Programme Name/s : **Mechanical Engineering**
Programme Code : **ME**
Semester : **Third**
Course Title : **FLUID MECHANICS AND MACHINERY**
Course Code : **313309**

I. RATIONALE

The knowledge of fluid properties, fluid flow & fluid machinery is essential in many fields of engineering like in power generation, irrigation, water supply, etc. This course aims to develop the skills that will enable the students to select appropriate hydraulic devices and machines like pressure gauges, flow measuring devices, pipes, pumps, turbines, etc. for a particular application.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

This course will enable the students to Select appropriate hydraulic machine(s) based on its application for efficient functioning

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Determine different properties of fluid and pressure measurements
- CO2 - Apply Bernoulli's theorem to various flow measuring devices.
- CO3 - Calculate the various losses in flow through pipes
- CO4 - Select suitable hydraulic turbine and pump for the given application
- CO5 - Evaluate the performance of hydraulic turbines and pumps

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313309	FLUID MECHANICS AND MACHINERY	FMM	DSC	3	-	2	1	6	3	3	30	70	100	40	25	10	25#	10	25	10	175

Total IKS Hrs for Sem. : 1 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain various properties of fluids TLO 1.2 Explain different types of fluids TLO 1.3 Compare given fluids based on the required physical properties TLO 1.4 Calculate pressure head using manometer. TLO 1.5 Calculate fluid pressure, total pressure and center of pressure on given immersed body for given position in specified liquid	**Unit - I Properties of Fluid and Fluid Pressure Measurement** 1.1 Properties of Fluid: Density, Specific gravity, Specific volume, Specific Weight, Dynamic viscosity, Kinematic viscosity, Surface tension, Capillarity, Vapor Pressure, Compressibility, Types of fluids, Simple numerical on properties of fluids 1.2 Fluid Pressure: Fluid pressure, Pressure head, Pressure intensity, Pascal's law, Concept of absolute vacuum, gauge pressure, atmospheric pressure, absolute pressure, Different units of pressure and their inter-relation, Simple numerical 1.3 Fluid Pressure Measurement Devices: Construction and working principle of piezometer, simple U-tube manometer and differential U-tube manometers, Numerical on above manometers, Construction and working principle of Bourdon tube pressure gauge 1.4 Hydrostatics: Total pressure, center of pressure- regular surface forces on immersed bodies in liquid in horizontal and vertical position, Simple Numerical	Lecture Using Chalk-Board Presentations Video Demonstrations Model Demonstration

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Classify different types of fluid flows TLO 2.2 Apply Continuity equation and Bernoulli's equation to the various flow measuring devices TLO 2.3 Describe procedure to calculate discharge using the given flow measuring device TLO 2.4 Calculate the flow rate using given flow measuring device	**Unit - II Fundamentals of Fluid Flow and Flow Measurement** 2.1 Types of Fluid Flows: steady, unsteady, uniform, non uniform, rotational, irrotational, 1-D, 2-D and 3-D flows, Laminar, turbulent, Concept of Reynold's number 2.2 Continuity equation, Bernoulli's theorem 2.3 Construction and working principle of Venturimeter, coefficient of discharge, simple numerical on it 2.4 Construction and working principle of Orifice meter, Hydraulic coefficients (Cd, Cc, Cv), simple numerical on it 2.5 Construction and working principle of Pitot Tube and numerical on it	Lecture Using Chalk-Board Presentations Video Demonstrations Model Demonstration Hands-on
3	TLO 3.1 State laws of fluid friction for laminar and turbulent flow TLO 3.2 Calculate frictional losses using Darcy's equation and Chezy's equation TLO 3.3 Describe various minor losses in fluid flow TLO 3.4 Interpret hydraulic gradient line and total energy line TLO 3.5 Calculate hydraulic power transmission, hydraulic efficiency through pipes TLO 3.6 Describe water hammer phenomenon with remedial measures	**Unit - III Flow through Pipes** 3.1 Laws of fluid friction for laminar and turbulent flow 3.2 Darcy's equation and Chezy's equation for calculation of frictional losses, Numerical on above equations 3.3 Minor losses in fittings and valves (No numerical) 3.4 Hydraulic gradient line and total energy line 3.5 Hydraulic power transmission through pipes, Simple numerical 3.6 Water hammer phenomenon in pipes, causes and remedial measures	Lecture Using Chalk-Board Presentations Video Demonstrations Hands-on Role Play

