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**PRESIDENCY UNIVERSITY
BENGALURU
SCHOOL OF ENGINEERING**

TEST – 1

Sem A Y: Sem 2019-20

Date: 27.09.2019

Course Code: MEC 319

Time: 11.00 AM to 12.00PM

Course Name: HYDRAULICS & PNEUMATICS

Max Marks: 40

Program & SEM: B.Tech, (MEC) & V DE

Weightage: 20%

Instructions:

(i) *Answer all questions and draw sketches using pencil only*

Part A [Memory Recall Questions]

Answer both the Questions. Each Question carries four marks. (2Qx4M=8M)

1. Describe any two differences between Single acting and Double acting cylinder.

(C.O.NO.1)[Knowledge]

2. State any four disadvantages of Hydraulic system.

(C.O.NO.1)[Knowledge]

Part B [Thought Provoking Questions]

Answer both the Questions. Each question carries six marks. (2Qx6M=12M)

3. Discuss the characteristics of Positive Displacement Pumps used in general application.

(C.O.NO.1)[Comprehension]

4. Estimate the theoretical flow rate from a fixed-displacement axial piston pump with a nine-bore cylinder operating at 2000 RPM? Each bore has a diameter of 15 mm and stroke is 20 mm.

(C.O.NO.1)[Application]

Part C [Problem Solving Questions]

Answer both the Questions. Each question carries ten marks. (2Qx10M=20M)

5. Explain Vane pump with a neat sketch and also derive an expression for its volumetric efficiency.

(C.O.NO.1) [Comprehension]

6. Generalize the expression for overall pump efficiency. (C.O.NO.1) [Comprehension]



SCHOOL OF ENGINEERING

Semester: V SEM

Course Code: MEC 319

Course Name: HYDRAULICS AND PNEUMATICS

Date: 27-09-2019

Time: 11 AM TO 12 PM

Max Marks: 40

Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type			Thought provoking type			Problem Solving type			Total Marks
			[Marks allotted]	Bloom's Levels		[Marks allotted]	Bloom's Levels		[Marks allotted]	Bloom's Levels		
				K			C			A		
1	1	MODULE-1	4									
2	1	MODULE-1	4									
3	1	MODULE-1				6						
4	1	MODULE-1				6						
5	1	MODULE-1				10						
6	1	MODULE-1				10						
	Total Marks											

K = Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

Annexure- II: Format of Answer Scheme



SCHOOL OF ENGINEERING

SOLUTION

Semester: V SEM

Course Code: MEC319

Course Name: HYDRAULICS AND PNEUMATICS

Date: 27-09-2019

Time: 11 AM TO 12 PM

Max Marks: 40

Weightage: 20%

Part A

(2Q x 4M = 8Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	<p>Hydraulic system is the technology that deals with the generation, control, and transmission of power, using pressurized liquid.</p> <p>Components are pump, oil tank, flow control valve, pressure relief valve, hydraulic cylinder, directional control valve, throttle valve.</p>	<p>Definition=2M</p> <p>Any 4 parts=2M</p>	5 Min
2	<p>Advantages:</p> <ol style="list-style-type: none"> 1. Easy and accuracy of control(by the use of simple lever and push button) 2. Multiplication of force(without using cumbersome gears, pulleys and levers) 3. Constant force or torque(regardless of speed changes) 4. Simplicity, safety, economy(fewer moving parts compare to mechanical or electrical system) 5. High force density and compact construction 6. Long life cycle and low maintenance 7. Easily automated 8. Easy reversal movement. 	Each adv=1 M	5 Min

Part B

(Q x M = Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
3.	<ol style="list-style-type: none"> 1. These are low pressure, high volume flow pumps. 2. They are used only for fluid transport and are not used in fluid power industry because they cannot withstand high pressures. 	Any 6=6 M	10 Min

