/cm^2. Find the pressure at a radius of 300mm.	Remember	CAAE003.03
8	If the cylindrical vessel of dia 15cm and length 100cm contains water at a height of 80cm is rotated at 950r.p.m. About its vertical axis, find the area uncovered at the base of the tank.	Remember	CAAE003.04
9	A rectangular pontoon of size 6m length, 3m width and 1.5 m height has a length of 0.95m in sea water of specific weight 10055 N/m^3. Determine its metacentric height assuming it to have a uniform composition.	Understand	CAAE003.03
10	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.	Understand	CAAE003.02
UNIT-III FLUID DYNAMICS			
Part - A (Short Answer Questions)			
1	Describe the different forces present in a fluid flow.	Understand	CAAE003.06
2	Explain Euler's equation of motion?	Understand	CAAE003.07
3	Describe the factors to be determined when viscous fluid flows through the circular pipe?	Understand	CAAE003.06
4	Identify the different forms of energy in a flowing fluid?	Understand	CAAE003.06

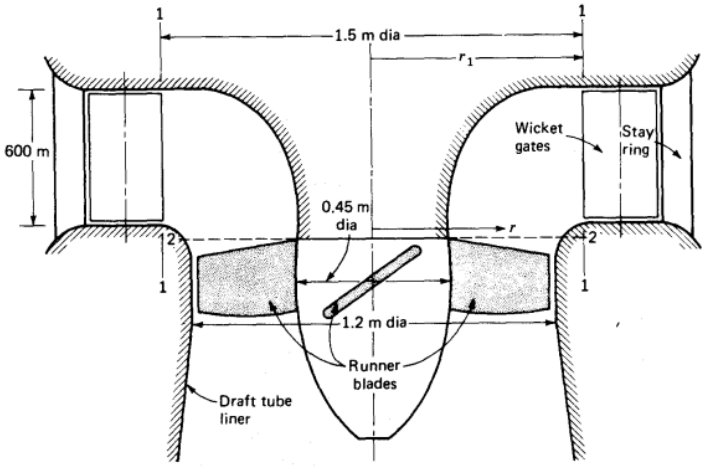
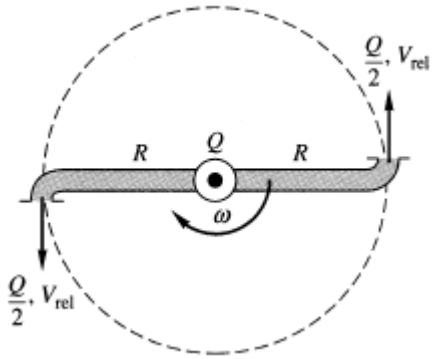
5	Discuss the range of Reynold's number for laminar and turbulent flow in a pipe.	Understand	CAAE003.06
6	What are the different types of forces to be considered in momentum equation?	Remember	CAAE003.06
7	Explain about body forces for a differential small fluid element.	Remember	CAAE003.06
8	Mention different types of surface forces acting on a fluid element.	Understand	CAAE003.06
9	State Navier-Stokes Equation in Differential form for fluid dynamics.	Understand	CAAE003.07
10	Define moment of momentum equation.	Remember	CAAE003.07
11	Define continuity and Bernoulli's equation.	Remember	CAAE003.07
12	Define the concept of free jet of a liquid?	Understand	CAAE003.07
13	Discuss the importance of Buckingham's π theorem.	Understand	CAAE003.08
14	Explain different types of Pitot tubes.	Understand	CAAE003.07
15	Discuss the application of Bernoulli's equation in fluid dynamics.	Remember	CAAE003.07
16	Explain the concept of local derivative used foe momentum equation.	Remember	CAAE003.06
17	Write the expression for coefficient of discharge for venture meter and orifice meter.	Understand	CAAE003.07
18	Describe the concept of convective derivative used foe momentum equation.	Understand	CAAE003.06
Part - B (Long Answer Questions)			
1	Explain the effect of forces in fluid dynamics and its importanc in having the governing equations of fluid dynamics.	Understand	CAAE003.06
2	State Bernoulli's theorem for compressible flow. Develop an expression for Bernoulli's equation when the process is (i) Isothermal and (ii) Adiabatic.	Remember	CAAE003.07
3	For the Euler's equation of motion which forces are taken into consideration?	Remember	CAAE003.06
4	What is Euler's equation? How will you obtain Bernoulli's equation from it?	Understand	CAAE003.07
5	Discuss the relative merits and demerits of Venturimeter with respect to Orifice meter.	Understand	CAAE003.07
6	Derive an expression for Bernoulli's theorem from first principle and state the assumptions made for such derivation.	Understand	CAAE003.07
7	Name the different forces present in a flow. For the Euler's equation of motion, which forces are taken into consideration?	Understand	CAAE003.07
8	Describe with the help of a neat sketch the construction, operation and use of Pitot- static tube.	Understand	CAAE003.06
9	Explain the difference between the pitot tube and pitot static tube.	Understand	CAAE003.07
10	Differentiate the importance between the momentum equation and impulse momentum equation?	Remember	CAAE003.06
11	Derive Euler's equation of motion along a stream line for an ideal fluid and clearly the assumptions.	Understand	CAAE003.07
12	Explain why divergence is more gradual than convergence in a Venturimeter?	Understand	CAAE003.07

