IINSTITUTE OF AERONAUTICAL ENGINEERING

Dundigal, Hyderabad -500 043

MECHANICAL ENGINEERING

COURSE DESCRIPTION FORM

Course Title	**MECHANICS OF FLUIDS AND HYDRAULIC MACHINES**			
Course Code	**A40112**			
Regulation	R13			
Course Structure	Lectures	Tutorials	Practicals	Credits
	4	-	-	4
Course Coordinator	Mr. G.Sarat Raju ,Associate Professor, Mr. N. Krishna Mohan			
Team of Instructors				

I. COURSE OVERVIEW:

The aim of this course is to introduce basic principles of fluid mechanics and it is further extended to cover the application of fluid mechanics by the inclusion of fluid machinery. Nowadays the principles of fluid mechanics find wide applications in many situations. The course deals with the fluid machinery, like turbines, pumps in general and in power stations. This course also deals with the large variety of fluids such as air, water, steam, etc; however the major emphasis is given for the study of water.

II. PREREQUISITES:

Level	Credits	Periods / Week	Prerequisites
UG	4	4	Engineering physics, Thermodynamics, Engineering Mechanics.

III. COURSE ASSESSMENT METHODS:

Session Marks	University End Exam Marks	Total Marks
Mid Semester Test There shall be two midterm examinations. Each midterm examination consists of subjective type and objective type tests. The subjective test is for 10 marks of 60 minutes duration. Subjective test of shall contain 4 questions; the student has to answer 2 questions, each carrying 5 marks. The objective type test is for 10 marks of 20 minutes duration. It consists of 10 Multiple choice and 10 objective type questions, the student has to answer all the questions and each carries half mark. First midterm examination shall be conducted for the first two and half units of syllabus and second midterm examination shall be conducted for the remaining portion. **Assignment** Five marks are earmarked for assignments. There shall be two assignments in every theory course. Marks shall be awarded considering the average of two assignments in each course.	75	100

IV. EVALUATION SCHEME:

S. No	Component	Duration	Marks
1	I Mid Examination	90 minutes	20
2	I Assignment	-	5
3	II Mid Examination	90 minutes	20
4	II Assignment	-	5
5	External Examination	3 hours	75

V. COURSE OBJECTIVES:

The objectives of the course are to enable the student;

1. To understand the basic principles of fluid mechanics
2. To identify various types of flows
3. To understand boundary layer concepts and flow through pipes
4. To evaluate the performance of hydraulic turbines
5. To understand the functioning and characteristic curves of pumps

VI. COURSE OUTCOMES:

1. Able to explain the effect of fluid properties on a flow system.
2. Able to identify type of fluid flow patterns and describe continuity equation
3. To analyze a variety of practical fluid flow and measuring devices and utilize fluid mechanics principles in design.
4. To select and analyze an appropriate turbine with reference to given situation in power plants.
5. To estimate performance parameters of a given Centrifugal and Reciprocating pump.
6. Able to demonstrate boundary layer concepts.

VII. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		Level	Proficiency assessed by
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, Engineering in the field of Mechanical Engineering.4e	H	Assignments, Tutorials
PO2	**Problem analysis**: An Ability to analyze complex engineering problems to arrive at relevant conclusions using knowledge of Mathematics , science and Engineering	H	Assignments
PO3	**Design/development of solutions**: Competance to design a system, component or process to meet socital need within realistic constraints.	S	Mini Projects
PO4	**Conduct investigations of complex problems**: To design and conduct research oriented experiments as well as analyze and implement data using research methodologies.	S	Projects
PO5	**Modern tool usage**: An ability to formulate solve complex engineering problems using modern engineering and information technology tools.	S	Mini Projects
PO6	**The engineer and society**: To utilize the engineering practices, techniques, skills to meet needs of the health, safety, legal, cultural, and society issues.	N	--
PO7	**Environment and sustainability**: To Understand the impact of the engineering solutions in societal contexts, and demonstrate the knowledge for sustainable development.	N	--

