	Alexandria Higher Institute of Engineering & Technology (AIET)		
	Mechatronic Department		3rd Year
	EME312	Fluid Mechanics	Final, June, 23, 2011
	Examiners:	Dr. Rola Afify and committee	Time: 3 hours

Answer the following questions:

Question one (12 marks)

a) The pressure of 1 m^3 of a fluid is increased 10 to 20 bar at a constant temperature, calculate the final volume of the fluid in the following cases:-
   i. The fluid is an ideal gas.
   ii. The fluid is water (k = 2 x 10^9 N/m^2).
   Use the results to explain the main difference between liquids and gases.

b) A rectangular tank (3 m long, 2 m wide, and 2.5 m high) contains oil of specific gravity γ = 0.9. Calculate the magnitude, direction, and line of action of the pressure force on the following:
   i. The sides of the tank.
   ii. The tank's bottom.

Question two (12 marks)

a) State whether the following statements are true or false? For wrong statement, write down the correct one.
   i. The flow is always from the point of higher pressure to the point of lower pressure.
   ii. The only energy loss for a flow in a pipe is friction loss.
   iii. In laminar flow, the fluid moves in parallel layers.
   iv. For a viscous flow in a small diameter pipe, the flow expected to be turbulent.
   v. Hydraulic Gradient (H.G.) is parallel to Total Energy Line (T.E.L) if the area of pipe is constant.
   vi. The actual discharge equation for venturi and orifice meter is $Q_{act} = C_d A_1 \sqrt{\frac{2gh\left(\left(\rho_{man}/\rho\right)-1\right)}{\left(A_1/A_2\right)^2-1}}$, as $C_{dv} = 0.65$ for venturi meter and $C_{do} = 0.97$ for orifice meter.

b) Two water tanks A and B are connected with a cast iron pipe (ε = 0.25 mm) 15 cm diameter and 800 m long has a coefficient of friction (f = 0.025). Along the pipe, there are a fully opened gate valve (k = 1.2), three 45° bends (k for each= 0.8) and four 45° bends (k for each= 0.6).
   For sudden contraction k = 0.5 and enlargement k = 1.0.
   i. Find the difference in levels between water surfaces in two tanks, so that a discharge of 60 lit/s flows from tank A to tank B.
   ii. If the valve is partially closed to reduce the discharge to 60% of its initial value, keeping the same difference in levels, what will be the head lost in the valve.

Question three (12 marks)

a) Compare between vane pump and axial flow pump.

b) A three cylinders piston pump, having ram 30 cm diameter by 60 cm stroke, is required to lift 80 liter of water per second against a static head of 85 m. The friction loss in the suction pipe is 1.2 m and in delivery pipe is 12 m. The water velocity is 1 m/s. The mechanical efficiency of the pump (η_m) is 90% and the volumetric efficiency (η_{vol}) is 98%. Calculate the speed at which the pump should run and the power required to drive it.

Question Four (12 marks)

a) Explain why all pumps are usually installed near suction tank and in the lowest possible position with respect to suction level.

b) A centrifugal pump has the following performance at rotating speed of 2900 rpm:

Q (lit/s)	0	5	10	15	20	25
hm (m)	70	74	73	65	53	40
η (%)	0	60	76	72	58	41

If this pump is used in a system where the difference between delivery and suction levels (h_{st}) is 50 m and losses in suction pipe is 5 m and in delivery pipe is 10 m, kinetic energy is 0.2 and the pump is placed 3 m above suction level, calculate:

i. The head required from pump.
ii. The pump discharge.
iii. The shaft power consumed at pump operating point.
iv. The manometric suction head.

Question Five (12 marks)

a) Draw a complete hydraulic circuit used to move a cylinder forward and backward with a controllable velocity. This circuit contains:-

i. Vented reservoir. ii. Hydraulic pump. iii. Electric motor.
iv. Filter. v. Check valve vi. Relief valve.
vii. Directional control. viii. Flow control valve. ix. Cylinder.

b) Write the functions of:-

i. Oil tank.
ii. Valves.
iii. Piping.