



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

MECHANICAL ENGINEERING

COURSE DESCRIPTOR

Course Title	DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEM				
Course Code	AME519				
Programme	B.Tech.				
Semester	V	ME			
Course Type	Elective				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lectures	Tutorials	Credits	Laboratory	Credits
	3	1	3	-	-
Chief Coordinator	Mr. G Musalaiah, Assistant Professor				
Course Faculty	Mr. G Musalaiah, Assistant Professor				

I. COURSE OVERVIEW:

This course provides students with an introduction to principal concepts and methods of fluid mechanics. Topics covered in the course include pressure, hydrostatics, and buoyancy; open systems and control volume analysis; mass conservation and momentum conservation for moving fluids; viscous fluid flows, flow through pipes; dimensional analysis; boundary layers, and lift and drag on objects. Students will work to formulate the models necessary to study, analyze, and design fluid systems through the application of these concepts, and to develop the problem solving skills essential to good engineering practice of fluid mechanics in practical applications.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AME008	IV	Mechanics of fluids and hydraulic machines	4

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Design of Hydraulic and Pneumatic system	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✗	Chalk & Talk	✓	Quiz	✓	Assignments	✗	MOOCs
✓	LCD / PPT	✓	Seminars	✗	Mini Project	✓	Videos
✗	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with “either” or “choice” will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	Theory		Total Marks
	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz / Alternative Assessment Tool (AAT):

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Presentation on real-world problems
PO 2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Seminar
PO 4	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.	1	Term Paper

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	Professional Skills: To produce engineering professional capable of synthesizing and analyzing mechanical systems including allied engineering streams.	1	Seminar
PSO 2	Software Engineering Practices: An ability to adopt and integrate current technologies in the design and manufacturing domain to enhance the employability.	-	-
PSO 3	Successful Career and Entrepreneurship: To build the nation, by imparting technological inputs and managerial skills to become technocrats.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES :

The course should enable the students to:	
I	Understand of basic knowledge of hydraulic and pneumatic systems.
II	Classification of pumps based on the working phenomenon.
III	Use of hydraulic power pack in the hydraulic systems.
IV	Design of hydraulic circuits based on the application.

IX. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	To expose the student to the different types of hydraulic and pneumatic systems and their operating principle To learn the fundamentals and working of different pumps used in the hydraulic system.	CLO 1	Outline of various systems.
		CLO 2	Understand the principles.
		CLO 3	Understand the properties of hydraulic fluid.
CO 2	Understanding the application of hydraulic power pack in the domain of a hydraulic system.	CLO 4	Define pump and its types.
		CLO 5	Understand the flow rate of pumps and efficiency.
		CLO 6	Selection and specifications of different types of pumps.
CO 3	To enhance the different hydraulic circuits and function of accumulator used in the hydraulic system Applying the knowledge of hydraulic and pneumatic systems in the field of automation in the industries and various applications.	CLO 7	Discuss about actuators and effect of pressure.
		CLO 8	Define elements of power pack systems.
		CLO 9	Discuss about the capacity of hydraulic systems.
		CLO 10	Understand the importance of safety systems.
CO 4	To expose the student to the different types of hydraulic and pneumatic systems and their operating principle.	CLO 11	Define hydraulic circuits and valves.
		CLO 12	Explain about different hydraulic circuits.
		CLO 13	Discuss the various types of control valves.
		CLO 14	Understand the working of solenoid valve.
CO 5	To learn the fundamentals and working of different pumps used in the hydraulic system.	CLO 15	Understand the hydraulic and pneumatic equipment in detailed.
		CLO 16	Describe the importance of filters, grills, registers & Explain the working of fans and blowers.
		CLO 17	Discuss the maintenance and troubleshooting of hydraulic systems.
		CLO 18	Understand the hydraulic and pneumatic equipment in detailed.

X. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AME519.01	CLO 1	Outline of various systems.	PO 1	3
AME519.02	CLO 2	Understand the principles.	PO 2, PO4	3
AME519.03	CLO 3	Understand the properties of hydraulic fluid.	PO 1, PO2	2
AME519.04	CLO 4	Define pump and its types.	PO 2, PO4	2
AME519.05	CLO 5	Understand the flow rate of pumps and efficiency.	PO 1	1
AME519.06	CLO 6	Selection and specifications of different types of pumps.	PO 1	1

