GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

Course Curriculum

FLUID MECHANICS AND HYDRAULIC MACHINES (Code: 3331903)

Diploma Programmes in which this course is offered	Semester in which offered
Mechanical Engineering	3rd Semester

1. RATIONALE

The main objective of this course is to understand the fundamentals of the fluid mechanics such as fluid and flow properties, fluid behaviour at rest and in motion and fundamental equations like mass, energy and momentum conservation of the fluid flow thereby developing an understanding of fluid dynamics in variety of fields. Applications of these basic equations have been highlighted for flow measurements. Hydraulic machinery plays an important role in the conversion of hydraulic energy to mechanical energy and vice-versa. Hydraulic turbines are used for meeting our day-to-day power demands. Also different types of pumps are essential equipment in all the industries. It is also tried to develop an understating of hydraulic & pneumatic devices generally used in industries through this course. Hydraulic systems have a wide range of applications in machine tools, material handling, marine, mining, metal processing, equipment and other fields. Similarly pneumatic control is extensively used as an effective method of automation technique.

2. COMPETENCY (Programme Outcome according to NBA Terminology)

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency.

- **Select, operate and maintain fluid machinery based on fluid laws and characteristics**.

3. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
4	0	2	6	70	30	20	30	150

Legends: L -Lecture; **T -**Tutorial/Teacher Guided Student Activity; **P -**Practical; **C -** Credit; **ESE**-End Semester Examination; **PA** -Progressive Assessment

4. COURSE DETAILS

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit – I **Fluid and fluid properties**	1.a Explain the effect of fluid properties on a flow system.	1.1 Concept and classification of fluid. 1.2 Properties of fluid 1.3 Newton's law viscosity. 1.4 Simple numerical examples.
Unit – II **Fluid statics**	2.a Select and use pressure measuring devices.	2.1 Laws of fluid statics. 2.2 Types, working and applications of pressure measuring devices (Manometers and mechanical gauges) with simple numerical examples. 2.3 Selection criteria for pressure measuring devices.
Unit – III **Fluid kinematics**	3.a Identify type of fluid flow patterns. 3.b Describe and use Continuity equitation to one dimensional fluid flow situations.	3.1 Concept of control volume. 3.2 Fluid flow i. Continuity and energy equation. ii. Momentum equations (without derivation) and its application in impact of jet.(The detail applications should be dealt in Unit VII.) iii. Types of fluid flow. iv. Flow patterns for ideal, laminar, turbulent and compressible fluid flow of one dimension. 3.3 Simple numerical problems on all of above.
Unit – IV **Fluid dynamics and flow measurement**	4.a Explain and Apply Fluid equations (Energy, Momentum and Bernoulli's) in simple Industrial situations. 4.b Select and use flow measuring devices based on given situation.	4.1 Fluid energy-types and interrelations. 4.2 Euler's equation. i. Concept and definition. ii. Understanding various terms in Euler's equation (No derivation). 4.3 Bernoulli's equation. i. Concept and definition. ii. Limitations and assumptions. iii. Derivation from Euler's

		equation. iv. Applications. 4.4 Flow measurement. i. Parameters and units of measurements related to following devices. ii. Devices- classifications, principle, working, applications without derivation. (Pitot tube, Venturi meter, Flow nozzle, Rota meter, Orifice, Notch). 4.5 Selection criteria for flow measuring device. 4.6 Simple numerical examples on all of above.
Unit – V **Flow through pipes**	5.a Explain water hammer and surge tank 5.b Select pipe of appropriate size based on given situation.	5.1 Introduction to pipe and pipe flow. 5.2 Reynolds's experiment, friction factor, Darcy's equation, Moody's chart. 5.3 Water hammer effect. 5.4 Selection criteria for pipes and pipe sizes. 5.5 Simple numerical examples.
Unit – VI **Hydraulic pumps & prime movers**	6.a Select and use an appropriate pump with reference to given application. 6.b Estimate performance parameters of a given Centrifugal and Reciprocating Pump. 6.c Interpret characteristic curves of a given pump. 6.d Select an appropriate turbine with reference to given situation.	**Pumps:** 6.1 Concept and classification of pumps. 6.2 Detailed study(construction, working and applications) of i. Centrifugal pump. ii. Reciprocating pump. iii. Submersible pump. iv. Rotary positive displacement type pumps like Gear pump and Van pump. v. Vacuum pump. 6.3 Performance (efficiency, discharge, head, specific speed and power consumption) of centrifugal pump and reciprocating pump with simple numerical example. 6.4 Characteristic curves of centrifugal pump and reciprocating pump. 6.5 Need for priming of centrifugal pump. 6.6 Selection of pumps. **Hydraulic prime movers (Turbine).** 6.7 Classification, construction, working principle and applications

