



Government of Karnataka

Programme	Mechanical Engineering	Semester	III
Course Code	20ME34P	Type of Course	Programme Core
Course Name	Fluid Power Engineering	Contact Hours	8 hours/week 104 hours/semester
Teaching Scheme	L:T:P :: 3:1:4	Credits	6
CIE Marks	60	SEE Marks	40

DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

1. Rationale: Fluid power is one of the basic building blocks of modern automation and is most widely used system to convert fluid energy into useful work through the use of pump, compressor, control valves, actuators and other controlling elements. This technology is used to power a range of items such as tools, construction equipment and machineries, automotive and machineries in manufacturing sectors. Fluid power engineering involves study of properties of fluids, laws governing flow of fluids, working principles of fluid machineries and knowledge of control of machine movements. This course allows the students to develop the knowledge and understanding of the operational requirements of fluid power system and be able to recognise circuit components and build the circuits for applications needed in daily life

2. Course Outcomes: At the end of this course, student will be able to

CO-01	Measure fluid discharge through Channels and Pipes using instruments and estimate the size of the pipe needed for a given population size.
CO-02	Select the right hydraulic machinery to be used in a specific application for a given head and discharge.
CO-03	List the various components and its use in a given fluid power system.
CO-04	Build a simple fluid power system for a given application

3. Course Content

Week	CO	PO*	Lecture (Knowledge)	Tutorial (Activity)	Practice (Skill)
			3 hours/week	1 hour/week	4 hours/week (2 hours/batch twice in a week)
1	01	01,04	1. Explain classification and Properties of fluids- Units- Conversion of Cubic meters- Liters – Gallons -TMC 2. Explain Pascal Law, Equation of continuity, Concept of Total Energy 3. Explain Bernoulli's equation and its Applications- Venturi meter, Pitot tube, Orifice meter	Ref Table 1	1.Find Discharge of a fluid through Venturimeter
2	01	01,04	1. Explain Discharge through Rectangular Notch -Numerical Problems 2.Explain Discharge through V- notch - Numerical Problem 3. Explain Flow through Pipes- Major and Minor Losses	Ref Table 1	1. Finding Discharge through Rectangular Notch 2. Finding Discharge through V- Notch

3	01	01,04	1. Determine co-efficient of friction by using Chezy's and Darcy's formulae 2. Design a Pipe for a given number of Inhabitants 3. Design a Pipe for a given discharge	Ref Table 1	1. Finding Co-efficient of Friction in Pipes 2. You tube presentation on fluid flow through pipes and notches
4	02	01,02,04	1. Classification of Pumps 2. Explain the Working Principle of Centrifugal Pump and its Application 3. Explain the Working Principle of Monoblock and its Application	Ref Table 1	1. Find the discharge through Centrifugal Pump 2. Servicing and Repair of Centrifugal Pumps
5	03	01,02,04	1. Explain the Working Principle of Submersible pump and its application 2. Explain the Working Principle of Reciprocating pump and its application 3. Select a suitable Pump for a given Application	Ref Table 1	Servicing and Repair of Submersible pumps
6	02	01,04	1. Classification of Hydraulic Turbines 2. Select a suitable Turbine for a given Head 3. Explain the Working Principle of Impulse Turbine and its Application	Ref Table 1	Determine Performance of Pelton wheel
7	02	01	1. Explain the Working Principle of Reaction Turbine and its Application 2. Explain the Importance of Draft tube, Penstock and Surge Tank 3. Video on Hydraulic Power Plant	Ref Table 1	Video on fluid flow from source to End application Eg: Oil Refineries, Hydraulic Power plant, Water distribution through pipe lines
8	03	01	Identify the basic components of Fluid power Systems with Symbols and Application <ul style="list-style-type: none"> • Air compressor • Air Drier • FRL Unit • Gear Pump • Pressure control Valve- Pressure Reducing Valve, Pressure Intensifier • Direction control Valves - 3/2 , 5/2, 4/2 • Flow control Valve • Needle Valve • Check Valve • Shuttle Valve • Quick Exhaust Valve • Time Delay Valve 	Ref Table 1	Video on Working principles of components used in Fluid Power Systems
9	03	01	<ul style="list-style-type: none"> • Explain Valve Actuating mechanisms - Spring, Lever, Push button, Solenoid • Explain the role of Accumulators in fluid power systems. • Explain working principle of Actuators- Single Acting, Double acting Air Cylinders, Air Motors 	Ref Table 1	Video on Working principles of components used in Fluid Power Systems