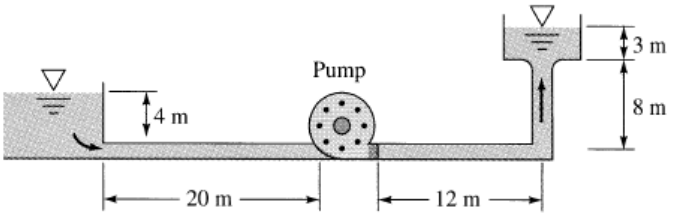
13	A jet plane which weighs 29.43 kN and having a wing area of 20 m2 flies at a velocity 950 km/hr, when the engine delivers 7357.5 kw power. 65% power is used to overcome the drag resistance of the wing. Calculate the co-efficients of lift and drag for the wing. The density of the atmospheric air is 1.21kg/m3.	Understand	CAAE003.07
14	State the different devices that one can use to measure the discharge through a pipe and also through an open channel.	Understand	CAAE003.07
15	Describe a device with which discharge through a pipe can be measured with a neat sketch and explain how one can obtain the actual discharge with its help?	Remember	CAAE003.06
16	What is the difference between momentum equation and impulse momentum equation?	Understand	CAAE003.07
17	Water is flowing through a pipe of 100mm diameter under a pressure of 19.62 N/cm^2 and with mean velocity of 3.0 m/s. Find the total head of water at a cross section, which is 8 m above the datum line.	Remember	CAAE003.05
18	Prove that the equation of the free jet of liquid is given by the expression $Y = x \tan \Theta - (gx^2/2U^2) \sec^2 \Theta$ Where x,y = co-ordinates of a point on the jet U = velocity of issuing jet Θ = inclination of jet with horizontal.	Understand	CAAE003.07
Part - C (Problem Solving and Critical Thinking Questions)			
1	When 2500 liters of water flows per minute through a 0.3m diameter pipe which later reduces to a 0.15 diameter pipe, Calculate the velocities of flow in the two pipes.	Understand	CAAE003.05
2	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 22.563n/cm^2 while the datum head at A and B are 28m and 30m. Calculate the loss of head between A and B.	Understand	CAAE003.07
3	A horizontal ventuimeter with inlet and throat and diameters 30cm and 15cm is used to measure the flow of water. The reading of differential manometer connected to the inlet and the throat is 20cm of mercury. Determine the rate of flow. Take $C_d = 0.98$.	Understand	CAAE003.07
4	Two velocity components are given in the following case, find the third component such that they satisfy the continuity equation. $U= x^3 + y^2+2z^2$ $V= -x^2y- yz -xy$	Remember	CAAE003.05
5	The velocity components in a two-dimensional flow field for an incompressible fluid are expressed as $U= y^3/3 + 2x-x^2y$ $v= xy^2-2y-x^3/3$. a) Show that these functions represent a possible case of an ir-rotational flow. b) Obtain an expression for stream function Ψ c) Obtain an expression for velocity potential Φ	Remember	CAAE003.04
6	For a three-dimensional flow field described by $V = (y^2+z^2)$: + $(x^2+z^2)j$ + $(x^2+y^2)k$ find at (1,2,3). (i) the component of acceleration (ii) the components of rotation	Remember	CAAE003.04

