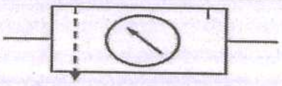
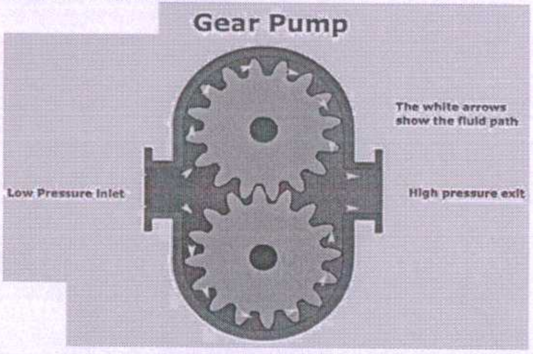
SCHEME OF VALUATION

(Scoring Indicators)

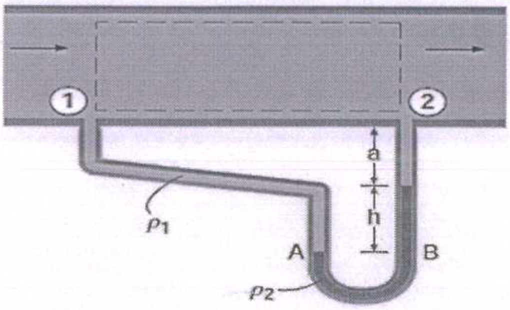
Revision: 2015 **Course Code: 3022**

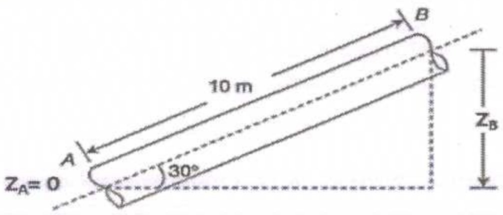
Course Title: Fluid Mechanics & Pneumatics

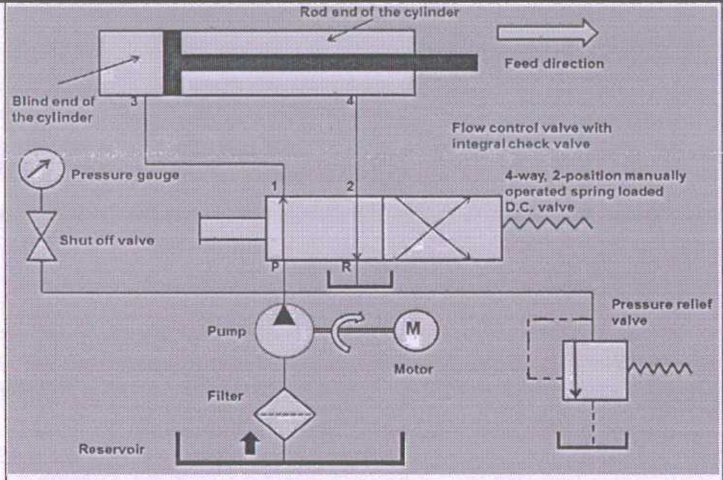
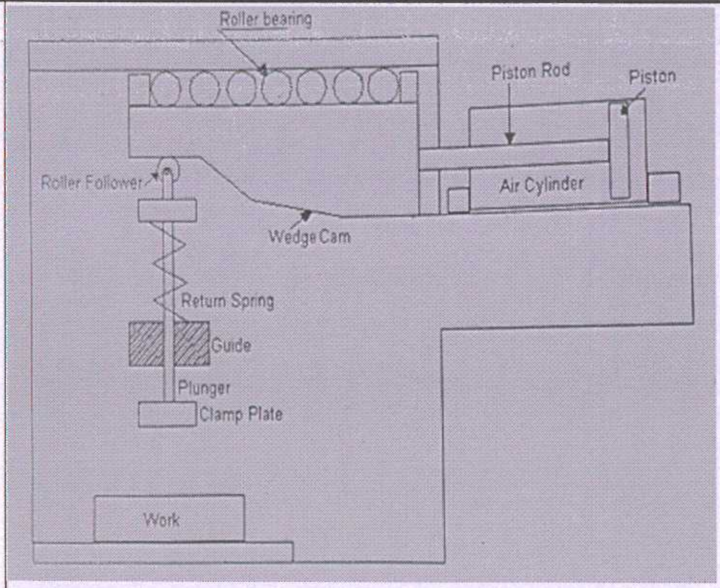
Question No.	Scoring Indicator	Split up score	Sub Total	Total
	PART- A			
I. 1	Incompressible, Non- viscous, No surface tension **(any two)**	1 x 2	2	10
I. 2	Q = constant or AV = constant; where Q is discharge in m^3/s, A is area of flow in m^2 and V is average velocity in flow section in m/s	2	2	
I. 3	The rate of change of viscosity of hydraulic oil with change in its temperature, indicated on an arbitary scale.	2	2	
I. 4		2	2	
I. 5	Duplex type of cylinder consists of two pistons and piston rods, with one piston rod operates inside the other one **or** Duplex cylinders are the type of pneumatic cylinders used where two operations are to be performed in a stroke on a sequence.	2	2	
	PART- B			
II. 1	$\textbf{Pressure head} = \left(\frac{P}{\rho g}\right) = \left(\frac{320 \times 10^3}{1000 \times 9.81}\right) = 32.62 \textbf{ m of water}$	3	6	
	$\textbf{Pressure head} = \left(\frac{320 \times 10^3}{13.6 \times 1000 \times 9.81}\right) = 2.40 \textbf{ m of mercury}$	3		
II. 2	The pressure exerted by the column of atmospheric air at a given location is called **local atmospheric pressure.**	1.5	6	
	For the calculations, atmospheric pressure tabulated with respect sea level is used to maintain uniformity. It is called **standard atmospheric pressure.**	1.5		
	Most pressure-measuring devices, however, are calibrated to read zero in the atmosphere and so they indicate the difference between the absolute pressure and the local atmospheric pressure. This difference is called the **gage pressure.**	1.5		
	Pressures below local atmospheric pressure are called **vacuum pressures** and are measured by vacuum gages that indicate the difference between the local atmospheric pressure and the absolute pressure.	1.5		
II. 3	**Steady flow-** At given location in a control volume, the flow parameters remain constant at all time **or** At given location in a control volume, the flow paramerts are independent of time.	2	6	
	Uniform flow- At the given instant, the flow parameters are same at all locations within a control volume **or** At the given instant, the flow parameters are independent of space variables.	2		
	Irrotational flow- The flow takes place with particles not having rotation about their mass centers **or** If the flow particles does not have any angular velocity/ vorticity components.	2		