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Calculate the force exerted by a jet, work done and efficiency for the given vane condition TLO 4.2 Explain the working of hydroelectric power plant TLO 4.3 Explain the construction and working of given hydraulic turbine along with velocity diagrams TLO 4.4 Select the suitable hydraulic turbine for given application with justification TLO 4.5 Evaluate the performance of given hydraulic turbine	**Unit - IV Hydraulic Turbines** 4.1 Impact of jet on fixed vertical flat plate, moving vertical flat plate, curved vanes with special reference to turbines and pumps, Numerical on above conditions 4.2 Layout of hydroelectric power plant and function of each component, Water Storage systems used in Ancient India (IKS) 4.3 Classification of hydraulic turbines 4.4 Construction, working principle, velocity diagram and applications of Pelton wheel, Kaplan turbine and Francis turbine 4.5 Draft tubes: Types, Concept of cavitation in turbines 4.6 Calculation of Work done, Power output, efficiency of Pelton turbine only 4.7 Criteria for selection of hydraulic turbines and performance characteristics	Lecture Using Chalk-Board Presentations Video Demonstrations Model Demonstration Case Study Hands-on
5	TLO 5.1 Describe the construction and working of different types of hydraulic pumps TLO 5.2 Select the suitable hydraulic pump for given application with justification TLO 5.3 Evaluate the performance of given hydraulic pump TLO 5.4 Apply the troubleshooting procedure to rectify identified fault in centrifugal pump TLO 5.5 Distinguish between centrifugal and reciprocating pump	**Unit - V Centrifugal and Reciprocating Pumps** 5.1 Centrifugal Pumps: Water lifting devices used in Ancient India (IKS), Classification, Construction and working principle of Centrifugal pump, Types of casings and impellers, Priming methods, Static head, Manometric head, NPSH, Work done, Manometric efficiency, Overall efficiency, Numerical on above parameters, Performance Characteristics of Centrifugal pumps, Troubleshooting, Construction, working and applications of multistage pump 5.2 Reciprocating Pump: Construction, working principle and applications of single and double acting reciprocating pumps, Slip, Negative slip, Cavitation and Separation, Use of air vessels, Indicator diagram with effect of acceleration head & frictional head, Pump selection criteria based on head and discharge (No numerical on reciprocating pumps)	Lecture Using Chalk-Board Presentations Video Demonstrations Model Demonstration Case Study Hands-on

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Use Bourdon tube pressure gauge for pressure measurement LLO 1.2 Use U-tube Manometer for pressure measurement	1	*Measurement of water pressure by using Bourdon tube pressure gauge and U-tube Manometer	2	CO1
LLO 2.1 Calculate discharge of water using a measuring tank and stopwatch	2	Measurement of discharge of water by using a measuring tank and stopwatch	2	CO2

