Programme Name/s : **Production Engineering**
Programme Code : **PG**
Semester : **Third**
Course Title : **INDUSTRIAL FLUID POWER**
Course Code : **313315**

I. RATIONALE

Diploma engineering holder is required to operate and use fluid operated devices for various engineering applications. This course will give the basic knowledge and skills to select and use different types of fluid powered equipment for various industrial applications.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Construct fluid power circuits for simple industrial applications.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Measure properties of fluid using appropriate measuring devices.
- CO2 - Calculate friction losses in flow through pipes.
- CO3 - Select relevant components for hydraulic and pneumatic systems.
- CO4 - Select relevant control valves and actuators for hydraulic and pneumatic systems in given situation.
- CO5 - Develop different hydraulic and pneumatic circuits for given simple applications.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical							
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
313315	INDUSTRIAL FLUID POWER	IFP	DSC	4	-	2	-	6	3	3	30	70	100	40	25	10	-	-	-	-	125

Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Classify fluids TLO 1.2 State properties of fluid. TLO 1.3 Describe pressure measurement devices. TLO 1.4 Calculate centre of pressure and total pressure of an immersed surface.	**Unit - I Basics of fluid power** 1.1 Classification of fluids, properties of fluids: Viscosity, Specific gravity, Specific weight, Demulsibilty, Neuralization number, Lubricity, Low foam tendency, Heat dissipation and ISO grades of oil. 1.2 Concept of Atmospheric, Gauge and Vacuum pressure. 1.3 Pressure measurement devices : U tube manometer (No numericals), Bourdon tube pressure gauge, construction and working. 1.4 Concept of Static pressure, Pressure head, Center of pressure and Total pressure (Simple Numerical).	Fluid samples for Demonstration of properties of fluids. Models /Charts of pressure measurement devices .

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 State types of fluid flow. TLO 2.2 Apply Pascal's law, Continuity equation, Bernoulli's Theorem. TLO 2.3 Calculate frictional coefficient using Darcy's equation. TLO 2.4 Determine minor losses for fittings and valves.	**Unit - II Fluid Flow and flow through pipes** 2.1 Types of fluid flow: Steady, Unsteady, Laminar, Turbulent, One, Two and Three dimensional flow, Uniform and Non uniform flow. 2.2 Pascal's law, Continuity equation, Bernoulli's Theorem. 2.3 Flow through pipes: Laws of fluid friction for Laminar and Turbulent flow. 2.4 Darcy's and Chezy's equation for frictional losses , Minor losses in fittings and Valves (Simple Numericals on sudden enlargement and contraction).	Display chart for types of fluid flow. Models/Setup of friction through pipes. Display chart for minor losses.
3	TLO 3.1 Draw layout of fluid power system. TLO 3.2 Describe construction and working of pump/compressor. TLO 3.3 Select pump/compressor for given application. TLO 3.4 Select various accessories required in the given hydraulic/pneumatics. TLO 3.5 Use of ISO symbols for fluid power system.	**Unit - III Components of Industrial Fluid power system** 3.1 General layout of oil Hydraulic and Pneumatic system and its comparison. 3.2 Pumps for oil hydraulic system : Gear pump, Vane pump and Piston pump. 3.3 Compressor for pneumatic system :Construction and working of reciprocating , screw, vane and centrifugal compressor. 3.4 Accessories for Hydraulic and Pneumatic system : Oil reservoir, Pipes, Hoses, fittings, Oil filters, Air filters, FRL unit, Seals and Gaskets, Intensifiers, Accumulators, Heat exchanger and muffler. 3.5 ISO symbols of components of fluid power system.	Display chart for Layout of fluid power system. Demonstration set up of fluid power system Models/charts of pumps, compressor and accessories. Display chart for ISO symbols.
4	TLO 4.1 Classify control valves. TLO 4.2 Describe construction and working of control valves. TLO 4.3 Select appropriate control valves for given application. TLO 4.4 Compare control valves based on function and construction.	**Unit - IV Control valves and Actuators** 4.1 Classification of Control valves: As per type of control valve element and parameter under control. 4.2 Pressure control valves: Construction and working of Pressure relief valve, Pressure reducing valve, Sequence valve and Counter balance valve. 4.3 Direction control valve : Construction and working of 2/2 , 3/2, 4/2, 4/3 DC valves. 4.4 Flow control valve : Pressure compensated and non-compensated. 4.5 Special valves in pneumatics: Dual (twin) Pressure valve, Shuttle valve, Quick exhaust valve, Time delay valve.	Models/charts of Control valves: pressure control valve, direction control valve , flow control valve and special valves of fluid power systems. Models/charts of Actuators used in fluid power system.