7	In a straight uniform pipe, the discharge is reduced from 0.1 m^3/s to zero in 10 seconds. If the cross-sectional area of the pipe is 200 sq. cm, state the nature and value of acceleration.	Understand	CAAE003.07
8	A nozzle is so shaped that the velocity of flow along the centerline changes linearly from 1-5 m/s to 15 m/s in a distance of 0.375. Determine the magnitude of the convective acceleration at the beginning and end of this distance.	Understand	CAAE003.07
9	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.	Remember	CAAE003.07
10	For a two-dimensional flow $\Phi = 3xy$ and $x = 3/2 (y^2-x^2)$. Determine the velocity components at the points (1, 3) and (3, 3). Also find the discharge passing between the streamlines passing through the points given above.	Remember	CAAE003.04
UNIT-IV BOUNDARY LAYER THEORY AND PIPE FLOW			
Part - A (Short Answer Questions)			
1	What do you understand by the terms boundary layer theory.	Understand	CAAE003.08
2	What is meant by boundary layer?	Understand	CAAE003.08
3	What do you mean by boundary layer separation?	Understand	CAAE003.08
4	Define displacement thickness in a boundary layer.	Remember	CAAE003.08
5	What are the different methods of preventing the separation of boundary layers?	Understand	CAAE003.08
6	Describe the effect of pressure gradient on boundary layer separation.	Remember	CAAE003.08
7	List the types of similarities or similitude used in model analysis	Remember	CAAE003.08
8	Define laminar sub layer and boundary layer thickness.	Remember	CAAE003.08
9	Define dimensional homogeneity.	Remember	CAAE003.08
10	Define Froude Number and its applications.	Remember	CAAE003.09
Part - B (Long Answer Questions)			
1	Develop an expression for displacement thickness due to formation of boundary layer.	Understand	CAAE003.08
2	Assuming the velocity distribution is laminar boundary layer along a flat plate is given by eq. Determine the displacement and energy thickness. u/U=2 y/δ-[y/δ]^2	Understand	CAAE003.08
3	Develop an expression for momentum thickness of boundary layer.	Understand	CAAE003.08
4	Explain Magnus effect and theory of lift for airfoils.	Understand	CAAE003.09
5	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.	Remember	CAAE003.08
6	What are the boundary conditions that must be satisfied by a given velocity profile in laminar boundary layer flows.	Understand	CAAE003.08
7	Discuss the development of boundary layer over a flat plate explaining laminar and turbulent boundary layer and establishment length.	Understand	CAAE003.08

8	Explain boundary layer separation? Mention few methods to prevent or delay the separation of boundary layer?	Remember	CAAE003.08
9	Develop Prandtl's boundary layer equation.	Understand	CAAE003.08
10	Develop expressions for boundary layer thickness, boundary shear stress and friction drag in a turbulent boundary layer	Understand	CAAE003.08
Part - C (Problem Solving and Critical Thinking Questions)			
1	A plate of 600mm length and 400mm wide is immersed in a fluid of specific gravity 0.9 and kinematic viscosity $v=10^{-4}m^{2/s}$. The fluid is moving with a velocity of 6m/s. determine boundary layer thickness, shear stress at the end of the plate and drag force one side of the plate.	Understand	CAAE003.08
2	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 $R_e=5 \times 10^5$, Calculate 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.	Understand	CAAE003.09
3	Oil with a free stream velocity of 2m/s flows over a thin plate 2m wide and 2m long. Calculate the boundary layer thickness and the shear stress at the trailing end point and determine the total surface resistance of the plate. Take specific gravity 0.86 and kinematic viscosity 10^{-5} m^2/s.	Understand	CAAE003.08
4	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 the drag force on one side of the plate. Take density of air is $1.25Kg/m^3$ and kinematic viscosity 0.15 stokes.	Remember	CAAE003.09
5	Describe short notes on the separation of the boundary layer.	Remember	CAAE003.08
6	Differentiate between and energy and momentum thickness of the boundary layer.	Remember	CAAE003.08
7	Discuss the two forces applied on a flowing fluid.	Understand	CAAE003.08
8	A smooth flat plate of size 30 cm X 60 cm is placed in a stream of water of uniform velocity 60 cm/sec. Flow takes parallel to the 30 cm length of the plate. If the kinematic viscosity of water is 0.011 stoke, is the boundary layer formed on the plate laminar or turbulent? Determine the shear stress at the trailing edge, maximum boundary layer thickness, mean drag coefficient and the work done by the fluid on one side of the plate per unit time in Joules.	Understand	CAAE003.10
9	A stream lined train is 350 m long and has an average cross-section with a perimeter of 110.2 m above the wheels. Assuming that the boundary layer is completely turbulent, compute the surface drag for a speed of 120 mph and power required to overcome this drag. Dynamic viscosity of air = 0.000185 poise and specific weight = 12 N/m^3.	Understand	CAAE003.09
10	A smooth flat plate of size 6 m by 3m is towed in a liquid of density 900kg/ m^3 and viscosity 0.12 poises at a uniform velocity of 2.5 m/s. The motion is parallel to the 6 m side of the plate. What is the length of the plate over which the boundary layer is laminar?> Calculate the surface drag on both sides of plate.	Understand	CAAE003.09