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AME519.07	CLO 7	Discuss about actuators and effect of pressure.	PO 1, PO2	2
AME519.08	CLO 8	Define elements of power pack systems.	PO 1, PO4	1
AME519.09	CLO 9	Discuss about the capacity of hydraulic systems.	PO 2, PO4	2
AME519.10	CLO 10	Understand the importance of safety systems.	PO 1, PO2	3
AME519.11	CLO 11	Define hydraulic circuits and valves.	PO 2, PO4	1
AME519.12	CLO 12	Explain about different hydraulic circuits.	PO 1	3
AME519.13	CLO 13	Discuss the various types of control valves.	PO 1	1
AME519.14	CLO 14	Understand the working of solenoid valve.	PO 1, PO2	2
AME519.15	CLO 15	Understand the hydraulic and pneumatic equipment in detailed.	PO 1, PO4	1
AME519.16	CLO 16	Understand the programmable logic circuits and controllers.	PO 2, PO4	2
AME519.17	CLO 17	Discuss the maintenance and troubleshooting of hydraulic systems.	PO 1, PO2	3
AME519.18	CLO 18	Understand the hydraulic and pneumatic equipment in detailed.	PO 2, PO4	1

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

Course Outcomes (COs)	Program Outcomes (POs)			
	PO 1	PO 2	PO 4	PSO1
CO 1	3			1
CO 2		2	1	
CO 3	3			
CO 4		2	1	1
CO 5	3	2		1

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

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3	2											1		
CLO 2	3	2		1											
CLO 3	3												1		
CLO 4		2		1									1		

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 5	3	2													
CLO 6	3			1											
CLO 7		2													
CLO 8	3	2													
CLO 9		2		1											
CLO 10	3			1											
CLO 11													1		
CLO 12	3	2											1		
CLO 13	3														
CLO 14		2													
CLO 15	3														
CLO 16	3	2											1		
CLO 17				1									1		
CLO 18	3	2											1		

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XIII. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1, PO2, PO4, PSO1	SEE Exams	PO1, PO2, PO4, PSO1	Assignments	PO1, PO2, PO4, PSO1	Seminars	PO1, PO2, PO4, PSO1
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO1, PO2, PO4, PSO1						

XIV. ASSESSMENT METHODOLOGIES – INDIRECT

✓	Early Semester Feedback	✓	End Semester OBE Feedback
✗	Assessment of Mini Projects by Experts		

XV. SYLLABUS

Unit-I	OIL AND HYDRAULIC SYSTEMS
Introduction, history of fluid power, Pascal's law, Bramah's press, Bernoulli's principle, Toricelli principle, fluid principle, fluid properties, viscosity, effect of temperature, dust and decay of oils, basic systems of hydraulic, physical units of fluid power, units of measurement, types of hydraulic fluid and selection criteria, properties of hydraulic fluid, physical characteristic, maintenance of hydraulic oils, oil hydraulic element and their representation in the circuits, comparison of mechanical, electrical, hydraulic and pneumatic systems for force and motion, analysis in automation.	
Unit-II	HYDRAULIC PUMPS
Classification of pumps, gear pump, types of gear pumps, screw pump, vane pump, types of vane pumps, piston pump, bent axis in line piston pump, internal and external gear pumps, selection and sizing specification of pumps, specification of pumps, pump and pressure pulsation, flow rate and power of hydraulic pump, power and pump efficiencies, pressure, flow efficiencies, oil compatibility, size, noise, pump ripple, checklist; Actuators, design of linear actuator, cushioning, seals, mounting details, piston rod diameter and its effect on the pressure, servo controlled valves, hydraulic balanced circuits, sequencing and synchronizing circuits, rotary actuators.	
Unit-III	HYDRAULIC POWER PACK
Element of power pack, design of hydraulic power pack, line pressure, discharge and motor. Selection, power pack size and capacity, importance of pressure relief valve and safety systems, heating and cooling systems for hydraulic power pack.	
Unit -IV	HYDRAULIC CIRCUITS AND ACCUMULATOR
Hydraulic circuits, manual or automatic hydraulic system, regenerative circuit, use of check valves in hydraulic circuit, selection of pump, standard in circuit, circuit diagram representation, sequencing and synchronizing circuits; accumulator, low cost automation; meter-in circuit, meter-out circuit, bleed-off circuit, direction control valves, solenoid valves, flow control and pressure control valves, pressure compensation, accumulator.	
Unit -V	AUTOMATION
Hydraulic and pneumatic equipment in automation, low cost automation, relay circuit, programmable logic circuit, automation, micro controller; maintenance and troubleshooting of hydraulic and pneumatic circuit.	
Text Books:	
1. S. R. Majumdar, —Oil Hydraulic Systems, Tata McGraw-Hill, 1 st Edition, 2013. 2. S. R. Majumdar, —Pneumatic Systems, Principles & Maintenance, Tata McGraw-Hill, 1 st Edition, 2013. 3. T. Jagadeesha, —Hydraulic and Pneumatics, I.K Publishing House (Pvt).Ltd, 1 st Edition, 2013.	
Reference Books:	
1. Andrew Parr, —Hydraulic & Pneumatic, Butterworth-Heinemann Ltd, 2 nd Edition, 2013. 2. Antony Esponssito, —Fluid Power with applications, Prentice Hall, 5 th Edition, 2015.	

