Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bengaluru

Course Title: Fluid Power Engineering		Course Code: 15MC33T
Mode (L:T:P) : 4:0:0	Credits:4	Core/ Elective: Core
Type of Course: Lectures & Student Activities		Total Contact Hours: 52
CIE= 25 Marks		SEE= 100 Marks

Prerequisites: Knowledge of Applied Science

Course Objectives: Understand the properties of fluid, Components of fluid power system,

Engineering application of hydraulic and pneumatic systems

Course Outcome: At the end of the semester the students will be able to

1. Understand various technical terms associated with properties of fluid
2. Know the various components of fluid power system
3. Develop a hydraulic circuits for engineering applications
4. Develop a pneumatic circuits for engineering applications

Course Outcome		Cognitive Level	Linked with PO	Teaching Hours
CO1	Understand various technical terms associated with properties of fluid	*R/U*	1,2	4
CO2	Know the various components of fluid power system	*U*	1,2	12
CO3	Develop a hydraulic circuits for engineering applications	*U/A*	1,2	18
CO4	Develop a pneumatic circuits for engineering applications	*U/A*	1,2	18
		Total sessions		**52**

Legend: R; Remember, U: Understand A: Application

Mapping of Course Outcomes with Program Outcomes

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
Fluid Power Engineering	**3**	**3**	-	-	-	-	-	-	-	-

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.
If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3
If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2
If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1
If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

Course Content and Weightage For SEE

Unit No	Unit Name	CO	Hour	Marks allocated for different Cognitive level Questions			Marks Weightage (%)
				R	U	A	
1	Introduction to Fluid power system	1	4	05	10	-	10.34
2	Components of fluid power system	2	12	-	40	-	27.6
3	Basic oil power circuits	3	08	-	05	10	10.34
4	Engineering applications of oil power system	3	10	-	10	20	20.69
5	Basic pneumatic circuits	4	08		05	10	10.34
6	Engineering applications of pneumatic system	4	10	-	10	20	20.69
	Total		52	145 Marks			100

Contents

Unit –I

Introduction to Fluid power system

Properties of fluids: Density, specific gravity, pressure, absolute pressure, gauge pressure, Kinetic viscosity, absolute viscosity, Capillarity, surface tension. PASCAL's law and Bernoulli's theorem (No derivation) applications of Bernoulli's theorem, major losses and minor losses as fluid flows through a pipe, Types of fluid power system: Oil power fluid system, Pneumatic system, Comparison of oil power Fluid system and pneumatic system. .Advantages and applications of fluid power, Fluidics, coanda effect, Fluid logic: AND and NOR Function, Pneumatic sensors: Interruptible jet sensor, Reflex sensor, Back pressure sensor. **4Hours**

Unit –II

Components of fluid power system

Single acting reciprocating pump, Centrifugal pump, vane pump and Gear pump, fluid reservoir, single stage reciprocating air compressor, Centrifugal air compressors, Rotary vanes compressor, axial flow air compressor, Twin lobe air compressor, screw compressor, filter, pressure regulator, lubricator, FLR Unit in combination,2/2 spool type DC valves, 3/2 spool type DC valves, 5/2 spool type Dc valves, 5/2 pilot operated DC valve, 5/3 Spool type DC valves, pressure reducing valve, pressure relief valve, pressure intensifier, twin pressure valve, shuttle valve, flow control valves ,quick exhaust valve, time delay valve, needle valve, check valve, DC valve actuation mechanism, spring ,lever, push button, solenoid, Gas loaded accumulator, single acting and double fluid power cylinders.

12Hours

Unit –III

Basic oil power circuits

Circuit symbols for; Cylinders, Direction control valves, flow control valves, pressure control valves, actuations such as mechanical control, electrical control, pressure control, actuation of single acting cylinder, double acting cylinder. Circuit to actuate single acting and double acting cylinders, Circuit to control speed of a single acting and double acting cylinder,(meter in meter out),

8Hours

Unit –IV

Engineering applications of oil power system

Pump unloading circuit, circuit to achieve faster extension as in drilling machine, counter balance valve application as in power press to avoid free fall of hammer due to gravity, circuit to lock the cylinder using pilot check valve to protect the piston rod from external forces on that, application of sequencing of circuit as in case of punching machine to clamp the work piece and to perform punching operation, to obtain automatic reciprocating of cylinders, fail safe circuit against over loading and to prevent injury to the operator, accumulator circuit to store energy and supply when needed.