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 3.1 Calculate total energy available at different sections of a pipe layout LLO 3.2 Verify Bernoulli's theorem	3	Measurement of total energy available at different sections of a pipe layout to verify Bernoulli's theorem	2	CO2
LLO 4.1 Apply Bernoulli's theorem to Venturimeter LLO 4.2 Measure discharge through pipe using Venturimeter	4	*Measurement of discharge through pipe using Venturimeter	2	CO2
LLO 5.1 Measure discharge using sharp edged circular orifice	5	Measurement of discharge through a pipe provided with sharp edged circular orifice	2	CO2
LLO 6.1 Apply Bernoulli's theorem to Orifice meter LLO 6.2 Measure discharge through pipe using orifice meter	6	Measurement of discharge through pipes using orifice meter	2	CO2
LLO 7.1 Calculate Reynolds number at given flow rate of water LLO 7.2 Interpret the type of flow based on calculated Reynolds number	7	Interpretation of the type of flow using Reynolds apparatus	2	CO2
LLO 8.1 Calculate Darcy's friction factor 'f' in pipe of different diameters LLO 8.2 Interpret effect of material and diameter of pipe, flow rate of water on Darcy's friction factor 'f'	8	*Calculation of Darcy's friction factor 'f' in pipes of different diameters for different discharges	2	CO3
LLO 9.1 Calculate minor frictional losses due to sudden expansion in a pipe LLO 9.2 Calculate minor frictional losses due to sudden contraction in a pipe	9	*Determination of minor frictional losses in sudden expansion and sudden contraction in a pipe	2	CO3
LLO 10.1 Calculate minor frictional losses due to bend provided in a pipe LLO 10.2 Calculate minor frictional losses due to elbow provided in a pipe	10	Determination of minor frictional losses in elbow and bend in a pipe	2	CO3
LLO 11.1 Calculate the force exerted by a jet on flat plate LLO 11.2 Calculate the work done by a jet on flat plate	11	Determination of the force exerted and work done by a jet on flat plate	2	CO5
LLO 12.1 Measure the power output of Pelton wheel at different flow rates LLO 12.2 Calculate overall efficiency of Pelton wheel LLO 12.3 Plot performance characteristics of Pelton wheel based on results	12	*Determination of overall efficiency of Pelton turbine using Pelton wheel test rig	2	CO5

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 13.1 Identify various components of centrifugal pump LLO 13.2 Assess the condition of various components of centrifugal pump LLO 13.3 Suggest remedial action to be taken	13	*Dismantling and Assembly of a Centrifugal pump	2	CO4
LLO 14.1 Measure the manometric head (Hm) at different flow rates LLO 14.2 Calculate overall efficiency of centrifugal pump LLO 14.3 Plot performance characteristics based on the results	14	*Determination of overall efficiency of Centrifugal pump using Centrifugal pump test rig	2	CO5
LLO 15.1 Identify various components of available reciprocating pump LLO 15.2 Assess the condition of various components of reciprocating pump LLO 15.3 Suggest remedial action to be taken	15	Dismantling and Assembly of a Reciprocating pump	2	CO4
LLO 16.1 Calculate overall efficiency of reciprocating pump LLO 16.2 Calculate percentage slip of reciprocating pump	16	*Determination of overall efficiency and percentage slip of Reciprocating pump using Reciprocating pump test rig	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Assignment

- Prepare a chart showing the various units of pressure and interrelation among them.

Micro project

- Prepare a detailed report based on locations and specifications of Pelton wheel/ Kaplan/ Francis/ any other turbine used in India or Abroad from the internet.
- Prepare a detailed report based on the range of products, manufacturer and technical specifications of Centrifugal/ reciprocating/ multistage pumps/ submersible pumps/any other pump from the local market or internet.
- Visit a hydroelectric power plant and prepare a report on layout of plant, components of plant and specifications of turbines used in the plant.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Centrifugal pump test rig along with necessary pipe fittings and accessories comprising of: Centrifugal pump with motor: Variable speed, 2800 RPM Supply tank: 80 Ltrs. made of Mild steel with FRP lining Bourdon tube pressure gauge: Range-0-12 bar Venturimeter: 13 mm (Mild steel) U-tube manometer: Wall/ Stand mounted thick walled Borosilicate glass tube Measuring tank: 40 Ltrs. made of Mild steel with FRP lining and fitted with piezometer tube and scale Stop watch: Electronic with least count of 0.01 sec Measuring scale: Range up to 60 cm Any other measuring device like rotameter/ flow meter of suitable specifications	1,2
2	Impact of jet test rig with necessary pipe fittings and accessories comprising of: Plexiglass cylindrical tank, 5 mm diameter nozzle, 8 mm diameter nozzle, impact object of flat shape having 30 mm diameter, Nozzle distance-impact object- 20 mm, Set of stainless steel weights Measuring tank: 40 Ltrs. made of Mild steel with FRP lining and fitted with piezometer tube and scale Stop watch: Electronic with least count of 0.01 sec Measuring scale: Range up to 60 cm	11
3	Pelton wheel test rig with necessary pipe fittings and accessories comprising of: Pelton wheel: Speed- 750-900 rpm, Output power- 3.7 kW (5 HP), Head- 45-50 m, Discharge- 700-900 LPM Centrifugal pump, Venturimeter, U-tube differential manometer, Water storage and supply arrangement as per requirement	12
4	Working model of centrifugal pump having technical Specifications: Power: 1HP (0.75 kW) Max. head: Up to 34 meters Max. discharge: Up to 2700 LPH OR Any other suitable centrifugal pump which can be dismantled and assembled using spanner set and tool kit	13

