

COURSE MODULE

Hydraulics and pneumatics			VII
Course Code	BME702	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	03
Examination nature (SEE)			Theory
Course objectives: - To provide an insight into the capabilities and applications of hydraulic and pneumatic fluid power. To understand concepts and relationships surrounding force, pressure, energy and power in fluid power systems. - To examine concepts centering on sources of hydraulic power, rotary and linear actuators, distribution systems, hydraulic flow in pipes, and control components in fluid power systems. - Exposure to build and interpret hydraulic and pneumatic circuits related to industrial applications. - To familiarize with logic controls and trouble shooting			
Teaching Learning Process (General Instructions) These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes. - Intellectual skills; Concept of how to understand the procedures and codes for hydraulics and pneumatics - Cognitive strategy; Learner will use personal strategies to think and organize the course. - By creating learning activities to accomplish the course outcome. - By preparing a ppt, showing animated videos and by giving some field-based activity.			
MODULE-1			
Introduction to fluid power systems: components, advantages and applications. Transmission of power at static and dynamic states. Pascal's law and its applications. Fluids for hydraulic system: types, properties, and selection. Additives, effect of temperature and pressure on hydraulic fluid. Seals, sealing materials, compatibility of seal with fluids. Fluid conditioning through filters, strainers; sources of contamination and contamination control; heat exchangers.			
MODULE-2			
Pumps and Actuators Pumps: Classification of pumps, pumping theory of positive displacement pumps, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable displacement pumps, Pump performance characteristics, pump selection factors, problems on pumps. Actuators: Classification cylinder and hydraulic motors, Hydraulic cylinders, single and double acting cylinder, mounting arrangements, cushioning, special types of cylinders, problems on cylinders. Construction and working of rotary actuators such as gear, vane, piston motors, and Hydraulic Motor. Theoretical torque, power, flow rate, and hydraulic motor performance; numerical problems. Symbolic representation of hydraulic actuators (cylinders and motors).			

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Accumulators: Types, selection/ applications of accumulators

MODULE-3

Components and Hydraulic Circuit Design

Components:

Classification of control valves, Directional Control Valve symbolic representation, constructional features of poppet, sliding spool, shuttle valve, and check valves.

Pressure control valve types, direct operated types and pilot operated types.

Flow Control Valves compensated and non-compensated FCV, needle valve, temperature compensated, pressure compensated, pressure and temperature compensated FCV, symbolic representation. Hydraulic

Circuit Design: Control of single and double acting hydraulic cylinder, regenerative circuit, pump unloading circuit, double pump hydraulic system, counterbalance valve application, hydraulic cylinder sequencing circuits, cylinder synchronizing circuit using different methods, hydraulic circuit for force multiplication; speed control of hydraulic cylinder metering in, metering out. Hydraulic circuit examples with accumulator.

MODULE-4

Pneumatic Power Systems

Introduction to Pneumatic systems: Pneumatic power system, advantages, limitations, applications, Choice of working medium. Characteristics of compressed air and air compressors. Structure of pneumatic control System, fluid conditioners dryers and FRL unit.

Pneumatic Actuators: Linear cylinder – types of cylinders, working, end position cushioning, seals, mounting arrangements, and applications. Rotary cylinder types, construction and application, symbols.

Pneumatic Control Valves: DCV such as poppet, spool, suspended seat type slide valve, pressure control valves, flow control valves, types and construction, use of memory valve, Quick exhaust valve, time delay valve.

MODULE-5

Pneumatic Control Circuits Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, speed control of cylinders supply air throttling and exhaust air throttling.

Signal Processing Elements: Use of Logic gates OR and AND gates in pneumatic applications. Practical examples involving the use of logic gates.

Multi Cylinder Application: Coordinated and sequential motion control, motion and control diagrams. Signal elimination methods, Cascading method principle, Practical application examples (up to two cylinders) using cascading method (using reversing valves).

PRACTICAL COMPONENT OF IPCC (May cover all / major modules)

Sl.NO	Experiments
1	A] Study of Construction and working Hydraulic pumps and Pneumatic B] Study of Hydraulic and Pneumatic valves. C] Study of solenoid valves, limit switches. Pressure, flow control valve
2	Basic hydraulic circuit for the working of a double acting cylinder and a hydraulic motor
3	Basic pneumatic circuit for the working of single and double acting cylinder.
4	Speed control circuits. Different Metering methods Inlet & outlet flow control (meter in & meter out circuit)

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5	Circuits for the Use of different direction control valves and valve actuation in single and double acting cylinder, and multi actuation circuit.
6	Hydraulic Counterbalancing circuit.
7	Hydraulic or Pneumatic Regenerative circuit.
8	Hydraulic or Pneumatic Sequencing circuit.
9	Can be Demo experiments for CIE Circuit with cam operated pilot valves operating a pilot operated 4way direction control Valve or proximity/ limit switches, solenoid operated 4way direction control valve for Auto reversing circuit.
10	Can be Demo experiments for CIE Circuit with cam operated pilot valves operating a pilot operated 4way direction control Valve or proximity/ limit switches, solenoid operated 4way direction control valve for Auto reversing circuit.