XVI. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Derivation of Pascal's law, Bramah's press, Bernoulli's principle, Toricelli principle, fluid principle.	CLO 1	T2:2.3
2	Discuss the fluid properties, viscosity, effect of temperature, dust and decay of oils.	CLO 1	R1:2.6

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
3	Understand basic systems of hydraulic, physical units of fluid power, units of measurement.	CLO 2	T1:2.6
4	Classification of hydraulic fluid and selection criteria, properties of hydraulic fluid, physical characteristic.	CLO 2	T2:2.7 R1:2.18
5	Maintenance of hydraulic oils	CLO 3	T2:2.22
6	Discuss oil hydraulic element and their representation in the circuits.	CLO 3	T2:2.25
7	Comparison of mechanical and electrical systems	CLO 3	T2:2.26 R1:2.55
8	Comparison hydraulic and pneumatic systems for force and motion.	CLO 3	T2:2.16 R1:2.61
9	Analysis in automation.	CLO 2	T2:2.30 R1:2.58
10	Classification of pumps, gear pump, types of gear pumps, screw pump.	CLO 5	T2:3.6 R1:4.29
11	Discuss the working of vane pump, types of vane pumps, piston pump, bent axis in line piston pump.	CLO 5	T2:3.14 R1:4.31
12	Explain internal and external gear pumps, selection and sizing specification of pumps.	CLO 4	T2:3.14 R1:4.33
13	Understand pump and pressure pulsation, flow rate and power of hydraulic pump.	CLO 4	R1:4.36
14	Power and pump efficiencies, pressure, flow efficiencies.	CLO 6	T2:3.18 R1:4.64
15	Discuss Oil compatibility, size, noise, pump ripple, checklist.	CLO 5	T2:3.22
16	Actuators, design of linear actuator, cushioning, seals, mounting details.	CLO 4	T2:3.28 R1:4.67
17	Explain piston rod diameter and its effect on the pressure, servo controlled valves.	CLO 5	T2:4.2
18	Describe hydraulic balanced circuits, sequencing and synchronizing circuits, rotary actuators.	CLO 6	T2:4.3 R1:4.71
19	Describe Element of power pack.	CLO 9	T1:4.8 R2:4.68
20-21	Design of hydraulic power pack, line pressure, discharge and motor.	CLO 9	T2:4.15 R1:5.74
22	Describe Selection, power pack size and capacity.	CLO 10	T1:4.12 R2:5.75
23-24	Importance of pressure relief valve	CLO 7	T1:4.8 R1:5.72
25	Importance of safety systems	CLO 10	T1:5.8 R1:5.73
26-27	Heating and cooling systems for hydraulic power pack.	CLO 7	T1:5.14 R1:6.78
28	Describe hydraulic circuits, manual or automatic hydraulic system	CLO 11	T2:5.19 R1:6.81
29-30	Discuss regenerative circuit, use of check valves in hydraulic circuit	CLO 12	T1:6.4 R2:6.8
31	Explain selection of pump, standard in circuit, circuit diagram representation.	CLO 13	T2:7.7 R1:7.74
32-33	Explain sequencing and synchronizing circuits; accumulator, low cost automation.	CLO 14	T1:7.12 R2:8.75
34	Describe meter-in circuit, meter-out circuit, bleed-off circuit.	CLO 14	T1:7.8 R1:8.72
35	Discuss direction control valves, solenoid valves, flow control.	CLO 15	T1:8.8 R1:8.73
36	Describe pressure control valves, pressure compensation, accumulator.	CLO 17	T1:9.14 R1:10.78

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
37-38	Explain hydraulic and pneumatic equipment in automation.	CLO 16	T2:9.19 R1:10.814
39-40	Understand low cost automation.	CLO 18	T1:10.4 R2:11.68
41-43	Discuss relay circuit, programmable logic circuit, automation, micro controller	CLO 17	T2:10.7 R1:12.74
44-45	Explain maintenance and troubleshooting of hydraulic and pneumatic circuit.	CLO 18	T1:11.12 R2:12.75

XVII. GAPS IN THE SYLLABUS-TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed Actions	Relevance With POs	Relevance With PSOs
1	To improve standards and analyze the concepts.	Seminars	PO 1	PSO 1
2	To understand the technology of thermo-electric refrigeration, solar powered refrigeration, etc.	Seminars / NPTEL	PO 4	PSO 1
3	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 2	PSO 1

Prepared by:

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