INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

MECHANICAL ENGINEERING

TUTORIAL QUESTION BANK

Course Title	**FLUID MECHANICS AND MACHINES**				
Course Code	AMEB08				
Programme	B.Tech				
Semester	IV	ME			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Dr. CH VKNSN Moorthy, Professor				
Course Faculty	Dr. CH VKNSN Moorthy, Professor Mr. G. Sarath Raju, Assistant Professor				

COURSE OBJECTIVES:

The course should enable the students to:	
I	Learn about the application of mass and momentum conservation laws for fluid flows.
II	Understand the importance of dimensional analysis.
III	Obtain the velocity and pressure variations in various types of simple flows.
IV	Analyze the flow in water pumps and turbines.

COURSE OUTCOMES (COs):

COs	**Course Outcome**
CO1	Discuss the basic concepts and methodologies of fluid statics
CO2	Understand various laws for fluid kinematics and dynamics
CO3	Understand the concepts of boundary layer theory and closed conduit flow
CO4	Explore the design, working and performance of turbines
CO5	Analyse the design, working, performance of pumps and dimensionality laws

COURSE LEARNING OUTCOMES (CLOs):

CLO Code	**CLOs**	**At the end of the course, the student will have the ability to:**
AMEB08.01	CLO 1	Define the properties of fluids and its characteristics.
AMEB08.02	CLO 2	Explain the hydrostatic forces on submerged bodies.

CLO Code	CLOs	At the end of the course, the student will have the ability to:
AMEB08.03	CLO 3	Define different types of manometers.
AMEB08.04	CLO 4	Apply the law of conservation of mass and derive continuity equation.
AMEB08.05	CLO 5	Demonstrate practical understanding of friction losses in internal flows.
AMEB08.06	CLO 6	Compare the results of analytical models introduced in lecture to the actual behavior of real fluid flows and draw correct and sustainable conclusions.
AMEB08.07	CLO 7	Calculate the performance analysis in turbines can be used in power plants.
AMEB08.08	CLO 8	Calculate the performance analysis in pumps.
AMEB08.09	CLO 9	Draw and analysis of performance characteristic curves of pumps.
AMEB08.10	CLO 10	Draw and analysis of performance characteristic curves of turbines.
AMEB08.11	CLO 11	Draw and analysis of characteristic curves of flow meters.
AMEB08.12	CLO 12	Determine the coefficient of impact of different types of vanes.
AMEB08.13	CLO 13	Determine the coefficient of discharge of different types of flow meters.
AMEB08.14	CLO 14	Determine the friction factor of different types of cross section of pipes.
AMEB08.15	CLO 15	Draw the characteristic curves of friction apparatus.
AMEB08.16	CLO 16	Determine the friction factor using moody's chart.
AMEB08.17	CLO 17	Applying the Darcy's Weisbach equation for the measurement of coefficient of friction.
AMEB08.18	CLO 18	Evaluate the performance of hydraulic turbines.
AMEB08.19	CLO 19	Evaluate the performance of hydraulic pumps.
AMEB08.20	CLO 20	Analyze flow in closed pipes, and design and selection of pipes including sizes.
AMEB08.21	CLO 21	Explain the working principle of various types of hydro turbines and know their application range
AMEB08.22	CLO 22	Demonstrate the various types of major and minor losses in pipes and explain flow between parallel plates.

	UNIT – I			
	FLUID STASTICS			
	Part - A (Short Answer Questions)			
S No	**QUESTION**	**Blooms taxonomy level**	**Course Outcomes**	**Course Learning Outcomes**
1	Define mass density and state its SI units	Understand	CO1	AMEB08.01
2	Define Weight density and state its SI units	Remember	CO1	AMEB08.01
3	Define Specific volume and state its SI units	Remember	CO1	AMEB08.01
4	Define specific gravity of a fluid and state its SI units	Understand	CO1	AMEB08.01
5	Differentiate between Liquids and gases	Remember	CO1	AMEB08.01
6	Differentiate between Real fluids and ideal fluids	Understand	CO1	AMEB08.01
7	Differentiate between Specific weight and specific volume of a fluid.	Understand	CO1	AMEB08.01
8	Differentiate between Newtonian and non-newtonian fluids	Remember	CO1	AMEB08.01
9	Define dynamic viscosity and state its units	Remember	CO1	AMEB08.01

10	Define and explain Newton's law of viscosity.	Remember	CO1	AMEB08.01
11	Why does the viscosity of a gas increases with the increases in temperature while that of a liquid decreases with increase in temperature?	Remember	CO1	AMEB08.01
12	One litre of crude oil weighs 9.6N.calculate its specific weight, density and specific gravity.	Remember	CO1	AMEB08.01
13	Define vapour pressure	Remember	CO1	AMEB08.01
14	What is the principle of continuity equation?	Remember	CO1	AMEB08.01
15	Write the general 3 dimensional continuity equation	Remember	CO1	AMEB08.01
16	Define the property of capillarity	Understand	CO1	AMEB08.01
17	Define kinematic viscosity and state its units	Remember	CO1	AMEB08.01
18	Differentiate between compressible and in compressible fluids	Remember	CO1	AMEB08.01
19	Write the continuity equation for steady compressible fluid flow	Understand	CO1	AMEB08.01
20	Write the continuity equation for steady incompressible fluid flow	Understand	CO1	AMEB08.01
	Part - B (Long Answer Questions)			
1	Explain in detail mass density, write its units and explain the effect of temperature and pressure on mass density	Understand	CO1	AMEB08.01
2	Explain in detail weight density, write its units and explain the effect of temperature and pressure on weight density	Understand	CO1	AMEB08.01
3	Derive the relation between the mass density and weight density	Understand	CO1	AMEB08.02
4	Explain in detail specific gravity, write its units and explain the effect of temperature and pressure on specific gravity	Understand	CO1	AMEB08.03
5	Explain with a neat sketch the viscosity, newton's law of viscosity, and the effect of temperature and pressure on viscosity	Understand	CO1	AMEB08.02
6	Explain in detail the kinematic and dynamic viscosity and derive the relation between them.	Understand	CO1	AMEB08.02
7	Explain in detail the momentum equation along with its derivation.	Understand	CO1	AMEB08.01
8	Define density and specific weight and derive the relation between them.	Remember	CO1	AMEB08.03
9	The pressure 3 metre below the free surface of a liquid is 13.72 kN/m^2. Determine its specific weight	Remember	CO1	AMEB08.02
10	State the principle of continuity equation. Derive the general 3-D continuity equation for a fluid flow	Remember	CO1	AMEB08.02
11	State the principle of continuity equation. Derive the 1-D continuity equation for a fluid flow along a stream line flow	Remember	CO1	AMEB08.02
12	State and explain the momentum equation.	Remember	CO1	AMEB08.02
13	How thick is the layer of liquid mud (specific gravity 1.6) at the bottom of a river with water 8 m deep, if there is a pressure of 343 kN/m^2 at the bottom of the mud? Treat the mud as a fluid	Understand	CO1	AMEB08.03