	<p>3. They have relatively small volumetric efficiency compared to positive pumps and low pressure discharge output.</p> <p>4. Max pressure limited to 15 to 20 bars</p> <p>5. Examples of these pumps are: Ex: Centrifugal pumps (Impeller Type) Axial Pumps (Propeller Type)</p>		
4	<p>Theoretical flow rate is given by</p> $Q = \frac{V \cdot N \cdot n}{60}$ <p> $= \frac{2 \cdot 0.015 \cdot 2000}{60}$ $= 0.5 \text{ m}^3/\text{s}$ $= 0.5 \times 3.6 \text{ m}^3/\text{s}$ $= 1.8 \text{ m}^3/\text{s}$ </p>	<p>Formula=2M Each Step=2 M Final Answer=2M</p>	10 Min

Part C

(Q x M = Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
5		<p>Diagram=5 M</p> <p>Sketch=5 M</p>	15 Min

From geometry, we can find the maximum possible eccentricity

$$e_{\max} = \frac{D_C - D_R}{2}$$

This maximum value of eccentricity produces a maximum volumetric displacement

$$V_{D_{\max}} = \frac{\pi}{4} (D_C^2 - D_R^2) L$$

Noting that we have the difference between two squared terms yields

$$V_{D_{\max}} = \frac{\pi}{4} (D_C + D_R)(D_C - D_R) L$$

Substituting the expression for e_{\max} yields

$$V_{D_{\max}} = \frac{\pi}{4} (D_C + D_R)(2e_{\max}) L$$

The actual volumetric displacement occurs when $e_{\max} = e$

$$V_{D_{\max}} = \frac{\pi}{4} (D_C + D_R) e L$$

6

The actual power delivered to a pump from a prime mover via a rotating shaft is called brake power and the actual power delivered by a pump to the fluid is called hydraulic power.

Expression for
Mechanical
efficiency=4 M

Expression for
Volumetric
efficiency=3 M

Expression for
Overall
Efficiency=3 M

15 Min



Roll No.

**PRESIDENCY UNIVERSITY
BENGALURU**

SCHOOL OF ENGINEERING

TEST – 2

Sem & AY: Odd Sem 2019-20

Date: 16.11.2019

Course Code: MEC 319

Time: 11:00 AM TO 12:00 PM

Course Name: HYDRAULICS & PNEUMATICS

Max Marks: 40

Program & Sem: B.Tech, & V

Weightage: 20%

Instructions:

(i) Answer all questions, write sketches using pencil only

Part A [Memory Recall Questions]

Answer both the Questions. Each Question carries five marks. (2Qx5M=10M)

1. Define 2/4 way valve with a neat sketch (C.O.NO.2) [Knowledge]
2. Classify Direction control valves based on the type of construction and number of working ports. (C.O.NO.2) [Knowledge]

Part B [Thought Provoking Questions]

Answer both the Questions. Each Question carries eight marks. (2Qx8M=16M)

3. A pump supplies oil at 0.0016 cubic meter per second to a 40 mm diameter double acting hydraulic cylinder. If the load is 5000 N (extending and retracting) and rod diameter is 20 mm find the following, a). Hydraulic pressure during the extending stroke, b). Piston velocity during the extending stroke. c). Cylinder KW power during the extending stroke. d). Hydraulic pressure during retracting stroke. e). Piston velocity during the retraction stroke. f). Cylinder KW power during the retraction stroke (C.O.NO.3) [Comprehension]
4. Explain the control of a double acting cylinder with a neat sketch. (C.O.NO.3) [Comprehension]

Part C [Problem Solving Questions]

Answer the Question. The Question carry fourteen marks (1Qx14M=14M)

5. Illustrate regenerative circuit with a neat sketch, also explain regenerative circuit analysis and its application in drilling. (C.O.NO.3) [Comprehension]