UNIT-V TURBO MACHINERY			
Part - A (Short Answer Questions)			
1	What are called turbines?	Understand	CAAE003.13
2	What is known as Euler's equation for turbo-machines?	Understand	CAAE003.13
3	Define compressor used in turbo machinery.	Remember	CAAE003.13
4	What is the use of velocity triangles?	Understand	CAAE003.16
5	Write the equation for Euler turbo machine?	Remember	CAAE003.17
6	Define Mechanical efficiency.	Understand	CAAE003.13
7	What are an impulse turbine and a reaction turbine?	Understand	CAAE003.15
8	Define cavitation and its importance.	Understand	CAAE003.13
9	Classify the fluid machine types.	Remember	CAAE003.15
10	Define Impulse Momentum Equation (or) Momentum Equation.	Understand	CAAE003.13
Part - B (Long Answer Questions)			
1	Explain Performance analysis of turbine.	Understand	CAAE003.13
2	The reaction turbines at the installation of Srisailam dam, have a rated capacity of 115000hp at 180rpm under a head of 487ft. The diameter of each turbine is 11ft and the discharge is 2350cfs. Evaluate the speed factor, the unit speed, unit discharge and unit power, and the specific speed.	Understand	CAAE003.13
3	Discuss Performance analysis of compressor, fan, burner, turbine, exhaust nozzle.	Understand	CAAE003.15
4	A centrifugal pump has r2 =9 in, b2 =2 in, and β2 =35° and rotates at 1060 r/min. If it generates a head of 180 ft, determine the theoretical (a) flow rate in gal/min and (b) horsepower. Assume near-radial entry flow.	Understand	CAAE003.13
5	A turbine model test with 250 mm diameter impeller showed an efficiency of 90%. What efficiency could be expected from 1.5m diameter impeller?	Understand	CAAE003.13
6	Assuming uniform axial velocity over section 2 of fig. using fig data, determine the angle of the leading edge of the propeller at r =0.225, 0.45, and 0.6m for a propeller speed of 240 rpm.  	Remember	CAAE003.13

7	The wicket gates of the propeller turbine of fig. are turned so that the flow makes an angle of 45° with a radial line at section 1, where the speed is 4.005 m/s. Determine the magnitude of tangential velocity component Vα over section 2.  	Remember	CAAE003.13
8	What are the minor losses in pipes? Give the appropriate formulae to calculate the losses.	Understand	CAAE003.13
9	What would be the technical classification of the following turbo machines: (a) a household fan, (b) a windmill,(c) an aircraft propeller, (d) a fuel pump in a car,(e) an eductor, (f) a fluid-coupling transmission, and (g)a power plant steam turbine?	Understand	CAAE003.13
10	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.  	Understand	CAAE003.13
Part - C (Problem Solving and Critical Thinking Questions)			
1	A typical household basement sump pump provides adischarge of 5 gal/min against a head of 15 ft. Estimate (a) the maximum efficiency and (b) the minimum horsepowerrequired to drive such a pump at 1750 r/min.	Understand	CAAE003.13

2	An axial-flow pump delivers 40 ft^3/s of air which enters at 20^0C and 1 atm. The flow passage has a 10-in outer radius and an 8-in inner radius. Blade angles are $\alpha 1 = 60^0$ And $\beta 2 = 70^0$, and the rotor runs at 1800 rpm. For the first stage, compute (a) the head rise; and (b) the power required.	Understand	CAAE003.17
3	Water is flowing through a rough pipe of diameter 600mm at the rate 600liters/sec. the wall roughness is 3mm. find the power lost for 1km length of pipe.	Understand	CAAE003.13
4	It is proposed to run the pump of at 880r/min to pump water at 20°C through the system in Fig. P11.66.The pipe is 20-cm-diameter commercial steel. What flowrate in ft3/min will result? Is this an efficient application? 	Remember	CAAE003.13
5	A compound piping system consists of 1800m of 0.50m, 1200m of 0.40m and 600m of 0.30m new cast iron pipes connected in series. Convert the system to (a) an equivalent length of 0.40m pipe and (b) Equivalent size pipe 3600m long.	Understand	CAAE003.13
6	In an idealized radial turbine the absolute flow enters at 25□ □ with the blade angles as shown. The flow rate is 8 m3/s of water at20□ C. The blade thickness is constant at20 cm. Compute the theoretical power developed at 100% efficiency.	Remember	CAAE003.13
7	A pipeline 0.225 m in diameter and 1580m long has a slope of 1 in 200 for the first 790m and 1 in 100 for the next 790m. The pressure at the upper end of the pipeline is 107.91 kpa and at the lower end is 53.955 kpa. Taking f=0.032 determine the discharge through the pipe.	Understand	CAAE003.13
8	The velocities of water through a pipe of diameter 10cm are 4m/s and 3.5m/s at the center of the pipe and 2cm from the pipe center. Determine the wall shearing stress in the pipe for turbulent flow.	Understand	CAAE003.17
9	Determine the average height of the roughness for a rough pipe of diameter 10cm when the velocity at a point 4cm from wall is 40% more than the velocity at a point 1cm from pipe wall.	Understand	CAAE003.13
10	For turbulent flow in a pipe diameter 300mm, find the discharge when the center line velocity is 2m/s and the velocity at a point 100mm from the center as measured by pivot tube is 1.6m/s.	Remember	CAAE003.13

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