14	An 80 mm diameter shaft is rotating at 400 rpm in a bearing of length 120 mm. if the thickness of oil film is 1.5mm and dynamic viscosity of oil is 0.7Ns/m^2. Determine i) torque required to overcome friction in bearing, ii) power utilized in overcoming viscous resistance.	Understand	CO1	AMEB08.04
15	If the velocity distribution over a plate is given by u = (2/3)y – y^3, in which 'u' is the velocity in m/s at a distance 'y' meter above the plate, determine the shear stress at y=0 and y=0.3m. Take dynamic viscosity of fluid as 8.63 poise.	Understand	CO1	AMEB08.05
16	The surface tension of water in contact with air 20^0c is given as 0.0816N/m .The pressure inside the drop let of water is to be 0.0517N/cm^2 greater than the outside pressure. Calculate the diameter of the droplet of water	Understand	CO1	AMEB08.02
17	Explain the difference between Newtonian and non-Newtonian fluids	Understand	CO1	AMEB08.03
18	Explain the difference between Real and Ideal fluids	Remember	CO1	AMEB08.01
19	Explain in detail different types of fluids with a neat sketch of the graph	Understand	CO1	AMEB08.01
20	Define and explain why the spherical shape of a drop of liquid happen in fluids	Understand	CO1	AMEB08.01
	Part - C (Problem Solving and Critical Thinking Questions)			
1	a) Explain the term surface tension b) A 40 mm diameter shaft is rotating at 200 rpm in a bearing of length 120 mm. if the thickness of oil film is 1.5mm and dynamic viscosity of oil is 0.7Ns/m^2. Determine i) torque required to overcome friction in bearing, ii) power utilized in overcoming viscous resistance.	Apply	CO1	AMEB08.02
2	a) Explain the terms viscosity and kinematic viscosity b) State Newton's law viscosity and explain how viscosity varies with temperature for liquids and gases.	Understand	CO1	AMEB08.03
3	a) An oil film of thickness 1.5mm is used for lubrication between a square plate of size 0.9m x 0.9m and an inclined plane having an angle of inclination 20^0. The weight of the square is 392.4 N and it slides down the plane with a uniform velocity of 0.2 m/s. Determine the dynamic viscosity of the oil. b) Derive the units of viscosity and kinematic viscosity.	Apply	CO1	AMEB08.02
4	a) Define viscosity and derive Newton's law of viscosity. b) If the velocity distribution over a plate is given by u = (2/3)y – y^2, in which 'u' is the velocity in m/s at a distance 'y' meter above the plate, determine the shear stress at y=0 and y=0.15m. Take dynamic viscosity of fluid as 8.63 poise.	Apply	CO1	AMEB08.05
5	The diameters of a pipe at the sections 1 and 2 are 10 cm and 15 cm respectively. Find the discharge through the pipe if the velocity of water flowing through the pipe at section 1 is 5 m/s. Determine also the velocity at section 2.	Apply	CO1	AMEB08.04

6	a) An oil film of thickness 3mm is used for lubrication between a square plate of size 1.8m x 1.8m and an inclined plane having an angle of inclination 20^0. The weight of the square is 392.4 N and it slides down the plane with a uniform velocity of 0.2 m/s. Determine the dynamic viscosity of the oil. b) What are poise and stoke? Write the corresponding conversion factors with SI units.	Apply	CO1	AMEB08.04
7	a) Explain the principle of continuity equation. b) A 30 cm diameter pipe, conveying water, branched into two pipes of diameters 20 cm and 15 cm respectively. If the average velocity in the 30 cm diameter pipe is 2.5 m/s, find the discharge in this pipe. Also determine the velocity in 15 cm pipe if the average velocity in 20 cm diameter pipe is 2 m/s.	Apply	CO1	AMEB08.04
8	a) Explain the concept of surface tension with neat sketch b) The surface tension of water in contact with air 20^0c is given as 0.0716N/m .The pressure inside the drop let of water is to be 0.0417N/cm^2 greater than the outside pressure. Calculate the diameter of the droplet of water.	Apply	CO1	AMEB08.04
9	a) The velocity profile of a viscous fluid over a plate is parabolic with vertex 20cm from the plate, where the velocity is 120cm/s. calculate the velocity gradient and shear stress at distance of 0.5 and 15cm from the plate, given the viscosity of the fluid =6 poise. b) Define specific gravity, specific volume and specific weight.	Apply	CO1	AMEB08.03
10	a) An oil film of thickness 4.5mm is used for lubrication between a square plates is of size 2.7m x 2.7m and an inclined plane having an angle of inclination 20^0. The weight of the square is 392.4N and it slides down the plane with a uniform velocity of 0.2 m/s. Calculate the dynamic viscosity of the oil. b) Derive the relation between mass density and weight density.	Apply	CO1	AMEB08.04