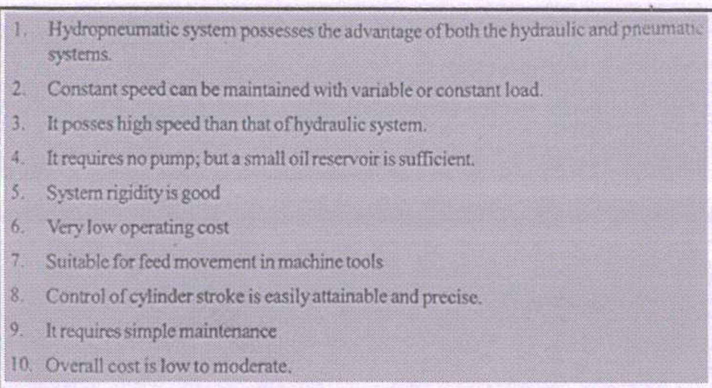
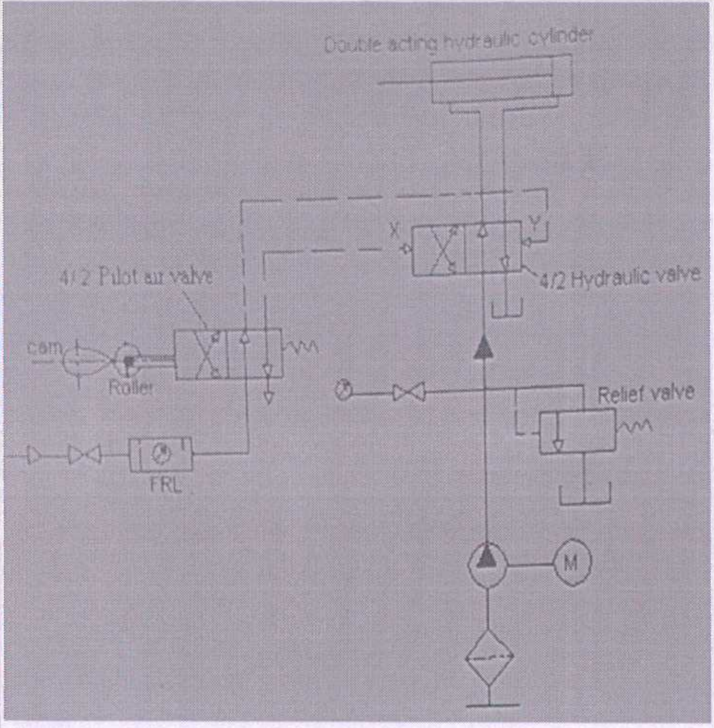
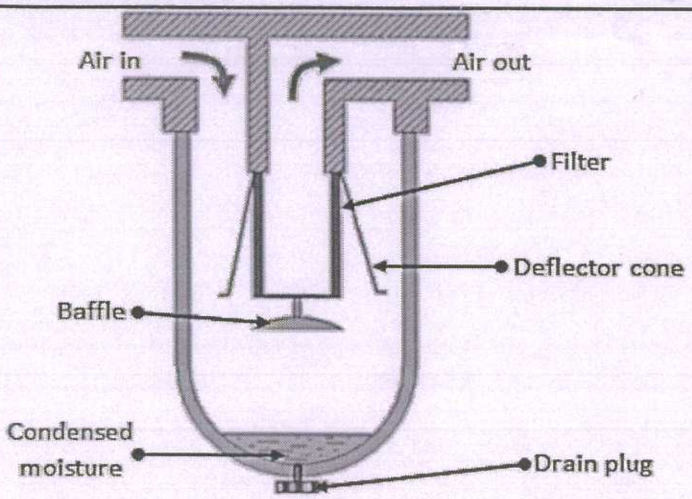
II. 4	The head losses in pipes are the reduction in pressure head of flowing fluid. It is classified as major head loss and minor head loss.	2	6	
	The pressure head losses happening due to friction incurred along the flow is called major head loss as it accounts for 75% to 90% of total head loss.	2		
	The total pressure head losses happening due to flow section variations along the flow is called minor head loss and it accounts to 10% to 25% of total head loss. The sum of losses occuring due to sudden contraction, sudden expansion, conical contraction, conical expansion, pipe fittings, bends, etc is minor head loss.	2		
II. 5	1. Automobiles- braking, power steering, etc 2. Hydraulic elevators and cranes 3. Construction machinery- Dump truck, road graders, excavators, bull dozers, etc 4. Farm machinery- tractors, etc 5. Hydraulic jacks, hoists and presses 6. Machine tools- shapers, riveting machines, drilling machines, grinding machines, etc 7. Propulsion systems- locomotives, ships, aircrafts, etc 8. Space crafts, missiles, etc 9. Fluid transfer- Hydraulic ram, pumps and motors 10. House hold applications (any six)	1 x 6	6	
II. 6	**Suitable simple sketch** 	3		
	Explanation of working	3	6	
II. 7	**Any six points of comparison** between pneumatic and hydraulic systems- with respect to design, safety, effectiveness, durability, reliabilty and economical aspects of system.	1 x 6	6	30