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Draw basic fluid circuits for given actuators. TLO 5.2 Select components for speed control circuit for given application. TLO 5.3 Construct sequencing hydraulic circuit for given application. TLO 5.4 Draw Pilot control Hydraulic circuits for given applications. TLO 5.5 Identify common faults in oil hydraulic system.	**Unit - V Oil Hydraulic and Pneumatic circuit** 5.1 Basic circuits to actuate Single Acting Cylinder, Double Acting Cylinder, motors. 5.2 Speed control circuits: Meter in, Meter out and their application (Shaper machine tool movement, Table movement of milling or Grinding machine). 5.3 Sequencing circuit for Simple applications. 5.4 Pilot control/impulse control circuit. 5.5 Maintenance of Oil hydraulic system-common faults,causes and remedies.	Charts of fluid power circuits. Animation of fluid power circuits. Charts for faults and remedies.

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Measure pressure of water, oil and compressed air. LLO 1.2 Calculate pressure of water, oil and compressed air.	1	*Measurement of pressure of given fluid using suitable instrument.	2	CO1
LLO 2.1 Measure parameters of Total energy. LLO 2.2 Calculate parameters of Total energy.	2	Verification of Bernoulli's theorem.	2	CO2
LLO 3.1 Measure parameters of water required to calculate friction factor. LLO 3.2 Calculate Darcy's friction factor.	3	Determination of Darcy's friction factor.	2	CO2
LLO 4.1 Measure parameters required to calculate minor frictional losses. LLO 4.2 Calculate minor frictional losses.	4	*Determination of minor frictional losses in pipes.	2	CO2
LLO 5.1 Identify components of hydraulic and pneumatic system. LLO 5.2 Draw ISO symbols of hydraulic and pneumatic components.	5	*Identification of hydraulic and pneumatic system components.	2	CO3
LLO 6.1 Actuate Pump and compressor. LLO 6.2 Measure pressure and flow rate.	6	Measure parameters of oil hydraulic pump and compressor.	2	CO3
LLO 7.1 Identify components of control valves. LLO 7.2 Set/Operate Control valves.	7	*Demonstration of Pressure relief valve, direction control valve and flow control valve.	2	CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 8.1 Identify components of actuators. LLO 8.2 Operate actuators.	8	* Demonstration of SA , DA cylinders and motors in fluid power system.	2	CO4
LLO 9.1 Identify components of FRL unit, Shuttle valve, Twin pressure valve. LLO 9.2 Set/Operate FRL unit, Shuttle valve, Twin pressure valve.	9	Demonstration of FRL unit, Shuttle valve, Twin pressure valve used in pneumatic system.	2	CO4
LLO 10.1 Select components for given circuit. LLO 10.2 Construct hydraulic circuit. LLO 10.3 Actuate given actuators.	10	Hydraulic circuit for SAC and DAC, Hydromotor.	2	CO4 CO5
LLO 11.1 Select components for given circuit. LLO 11.2 Construct pneumatic circuit. LLO 11.3 Operate given actuators.	11	Pneumatic circuits for SAC and DAC, Air motor.	2	CO4 CO5
LLO 12.1 Select components for given speed control circuit. LLO 12.2 Construct and actuate hydraulic speed control circuit.	12	* Speed control circuits: Meter-in and Meter out hydraulic circuit.	2	CO4 CO5
LLO 13.1 Select components for given speed control circuit. LLO 13.2 Construct and actuate pneumatic speed control circuit.	13	Speed control circuits for pneumatic system.	2	CO4 CO5
LLO 14.1 Select components for given sequencing hydraulic circuit. LLO 14.2 Construct and actuate given sequencing hydraulic circuit.	14	Sequencing hydraulic circuit.	2	CO4 CO5
LLO 15.1 Select components for given sequencing pneumatic circuit. LLO 15.2 Construct given sequencing pneumatic circuit. LLO 15.3 Actuate the sequencing circuit.	15	*Sequencing pneumatic circuit.	2	CO4 CO5
LLO 16.1 Operate given fluid power system. LLO 16.2 Trouble shoot the occurred faults. LLO 16.3 Solve the identified faults.	16	*Maintenance of Hydraulic and Pneumatic System.	2	CO4 CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Not Applicable