10Hours

Unit – V

Basic pneumatic circuits

Circuit to actuate single acting and double acting pneumatic cylinders ,Circuit to control speed of a single acting and double acting cylinder,(meter in meter out),Pilot controlled double acting cylinder, circuit for Double acting cylinder to advance by actuation of a solenoid valve and it's retract movements is delayed by time lag through a timer, **8Hours**

Unit – VI

Engineering applications of pneumatic system

Circuit to Press fit a pin to a hole with a pre-condition that while actuating of the cylinder, both the hands of the operator should be engaged (two handed safety circuits),A piston rod of a double acting cylinder is to extend when two 3/2 DC valves are actuated if one of the 3/2DC valve is released the cylinder returns to its initial position(AND function), A double acting cylinder extends if one or both 3/2DC valve are operated. If both 3/2 DC valves are released then cylinder retracts (OR function)

10Hours

References

1: Fluid power with applications - Anthony Esposito: Pearson prince hall,

2: Engineering fluid Mechanics - K L Kumar Eurasia publishing house private Ltd.(S Chand)

3: Hydraulics, Fluid Mechanics and Hydraulic Machines – Khurmi, S Chand and company

4: Pneumatic systems principles and maintenance – S.R. majumdar, tata McGraw hill education private Ltd, New Delhi.

5. Hydraulic and pneumatic controls – K.Shanmuga sundaram,S. CHAND publications

6: Hydraulic and pneumatic – R.K. Hegde, Niranjan murthy, SAPNA Publication

e-References

1. **http://www.nptel.ac.in/courses/112106175/Module%201/Lecture%201.pdf**
2. **http://www.asconumatics.eu/images/site/upload/_en/pdf1/00482gb.pdf**
3. **http://www.mdfirst.org/images/stories/documents_2012/Pneumatics-basics.pdf**
4. **http://www.festo.com/cat/en-in_in/products**
5. **http://www.janatics.com/products.htm**
6. **http://www.lagos.udg.mx/sites/default/files/Electroneumaticabasica(eng).pdf**

Student Activity

Activity No	Description of the Student Activity
1	Build a oil power circuit for an application beyond the curriculum and submit 2 to 3 pages hand written report
2	Build a pneumatic circuit for an application beyond the curriculum and submit 2 to 3 pages hand written report

Note:
1. Group of max four students should do any one of the above activity or any other similar activity related to the course COs and get it approved from concerned Teacher and HOD.
2. No group should have activity repeated or similar
3. Teacher should ensure activities by group must cover all COs
4. Teacher should asses every student by using suitable **Rubrics** approved by HOD

Rubrics

Dimension	Exemplary	Accomplished	Developing	Beginning	Roll No. of the Student				
	5/4	3	2	1	1	2	3	4	5
Organization	Information presented in logical, interesting sequence	Information in logical sequence	Difficult to follow presentation--student jumps around	Cannot understand presentation--no sequence of information	Ex: 2				
Subject Knowledge	Demonstrates full knowledge by answering all class questions with explanations and elaborations	At ease with expected answers to questions but does not elaborate	Uncomfortable with information and is able to answer only rudimentary questions	Does not have a grasp of the information. Cannot answer questions about subject	3				
Graphics	Explain and reinforce screen text and presentation	Relate to text and presentation	Occasionally uses graphics that rarely support text and presentation	Uses superfluous graphics or no graphics	4				
Oral Presentation	Maintains eye contact and pronounces all terms precisely. All audience members can hear	Maintains eye contact most of the time and pronounces most words correctly. Most audience members can hear presentation	Occasionally uses eye contact, mostly reading presentation, and incorrectly pronounces terms. Audience members have difficulty hearing	Reads with no eye contact and incorrectly pronounces terms. Speaks too quietly	5				
Total Score=2+3+4+5=14/4=3.5=4									

Institutional Activity

Activity No	Description of the Institutional Activity
1	Organise seminar, workshop, lecture from eminent person in the following domain: a) Recent trends in Low Cost Automation b) Modern trends in Hydraulics and Pneumatics c) Safety issues in Fluid Power System b) Impact of oil power hydraulic systems on environment c) Design for safety e) Role of professional bodies in Automation such as institute of engineers.
2	Organise nearby industrial visit
3	Motivate student to take case study on Low Cost Automation to inculcate self and continuous learning

Course Assessment Pattern

Particulars			Max Marks	Evidence	Course outcomes
Direct Assessment	**CIE**	Three test (Average of three tests)	20	Blue books	1,2,3,4
		Student Activity	05	Student Activity Sheets	1,2,3,4
	SEE	End of the course	100	Answer scripts at BTE	1,2,3,4
Indirect Assessment	**Student Feedback on course**	Middle of the course		Feedback forms	1&2
		End of the course		Feedback forms	3&4

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

FORMAT OF I A TEST QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks
Ex: I test/6 th weak of sem 10-11 Am	I/II SEM		20
	Year:		
Name of Course coordinator : CO's:____			Units:__

Question no	Question	MARKS	CL	CO	PO
1					
2					
3					
4					

Note: Internal Choice may be given in each CO at the same cognitive level (CL).