Program Outcomes		Level	Proficiency assessed by
PO8	**Ethics**: An understanding and implementation of professional and Ethical responsibilties	N	--
PO9	**Individual and team work**:To Function as an effectively individual, and as an member or leader in Multi-disciplinary environment and adopt in diverse teams.	N	--
PO10	**Communication**: An ability to assimilate, communicate, give and receive instructions to present effectively with engineering community and society.	N	--
PO11	**Project management and finance**:An ability to provide leadership in managing complex engineering projects at multi-disciplinary environment and to become a professional engineer.	N	--
PO12	**Life-long learning**: Recognize the need and an ability to engage in lifelong to keep broadest with technological changes.	S	Projects

N= None S= Supportive H = Highly Related

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Level	Proficiency assessed by
PSO1	Professional Skills:To produce engineering professional capable of synthesizing and analyzing mechanical systems including allied engineering streams.	H	Lectures, Assignments
PSO2	Problem-solving Skills: An ability to adopt and integrate current technologies in the design and manufacturing domain to enhance the employability.	H	Projects
PSO3	To build the nation, by imparting technological input and managerial skills to become technocrats.	S	

N - None S - Supportive H - Highly Related

IX. SYLLABUS:

UNIT I FLUID STATICS: Dimensions and units, Physical properties of fluids-specific gravity, viscosity, surface tension- vapour pressure and their influence on fluid motion-atmospheric, gauge and vacuum pressures- measurement of pressure- piezometer, U-tube and differential manometers.

UNIT II

streamline, path line, streak line and stream tube, classification of flows- steady and unsteady, uniform and non uniform, laminar and turbulent, rotational and irrotational flows - equation of continuity for one dimensional flow and three dimensional flows.

Fluid dynamics: Surface and body forces, Euler's and Bernoulli's equations for flow along a stream line, Momentum equation and its application on force on pipe bend

UNIT III

BOUNDARY LAYER CONCEPTS: Definition, thickness, characteristics along thin plate, Laminar and turbulent boundary layers (No derivation), boundary layer in transition, Separation of boundary layer, submerged objects- drag and lift

Closed conduit flow: Reynolds's experiment, Darcy Weisbach equation-minor losses in pipes, Pipes in series and pipes in parallel, Total energy line - hydraulic gradient line, Measurement of flow: Pitot tube, venture meter, and orifice meter, flow nozzle

UNIT IV

Basics of Turbo machinery: Hydrodynamic force of jets on stationary and moving flat, inclined vanes, curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.

Hydraulic Turbines: classification of turbines, heads and efficiencies, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design-draft tube theory –functions and efficiency.

Performance of hydraulic turbines: Geometric similarity, unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer.

UNIT V

Centrifugal pumps: Classification, working, work done-barometric head losses and efficiencies- Specific speed – performance characteristic curves, NPSH.

Reciprocating pumps: working, discharge, slip, indicator diagrams.

TEXT BOOKS:

T1. Fluid Mechanics and Hydraulic Machines by Rajput

T2. Hydraulics, fluid mechanics and Hydraulic machinery, Modi and Seth/Rajsons Publications

REFERENCES:

R1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons.

R2. Fluid Mechanics and Machinery by D. Rama Durgaiah, New ager international

R3. Hydraulic Machines by Banga & Sharma, Khanna Publishers

R4. A Text Book of Fluid Mechanics and Hydraulic Machines/Dr. R K Bansal/Laxmi Publications.

X. COURSE PLAN:

The course plan is meant as a guideline. There may probably be changes.

