INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTION FORM

Course Title	**FLUID MECHANICS AND HYDRAULIC MACHINERY**			
Course Code	A30102			
Regulation	**R13 – JNTUH**			
Course Structure	Lectures	Tutorials	Practicals	Credits
	4	01	-	4
Academic Year	2016 - 2017			
Course Coordinator	G. Sharat Raju, Assistant Professor			
Team of Instructors	G. Sharat Raju, Assistant Professor			

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. Prerequisite(s):

Level	Credits	Periods	Prerequisite
UG	4	5	Mathematics, Physics, Chemistry

III. Marks Distribution

Sessional Marks	University End Exam Marks	Total Marks
There shall be 2 midterm examinations. Each midterm examination consists of subjective test. The subjective test is for 20 marks, with duration of 2 hours. Subjective test of each semester shall contain 5 one mark compulsory questions in part-A and part-B contains 5 questions, the student has to answer 3 questions, each carrying 5 marks. 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. 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	1 hour and 20 min	20
2	I Assignment lot		5
		TOTAL	**25**
3	II Mid Examination	1 hour and 20 min	20
4	II Assignment lot		5
		TOTAL	**25**
MID Examination marks to be considered as average of above 2 MID's TOTAL			
5	EXTERNAL Examination	3 hours	75
		GRAND TOTAL	**100**

V. Course Objectives:

The objectives of the course are to enable the student;

I. To understand the basic principles of fluid mechanics
II . To identify various types of flows
III. To understand the concept of storage requirements of hydro electric power stations.
IV. To evaluate the performance of hydraulic turbines
V. 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. Able to analyze the effect of impact of jet on various vanes and to study the working of hydro electric power station.
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.

VII. How Course Outcomes are assessed:

Program outcomes		Level	Proficiency assessed by
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	H	Assignments
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering	H	Exercise

	sciences.		
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	N	Projects
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	N	-------
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	N	Discussion, Seminars
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	S	Exercise
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	S	Discussion, Seminars
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	S	Discussions
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	S	Discussions
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	S	Discussion, Seminars
PO11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	S	Discussions, Seminars
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	S	Prototype, discussions

N= None **S=Supportive** **H=highly related**

VIII. How Program Specific Outcomes are Accessed

Program Specific Outcomes		Level	Proficiency assessed by
PSO1	**Professional Skills:** Able to utilize the knowledge of high voltage engineering in collaboration with power systems in innovative, dynamic and challenging environment, for the research based team work.	N	--------
PSO2	**Problem-Solving Skills:** Can explore the scientific theories, ideas, methodologies and the new cutting edge technologies in renewable energy engineering, and use this erudition in their professional development and gain sufficient competence to solve the current and future energy problems universally.	S	Lectures, Assignments
PSO3	**Successful Career and Entrepreneurship:** The understanding of technologies like PLC, PMC, process controllers, transducers and HMI one can analyze, design electrical and electronics principles to install, test , maintain power system and applications.	N	---------

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.

FLUID KINEMATICS:
Stream line, 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 flow.

UNIT-II
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.

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 – III:
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.

Hydroelectric power stations: Elements of hydro electric power station types-concept of

pumped storage plants-storage plants- storage requirements, mass curve (explanation only) estimation of power developed from a given catchment area; head and efficiencies.

UNIT-IV

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: unit and specific quantities, model analysis, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank.