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
5	Centrifugal pump test rig with necessary pipe fittings and accessories comprising of: Centrifugal pump with motor: Variable speed, 2800 RPM Vacuum gauge Bourdon type: Range- 0-760 mm of Hg Pressure gauge Bourdon type: Range- 0-4 kg/cm2 Compound gauge Bourdon type: 760 mm of Hg to 2 kg/cm2 Supply tank: 80 Ltrs. made of Mild steel with FRP lining Measuring tank: 40 Ltrs. made of Mild steel with FRP lining and fitted with piezometer tube and scale Stop watch: Electronic with least count of 0.01 sec Measuring scale: Range up to 60 cm	14
6	Working model of reciprocating pump having technical Specifications: Reciprocating Pump: 1.02HP/0.8KW, 2900 RPM, Single phase OR Any other suitable centrifugal pump which can be dismantled and assembled using spanner set and tool kit	15
7	Reciprocating pump test rig with necessary pipe fittings and accessories comprising of: Reciprocating Pump: 1 HP, 700 RPM Motor: 1 HP, 1500 RPM Supply tank: 80 Ltrs. made of Mild steel with FRP lining Measuring tank: 40 Ltrs. made of Mild steel with FRP lining and fitted with piezometer tube and scale Tachometer: 10-10,000 RPM, Accuracy- 0.5% Full scale Energy meter for motor input measurement Pressure & Vacuum gauge for measurement of head Dimmer to vary the speed Stop watch: Electronic with least count of 0.01 sec Measuring scale: Range up to 60 cm	16
8	Bernoulli's theorem Test rig along with necessary pipe fittings and accessories comprising of: Pump with Motor: Mono-block pump- Single phase, 0.5 HP Differential Venturi of 300 mm length made out of Acrylic square bar Supply tank: 80 Ltrs. made of Mild steel with FRP lining Piezometer tubes: Range- 0 to 12 bar Measuring tank: 40 Ltrs. made of Mild steel with FRP lining and fitted with piezometer tube and scale Stop watch: Electronic with least count of 0.01 sec Measuring scale: Range up to 60 cm	3
9	Venturimeter and orifice meterTest Rig along with necessary pipe fittings and accessories comprising of: Centrifugal pump with motor: Variable speed, 2800 RPM Supply tank: 80 Ltrs. made of Mild steel with FRP lining Venturimeter: 13 mm (Mild steel) , Orifice meter of suitable specifications) U-tube manometer: Connected to pipe and throat of Venturimeter , connected to pipe and vena contracta of orifice meter Measuring tank: 40 Ltrs. made of Mild steel with FRP lining and fitted with piezometer tube and scale Stop watch: Electronic with least count of 0.01 sec Measuring scale: Range up to 60 cm	4,6