			<ul style="list-style-type: none"> • Explain the importance of Seals and Packages 		
10	04	01,04	<ul style="list-style-type: none"> • Build a Fluid Power circuit to Control Speed of a Single Acting cylinder • Build a Fluid Power circuit to Control Speed of a Double Acting cylinder • Build a Fluid Power circuit for Pilot control Double Acting Cylinder 	Ref Table 1	Execute the circuit Practiced in the Class using Trainer Kit or Simulation Software
11	04	01,04,07	<ul style="list-style-type: none"> • Build a Fluid Power circuit for double Acting Cylinder being controlled by 4/2 DC Solenoid Operated Valve • Build a Circuit for Stamping operation by using 3/2 DC Valve with Single Acting Cylinder • Build a Circuit for Automatic Opening and Closing of Door by /using double Acting Cylinder being controlled by 4/2 DC Valve 	Study the latest technological changes in this course and present the impact of these changes on industry	Execute minimum 2 Circuits Practiced in the Class using Trainer Kit or Simulation Software
12	04	01,03,07	<ul style="list-style-type: none"> • Build a Fluid Power circuit for Automatic reciprocating motion of a double acting Cylinder • Build a circuit for feeding a strip with following sequences: Holding the strip, moving the strip forward on to the tool, maintaining the strip in that position and returning the strip to its original position after work is over. • Design a Circuit to press fit a pin to a hole with a precondition that while actuating of the cylinder, both the hands of the operator should be engaged 		Execute minimum 2 Circuits Practiced in the Class using Trainer Kit or Simulation Software
13	04	01,07	<ul style="list-style-type: none"> • Build Circuit for a machine device driven by a single acting cylinder with actuation at least two mutually operated DC valves (Safety circuit with OR and AND Gates) • Build Circuit for the Clamping Device of a Drilling Machine of a Drilling machine such that the clamps are activated before the drill is fed to the Work • Build a Circuit for your Own Application 		Execute minimum 2 Circuits Practiced in the Class using Trainer Kit or Simulation Software, including developing your Own Pneumatic Circuit to perform certain function
Total in hours			39	13	52

- *PO= Program Outcome as listed and defined in year 1 curriculum
- Course Co-Ordinator must prepare PO – CO mapping with strength (Low/Medium/High) before course planning

Table 1: Suggestive Activities for Tutorials: (The List is only shared as an Example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose activities that are relevant to the topic and on the availability of such resources at their institution)

Sl.No.	Suggestive Activities for Tutorials
01	Document and present the application of Pascal's Principle in Real Life by selecting Hydraulic Jack/Hydraulic Brakes/ Hydraulic Lift https://www.studiousguy.com
02	Present a report on possible failures in Submersible Pumps and trouble shoot the same.
03	Discuss and present the application of Pneumatics in farming using case study: Farming in California- The issues and Positivity's
04	Build and Present an Electro-Pneumatic Brake system used in Trains. Also, document Brake Cylinder Pressure effect.
05	Prepare a line Diagram of the pipe line of your Residence or College
06	Prepare a water distribution line diagram from Water reservoir to college
07	Prepare a line diagram for rain water harvesting of your Residence or College
08	Study and prepare a report on water distribution in Dip Irrigation System.

4. CIE and SEE Assessment Methodologies

Sl. No	Assessment	Test Week	Duration In minutes	Max marks	Conversion
1.	CIE-1 Written Test	5	80	30	Average of three tests 30
2.	CIE-2 Written Test	9	80	30	
3	CIE-3 Written Test	13	80	30	
4.	CIE-4 Skill Test-Practice	6	180	100	Average of two skill test reduced to 20
5	CIE-5 Skill Test-Practice	12	180	100	
6	CIE-6 Portfolio continuous evaluation of Tutorial sessions through Rubrics	1-13		10	10
Total CIE Marks					60
Semester End Examination (Practice)			180	100	40
Total Marks					100

5. Format for CIE written Test

Course Name	Manufacturing Processes	Test	I/II/III	Sem	III/IV
Course Code	20ME33P	Duration	80 Min	Marks	30
Note: Answer any one full question from each section. Each full question carries 10 marks.					
Section	Assessment Questions	Cognitive Levels	Course Outcome	Marks	
I	1				
	2				
II	3				
	4				
III	5				
	6				
Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, Cognitive level and course outcomes.					

5. (a)For CIE Skill Test -4

Duration :240 Min

SL. No.	CO	Particulars/Dimension	Marks
1	01	One Experimental Question on case related to Application of Bernoulli's theorem (Venturimeter/Orifice/Pitot tube) (Group of 5 Students) <ul style="list-style-type: none"> Writing observations and Tabular column -- 10 Marks Writing Equations required With all notations -- 15 Marks 	45

			<ul style="list-style-type: none"> • Conduction of Experiment --- 10 Marks • Calculation and Result --- 10 Marks 	
2		01	One Experimental Question on Channels/ Pipes (Group of 5 Students) <ul style="list-style-type: none"> • Writing observations and Tabular column -- 10 Marks • Writing Equations required With all notations -- 15 Marks • Conduction of Experiment --- 10 Marks • Calculation and Result --- 10 Marks 	45
3		01	Portfolio evaluation based on the average of all Practice Sessions (1-6 Weeks)	10
Total Marks				100

5. (b) For CIE Skill Test -5

Duration: 240 Min

SL. No.	CO	Particulars/Dimension	Marks
1	03,04	Two Skill based Question to Design a Pneumatic Circuit for the given case (Individual Experiment) = 45 Marks each <ul style="list-style-type: none"> • Writing Circuit Diagram with all components-25 marks • Building Circuit on the Kit -10marks • Showing the Result/output - 10 Marks 	90
2	03,04	Portfolio evaluation based on the average of all Practice Sessions (7-12 Weeks)	10
Total Marks			100

6. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	6
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
Average Marks= (8+6+2+2)/4=4.5							5

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

7. Reference:

Sl. No.	Description
1	Bansal. R.K., "Fluid Mechanics and Hydraulics Machines", 9th Edition, Laxmi Publications Private Limited, New Delhi. 2011.
2	R.S.Khurmi, "Fluid Mechanics and Machinery", S.Chand and Company, 2nd Edition, 2007.
3	Hydraulics & Pneumatics – Andrew Parr, Jaico Publishing House New Delhi.
4	Hydraulic and Pneumatic Controls Understanding Made Easy- K.S.Sundaram,- S.chand Company Delhi
5	Ramamrutham. S, "Fluid Mechanics, Hydraulics and Fluid Machines", Dhanpat Rai & Sons, Delhi, 2004.
6	P. N Modi and S. M. Seth, "Hydraulics and Fluid Mechanics Including Hydraulics Machines", 19th Edition, Standard Book House, 2013

7	Hydraulic and Pneumatic Controls- Srinivasan, R.- Vijay Nicole Imprints Private Limited, 2/e, 2008
8	Pneumatic And Pneumatics Controls -Understanding Made Easy - K.S.Sundaram,-S.chand Company Delhi
9	Pneumatic Systems - Majumdar, S.R. -Tata McGraw-Hill Publication, 3/e, 2013

8. LIST OF SOFTWARES/ LEARNING WEBSITES:

1. www.youtube.com/watch?v=VyR8aeioQrU
2. http://www.youtube.com/watch?v=R6_q5gxf4vs
3. www.howstuffworks.com
4. <http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-KANPUR/machine/ui/TOC.htm>
5. https://www.youtube.com/watch?v=F_70hKUYV5c&list=PLE17B519F3ACF9376
6. <https://www.youtube.com/watch?v=zOJ6gWDMTfE&list=PLC242EBB626D5FFB5>
7. <http://www.youtube.com/watch?v=0p03UTgpnDU>
8. <http://www.youtube.com/watch?v=A3ormYVZMXE>
9. <http://www.youtube.com/watch?v=TjzKpke0nSU>
10. <http://www.youtube.com/watch?v=vl7GteLxgdQ>
11. <http://www.youtube.com/watch?v=cIdMNOysMGI>
12. www.boschrexroth.co.in
13. <http://www.automationstudio.com/>
14. <http://www.howstuffworks.com/search.php?terms=hydraulics>
15. <http://hyperphysics.phy-astr.gsu.edu/hbase/fluid.html#flucon>
16. <http://www.youtube.com/watch?v=FVR7AC8ExIM>
17. <http://www.youtube.com/watch?v=iOXRoYHdCV0>
18. <http://www.youtube.com/watch?v=qDinpuq4T0U>
19. <http://www.youtube.com/watch?v=xxoAm3X4iw0>
20. www.festo.com
21. www.boschrexroth.co.in
22. www.nptel.iitm.ac.in
23. <http://www.howstuffworks.com/search.php?terms=pneumatics>

9. SEE Scheme of Evaluation

Duration :180 Min

SL. No.	CO	Particulars/Dimension	Marks
1	01	<p>One Experimental Question on case related to Application of Bernoulli's theorem (Venturimeter/Orifice/Pitot tube) (Group of 5 Students)</p> <ul style="list-style-type: none"> • Writing observations and Tabular column -- 10 Marks • Writing Equations required With all notations --15 Marks • Conduction of Experiment --- 10 Marks • Calculation and Result --- 1 5 Marks <p style="text-align: center;">OR</p> <p>One Experimental Question on Channels/Pipes (Group of 5 Students)</p> <ul style="list-style-type: none"> • Writing observations and Tabular column -- 10 Marks • Writing Equations required With all notations --1 5 Marks • Conduction of Experiment --- 10 Marks • Calculation and Result --- 1 5 Marks 	50
2	03,04	One Skill based Question to Design a Pneumatic Circuit for the given case (Individual Experiment)	30

		<ul style="list-style-type: none"> • Writing Circuit Diagram with all components-20 marks • Building Circuit on the Kit and Result -10 marks 	
3	CO1,CO2,CO3,CO4	Viva voce	20
	Total Marks		100

10 Equipment/software list with Specification for a batch of 20 students

Sl. No.	Particulars	Specification	Quantity
01	Bench mounted Test Rig for Venturi meter	-----	01
02	Bench mounted Test Rig for Notches	.....	01
03	Bench mounted Test Rig for Friction through pipes	.....	01
04	Centrifugal Pumps FOR Maintenance and Servicing	Used one	02
05	Mano block Pumps FOR Maintenance and Servicing	.....do.....	02
06	Submersible Pumps FOR Maintenance and Servicing	.....do.....	02
07	Pneumatics Trainer Kit with all standard accessories.	Standard size	
08	Compressor for Pneumatics Trainer Kit	6 Bar pressure Single phase 50 Hz	01
09	Hose pipes for Pneumatics Trainer Kit	.....	.....
10	Bench mounted Test Rig for Pelton wheel	Standard size	01