UNIT - II

FLUID KINEMATICS AND DYNAMICS

Part – A (Short Answer Questions)

S No	QUESTION	Blooms taxonomy level	Course Outcomes	Course Learning Outcomes
1	Explain stream line flow pattern.	Remember	CO2	AMEB08.06
2	Explain path line flow pattern.	Remember	CO2	AMEB08.06
3	Explain streak line flow pattern	Remember	CO2	AMEB08.07
4	Explain stream tube	Remember	CO2	AMEB08.06
5	Differentiate steady and unsteady flow.	Remember	CO2	AMEB08.06
6	Differentiate uniform and non-uniform flow	Remember	CO2	AMEB08.07
7	Differentiate laminar and turbulent flow	Remember	CO2	AMEB08.08
8	Differentiate rotational and irrotational flow	Remember	CO2	AMEB08.09
9	What is flow nozzle?	Remember	CO2	AMEB08.09
10	What is an Orifice?	Remember	CO2	AMEB08.09
11	What forces are included in Reynold’s equation	Remember	CO2	AMEB08.06

12	What forces are included in Navier Stoke's equation	Remember	CO2	AMEB08.06
13	What forces are included in Euler's equation	Understand	CO2	AMEB08.06
14	What are line forces?	Remember	CO2	AMEB08.08
15	What are body forces?	Understand	CO2	AMEB08.08
16	What are surface forces?	Understand	CO2	AMEB08.09
17	Write the assumptions of Bernoulli's equation	Understand	CO2	AMEB08.06
18	What is a Venturi?	Remember	CO2	AMEB08.06
19	What is the principle of Bernolli's equation	Remember	CO2	AMEB08.08
20	what is surface and body forces	Understand	CO2	AMEB08.06
	Part - B (Long Answer Questions)			
1	Write different types of flows and Explain in detail Steady flow	Understand	CO2	AMEB08.06
2	Write different types of flows and Explain in detail Unsteady flow	Understand	CO2	AMEB08.07
3	Write different types of flows and Explain in detail Uniform flow	Understand	CO2	AMEB08.06
4	Write different types of flows and Explain in detail non Uniform flow	Understand	CO2	AMEB08.07
5	Write different types of flows and Explain in detail Laminar flow	Understand	CO2	AMEB08.06
6	Write different types of flows and Explain in detail Turbulent flow	Remember	CO2	AMEB08.07
7	Write different types of flows and Explain in rotational flow	Understand	CO2	AMEB08.06
8	Write different types of flows and Explain in detail irrotational flow	Understand	CO2	AMEB08.07
9	Classify the patterns of flow and Explain in detail with neat sketch the Stream line flow	Understand	CO2	AMEB08.06
10	Classify the patterns of flow and Explain in detail with neat sketch the Streak line flow	Understand	CO2	AMEB08.07
11	Classify the patterns of flow and Explain in detail the path line flow and stream tube	Remember	CO2	AMEB08.06
12	Classify and Explain different types of forces acting on a fluid flow	Remember	CO2	AMEB08.07
13	Describe the working of a venture meter with a neat sketch.	Remember	CO2	AMEB08.06
14	Describe the working of an orifice meter with a neat sketch.	Understand	CO2	AMEB08.07
15	Derive Euler's equation for a fluid flow	Remember	CO2	AMEB08.08
16	State the principle and Derive Bernoulli's equation for a fluid flow	Remember	CO2	AMEB08.09
17	State the assumptions of Bernoulli's equation and list the applications of Bernoulli's equation	Understand	CO2	AMEB08.07
18	Describe the working of Pitot tube with neat sketch	Understand	CO2	AMEB08.08
19	Describe the working of Flow Nozzle with neat sketch	Understand	CO2	AMEB08.09
20	Explain the terms fluid statics, fluid dynamics, fluid kinetics and fluid kinematics	Remember	CO2	AMEB08.09
	Part – C (Problem Solving and Critical Thinking)			

1	a) Define path line, stream line steam tube and streak line. b) Water flows through a pipe AB 1.2 m dia. at 3m/s and then pass through pipe BC 1.5 m dia. At C the pipe branches, branch CD is 0.8 m dia. And carries $1/^3$ rd of the flow in AB the flow velocity in branch CE is 2.5 m/s. Calculate the volume rate of flow in AB, the velocity in BC, the velocity in CD and dia. of CE.	Apply	CO2	AMEB08.06
2	a) Explain various regions of Venturimeter with a neat sketch b) A horizontal venturimeter with inlet and throat diameters 30 cm and 15 cm respectively is used to measure the flow of water. The reading of differential manometer connected to the inlet and the throat is 20 cm of mercury. Determine the rate of flow. Take Cd = 0.98.	Understand	CO2	AMEB08.07
3	a) State the assumptions and derive Bernoulli's equation for flow along a stream line. b) Define and state examples of following flows i) Steady and unsteady ii) Laminar and turbulent	Remember	CO2	AMEB08.06
4	a) Explain body force, surface force and line force with examples b) A vertical Venturimeter with inlet and throat diameters 30 cm and 15 cm respectively is used to measure the flow of water. The reading of differential manometer connected to the inlet and the throat is 20 cm of mercury. Determine the rate of flow. Take Cd = 0.98. The throat is 25 cm above the inlet	Understand	CO2	AMEB08.07
5	a). Explain various regions of orifice meter with a neat sketch b). An orifice meter with orifice diameter 15 cm is inserted in a pipe of 30 cm diameter. The pressure difference measured by a mercury oil differential manometer on the two sides of the orifice meter gives a reading of 50 cm of mercury. Find the rate of flow of oil of specific gravity 0.9 when the co-efficient of discharge of the meter = 0.64.	Understand	CO2	AMEB08.08
6	a). Explain the pitot tube with neat sketch b) The water is flowing through a pipe having diameters 20cm and 15cm at sections 1 and 2 respectively. The rate of flow through pipe is 40 ltr/s. the section 1 is 6 m above datum line and section 2 is 3m above the datum. If the pressure at section 1 is 29.43 N/cm^2, Calculate the intensity of pressure at section 2.	Understand	CO2	AMEB08.12
7	a) 250 lps of water is flowing in a pipe having a diameter of 300 mm. If the pipe is bent by 135^0 find the magnitude and the direction of the resultant force on the bend. The pressure of water flowing is 39.24 N/cm^2. b) Define rotational and irrotational flows with examples.	Understand	CO2	AMEB08.08