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
10	Sharp edged circular orifice test rig along with necessary pipe fittings and accessories comprising of: Centrifugal pump with motor of suitable specifications Supply tank: 80 Ltrs. made of Mild steel with FRP lining Sharp edged circular orifice of suitable specifications U-tube manometer: Connected to pipe and Orifice meter Measuring tank: 40 Ltrs. made of Mild steel with FRP lining and fitted with piezometer tube and scale Stop watch: Electronic with least count of 0.01 sec Measuring scale: Range up to 60 cm	5
11	Reynolds apparatus Test rig with necessary pipe fittings and accessories comprising of: Tube: Clear acrylic 800 mm Length, 32mm Outer Dia. and 25mm Inner Dia. Dye Vessel: Material Stainless Steel, 1 liter capacity Constant Head Tank: 300mm x 300mm x 450mm Measuring Tank: 300mm x 300mm x 300mm Supply Tank: 600mm x 300mm x 300mm Valves (Gunn Metal): 2 Nos. for Drain, 1 No. for Water Control, 1 No. for Bye pass Stop watch: Electronic with least count of 0.01 sec Pump: Single phase, 0.5 HP	7
12	Flow through pipe Test rig with necessary pipe fittings and accessories comprising of: Pipes: 03 nos. Made of GI ½'', 1'', 1.5'' diameter or equivalent diameters and length 1m, 1.5m, 2m or equivalent length Large bend: Made of GI Sudden enlargement fitting of suitable size Sudden contraction fitting of suitable size Pump: 1HP Centrifugal pump Supply tank: 80 Ltrs. made of Mild steel with FRP lining U-tube manometer: Connected to pipe at required locations using plastic tubing Measuring tank: 40 Ltrs. made of Mild steel with FRP lining and fitted with piezometer tube and scale Gate valves to regulate the flow of water Stop watch: Electronic with least count of 0.01 sec Measuring scale: Range up to 60 cm	8,9,10

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Properties of Fluid and Fluid Pressure Measurement	CO1	8	2	4	6	12
2	II	Fundamentals of Fluid Flow and Flow Measurement	CO2	6	2	4	4	10
3	III	Flow through Pipes	CO3	6	2	4	4	10
4	IV	Hydraulic Turbines	CO4,CO5	14	2	8	12	22
5	V	Centrifugal and Reciprocating Pumps	CO4,CO5	11	4	4	8	16
Grand Total				**45**	**12**	**24**	**34**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Continuous assessment based on process and product related performance indicators. Each practical will be assessed considering

1) 60% weightage is to process
2) 40% weightage to product

Summative Assessment (Assessment of Learning)

- Continuous Assessment based on Process and Product related performance indicators. Each practical will be assessed considering

60% weightage to Process
40% weightage to Product

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	1	1	1	-	-	1			
CO2	3	1	1	1	-	-	1			
CO3	3	2	1	1	-	-	1			
CO4	3	2	2	-	1	-	2			
CO5	3	3	2	2	-	-	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Er. R.K. Rajput	A Textbook of Fluid Mechanics and Hydraulic Machines	S. Chand and Company Pvt. Ltd., New Delhi ISBN: 9789385401374
2	Dr. R.K. Bansal	Fluid Mechanics and Hydraulic Machines	Laxmi Publications Pvt. Ltd., New Delhi ISBN: 9788131808153
3	Dr. P.N. Modi, Dr. S.M. Seth	Hydraulics and Fluid Mechanics including Hydraulic Machines	Standard Book House, New Delhi ISBN: 13: 9788189401269
4	S. Ramamrutham	Hydraulic, Fluid Mechanics and Fluid Machines	Dhanpat Rai Publishing Company (P) Ltd. ISBN: 9789384378271