Course Outcome: At the end of the course, the student will be able to:

1. Identify and analyze the functional requirements of a fluid power transmission system for a given application.
2. Understand the operation, application, and maintenance of common fluid power components such as pumps, actuators and accumulators.
3. Design an appropriate hydraulic or pneumatic circuit or combination circuit like electro hydraulics, or pneumatics for a given application.
4. Explain the pneumatic working media, applications and components of pneumatic system.
5. Develop a comprehensive circuit diagram by integrating the components selected for the given application using signal processing element.

Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are 25 marks and that for the practical component is 25 marks.
- 25 marks for the theory component are split into 15 marks for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and 10 marks for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for 25 marks).
- The student must secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

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- 15 marks for the conduction of the experiment and preparation of laboratory record, and 10 marks for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test (duration 02/03 hours) after completion of all the experiments shall be conducted for 50 marks and scaled down to 10 marks.
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for 25 marks.
- The student must secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

The question paper will have ten questions. Each question is set for 20 marks.

- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
- The students must answer 5 full questions, selecting one full question from each module.
- Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component

Suggested Learning Resources: List of Textbooks:

1. Anthony Esposito, "Fluid Power with applications", Pearson edition, 2000.
2. Majumdar S.R., "Oil Hydraulics", Tala McGraw Hill, 2002.
3. Majumdar S.R., "Pneumatic systems Principles and Maintenance", Tata McGraw Hill, New Delhi, 2005

Reference Books:

1. John Pippenger, Tyler Hicks, "Industrial Hydraulics", McGraw Hill International Edition, 1980.
2. Andrew Par, Hydraulics and pneumatics, Jaico Publishing House, 2005.
3. FESTO, Fundamentals of Pneumatics, Vol I, II and III.
4. Herbert E. Merritt, "Hydraulic Control Systems", John Wiley and Sons, Inc.
5. Thomson, Introduction to Fluid power, Prentice Hall, 2004.
6. John Watton, "Fundamentals of fluid power control", Cambridge University press, 2012.

Web links and Video Lectures (e Resources):

List of URLs, Textbooks, Notes, Multimedia Content, etc.

1. <https://nptel.ac.in/courses/112105047/>
2. <https://www.youtube.com/watch?v=8xd7cWvMrvE>
3. <https://nptel.ac.in/courses/105103096/>
4. <https://nptel.ac.in/courses/112105047/>

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Activity Based Learning (Suggested Activities in Class)/ Practical Based Learning

1. Basic laws of hydraulics and Power in hydraulic systems used in fluid power systems.
2. Prepare working models of hydraulic crane using waste injections used by doctors. (Laboratory based)
3. Prepare report of agriculture equipment's working on hydraulics and pneumatics (Field based)
4. Collect technical specifications of pumps and motors and actuators. (Internet based)
5. Prepare visit report to observe use of pneumatic system used in automobile, Medical and agriculture (Field based)
6. Constructions and working of different types of circuits for various applications using hydraulic and pneumatic kit (portable).
7. Collections of animation videos of pumps, motors, actuators and Filters. (Software based)
8. Market survey of hydraulic oils used in hydraulic systems. (Field based)

The Correlation of Course Outcomes (CO's) and Program Outcomes (PO's)

Subject Code: BME702		TITLE; Hydraulics and pneumatics							Faculty Name: Dr. Srinivasa. K				
List of Course Outcomes	Program Outcomes												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	
	CO-1	3	2	2	-	-	-	-	-	-	-	2	
	CO-2	3	3	2	-	-	-	-	-	-	-	2	
	CO-3	2	2	3	3	-	3	2	-	-	-	2	
	CO-4	2	2	2	-	-	-	-	-	-	-	2	
	CO-5	3	3	3	3	-	3	2	-	-	-	2	
Program Specific Outcomes (PSOs)													
	PSO1						PSO2						
CO-1	2												
CO-2	2												
CO-3	3												
CO-4	2												
CO-5	3												
CO-6													

Note: 3 = Strong Contribution 2 = Average Contribution 1 = Weak Contribution - = No Contribution

List of course outcome	Working Knowledge profile									
	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9	
CO-1	✓	✓	✓							
CO-2	✓	✓				✓				
CO-3	✓	✓	✓	✓	✓	✓	✓			
CO-4	✓	✓				✓				
CO-5	✓	✓	✓	✓	✓	✓	✓	✓	✓	