		of: i. Pelton wheel. ii. Francis turbine. iii. Kaplan turbine. 6.8 Selection criteria of prime movers.
Unit – VII **Hydro pneumatic elements and devices**	7.a Select and use proper hydro-pneumatic devices/equipments.	7.1 Types, sketch, working, specifications, symbols and applications of hydraulic and pneumatic elements like: i. Cylinder. ii. Valve. iii. Manifolds, etc. 7.2 Hydraulic devices- i. Hydraulic press. ii. Hydraulic accumulator. iii. Hydraulic lift iv. Hydraulic ram v. Hydraulic crane vi. Hydraulic coupling vii. Hydraulic intensifier. (Explain working of each with labelled schematic diagram, their specifications and Applications)

5. SPECIFICATIONTABLE WITH HOURS & MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fluid and fluid properties	04	2	2	2	06
II	Fluid statics	07	2	3	4	9
III	Fluid kinematics	07	2	3	4	9
IV	Fluid dynamics and flow measurement	10	4	4	4	12
V	Flow through pipes	06	2	4	2	08
VI	Hydraulic pumps & prime movers	12	2	6	6	14
VII	Hydro pneumatics elements and devices	10	2	4	6	12
Total		**56**	**16**	**26**	**28**	**70**

Notes:

a. This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

b. If midsem test is part of continuous evaluation, unit numbers I, II, IV (Up to 4.3 only), and V are to be considered. It is also compulsory for student to complete exercises.no.1 to 5 to eligible for midsem test.
c. Ask the questions from each topic as per marks weightage. Numerical questions are to be asked only if it is specified. Optional questions must be asked from the same topic.

6. LIST OF EXERCISES/PRACTICAL

The practical/exercises should be properly designed and implemented with an attempt to develop different types of practical skills **(Course Outcomes in psychomotor and affective domain)** so that students are able to acquire the competencies (Programme Outcomes). Following is the list of practical exercises for guidance.

Note: Here only course outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of **Programme Outcomes/Course Outcomes in affective domain** as given in a common list at the beginning of curriculum document for this programme. Faculty should refer to that common list and should ensure that students also acquire those programme outcomes/course outcomes related to affective domain.

S. No.	Unit No.	Practical/Exercises (Course Outcomes in Psychomotor Domain according to NBA Terminology)	Approx. Hrs. Required
1	I	Demonstrate various fluid properties.	2
2	II	Demonstrate and Measure pressure using: i. Various manometers. ii. Various Pressure gauges.	4
3	IV	Verify Bernoulli's theorem.	2
4	IV	Measure fluid flow by Venturimeter and Nozzle.	4
5	IV	Measure fluid flow by Orifice meter and "V" notch.	4
6	III & V	Estimate Reynolds number using given test rig.	2
7	V	Determine major and minor head loss through pipes.	2
8	VI	Perform testing of centrifugal pump as per BIS.	2
9	VI	Perform testing of reciprocating pump as per BIS.	2
10	VII	Demonstrate use of different hydraulic and pneumatic devices.	2
11	ALL	A group of 5-6 students will take any one hydraulic/ pneumatic device for study/repair purpose. They will : a: Study the same and will prepare required sketches. b: Explain working. c: Identify faults if not working. d: Repair minor faults. (This exercise has to be identified and given to the students in the beginning of term.).	2
		Total	**28**

Notes:

a. It is compulsory to prepare log book of exercises. It is also required to get each exercise recorded in logbook, checked and duly dated signed by teacher.
b. Student activities are compulsory and are also required to be performed and noted in logbook.
c. Term work report must not include any photocopy/ies, printed manual/pages, lithos, etc. It must be hand written / hand drawn by student only.
d. Term work report content of each Exercise should also include following.
    1. Exercise description / data and objectives.
    2. Drawing of Exercise / setup with labels/nomenclature to carry out the Exercise.
    3. The specifications of machines / equipments / devices / tools /instruments /items/elements which are / are used to carry out and to check Exercise.
    4. Process parameters / setup settings' values applied to carry out Exercise.
    5. Steps / Process description to execute Exercise.
    6. Information on recent machines / equipments / devices / tools /instruments /items available in market to carry out the Exercise.
    7. Special / Additional notes or remarks.
e. For 20 marks ESE, students are to be assessed for competencies achieved. They should be given :
    i. any one set of exercise/practical to be performed, and
    ii. Competency based questions and answers.