Model Question Paper (CIE)

Date and Time	Semester/year	Course	Max Marks
1 Test (6 th weak of sem) 10-11 Am	III SEM	Fluid Power Engineering	20
	Year: 2015-16	Course code:15MC33T	
Name of Course coordinator : All questions carries equal marks			Units:1,2 CO: 1,2

Question No	Question	CL	CO	PO
1	Define kinematic and absolute viscosity of a fluid OR Define density and specific gravity of a fluid	R	1	1,2
2	Explain the bernoulli's theorem. OR Compare oil power hydraulic system and pneumatic system	U	1	1,2
3	With a neat sketch explain working of single acting reciprocating pump OR What is the necessity of fluid reservoir in oil power hydraulic system	U	2	1,2
4	With a neat sketch explain 3/2 spool type DC valve OR With a neat sketch explain twin pressure valve	U	2	1,2

Model Question Paper
III Semester Diploma in Mechatronics Engineering
Fluid Power Engineering

Instructions: Answer any six questions from part A and Seven full questions from part B

PART-A

Answer any six questions. **5X6=30 marks**

1. Define density and specific gravity of a fluid
2. Write a block diagram showing the components of oil power hydraulic system
3. With a neat sketch explain working of single acting reciprocating pump
4. Write a Circuit symbols for; Double acting Cylinders, 2/3Direction control valves, flow control valves, pressure, compressor ,accumulator
5. Build a circuit to control forward speed of a single acting Hydraulic cylinder
6. Build a circuit to control forward speed of a Double acting Hydraulic cylinder
7. Build a circuit to actuate single acting Pneumatic cylinder
8. Build a circuit to control forward speed of a Double acting Pneumatic cylinder
9. Build a circuit for Pilot controlled double acting cylinder

PART- B

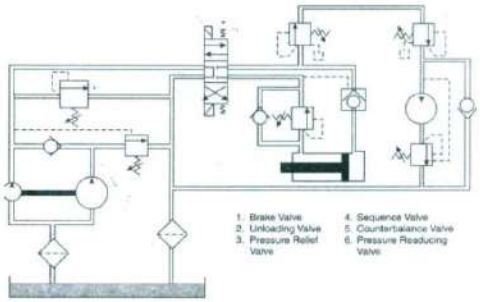
Answer any seven full questions. **10X7=70M**

1. a) Explain Bernoulli's theorem
   b) Explain coanda effect

2. a) With a neat sketch explain pressure regulator
   b) With a neat sketch explain working of centrifugal air compressor

3. a) With a neat sketch explain 2/2 spool type DC valve
   b) With a neat sketch explain oil lubricator

4. Identify the different components used in the given circuit



5. a) Build a Pump unloading circuit
   b) Develop a circuit to control reverse speed of a double acting hydraulic cylinder

6. a) Build a circuit counter balance valve application as in power press to avoid free fall of hammer due to gravity
   b) Build a circuit to obtain automatic reciprocating of cylinders

7. a) Build a accumulator circuit to store energy and supply when needed
   b) Build a circuit to lock the cylinder using pilot check valve to protect the piston rod from External forces
8. Build a circuit for a piston rod of a double acting cylinder is to extend when two 3/2 DC
9. valves are actuated if one of the 3/2DC valve is released the cylinder returns to its initial position(AND function)
10. Build a circuit for a double acting cylinder extends if one or both 3/2DC valve are Operated. If both 3/2 DC valves are released then cylinder retracts (OR function)

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Model Question Bank
III Semester Diploma in Mechatronics Engineering
Fluid Power Engineering

Unit -I

Introduction to Fluid power system
Cognitive level- Remember

1. Define density and specific gravity of a fluid
2. Define capillarity and surface tension
3. State pascal's law
4. State Bernoulli's theorem
5. List applications of bernoulli's theorem
6. List the advantages of fluid power system
7. List the applications of fluid power system in engineering

Cognitive level-Understanding

1. Explain absolute pressure and gauge pressure
2. Explain kinematic and absolute viscosity of a fluid
3. Explain the major losses and minor losses as fluid flows through a pipe
4. Compare oil power hydraulic system and pneumatic system
5. Explain coanda effect
6. With a neat sketch explain how AND logic function can be achieved using fluid
7. With a neat sketch explain how NOR logic function can be achieved using fluid
8. With a neat sketch explain interruptable jet sensor
9. With a neat sketch explain reflex sensor
10. With a neat sketch explain back pressure sensor