8	a) a pipe of diameter 400 mm carries water at a velocity of 25 m/s. the pressure at the points A & B are given as 29.43 N/cm^2 and 22.563 N/cm^2 respectively, while the datum head at A and B are 28 m and 30 m. Calculate the loss of head at A and B. b) Define uniform and non-uniform flows with examples.	Understand	CO2	AMEB08.07
9	a) The water is flowing through a taper pipe of length 100 m having diameters 600 mm at the upper end and 300 mm at the lower end, at the rate of 50 lps. The pipe has a slope of 1 in 30; determine the pressure at lower end if pressure at higher level is 19.62 N/cm^2. b) Derive an expression for Euler's equation of a flow along a stream line.	Understand	CO2	AMEB08.08
10	a). a pipe of diameter 800 mm carries water at a velocity of 50 m/s. the pressure at the points A & B are given as 29.43 N/cm^2 and 22.563 N/cm^2 respectively, while the datum head at A and B are 28 m and 30 m. Calculate the loss of head at A and B. b) Define compressible and in-compressible flows	Understand	CO2	AMEB08.09
	UNIT-III (CIE-I)			
	BOUNDARY LAYER CONCEPTS AND CLOSED CONDUIT FLOW			
	Part - A (Short Answer Questions)			
S No	**QUESTION**	**Blooms taxonomy level**	**Course Outcomes**	**Course Learning Outcomes**
1	Write the condition of Reynold's number for Laminar boundary layer region	Understand	CO3	AMEB08.10
2	What is the separation of boundary layer?	Understand	CO3	AMEB08.11
3	What is laminar flow over a flat plate?	Remember	CO3	AMEB08.10
4	What is turbulence flow over a flat plate?	Understand	CO3	AMEB08.11
5	Write Darcy weisbach equation.	Understand	CO3	AMEB08.10
6	Define coefficient of friction and friction factor	Remember	CO3	AMEB08.11
7	What is the condition for boundary layer separation	Understand	CO3	AMEB08.10
8	Explain the relation between coefficient of friction and friction factor	Understand	CO3	AMEB08.11
9	Define drag	Remember	CO3	AMEB08.10
10	Define lift	Remember	CO3	AMEB08.11
11	What is the expression for boundary layer thickness	Remember	CO3	AMEB08.10
12	Sketch the boundary layer formation over the flat plate	Understand	CO3	AMEB08.11
13	Name the region at the end of the plate after boundary layer formation	Remember	CO3	AMEB08.11
14	Write the expression for momentum thickness	Understand	CO3	AMEB08.10
15	What is transition flow over a flat plate.	Understand	CO3	AMEB08.10
	Part – B (Long Answer Questions)			
1	Explain with neat sketch different regions of boundary layer when a fluid is flowing over a horizontal flat plate	Evaluate	CO3	AMEB08.10
2	Derive the equation for energy thickness	Understand	CO3	AMEB08.10
3	Explain the laminar sub layer/	Understand	CO3	AMEB08.10
4	Explain how to construct a hydraulic gradient and total energy line, with a neat sketch.	Understand	CO3	AMEB08.10

5	Derive the equation for displacement thickness	Remember	CO3	AMEB08.10
6	Derive the equation for momentum thickness	Understand	CO3	AMEB08.10
7	What will happen when the pipes are connected in series and in parallel?	Understand	CO3	AMEB08.11
8	Derive an expression for loss of head due to sudden enlargement	Remember	CO3	AMEB08.11
9	Derive an expression for loss of head due to sudden contraction	Remember	CO3	AMEB08.10
10	Explain boundary layer separation with neat sketch	Remember	CO3	AMEB08.10
	Part – C (Problem Solving and Critical Thinking)			
1	a) Derive an expression for displacement thickness due to formation of boundary layer. b) Define boundary layer and boundary layer thickness.	Understand	CO3	AMEB08.10
2	a) Define drag and lift on a submerged body? b) For the velocity profile 2(y/δ)- $(y/\delta)^2$, find the thickness of boundary layer at the end of the plate and the drag force on one side of a plate 1 m long and 0.8 m wide when placed in water flowing with a velocity of 150 mm/s. calculate the value of coefficient of drag also. Take μ for water as 0.01 poise.	Apply	CO3	AMEB08.10
3	a) Define displacement thickness, momentum thickness and energy thickness. b) Calculate the displacement thickness, momentum thickness for the velocity distribution in the boundary layer given by $u/U=2(y/\delta) - \left(\frac{y}{\delta}\right)^2$	Apply	CO3	AMEB08.10
4	a) Define energy thickness, momentum thickness and boundary layer thickness. b) Derive an expression for momentum thickness of boundary layer.	Understand	CO3	AMEB08.10
5	a) Explain the boundary layer over a flat plate with neat sketch. b) A crude oil of kinematic viscosity and 0.4 stoke is flowing through a pipe of diameter 300 mm at the rate of 300 lps. Find the head loss due to friction for a length of 50 m of the pipe.	Understand	CO3	AMEB08.10
	UNIT-III (CIE-II)			
	BOUNDARY LAYER CONCEPTS AND CLOSED CONDUIT FLOW			
	Part - A (Short Answer Questions)			
S No	**QUESTION**	**Blooms taxonomy level**	**Course Outcomes**	**Course Learning Outcomes**
1	What is the principle used to derive Darcy-Weisbach equation.	Remember	CO3	AMEB08.10
2	What are the Froud’s Laws of friction	Remember	CO3	AMEB08.11
3	Write the expression for the head loss at entrance	Understand	CO3	AMEB08.11
4	Explain the expression for the head loss at exit	Understand	CO3	AMEB08.11
5	Write the expression for the head loss due to sudden enlargement	Remember	CO3	AMEB08.10
6	Describe the expression for the head loss due to sudden contraction	Remember	CO3	AMEB08.11
7	Write the expression for the head loss due to sudden obstruction	Remember	CO3	AMEB08.11