Lecture No.	Course Learning Outcomes	Topics to be covered	Reference
1	**Outline** of various units	**UNIT-I** Introduction, dimensions and units	R4, T2
2-4	**Explain** fluid properties	Physical properties of fluids-specific gravity, viscosity, Surface tension, vapour pressure and their influence on fluid motion	R4, T1
5	**Distinguish** various pressures	Atmospheric, gauge and vacuum pressures	R4
6-8	**Determine** pressure with different instruments	Measurement of pressure- piezometer, U-tube and differential manometers	R4, T1, T2
9-10	**Differentiate** various flow lines	**Unit-II: Fluid Kinematics**: Stream line, path line, streak line and stream tube	R4, T2
11-12	**Classify and describe** various flows	Classification of flows- steady and	R4, T1, T2

		unsteady, uniform and non uniform, laminar and turbulent, rotational and irrotational flows	
13	**Formulate** continuity equation for 1 and 3-d flow	Equation of continuity for one dimensional flow and three dimensional flows	R4, T1
14	**List** various forces	**Fluid dynamics:** Surface and body forces	R4
15-16	**Formulate** Euler's and Bernoulli's equations	Euler's and Bernoulli's equations for flow along a stream line	R4, T2
17-18	**Apply** momentum equation for a pipe bend	Momentum equation and its application on force on pipe bend	R4, T2
19	**Define** boundary layer	**UNIT-III : BOUNDARY LAYER CONCEPTS:** Definition, thickness, characteristics along thin plate	R4, T2
20-22	**Distinguish** boundary layer of laminar, turbulent and transition	Laminar and turbulent boundary layers (No derivation), boundary layer in transition	R4, T2
23-24	**Explain** separation of boundary layer	Separation of boundary layer, submerged objects- drag and lift	R4, T1
25	**Demonstrate** Reynold's experiment	**Closed conduit flow:** Reynolds's experiment	R4
26-27	**Formulate** the Darcy's equation	Darcy Weisbach equation-minor losses in pipes	T2
28-29	**Discuss** the series and parallel connections of pipes	Pipes in series and pipes in parallel	R4, T1
30-31	**Construct** total energy and hydraulic gradient lines	Total energy line - hydraulic gradient line	R4, T1, T2
32-35	**Measure** the discharge	Measurement of flow: Pitot tube, venture meter, and orifice meter, flow nozzle	R4, T2
36-37	**Discuss** the effect of hydrodynamic force on flat vanes	**UNIT – IV: Basics of Turbo machinery:** Hydrodynamic force of jets on stationary and moving flat, inclined vanes	R4, T1
38-39	**Draw** the velocity triangles for Curved vanes	Curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes	R4, T1
40	**Classify** the turbines	**Hydraulic Turbines:** classification of turbines, heads and efficiencies, impulse and reaction turbines	R4, T1, T2
41-44	**Evaluate** the performance of turbines	Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies	R4, T1, T2
45-46	**Describe** the functions of draft tube	Hydraulic design-draft tube theory – functions and efficiency	R4, T2
47-48	**Define** unit quantities and **Draw** characteristic curves	**Performance of hydraulic turbines:** Geometric similarity, unit and specific quantities, characteristic curves	R4, T2
49-51	**Illustrate** the governing of turbines	Governing of turbines, selection of type of	R4, T2

		turbine	
52	**Explain** Cavitation, water hammer, surge tank	Cavitation, surge tank, water hammer	R4, T2
53-55	**Classify and Explain** the working of centrifugal pump	**UNIT-V:Centrifugal pumps:** Classification, working, work done-barometric head losses and efficiencies	R4, T2
56-57	**Compare** the characteristic curves of centrifugal pump	Specific speed – performance characteristic curves, NPSH.	R4, T1, T2
58-60	**Describe and Evaluate** the performance of reciprocating pumps	**Reciprocating pumps:** working, discharge, slip, indicator diagrams	R4, T1, T2

XI. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
I					H						S		S		
II					H									S	
III		H			H								S		S
IV	H	H	S											H	S
V			S		H									H	S

XII. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
I			S										S		
II		H			H									S	
III											S		S		S
IV		H	S											H	S
V	H		S								S			H	S
VI	H	H			H										

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Prepared by: Mr. G.Sarat Raju, Associate Professor,
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