Unit -II

Components of fluid power system
Cognitive level-Understanding

1. Write a block diagram showing the components of oil power hydraulic system
2. Write a block diagram showing the components of pneumatic power system
3. With a neat sketch explain working of single acting reciprocating pump
4. With a neat sketch explain working of centrifugal pump
5. With a neat sketch explain working of vane pump
6. With a neat sketch explain working of gear pump
7. What is the necessity of fluid reservoir in oil power hydraulic system
8. With a neat sketch explain working of single acting reciprocating air compressor
9. With a neat sketch explain working of centrifugal air compressor
10. With a neat sketch explain working of rotary vane air compressor
11. With a neat sketch explain working of axial flow air compressor
12. With a neat sketch explain working of twin lobe air compressor
13. With a neat sketch explain working of screw air compressor
14. With a neat sketch explain air filter
15. With a neat sketch explain pressure regulator
16. With a neat sketch explain oil lubricator

17. Explain the necessity of the FRL Unit in a pneumatic system
18. With a neat sketch explain 2/2 spool type DC valve
19. With a neat sketch explain 3/2 spool type DC valve
20. With a neat sketch explain 5/2 spool type DC valve
21. With a neat sketch explain 5/2 pilot operated DC valve
22. With a neat sketch explain 5/3 spool type DC valve
23. With a neat sketch explain flow control valve
24. With a neat sketch explain pressure reducing valve
25. With a neat sketch explain pressure relief valve
26. With a neat sketch explain pressure intensifier
27. With a neat sketch explain twin pressure valve
28. With a neat sketch explain shuttle valve
29. With a neat sketch explain quick exhaust valve
30. With a neat sketch explain time delay valve
31. With a neat sketch explain needle valve
32. With a neat sketch explain check valve
33. Explain the various mechanical actuation of DC valve
34. Sketch and explain the solenoid actuation of DC valve
35. Explain is the purpose of accumulator in fluid power system
36. With a neat sketch explain gas loaded accumulator
37. With a neat sketch explain single acting fluid power cylinder
38. With a neat sketch explain double acting fluid power cylinder

Unit -III

Basic oil power circuits

Cognitive level-Understanding

1. Write a Circuit symbols for; Cylinders, Direction control valves, flow control valves, pressure control valves, actuations such as mechanical control, electrical control, pressure control, actuation of single acting cylinder, double acting cylinder

Cognitive level-Application

1. Build a circuit to actuate single acting Hydraulic cylinder
2. Build a circuit to control forward speed of a single acting Hydraulic cylinder
3. Build a circuit to control reverse speed of a single acting Hydraulic cylinder
4. Build a circuit to actuate Double acting Hydraulic cylinder
5. Build a circuit to control forward speed of a Double acting Hydraulic cylinder
6. Build a circuit to control reverse speed of a Double acting Hydraulic cylinder
7. Build a circuit for meter in and meter out of a Double acting Hydraulic cylinder
8. Build a circuit for meter in and meter out of a single acting Hydraulic cylinder

Unit -IV
Engineering applications of oil power system

Cognitive level-Application

1. Build a Pump unloading circuit
2. Build a circuit to achieve faster extension as in drilling machine
3. Build a circuit counter balance valve application as in power press to avoid free fall of hammer due to gravity
4. Build a circuit to lock the cylinder using pilot check valve to protect the piston rod from external forces
5. Build a circuit for an application of sequencing of circuit as in case of punching machine to clamp the work piece and to perform punching operation
6. Build a circuit to obtain automatic reciprocating of cylinders
7. Build a fail safe circuit against over loading and to prevent injury to the operator
8. Build a accumulator circuit to store energy and supply when needed

Unit -V
Basic pneumatic circuits

Cognitive level-Application

1. Build a circuit to actuate single acting Pneumatic cylinder
2. Build a circuit to control forward speed of a single acting Pneumatic cylinder
3. Build a circuit to control reverse speed of a single acting Pneumatic cylinder
4. Build a circuit to actuate Double acting Pneumatic cylinder
5. Build a circuit to control forward speed of a Double acting Pneumatic cylinder
6. Build a circuit to control reverse speed of a Double acting Pneumatic cylinder
7. Build a circuit for meter in and meter out of a Double acting Pneumatic cylinder
8. Build a circuit for meter in and meter out of a single acting Pneumatic cylinder
9. Build a circuit for Pilot controlled double acting cylinder
10. Build a circuit for Double acting cylinder to advance by actuation of a solenoid valve and it's retract movements is delayed by time lag through a timer

Unit -VI
Engineering applications of pneumatic system

Cognitive level-Application

1. Build a Circuit to Press fit a pin to a hole with a pre-condition that while actuating of the cylinder, both the hands of the operator should be engaged (two handed safety circuits)
2. Build a circuit for a piston rod of a double acting cylinder is to extend when two 3/2 DC valves are actuated if one of the 3/2DC valve is released the cylinder returns to its initial position(AND function)
3. Build a circuit for a double acting cylinder extends if one or both 3/2DC valve are operated. If both 3/2 DC valves are released then cylinder retracts (OR function)