7. SUGGESTED LIST OF STUDENT ACTIVITIES

1	Prepare a tabulated summary for types of fluid which is available around you. (Summary includes properties of fluid indicated in chapter-1)
2	List out any five pressure measuring devices available in market with its specifications and current market price.
3.	Prepare a tabulated summary for types of pipes available in market. (Summary includes type, specification, size range, material, rate and applications).
4	Identify any one hydraulic pump and one prime mover available in market in a group of five students with detail specifications and current price.
5	Visit a nearby related industry and prepare a summary of hydro-pneumatic devices used along with their specifications.

8. SPECIAL INSTRUCTIONAL STRATEGIES (If any)

Sr. No.	Unit	Strategies
1	I	Demonstration with fluids.
2	II	Video movies.
3	III	Video movies.
4	IV	Video movies.
5	V	Demonstration with pipes.
6	VI	Live models/actual equipments to be used.
7	VII	Live models/actual equipments to be used.

9. SUGGESTED LEARNING RESOURCES

(A) List of Books:

S. No.	Title of Books	Author	Publication
1	Fluid mechanics& hydraulic Machines.	R.K.Bansal	Lakhsmi publication
2	Fluid mechanics& hydraulic Machines. (in S.I. units)	R.S.Khurmi	S.chand & Co.Ltd
3	Hydraulic & Hydraulic machines	R.C. Patel & A.D. Pandya	Acharya Book Depot
4	Fluid mechanics& hydraulic	A.R. Basu	DHANPAT RAI&
5	Fundamental of fluid mechanics(in S.I. units)	Dr. D.S. Kumar	Ketson Pub. house
6	Fluid mechanics& hydraulic machines	S.C. Gupta	PERSON Education
7	Hydraulic Machines & Fluidics	Dr. Jagdishlal book co.	Metropolitan
8	Industrial Pneumatic control	Z.J. Lansky	Marcel Dekker, Inc

(B) List of major equipment/materials:

a. Different manometers.
b. Pitot tube.
c. Various mechanical pressure gauges.
d. Hydraulic test rig-comprising facilities to verify Bernoulli's theorem , to measure fluid flow by Venturimeter ; nozzle; orifice meter , rota meter, "V" notch and major and minor head loss through pipes.
e. Centrifugal pump test rig.
f. Reciprocating pump test rig.
g. Hydraulic prime movers (Pelton wheel) test rig.
h. Working model of Francis turbine and Kaplan turbine.
i. Working models and charts of hydraulic devices.
j. Reynolds's experiment test rig.
k. Vacuum pump.
l. Gear pump.
m. Submersible pump.
n. Hydraulic and pneumatic elements like cylinders, valves, manifold, distributors, etc.(All major types).
o. Hydraulic power pack.

(C) List of Software/Learning Websites, concerned subject:

a. www.youtube.com/watch?v=VyR8aeioQrU
b. http://www.youtube.com/watch?v=R6_q5gxf4vs
c. howstuffworks.com
d. http://www.elearningsofttech.com/elearning-solutions-subjects-engineering-degree-diploma-courses/hydraulics-fluid-mechanics/
e. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-KANPUR/FLUID-MECHANICS/ui/TOC.htm
f. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-KANPUR/machine/ui/TOC.htm
g. https://www.youtube.com/watch?v=F_7OhKUYV5c&list=PLE17B519F3ACF9376
h. https://www.youtube.com/watch?v=zOJ6gWDMTfE&list=PLC242EBB626D5FFB5
i. http://www.youtube.com/watch?v=0p03UTgpnDU
j. http://www.youtube.com/watch?v=A3ormYVZMXE
k. http://www.youtube.com/watch?v=TjzKpke0nSU
l. http://www.youtube.com/watch?v=vl7GteLxgdQ
m. http://www.youtube.com/watch?v=cIdMNOysMGI

10. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof. H.R. Sapramer,** Lecturer in Mechanical Engineering, Dr. J.N. Mehta Government Polytechnic, Amreli
- **Prof. M.P. Jakhaniya,** Lecturer in Mechanical Engineering, C.U. Shah Government Polytechnic, Surendranagar.
- **Prof. V.P. Patel,** Lecturer in Mechanical Engineering, N.M. Gopani Polytechnic, Ranpur
- **Prof. H.K. Patel,** Lecturer in Mechanical Engineering, Vallabh Budhi Polytechnic, Navsari.

Coordinator and Faculty Members from NITTTR Bhopal

- **Prof. Sharad Pradhan**, Associate Professor and Head Department of Mechanical Engineering
- **Dr. C.K. Chugh,** Professor, Department of Electronic Media