SCHOOL OF ENGINEERING

Semester: V

Course Code: MEC 319

Course Name: HYDRAULICS & PNEUMATICS

Program & Sem: B.TECH, V

Date: 16-11-2019

Time: 11 AM TO 12 PM

Max Marks: 40

Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels			Thought provoking type [Marks allotted] Bloom's Levels			Problem Solving type [Marks allotted]			Total Marks
			K			C			A			
1	CO2	2	5									
2	CO2	2		5								
3	CO3	3				8						
4	CO3	3					8					
5	CO3	3							14			
	Total Marks		5	5		8	8		14			40

K = Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

Annexure- II: Format of Answer Scheme



SCHOOL OF ENGINEERING

SOLUTION

Date: 16-11-2019

Time: 11 AM TO 12 PM

Max Marks: 40

Weightage: 20%

Part A

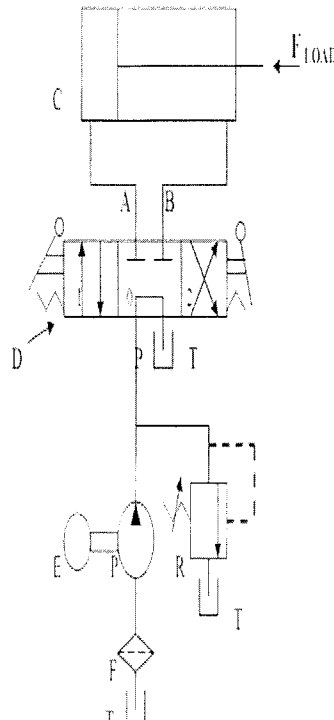
(Q x M = Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1.	<p>Fig 4.3. <u>2 / 4 valve symbol</u></p> <p>A valve with 4 service ports and 2 position is designated as 2 / 4 valve.</p>	<p>Sketch=3 M</p> <p>Explanation=2 M</p>	5 MIN
2.	<p><u>According to type of construction :</u></p> <ul style="list-style-type: none"> • Poppet valves • Spool valves <p><u>According to number of working ports :</u></p> <ul style="list-style-type: none"> • Two- way valves • Three – way valves • Four- way valves. 	<p>As per construction=2 M</p> <p>Working ports=3 M</p>	5 Min

Part B

(2Q x 8 M = 16 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
3.	<p><u>Extending stroke :</u></p> <p>Force, $F_{ext} = p \cdot A_p$ ----- 1</p> <p>Velocity, $v_{ext} = Q_o / A_p$ -----2</p>	<p>Extending stroke=2 M</p> <p>Retraction stroke=2M</p>	10 Min

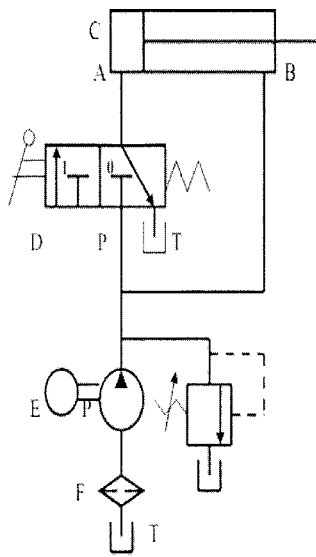
	<p>Retraction Stroke : Force, $F_{ret} = p \cdot (A_p - A_r)$ --- 3 Velocity, $v_{ret} = Q_p / (A_p - A_r)$ --- 4 Power (kW) = v_p (m / s) \cdot F (kN) = Q (m³ / s) \cdot p (kPa)</p>	Power=2 M Final correct answers with units=2M	
4.	 <p>C = Double acting cylinder P = Pump E = Electric Motor T = Tank F = Filter R = Relief Valve D = 3-position, 4 way, Tandem center, Manually operated and Spring Centered DCV</p>	Sketch=4 M Explanation=3 M Labelling=1 M	10 Min

Part C

(1Q x 14M = 14Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
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5.