PART- C

III. (a)	Orientation  	2	9	
	Manometric equation $P_1 + \rho_1 g(a+h) - \rho_2 gh - \rho_1 ga = P_2$ $P_1 - P_2 = \rho_2 gh - \rho_1 gh$	4		
	Substitution of parameters $\rho_1 = 1000\ kg/m^3, \rho_2 = 2000\ kg/m^3, g = 9.81\ m/s^2, h = 0.1\ m$	2		
	Answer $P_1 - P_2 = 981\ Pa$	1		
III. (b)	Equation $Total\ Pressure = \rho\ g\ A\ \overline{x}$	3	6	
	Substitution of parameters $\rho = 1000\ kg/m^3, g = 9.81\ m/s^2,$ $A = \frac{\pi D^2}{4} = \frac{\pi * 2^2}{4} = 3.14\ m^2, \overline{x} = 2.5\ m$	2		
	Answer $Total\ Pressure = 77008.5\ N$	1		
IV. (a)	$\text{Specific weight} = \frac{\text{weight of liquid}}{\text{volume of liquid}} = \frac{27 \times 10^3}{3} = 9000\ \frac{\text{N}}{\text{m}^3}$	2	9	
	$\text{Specific mass or Mass density} = \frac{\text{specific weight}}{\text{accelaration due to gravity}}$ $= \frac{9000}{9.81} = 917.4\ \frac{\text{kg}}{\text{m}^3}$	2		
	$\text{Specific volume} = \frac{1}{\text{specific mass}} = \frac{1}{917.4} = 0.0011\ \frac{\text{m}^3}{\text{kg}}$	2		
	$\text{Specific gravity} = \frac{\text{mass density of liquid}}{\text{mass density of standard fluid}}$ Mass density of standard fluid= mass density of water= 1000 kg/m^3 $\text{Specific gravity} = \frac{917.4}{1000} = 0.9174$	3		
IV. (b)	Equation As per Archimedes principle, Weight of the ship = weight of sea water displaced = specific weight of sea water x volume of sea water displaced	3	6	
	Substitution of parameters Specific weight of sea water= Specific gravity x mass density of water = 1.2 x 1000 = 1200 kg/m^3 Volume of sea water displaced= 108 m^3	2		
	Answer Weight of the ship = 129600 N	1		15