8	What is the expression for the head loss due to pipe bend?	Understand	CO3	AMEB08.11
9	Describe the expression for the head loss due to pipe fitting	Remember	CO3	AMEB08.11
10	What is Couette flow?	Remember	CO3	AMEB08.11
11	What is Poisuielle flow?	Remember	CO3	AMEB08.10
12	What is meant by TEL ?	Understand	CO3	AMEB08.10
13	What is meant by HGL?	Understand	CO3	AMEB08.11
14	Write the Darcy-Weisbach equation.	Remember	CO3	AMEB08.10
15	What is the difference between TEL and HGL	Understand	CO3	AMEB08.11
	Part – B (Long Answer Questions)			
1	Find the head lost due to friction in a pipe of diameter 300 mm and length 50m through which water is flowing at a velocity of 3m/s. Take the kinematic viscosity of water is 0.01 stoke.	Understand	CO3	AMEB08.10
2	Explain in detail Reynold's experiment with neat sketch	Remember	CO3	AMEB08.11
3	Define drag and explain the difference between pressure drag and friction drag	Remember	CO3	AMEB08.11
4	A crude oil of kinematic viscosity 0.4 stoke is flowing through a pipe of diameter 300 mm at the rate of 300 lps. Find the head lost due to friction for a length of 50m of the pope	Understand	CO3	AMEB08.11
5	Derive Darcy-Weisbach eauation.	Remember	CO3	AMEB08.10
6	Explain various minor energy losses.	Understand	CO3	AMEB08.11
7	An oil of specific gravity 0.7 is flowing through a pipe of diameter 300mm at the rate of 500 lps. Find the head lost due to friction and power required to maintain the flow for a length of 1000 m. Take kinematic viscosity as 0.29 stokes	Understand	CO3	AMEB08.11
8	Water is flowing through a pipe of diameter 600 mm and length 60m through which water is flowing at a velocity of 4 m/s. Take the kinematic viscosity of water is 0.01 stoke. Find the head lost due to friction.	Understand	CO3	AMEB08.11
9	The rate of flow of water through a horizontal pipe is 0.25 m^3/s. The diameter of the pipe which is 200mm is suddenly enlarged to 400 mm. The pressure intensity in the smaller pipe is 11.772 N/cm^2 Determine (i) loss of head due to sudden enlargement (ii) Power lost due to enlargement.	Understand	CO3	AMEB08.11
10	Derive an expression for the ratio of Length to diameter of a compound pipe	Understand	CO3	AMEB08.11
	Part – C (Problem Solving and Critical Thinking)			
1	a) Explain the sudden enlargement of pipe with neat sketch? b) A horizontal pipe of diameter 500 mm is suddenly contracted to a diameter of 250 mm. The pressure intensities in the large and smaller pipe is given as 13.734 N/cm^2 and 11.772 N/cm^2 respectively. Find the loss of head due to contraction if Cc = 0.62. Also determine the rate of flow of water.	Apply	CO3	AMEB08.10

2	a) Define HGL and TEL with a neat sketch. b) A pipe of diameter 20 cm and length 2000 m connects two reservoirs, having difference of water levels as 20 m. Determine the discharge through the pipe. If an additional pipe of diameter 20 cm and length 1200 m is attached to the last 1200 m length of the existing pipe, calculate the increase in the discharge. Take f = 0.015 and neglect minor losses.	Apply	CO3	AMEB08.10
3	a) Explain the sudden contraction of pipe with neat sketch? b) A horizontal pipe line 40 m long is connected to a water tank at one end and discharges freely into the atmosphere at the other end. For the first 25 m of its length from the tank is 150 mm diameter and its diameter is suddenly enlarged to 300 mm. The height of water level in the tank is 8 m above the centre of the pipe. Considering all losses of head which occur, determine the rate of flow. Take f = 0.01 for both sections of the pipe, also draw HGL and TEL.	Apply	CO3	AMEB08.10
4	a) Explain vena – contracta if the pipe is suddenly contracted. b) A pipe of diameter 40 cm and length 1000 m connects two reservoirs, having difference of water levels as 40 m. Determine the discharge through the pipe. If an additional pipe of diameter 20 cm and length 1200 m is attached to the last 1200 m length of the existing pipe, calculate the increase in the discharge. Take f = 0.015 and neglect minor losses.	Apply	CO3	AMEB08.10
5	a) Explain the sudden obstruction of fluid flow with an object with neat sketch b) A horizontal pipe of diameter 1000 mm is suddenly contracted to a diameter of 500 mm. The pressure intensities in the large and smaller pipe is given as 13.734 N/cm^2 and 11.772 N/cm^2 respectively. Find the loss of head due to contraction if Cc = 0.62. Also determine the rate of flow of water.	Apply	CO3	AMEB08.10

UNIT-IV

FLUID MACHINES

Part – A (Short Answer Questions)

S No	QUESTION	Blooms taxonomy level	Course Outcomes	Course Learning Outcomes
1	Differentiate impulse and reaction turbines.	Remember	CO4	AMEB08.10
2	What is specific speed of a turbine?	Remember	CO4	AMEB08.10
3	Mention different specific speeds for different turbines.	Remember	CO4	AMEB08.10
4	What is the purpose of draft tube?	Remember	CO4	AMEB08.10
5	Define unit speed and write its expression	Understand	CO4	AMEB08.10
6	Differentiate axial and radial flow turbines.	Remember	CO4	AMEB08.13
7	What are the different heads in turbines?	Understand	CO4	AMEB08.13
8	How governing of a turbine takes place?	Understand	CO4	AMEB08.13
9	How cavitation occurs?	Remember	CO4	AMEB08.13
10	What are unit quantities?	Remember	CO4	AMEB08.13