Sr.No	Author	Title	Publisher with ISBN Number
5	Victor Streeter, K.W. Bedford, E. Benjamin Wylie	Fluid Mechanics	McGraw-Hill Education ISBN: 9780070701403
6	K. Subramanya	Fluid Mechanics and hydraulic Machines: Problems and Solutions	Tata McGraw-Hill Co. Ltd., New Delhi ISBN: 9789353163426
7	R.S. Khurmi, N. Khurmi	A Textbook of Hydraulics, Fluid Mechanics and Hydraulic Machines	S. Chand and Company Pvt. Ltd., New Delhi ISBN: 9788121901628
8	Som S.K., Biswas G.	Introduction to Fluid Mechanics and Fluid Machines	Tata McGraw-Hill Co. Ltd., New Delhi ISBN: 9780071329194
9	Dr. Jagdish Lal	Fluid Mechanics and Hydraulic Machines	Metropoliton ISBN: 9788120004221
10	C.S.P. Ojha, P.N. Chandramouli, and R. Berndtsson	Fluid Mechanics and Machinery	Oxford University Press, New Delhi ISBN: 9780195699630
11	Raikar R.V.	Laboratory Manual Hydraulics and Hydraulic Machines	PHI Learning Pvt. Ltd., New Delhi ISBN: 9788120346642

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	http://www.aboutmech.com/2016/08/total-pressure-and-centre-of-pressure.html	Total Pressure and Centre of Pressure
2	https://www.youtube.com/watch?v=UJ3-Zm1wbIQ	Bernoulli's Principle
3	https://www.youtube.com/watch?v=_bfcdRhY7Rw	Working Principle of Venturimeter
4	https://www.youtube.com/watch?v=iRdJHPFVHwM	Orifice Meter Working Principle
5	https://www.youtube.com/watch?v=3zEdtkuNYLU	Pitot Tube Working Animation
6	https://www.youtube.com/watch?v=Rwl1mu0TJmE	Types of Notches
7	https://www.youtube.com/watch?v=FHTVmKdS_Lk&list=PLdoIhVhbPQV5z6g7aT_LpC8mJb31hNiBx&index=2	Impact of Jet on Fixed Vertical Plate
8	https://www.youtube.com/watch?v=tOoBx4-ieyU&list=PLdoIhVhbPQV5z6g7aT_LpC8mJb31hNiBx&index=3	Impact of Jet on Moving Vertical Flat Plate
9	https://www.youtube.com/watch?v=cpM6hF23eeQ&list=PLdoIhVhbPQV5z6g7aT_LpC8mJb31hNiBx&index=11	Impact Of Liquid Jet on Series of Flat Plate Mounted on a Wheel
10	https://www.youtube.com/watch?v=Jd5BN7SPkqI	Pelton Wheel
11	https://www.youtube.com/watch?v=0p03UTgpnDU	Kaplan Turbine Working and Design
12	https://www.youtube.com/watch?v=3BCiFeykRzo	Working of Francis Turbine
13	https://www.youtube.com/watch?v=IiE8skW8btE	Centrifugal Pump
14	https://www.youtube.com/watch?v=41vb6T42_Tk	Reciprocating Pump animation
15	https://www.youtube.com/watch?v=xqGyPdxLlRg	Jet Pump Working Animation
16	https://www.energy.gov/eere/water/types-hydropower-turbines	Types of Hydropower Turbines

Sr.No	Link / Portal	Description
17	https://www.realpars.com/blog/manometer#:~:text=Measuring%20pressure,-The%20tube%20is&text=When%20the%20pressures%20are%20equal,side%20because%20P1%20equals%20P2	Manometer working principle
18	https://tameson.com/pages/bourdon-tube-pressure-gauge	Bourdon Tube Pressure Gauge
19	http://ecoursesonline.iasri.res.in/mod/page/view.php?id=1086	Major and Minor Hydraulic Losses Through Pipes And Fitting
20	http://ecoursesonline.iasri.res.in/course/view.php?id=27	Fluid Mechanics Course
21	https://theconstructor.org/fluid-mechanics/types-fluid-flow-pipe/38078/	Types of Fluid Flows
22	https://www.chaitanyaproducts.com/blog/ancient-indian-water-conservation-techniques-part-1/	Water Storage Systems used in Ancient India (IKS)
23	https://www.youtube.com/watch?v=hQr5Op4S5q4&t=83s	Water Lifting Devices (Araghatta) used in Ancient India (IKS)
24	https://www.youtube.com/watch?v=uTrajIJ79ME&t=49s	Water Lifting Devices (Chadas) used in Ancient India (IKS)

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students