- Not Applicable

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	U tube differential manometer (Mercury/water), Bourdon tube pressure gauge Manometer 0--300cm Liquid : Mercury or water, Bourdon Gauge 0-20 Kg/cm2, Dial Size : 1.5 inch, 2.5 Inch, 4 Inch	1
2	Maintenance tool kit with spanner set (4-5 to 30-32), Allen keys set (0 - 6 mm)	16
3	Bernoulli's theorem apparatus With Pipe of Varying cross sectional area, Pump of Max Head 21 Meter, Water flow 1.35 Lit/Sec, Motor rating -O.37KW, Sump Tank Capacity:250 Liiter	2
4	Test rig of frictional losses (Darcy's friction factor) Pump: Maximum Head 21 m, Water Flow :1.35 Lit/sec Maximum, Motor rating: 0.37 KW, Sump Capacity : 250 Liter	3
5	Test rig of minor frictional losses in pipes, The set up with sudden enlargement and contraction , pipe fittings, Pump: Maximum Head 21 m, Water Flow :1.35 Lit/sec Maximum, Motor rating: 0.37 KW, Sump Capacity : 250 Liter	4
6	Hydraulic Trainer kit with various components like Hydraulic power pack, Set of Pressure relief, Pressure reducing and Sequence valve , 3/2 , 4/2,4/3 DCV, Flow control valve with built in check valve, pipes and hoses, SA Cylinder, DA Cylinder	5,6,7,8,10,12,14,16
7	Pneumatic trainer kit with portable compressor Pressure up to 12 Bar, FRL Unit, 3/2 , 5/2,5/3 DCV, Flow control valve with check valve, Twin pressure valve, Shuttle valve, pipes and low pressure hoses, SA Cylinder, DA Cylinder	5,6,7,8,9,11,13,15,16
8	Charts, cut section models, actual samples of different components of fluid power system	7,8,9

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Basics of fluid power	CO1	8	2	4	4	10
2	II	Fluid Flow and flow through pipes	CO2	12	4	4	4	12
3	III	Components of Industrial Fluid power system	CO3	14	2	8	6	16
4	IV	Control valves and Actuators	CO4	14	4	6	6	16
5	V	Oil Hydraulic and Pneumatic circuit	CO5	12	0	4	12	16
Grand Total				**60**	**12**	**26**	**32**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Class Test, Term work

Summative Assessment (Assessment of Learning)

- Theory

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	2	-	3	-	2	2			
CO2	3	2	-	3	-	2	2			
CO3	3	-	-	-	-	2	-			
CO4	3	-	-	-	-	2	-			
CO5	3	2	3	3	-	2	3			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Dr. P. N. Modi, Dr. S. M. Seth	Hydraulics and Fluid mechanics including hydraulics machines	Standard Book House, Rajsons Publication Pvt. Ltd., New Delhi, ISBN 978-81-89401-26-9, Year: 2017
2	C. P. Kothandaraman, R. Rudramoorthy	Fluid Mechanics and Machinery	New Age International (P) Limited, New Delhi, ISBN : 978-81-224-3398-2, Year : 2012
3	Majumdar S.R.	Oil Hydraulic system-Principles and maintenance	Tata McGraw Hill, ISBN: 978-0-07-463748-7, Year : 2013
4	Majumdar S.R.	Pneumatics Systems Principles and Maintenance	Tata McGraw Hill, ISBN-978-0-07-460231-7, Year: 2015
5	Shanmuga Sundaram	Hydraulic and Pneumatic Controls	S. Chand Publishing, New Delhi, ISBN: 978-8-12-192635-5, Year:2013
6	Andrew Parr	Hydraulics & Pneumatics A Technicians & Engineers Guide	Butterworth-Heinemann Publisher, New Delhi ISBN: 978-0-08-096675-5, Year: 2006

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description

Sr.No	Link / Portal	Description
1	https://en.wikipedia.org/wiki/Hydraulic_pump	Hydraulic Pumps (all types)
2	https://www.youtube.com/watch?v=Qy1iV6EzNHg	Animation of Hydraulic pumps (all types)
3	https://www.youtube.com/watch?v=pWuxYnqYDnk	Animation of Hydraulic pumps
4	https://www.youtube.com/watch?v=sEVTIRYHoGg	Eaton Pump assembly
5	https://www.youtube.com/watch?v=XAItnsUcES0	Pneumatic control valves animation
6	https://www.youtube.com/watch?v=yIot4shcOkE	Control valve symbol generation
7	https://www.youtube.com/watch?v=jsMJbJQkGTs	Animation of D.C.Valve
8	https://www.youtube.com/watch?v=CQPwvWXbV3w	Animation of 4/2,4/3 D.C Valves
9	https://www.youtube.com/watch?v=bovfDsAYSbc	Animation of Hydraulic cylinder
10	https://www.youtube.com/watch?v=icaqvfAtccY	Telescopic cylinder animation
11	https://www.youtube.com/watch?v=MmYpzgh6Gok	Pneumatic cylinder
12	https://www.youtube.com/watch?v=4eCuPVxezzY	Speed control hydraulic circuit

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students