11	What is overall efficiency of turbine?	Remember	CO4	AMEB08.13
12	When do you use pelton wheel turbine?	Remember	CO4	AMEB08.13
13	Name different types of draft tubes	Remember	CO4	AMEB08.13
14	What is water hammer?	Remember	CO4	AMEB08.13
15	Draw O.C curves for turbines	Understand	CO4	AMEB08.13
16	Define unit power and write its expression	Remember	CO4	AMEB08.13
17	Define unit discharge and write its expression	Remember	CO4	AMEB08.10
18	What are specific quanties?	Remember	CO4	AMEB08.10
19	What is the formula for draft tube efficiency?	Remember	CO4	AMEB08.10
20	What is the power that is used in specific speed of turbine?	Remember	CO4	AMEB08.10
	Part – B (Long Answer Questions)			
1	A Pelton wheel having a mean bucket diameter of 1.0 m is running at 1000 r.p.m. the side clearance angle is 150 and discharge through the nozzle is 0.1 m^3/s, determine power available at the nozzle and hydraulic efficiency of the turbine.	Understand	CO4	AMEB08.10
2	A turbine develops 18000 KW when running at 200 rpm. The head on the turbine is 60 m. if the head on the turbine reduced to 36m, determine the speed and power developed by the turbine.	Understand	CO4	AMEB08.10
3	Draw and explain in detail the velocity triangles of Pelton turbine.	Understand	CO4	AMEB08.10
4	A hydraulic turbine under a head of 50 metres develops 14520 kW running at 220 rpm. What is the specific speed of the turbine? What types of turbine is this. Find also the normal speed and output if the head on the turbine is reduced to 20 metres.	Understand	CO4	AMEB08.10
5	A Pelton wheel is having a mean bucket diameter of 1 m and is running at 1000 rpm, The net head on the Pelton wheel is 700 m. If the side clearance angle is 15^0 and discharge through nozzle is 0.1 m^3/s find the power available at the nozzle and hydraulic efficiency of the turbine.	Understand	CO4	AMEB08.10
6	Derive an expression for unit discharge of a turbine	Understand	CO4	AMEB08.10
7	Determine the power given by the jet of water to the runner of a Pelton wheel which is having tangential velocity as 20 m/s. The net head on the turbine is 50 m and discharge through the jet water is 0.03 m^3/s. The side clearance angle is 15^O and take C_v=0.975	Understand	CO4	AMEB08.10
8	What is the necessity of a surge tank in turbines. Explain different types of surges with the aid of neat diagrams.	Understand	CO4	AMEB08.10
9	Explain the working of Francis turbine with neat diagram	Understand	CO4	AMEB08.10
10	A turbine develops 9000 KW when running at 100 rpm. The head on the turbine is 30 m. if the head on the turbine reduced to 18m, determine the speed and power developed by the turbine.	Understand	CO4	AMEB08.10
11	Derive an expression for specific speed of a turbine	Understand	CO4	AMEB08.10
12	How to govern the impulse turbines? Explain with a neat sketch.	Apply	CO4	AMEB08.10
13	Derive an expression for unit power of a turbine	Understand	CO4	AMEB08.13

14	A hydraulic turbine under a head of 25 metres develops 7260 kW running at 110 rpm. What is the specific speed of the turbine? What types of turbine is this. Find also the normal speed and output if the head on the turbine is reduced to 20 metres.	Understand	CO4	AMEB08.13
15	Derive an expression for unit speed of a turbine	Understand	CO4	AMEB08.13
16	Explain the working of a Pelton wheel with neat sketches?	Understand	CO4	AMEB08.13
17	A Francis turbine works under a head of 8.5 m at a speed of 300 rpm. A power of 100 KW is developed with a discharge of 3 m3/sec. The runner diameter is 2.2 m. Find the speed, discharge and power if the head is increased to 18m.	Understand	CO4	AMEB08.13
18	A hydraulic turbine working under a head of 165 metres runs at 300 rpm, the discharge of the turbine being 0.60m^3/sec. The overall efficiency of the turbine is 85%. Find the type of turbine.	Understand	CO4	AMEB08.13
19	A turbine is to operate under a head of 30 metres at 250 rpm. The discharge is 10.5m^3/sec. if the efficiency is 85% determine i. Power generated ii. The specific speed of the turbine iii. Type of turbine iv. Performance under a head of 25 metres.	Remember	CO4	AMEB08.13
20	a) How do you achieve the governing of turbines? Explain with neat sketches. b) Discuss the different characteristic curves of turbines?	Understand	CO4	AMEB08.13
	Part – C (Problem Solving and Critical Thinking)			
1	a) Differentiate the impulse and reaction turbines. b) An inward flow reaction turbine has external and internal diameters as 1 m and 0.5 m respectively. The velocity of flow through the runner is constant and is equal to 1.5 m/s. Determine the discharge through the runner and width of the turbine at outlet if the width of the turbine at inlet is 200mm	Apply	CO4	AMEB08.10
2	a) Give the classification of turbines. b) A Kaplan turbine develops 20MW power at an average head of 69 m. assuming speed ratio of 4, flow ratio of 1.2, diameter of the boss = 0.35 x diameter of the runner and an overall efficiency of 90%. Calculate the diameter, speed and specific speed of the turbine.	Apply	CO4	AMEB08.10
3	a) Define the following; i. Unit speed ii. Unit discharge iii. Unit power iv. Degree of reaction b) A Pelton wheel having a mean bucket diameter of 2.0 m is running at 2000 r.p.m. the side clearance angle is 300 and discharge through the nozzle is 0.2 m^3/s, determine power available at the nozzle and hydraulic efficiency of the turbine.	Apply	CO4	AMEB08.10