UNIT-V:

Centrifugal pumps: Classification, working, work done- manomertic head, static head - losses and efficiencies- Specific speed – model analysis, pumps in series and parallel-performance characteristic curves, NPSH, water hammer

List of Text Books / References / Websites / Journals / Others

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 age international
R3. Hydraulic Machines by Banga & Sharma, Khanna Publishers.
R4. Instrumentation for Engineering Measurements by James W.Dally , Willam E.Riley, John Wiley & Sons Inc . 2004(chapter 12-Fuid Flow Measurements).
R5. Power plant Engineering by Arora and Domkundwar

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	Introduction, dimensions and units	R4, T2
6	**Distinguish** various pressures	Atmospheric, gauge and vacuum pressures	R4
7-10	**Determine** pressure with different instruments	Measurement of pressure- piezometer, U-tube and differential manometers	R4, T1, T2
11-12	**Differentiate** various flow lines	**Fluid Kinematics**: Stream line, path line, streak line and stream tube	R4, T2
13-14	**Classify and describe** various flows	Classification of flows- steady and unsteady, uniform and non uniform, laminar and turbulent, rotational and irrotational flows	R4, T1, T2
15-16	**Formulate** continuity equation for 1 and 3-d flow	Equation of continuity for one dimensional flow and three dimensional flows	R4, T1
17	**List** various forces	**Fluid dynamics:** Surface and body	R4

		forces	
18-20	**Formulate** Euler's and Bernoulli's equations	Euler's and Bernoulli's equations for flow along a stream line	R4, T2
21-22	**Apply** momentum equation for a pipe bend	Momentum equation and its application on force on pipe bend	R4, T2
23	**Discuss how friction varies with Reynold's Number**	**Reynold's Experiment**	R4, T2
24-25	**Formulate** the Darcy's equation	Darcy's weisbach equation-minor losses in pipes	R4, T2
26-27	**Discuss** the series and parallel connections of pipes	Pipes in series and pipes in parallel	R4, T1
28	**Construct** total energy and hydraulic gradient lines	Total energy line - hydraulic gradient line	R4
36-39	**Measure** the discharge	Measurement of flow: Pitot tube, venture meter, and orifice meter, flow nozzle	R4, T2
40-41	**Discuss** the effect of hydrodynamic force on flat vanes	**UNIT – III: Basics of Turbo machinery:** Hydrodynamic force of jets on stationary and moving flat, inclined vanes	R4, T1
42-45	**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
46-47	**Discuss** the various elements of Hydro electric power station	Elements of Hydro electric power station	T2,R5
48	**Explain the concept of** pumped storage plants	Concept of pumped storage and requirements	R5
49	**Explain** mass curve	Mass curve	T2
50-52	**Estimation** of power developed from a given catchment area and efficiencies	Power developed from given catchment area and efficiencies	T1, R5
53	**Classify** the turbines	**UNIT-IV Hydraulic Turbines:** classification of turbines, heads and efficiencies, impulse and reaction turbines	R4, T1, T2
53-54	**Evaluate** the performance of turbines	Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies	R4, T1, T2
55	**Describe** the functions of draft tube	Hydraulic design-draft tube theory –functions and efficiency	R4, T2
56	**Define** unit quantities and **Draw** characteristic curves	**Performance of hydraulic turbines:** Geometric similarity, unit and specific quantities, characteristic curves, model analysis.	R4, T2
57-59	**Illustrate** the governing of turbines	Governing of turbines, selection of type of turbine	R4, T2
60	**Explain** Cavitation, water hammer, surge tank	Cavitation, surge tank	R4, T2
61-63	**Classify and Explain** the working of centrifugal pump	**UNIT-V:Centrifugal pumps:** Classification, working, work done-manomertic head and static head losses and efficiencies	R4, T2

64-65	**Compare** the characteristic curves of centrifugal pump	Specific speed modal analysis – performance characteristic curves, NPSH.	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	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	H		S				S								
2				S			S	S		S				S	
3	H	H	S			S		S				S		S	
4	H	H		S										S	
5	H	H										S			

S – Supportive **H - Highly Related**

XII. Mapping Course Outcomes Leading to the Achievement of the Program Outcomes and Program Specific Outcomes

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1		S										S			
2	S					S									
3	H	H		S			S					S		S	
4	H		S									S		S	
5	H		S									S		S	

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Prepared by: G. Sarat Raju, Assistant Professor

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