- C = Double acting cylinder
- P = Pump
- E = Electric Motor
- T = Tank
- F = Filter
- R = Relief Valve
- D = 2-position, 3 way, Manually operated and Spring return DCV

Sketch=6 M

Analysis=4 M

Application in drilling=4 M

20 Min

Cylinder Extending Speed

$$Q_T = Q_P - Q_R$$

Or $Q_P = Q_T + Q_R \quad \dots (1)$

$$Q_P = A_p V_{p_{ext}} - (A_p - A_r) V_{p_{ext}}$$

Therefore, $Q_P = A_r V_{p_{ext}}$

Hence the extending speed of the piston. $V_{p_{ext}} = \frac{Q_p}{A_r} \quad \dots (2)$

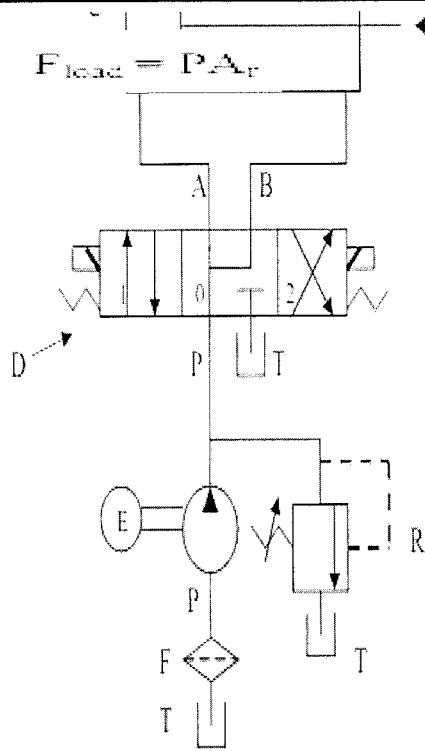
$$V_{p_{ret}} = \frac{Q_p}{A_p - A_r} \quad \dots (3)$$

Dividing eq(1) with (4) we have $\frac{V_{p_{ext}}}{V_{p_{ret}}} = \frac{Q_p \cdot A_r}{Q_p \cdot (A_p - A_r)} = \frac{A_r}{A_p - A_r}$

Simplifying we obtain the ratio of extension speed and retracting speed

$$\frac{V_{p_{ext}}}{V_{p_{ret}}} = \frac{A_r}{A_p - A_r} - 1 \quad \dots (4)$$

Load-Carrying Capacity during Extension :



C - Double acting cylinder

D - 3 Position, 4 Way,
Regenerative center,
solenoid actuated,
spring centered DCV

R - Relief Valve

F - Filter

E - Electric Motor

T - Tank

P - Pump



Roll No																			
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**PRESIDENCY UNIVERSITY
BENGALURU**

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Semester: Odd Semester: 2019 - 20

Course Code: MEC 319

Course Name: HYDRAULICS & PNEUMATICS

Program & Sem: B.Tech (MEC) & V (DE-I)

Date: 20 December 2019

Time: 9:30 AM to 12:30 PM

Max Marks: 80

Weightage: 40%

Instructions:

- (i) Read the all questions carefully and answer accordingly.
- (ii) Draw all sketches with pencil only.

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries 2 marks.

(10Qx2M=20M)

1. Pumps are classified mainly as _____ (C.O.No.1) [Knowledge]
2. A hydraulic pump is a device which converts ___ energy into _____ energy (C.O.No.2) [Knowledge]
3. Define Slip stick effect. (C.O.No.3) [Knowledge]
4. Recognize the symbol for 3/2 Poppet valve. (C.O.No.4) [Knowledge]
5. List two functions of pressure relief valve in a hydraulic system. (C.O.No.3) [Knowledge]
6. Two limitations of hydraulic systems are ____ & ____ (C.O.No.1) [Knowledge]
7. Distinguish between Hydraulic pump and Hydraulic motor (C.O.No.3) [Knowledge]
8. Examples for positive-displacement are _____ & _____ (C.O.No.1) [Knowledge]
9. The performance of hydraulic motors depends on _____ & _____ (C.O.No.2) [Knowledge]
10. Mechanical efficiency of a pump is the ratio of _____ to _____ (C.O.No.2) [Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each Question carries 8 marks.