4	a) Define the following efficiencies; i. Mechanical ii. Volumetric iii. Overalliv. Hydraulic b) A Pelton wheel is having a mean bucket diameter of 1 m and is running at 1000 rpm. The net head on the Pelton wheel is 700 m. if the side clearance angle is 15^0 and discharge through nozzle is $0.1m^3/s$, calculate: i. Power available at the nozzle, and ii. Hydraulic efficiency of the turbine.	Apply	CO4	AMEB08.10
5	a).Explain degree of reaction for reaction turbines. b). A turbine is to operate under a head of 90 metres at 750 rpm. The discharge is $31.5m^3$/sec. if the efficiency is 85% determine i. Power generated ii. The specific speed of the turbine iii. Type of turbine and Performance under a head of 75 metres.	Apply	CO4	AMEB08.10
6	a) A Pelton wheel is to be designed for the following specifications. Shaft power = 735.75 KW, head = 200 m, speed = 800 rpm, overall efficiency = 0.86 and jet diameter not to exceed $1/10^{th}$ of wheel diameter. Determine i. wheel diameter, ii. No. of jets required and iii. Diameter of jet. Take Cv=0.98 and Kv=0.45. b) Explain the function of draft tube.	Understand	CO4	AMEB08.13
7	a) Draw and explain OC curves of turbines under constant head. b) A turbine is to operate under a head 25 m at 200 rpm. The discharge is 9 cumec. If the efficiency is 90% , determine the performance of the turbine under head of 20 m.	Understand	CO4	AMEB08.13
8	a) How to govern the impulse turbines? Explain with a neat sketch. b) A turbine develops 9000 KW when running at 100 rpm. The head on the turbine is 30 m. if the head on the turbine reduced to 18m, determine the speed and power developed by the turbine.	Understand	CO4	AMEB08.13
9	a) Explain the terms; i. Cavitation and ii. Water hammer b) A Kaplan turbine develops 24647.6 KW power at an average head of 39 m. assuming speed ratio of 2, flow ratio of 0.6, diameter of the boss = 0.35 x diameter of the runner and an overall efficiency of 90%. Calculate the diameter, speed and specific speed of the turbine.	Apply	CO4	AMEB08.13
10	a) Derive an expression for specific speed of a turbine. b) A Francis turbine with an overall efficiency of 75% is required to produce 148.25 KW power. It is working under a head of 7.62 m. the peripheral velocity = $0.26\sqrt{(2gH)}$ and the radial velocity of flow at inlet is $0.96\sqrt{(2gH)}$. The wheel runs at 150 rpm and the hydraulic losses in the turbine are 22% of the available energy. Assuming radial discharge determine; i. The guide blade angle, ii. The wheel vane angle at inlet and iii. Diameter of the wheel at inlet.	Apply	CO4	AMEB08.13

UNIT-V

DIMENSIONAL ANALYSIS AND PUMPS

	Part - A (Short Answer Questions)			
S No	**QUESTION**	**Blooms taxonomy level**	**Course Outcomes**	**Course Learning Outcomes**
1	What is the function of pump?	Understand	CO5	AMEB08.14
2	Draw the neat diagram of centrifugal pump.	Understand	CO5	AMEB08.14
3	What is static head?	Understand	CO5	AMEB08.14
4	What is Manometric head?	Understand	CO5	AMEB08.14
5	Define specific speed for centrifugal pump?	Understand	CO5	AMEB08.14
6	Draw the O.C curves for centrifugal pump.	Understand	CO5	AMEB08.14
7	Draw the Muschel curves for centrifugal pump.	Understand	CO5	AMEB08.14
8	How cavitation occurs in centrifugal pumps.	Remember	CO5	AMEB08.15
9	What water hammer?	Remember	CO5	AMEB08.15
10	What is NPSH?	Understand	CO5	AMEB08.14
11	Name different efficiency of centrifugal pump	Understand	CO5	AMEB08.14
12	What are the functions of multistage centrifugal pump?	Understand	CO5	AMEB08.15
13	Define priming of centrifugal pump.	Understand	CO5	AMEB08.15
14	How can you prevent cavitations?	Remember	CO5	AMEB08.14
15	Write expression for Thomas cavitation factor	Remember	CO5	AMEB08.14
16	Define slip of reciprocating pump	Remember	CO5	AMEB08.14
17	What is meant by indicator diagram?	Remember	CO5	AMEB08.14
18	Write an expression for work done by reciprocating pump	Remember	CO5	AMEB08.15
19	Define suction head and delivery head	Understand	CO5	AMEB08.15
20	Draw constant efficiency curves for centrifugal pump	Understand	CO5	AMEB08.14
	Part - B (Long Answer Questions)			
1	A centrifugal pump is to discharge 0.118 m^3/s at a speed of 1450 rpm against a head of 25 m. The impeller diameter is 250 mm, its width at outlet is 50 mm and manometric efficiency is 75%. Determine the vane angle at the outer periphery of the impeller.	Understand	CO5	AMEB08.14
2	The diameter of an impeller of a centrifugal pump at inlet and outlet are 30 cm and 60 cm respectively. Determine the minimum starting speed of the pump, if it works against a head of 30 m.	Understand	CO5	AMEB08.14
3	Derive an expression specific speed of a centrifugal pump.	Understand	CO5	AMEB08.14
4	Draw and explain characteristic curves for centrifugal pumps.	Remember	CO5	AMEB08.14
5	What will happen when the pumps are connected in series and parallel?	Evaluate	CO5	AMEB08.14
6	What is Cavitation. Explain how it is detected. What are the effects of Cavitation. Explain how cavitation can be avoided.	Understand	CO5	AMEB08.14
7	A centrifugal pump having an overall efficiency of 80% delivers 1850 liters of water per minute to a height of 20 meters through a pipe of 100mm diameter and 95 meters length. Taking f=0.0075, find the power required to drive the pump.	Understand	CO5	AMEB08.14