V. (a)	**Orientation**  	2	9	
	Bernoulli's equation $P_A + \left(\frac{\rho {V_A}^2}{2}\right) + (\rho g Z_A) = P_B + \left(\frac{\rho {V_B}^2}{2}\right) + (\rho g Z_B)$	4		
	Substitution of parameters ρg = Specific weight= 9879 N/m³ As flow cross- section is uniform, $V_A = V_B$ Z_A= 0, Z_B= 10 x sin 30= 5 m P_B= 12 x 10³ Pa	2		
	Answer P_A= 61395 Pa	1		
V. (b)	**Equation** Q_{actual}= C_d x $Q_{theoretical}$= C_d x $\left(\frac{8}{15} * tan\left(\frac{\theta}{2}\right) * \left(\sqrt{2g}\right) * (H)^{5/2}\right)$	3	6	
	Substitution of parameters C_d= 0.60, θ= 60⁰, g= 9.81 m/s², H= 0.30 m $Q_{theoretical}$= 0.068 m³/s	2		
	Answer Q_{actual}= 0.60 x 0.068 = 0.041 m³/s	1		
VI. (a)	**Equation** Pumping power= ρ g Q H_{net}	2	9	
	Computation of head As per Darcy weisbach equation, $H_f = \frac{f L V^2}{2 g D}$ Flow cross- section, $A = \frac{\pi D^2}{4} = \frac{\pi * 0.2^2}{4} = 0.03\ m^2$ Average velocity, $V = \frac{Q}{A} = \frac{0.07}{0.03} = 2.33\ m/s$ $H_f = \frac{0.02 * 1000 * 2.33^2}{2 * 9.81 * 0.2}$= 27.67 m	4		
	Substitution of parameters $\rho = 1000\ kg/m^3$, g = $9.81\ m/s^2$, Q= 0.07 m³/s, For maintaining the flow, H_{net}= major head loss (H_f)	2		
	Answer Pumping power= 19 kW	1		
VI. (b)	**Equation** $Q_{theoretical} = \frac{A_1 A_2 \left(\sqrt{2 g H_L}\right)}{\sqrt{{A_1}^2 - {A_2}^2}}$	3	6	
	Substitution of parameters $A_1 = \frac{\pi D^2}{4} = \frac{\pi * 0.04^2}{4} = 0.001 m^2$ $A_2 = \frac{\pi d^2}{4} = \frac{\pi * 0.02^2}{4} = 0.0003 m^2$ g = $9.81\ m/s^2$, H_L= 3 m of water	2		
	Answer $Q_{theoretical}$ = 2.42 x 10⁻³ m³/s	1		15

VII. (a)	Rotary type hydraulic actuators are hydraulic motors and linear motion type hydraulic actuators are hydraulic cylinders	1	9	
	Explanation and Simple sketch of any one type of hydraulic motor	4		
	Explanation and Simple sketch of any one type of hydraulic cylinder	4		
VII. (b)	Simple sketch of any one type of hydraulic accumulator- weight loaded or spring loaded or gas loaded	3	6	
	Explanation on the working of the same hydraulic accumulator	3		
VIII. (a)	 Basic hydraulic circuit	6	9	
	Name of any six components	3		
VIII. (b)	The pressure control valves are pressure relief valves and pressure reducing valves and their function is to regulate- limit or reduce the line pressure. When line pressure reaches set value, pressure relief valve divert the working fluid to tank and protect the system. While pressure reducing valves are intended to decrease the pressure of working fluid being admitted towards actuation.	2	6	
	The flow control valves like gate valves, butterfly valves and globe valves essentially control the volume flow rate of working fluid and can shut off the lines if required.	2		
	The direction control valves are used to effect actuation in the required manner by diverting or restricting the flow passages. Sliding spool type DC valves, check valves, etc are of this category.	2		15
IX. (a)	 **Diagragm**	6	9	
	Explanation on working	3		

IX. (b)	 1. Hydropneumatic system possesses the advantage of both the hydraulic and pneumatic systems. 2. Constant speed can be maintained with variable or constant load. 3. It posses high speed than that of hydraulic system. 4. It requires no pump; but a small oil reservoir is sufficient. 5. System rigidity is good 6. Very low operating cost 7. Suitable for feed movement in machine tools 8. Control of cylinder stroke is easily attainable and precise. 9. It requires simple maintenance 10. Overall cost is low to moderate. (Any six)	1 x 6	6	
X. (a)	 Diagragm	6	9	
	Explanation on working	3		
X. (b)	 Simple sketch	3		
	Air filters are used to prevent any solid contaminants from entering in the system. Air filter provided with water trap condense and remove water vapor that is present in the compressed air.	3	6	15