(5Qx8M=40M)

11. Explain the working of a vane motor with a neat diagram. (C.O.No.2) [Comprehension]
12. Distinguish between balanced vane motor and unbalanced vane motor with a neat diagrams (C.O.No.1) [Comprehension]

13. Explain closed center 3/4 way direction control valve (mid-position) with a neat diagram and its symbol. (C.O.No.3) [Comprehension]
14. Write the symbols for the following pneumatic parts,
 a. Push button operated valve b. Pedal operated valve c. Spring return/reset
 d. roller-lever operated limit switch e. Pilot operated valve f. Solenoid actuated valve
 g. Air service unit h. Pressure source
 (C.O.No.4) [Comprehension]
15. Explain the following parts with a neat cross sectional diagram.
 a. Compressed air lubricator b. Compressed Air regulator (C.O.No.4) [Comprehension]

Part C [Problem Solving Questions]

Answer both the Questions. Each Question carries 10 marks. (2Qx10M=20M)

16. With a neat sketch explain the sequencing of A+B+B-A- of two cylinders. Also write the travel step diagram, and indicate an application. (C.O.No.4) [Comprehension]
17. Illustrate the control of a pneumatic double acting cylinder using two electrical power sources of 0V and 24V enabled DCV. This is used to draw molten metal by raising and lowering of the ladle in a smelting crucible. Also note that speed of raising and lowering is separately adjustable as shown in figure 1

(C.O.No.3) [Application]

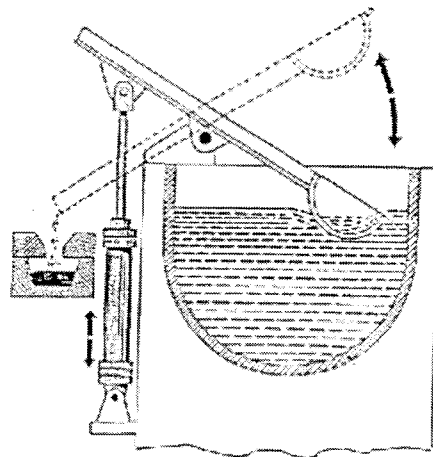


Figure 1



SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Extract of question distribution [outcome wise & level wise]

Q.NO	C.O.NO (% age of CO)	Unit/Module Number/Unit /Module Title	Memory recall type	Thought provoking type	Problem Solving type [Marks allotted]	Total Marks
			[Marks allotted]	[Marks allotted]		
			Bloom's Levels	Bloom's Levels		
			K	C	A	
1	1	1	2			2
2	2	2	2			2
3	3	3	2			2
4	4	4	2			2
5	4	4	2			2
6	1	1	2			2
7	3	3	2			2
8	1	1	2			2
9	2	2	2			2
10	2	2	2			2
11	2	2		8		8
12	1	1		8		8
13	3	3		8		8
14	4	4		8		8
15	4	4		8		8
16	4	4		10		10
17	3	3			10	10
Total Marks			20	50	10	80

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I hereby certify that all the questions are set as per the above guidelines.

Faculty Signature:

Reviewer Comment:

Format of Answer Scheme



SCHOOL OF ENGINEERING

SOLUTION

Semester: Odd Sem. 2019-20

Course Code: MEC 319

Course Name: HYDRAULICS & PNEUMATICS

Program & Sem: B.Tech (MEC) & V (DE-I)