8	Draw and explain centrifugal pump working with neat sketch.	Understand	CO5	AMEB08.14
9	Explain different efficiencies of centrifugal pump.	Understand	CO5	AMEB08.14
10	How number of vanes effects head and efficiency of a centrifugal pump.	Understand	CO5	AMEB08.14
11	A centrifugal pump is to discharge 0.118 m^3/s at a speed of 1450 rpm against a head of 25 m. The impeller diameter is 250 mm, its width at outlet is 50 mm and manometric efficiency is 75%. Determine the vane angle at the outer periphery of the impeller.	Understand	CO5	AMEB08.14
12	The diameter of an impeller of a centrifugal pump at inlet and outlet are 30 cm and 60 cm respectively. Determine the minimum starting speed of the pump, if it works against a head of 30 m.	Understand	CO5	AMEB08.14
13	Derive an expression specific speed of a centrifugal pump.	Understand	CO5	AMEB08.16
14	Draw and explain characteristic curves for centrifugal pumps.	Understand	CO5	AMEB08.16
15	What will happen when the pumps are connected in series and parallel?	Remember	CO5	AMEB08.14
16	What is Cavitation? Explain how it is detected. What are the effects of Cavitation? Explain how cavitation can be avoided.	Remember	CO5	AMEB08.14
17	A centrifugal pump having an overall efficiency of 80% delivers 1850 liters of water per minute to a height of 20 meters through a pipe of 100mm diameter and 95 meters length. Taking *f*=0.0075, find the power required to drive the pump.	Understand	CO5	AMEB08.15
18	Draw and explain centrifugal pump working with neat sketch.	Understand	CO5	AMEB08.15
19	Explain different efficiencies of centrifugal pump.	Understand	CO5	AMEB08.15
20	How number of vanes effects head and efficiency of a centrifugal pump.	Understand	CO5	AMEB08.14
	Part – C (Problem Solving and Critical Thinking)			
1	a) What is the necessity of priming in centrifugal pumps? b) A centrifugal pump is to discharge 0.118 m^3/s at a speed of 1450 rpm against a head of 25 m. The impeller diameter is 250 mm, its width at outlet is 50 mm and manometric efficiency is 75%. Determine the vane angle at the outer periphery of the impeller.	Understand	CO5	AMEB08.15
2	a) Give the classification of centrifugal pumps. b) A centrifugal pump delivers water against a net head of 14.5 m and a design speed of 1000 rpm. The vanes are curved back to an angle of 30^0 with the periphery. The impeller diameter is 300 mm and outlet width 50 mm. determine the discharge of the pump if manometric efficiency 95%.	Apply	CO5	AMEB08.14
3	a) Differentiate between centrifugal and reciprocating pumps. b) The diameter of an impeller of a centrifugal pump at inlet and outlet are 30 cm and 60 cm respectively. Determine the minimum starting speed of the pump, if it works against a head of 30 m.	Apply	CO5	AMEB08.14

4	a) Define NPSH in pumps. b) The diameters of an impeller of a centrifugal pump at inlet and outlet are 30 cm and 60 cm respectively. The velocity of flow at outlet is 2 m/s and the vanes are set back at angle of 45^0 at the outlet. Determine the minimum starting speed of the pump, if the manometric efficiency is 70%.	Understand	CO5	AMEB08.15
5	a) Explain the importance of multistage centrifugal pump. b) A four stage centrifugal pump has four identical impellers keyed to the same shaft. The shaft is running at 400 rpm and the total manometric head developed by the multistage pump is 40 m. The discharge through the pump is 0.2 m^3/s. the vanes of each impeller are having outlet angle as45^0. If the width and diameter of each impeller at outlet is 5 cm and 6 cm respectively. Calculate the manometric efficiency.	Apply	CO5	AMEB08.14
6	a) Explain the working of a reciprocating pump with a neat sketch. b) A double acting reciprocating pump running at 40 rpm is discharging 1 m^3 of water per minute. The pump has a stroke of 400 mm. the diameter of the piston is 200 mm. the delivery and suction heads are 20 m and 5 m respectively. Determine the slip of the pump and the power required to drive the pump.	Apply	CO5	AMEB08.14
7	a) What is the function of an air vessel in reciprocating pumps? b) A single stage centrifugal pump with impeller diameter of 30 cm rotates at 2000 rpm and lifts 3 m^3 of water per second to a height of 30 m with an efficiency of 75%. Calculate the no. of stages and diameter of each impeller of a similar multistage pump to lift 5 m^3 of water per second to a height of 200 m when rotating at 1500 rpm.	Apply	CO5	AMEB08.14
8	a) Determine the number of pumps required to take water from a deep well under a total head of 89 m all the pumps are identical and running at 800 rpm. The specific speed of each pump is given as 25 while the rated capacity of each pump is 0.16 m^3/s. b) Draw and explain characteristic curves of centrifugal pumps.	Apply	CO5	AMEB08.14
9	a) Derive an expression for work done by the centrifugal pump. b) A single-acting reciprocating pump running at 30 r.p.m., delivers 0.012 m^3/s of water. The diameter of the piston is 25 cm and stroke length 50 cm. Determine: i. The theoretical discharge of the pump ii. Co-efficient of discharge, and iii. Slip and percentage slip of the pump.	Apply	CO5	AMEB08.15

10	a) Define the following; i. Manometric efficiency ii. Mechanical efficiency and iii. Overall efficiency. b) A single-acting reciprocating pump has a plunger of diameter 250 mm and stroke of 350 mm. if the speed of the pump is 60 rpm and it deliver 16.5 lps of water against a suction head of 5 m and a delivery head of 20 m. Determine the theoretical discharge, coefficient of discharge, the slip, the percentage of slip and the power required to drive the pump.	Apply	CO5	AMEB08.14

Prepared By:
Dr. CH.V.K.N.S.N Moorthy, Professor

HOD, MECHANICAL ENGINEERING