ESO 201A/202

Quiz 1 B **40 minutes** **20 marks** **August 28, 2014**

Name: **Roll No:**

Please write your answer(s) in the box(es) provided with each question and RETURN the question paper. *A separate sheet will be provided for rough work.*

Q 1. *(3 marks)* The power generation potential of a wind turbine may be written as

$$\dot{W} \propto D^a \rho^b V^c$$

where ρ is the air density, V is the wind speed, and D is the diameter of the blades. The values of $a, b,$ and c are:

$a =$ 2	$b =$ 1	$c =$ 3

1 marks each

Q 2. *(3 marks)* A fan is to accelerate quiescent air to a speed of 10 $m.s^{-1}$ at a mass flow rate of 6 $kg.s^{-1}$. If the efficiency of the fan is 75%, then the power input to the fan is:

$\dot{W}_{fan,in} =$ 400 W

3 marks

Q 3. *(3 marks)* A pump is pumping an incompressible oil at the rate of 0.15 $m^3.s^{-1}$. The pump inlet and exit are at the same elevation and the pipe diameters at the inlet and exit are also same. The pressure at the inlet of the pump is 1 bar and at the exit it is 4 bar. Answer the following:

(a) Rate of flow work (in) at the inlet = 15 kW

(b) Rate of flow work (out) at the exit = 60 kW

(c) Minimum power input to the pump = 45 kW

1 mark each

Q 4. *(4 marks)* A piston-cylinder device contains 1 kg of a wet steam at 150 °C with a quality of 60%. The enthalpy of evaporation, h_{fg}, at 150 °C is 2115 $kJ.kg^{-1}$. Answer the following:

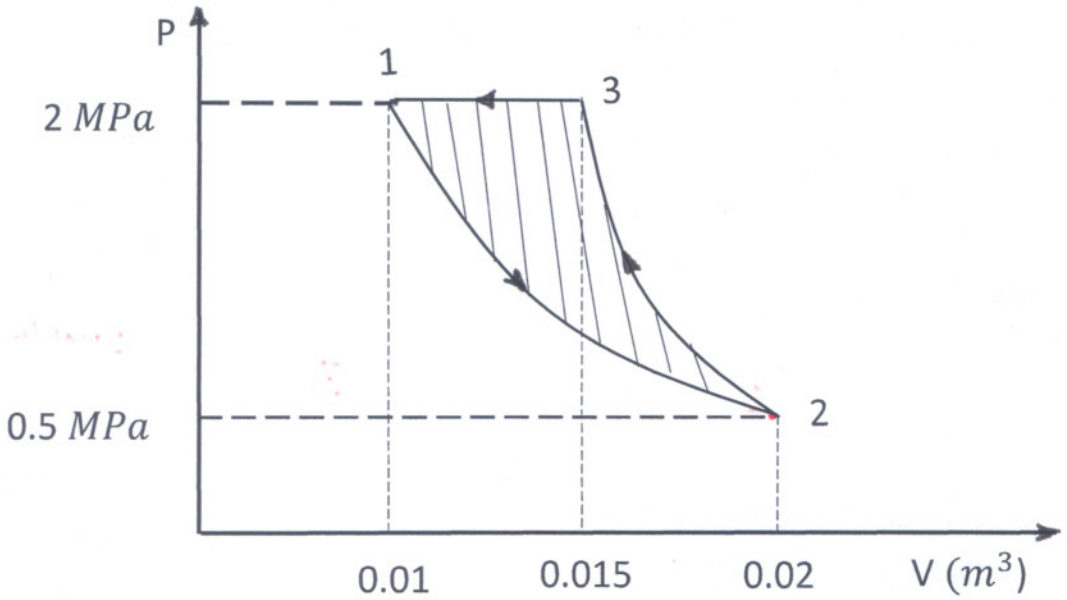
(a) If the wet steam as given above is heated at constant pressure until it becomes dry saturated vapor, then $q_{in} =$ 846 $kJ.kg^{-1}$

2 marks

(b) If the wet steam as given above is cooled at constant pressure until it becomes saturated liquid, then q_{out} = 1269 $kJ.kg^{-1}$

2 marks

Q.5 *(7 marks)* Consider the cyclic process 1-2-3-1 shown below on the P-V diagram:



The area of the shaded region is 15 kJ and the process 1-2 is a polytropic process with a polytropic exponent of 2. Answer the following:

(a) $W_{net,in}$ for the cycle = 15 kJ — 1 mark

(b) $Q_{net,out}$ for the cycle = 15 kJ — 1 mark

(c) W_{in} during the process 3-1 = 10 kJ — 2 marks

(d) W_{out} during the process 1-2 = 10 kJ — 3 marks