Date: 20.12.2019

Time: 9:30 AM to 12:30 PM

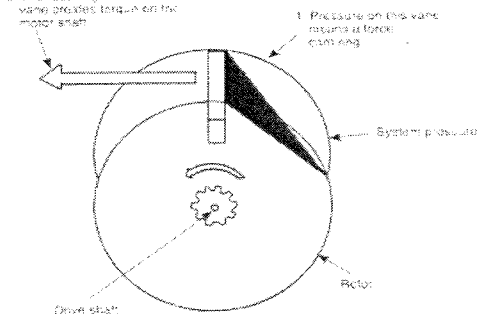
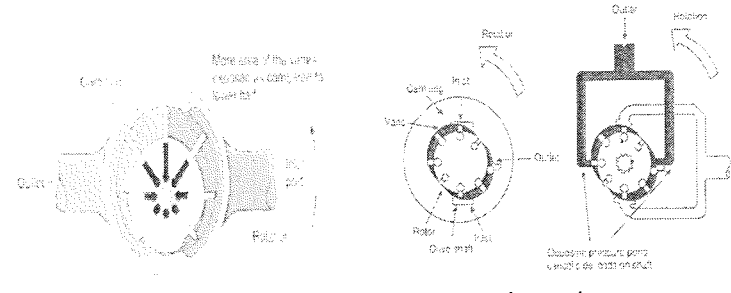
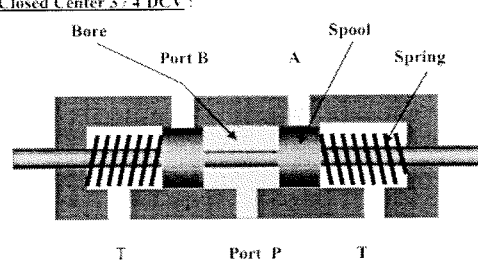
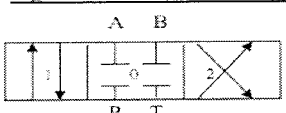
Max Marks: 80

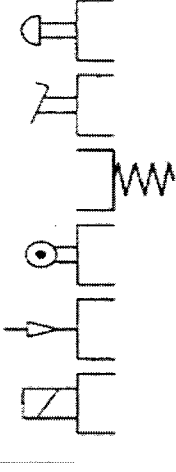
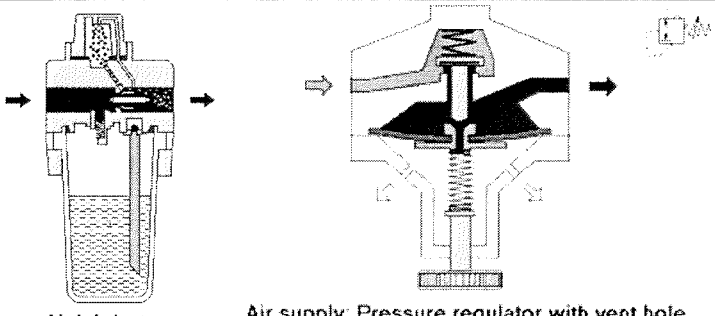
Weightage: 40%

Part A

(10Q x 2M = 20Marks)

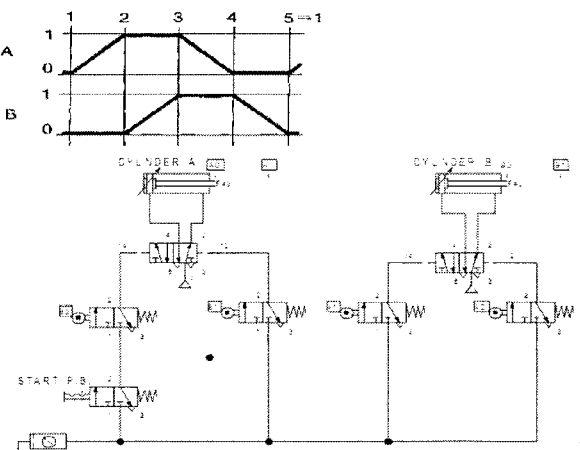
Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	Positive displacement pumps and Non-positive displacement pumps	2 Marks	5 Min
2	A hydraulic motor is device which converts hydraulic energy into rotary/ mechanical energy.	2 Marks	5 Min
3	There is a limitation in achieving smooth movement of cylinder with low speed setting of flow control valve. This results in jerky motion of piston which is called as stick slip effect.	2 Marks	5 Min
4	<p><u>2 / 2 DCV (Poppet design) :-</u></p> <p>a. Valve Closed b. Valve Opened</p> <p>Fig 4.6. 2 / 2 DCV Poppet Design</p>	2M	5 Min
5	Pressure relief valve acts as safety device, and can also be used for sequencing of cylinders.	Each=1 M	5 Min
6	<ol style="list-style-type: none"> leakage is impossible to eliminate completely lines can burst, possibly resulting in injuries to people hydraulic oils can cause fires if an oil leak occurs in an area of hot equipment 	Any two=2 Marks	5 min
7	HYDRAULIC PUMP: converts mechanical into hydraulic energy. HYDRAULIC MOTOR: converts hydraulic energy into mechanical work.	Each=1M	5 min
8	Gear Pump, Vane Pump, Lobe Pump,	Each=1M	5 min
9	<ul style="list-style-type: none"> Manufacturing precision Maintenance of close tolerance Internal leakage Friction between internal parts Internal fluid turbulence 	Any two=2M	5 min
10	<p>Mechanical Efficiency: It is the ratio of pump output power assuming no leakage to the actual power delivered to pump.</p> <ul style="list-style-type: none"> $(\eta_m) = \frac{pQT}{TAN}$ 	2 M	5 min

Q No	Solution	Scheme of Marking	Max. Time required for each Question
11		<p>Sketch= 4 M</p> <p>Explanation=4 M</p>	<p>15 Min</p>
12		<p>Each diagram=2M</p> <p>Each difference=2 M</p>	<p>15 Min</p>
13	<p>b.) <u>Closed Center 3 / 4 DCV :</u></p>  <p><u>Mid Position: Closed Center</u></p> <p><u>Fig 4.10a. Closed Center 3 / 4 DCV</u></p>  <p><u>Fig 4.10b. Symbol</u></p> <ul style="list-style-type: none"> ▪ All ports are closed to each other. ▪ Hence actuator connected to port A and B hydraulically locked cannot be moved by an external force. ▪ The pump flow must go over the pressure relief valve. ▪ It wastes pump power, increase wear and shorten pump life. 	<p>Cross-sectional view=3 M</p> <p>Symbol=2 M</p> <p>Explanation=3 M</p>	<p>15 Min</p>

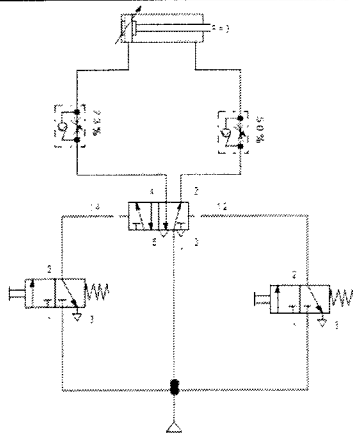
14	<p>PUSH BUTTON OPERATED VALVE</p> <p>PEDAL OPERATED VALVE</p> <p>SPRING RESET</p> <p>ROLLER LEVER OPERATED LIMIT SWITCH</p> <p>PILOT OPERATED VALVE</p> <p>SOLENIOD ACTUATED VALVE</p> <p>Pressure Source</p> <p>Air Service Unit</p>		<p>Each correct answers=1 Marks</p> <p>15 Min</p>
15	 <p>Air lubricator</p> <p>Air supply: Pressure regulator with vent hole</p>	<p>Each diagrams=2 M</p> <p>Each Explanations=2 M</p>	15 Min

Part C

(2Q x 10M = 20Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
16		<p>Travel-step diagram=2 M</p> <p>Circuit=3M</p> <p>Explanation=3 M</p> <p>Application=2M</p>	30 Min

17



Ensure the push buttons are replaced by solenoid valves on either sides.
And power sources of 0V and 24 V are mentioned.

Circuit: 4 Marks

Explanation: 4 M

Flow control valves with % = 2 Marks

30 Min