Cranfield UNIVERSITY

MSc in Water and Wastewater Engineering
MSc in Water and Wastewater Technology

Pumps and Pumping Systems

Module Co-ordinator
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Module: **Pumps and Systems**

Date: **8 - 12 March 2010**

Day:	Monday	Tuesday	Wednesday	Thursday	Friday
Date:	**08-Mar-10**	**09-Mar-10**	**10-Mar-10**	**11-Mar-10**	**12-Mar-10**
Time					
9:00-10:30	Introduction (course) (HY) The Pumping System (HY)	Pump Basics II (AS)	Pump Drives (AS)	System Design inc (PC&AS) Sludge Systems	Pressure Surge (SJ)
11:00-12:30	The Pumping System (HY)	Pump Basics III (AS)	Specification and Testing (AS)	Pumping Station Design (PC)	Pressure Surge (SJ) Course Windup (HY)
Lunch					
14:00-15:30	Pump Basics I (AS)	Sumps and Intakes Model tests inc. sump sizing (HY)	System Design (PC)	Pumping Station Design Project(PC)	
16:00-17:30	Laboratory session (HY+AS)	Tutorial/Group Studies (AS+HY)	Tutorial/Group Studies (AS+PC)	Problem solving/Review Assignment (AS+PC+HY)	

Notes

Pre-module exercises:

Post-module exercises:

Lecturers:

HY: Dr Hoi Yeung
AS: Tony Salisbury
PC: Peter Clark Black & Veatch
SJ: Sarah Jones

USEFUL CONVERSIONS (SI – IMPERIAL AND US UNITS)

Length	1 foot = 0.3048m	
Volume	1 cu ft = 28.3168 dm^3 = 28.3169 x 10^{-3} m^3 1 US gallon = 3.785 litres = 3.785 x 10^{-3} m^{-3} 1 Imperial gallon = 4.546 litres	
Mass	1 ton = 1016.05 kg = 1.016 metric tonne 1 lb = 0.4536 kg	
Density	1 lb/ft^3 = 16.019 kg/m^3	
Force	1 lb force = 4.448 N	
Torque	1 lb ft = 1.356 Nm	
Pressure	1 lb per square inch = 6894.76 N/m^3 1 in of mercury = 3386.4 N/m^3 1 cm of Hg = 1334 N/m^3	
Viscosity	dynamic kinetic	1 lb/ft.second = 1.488 kg/ms (=1cP) 1 ft^2/s = 0.092 m^2/s
Flow rate	1 USgpm = 6.3 x 10^{-5} m^3/s 1 Imp gpm = 7.6 x $10^{-5}m^3$/s	
Power	1 horse power = 0.725 kW	

Temperature degree C = $\frac{5}{9}$ (degree F – 32)

Kelvin = $\frac{5}{9}$ (degree F + 459.67)

USEFUL FORMULA – computer format – use pure SI units

Pressure = ρ*g*H $[\rho g H]$

Liquid kW = ρ*g *H *Q/1000 $[\frac{\rho g H Q}{1000}]$

kW absorbed = ρ*g*H*Q/(1000*η) $[\frac{\rho g H Q}{1000\eta}]$

η = Efficiency = decimal pump efficiency (not percentage)

Type number = ks = 2*π*N*Q^0.5/(60*(g*H)^0.75) $[\frac{2\pi N Q^{0.5}}{60(gH)^{0.75}}]$

Suction type number = kss = 2* π *N*Q^0.5/(60*(g*NPSH)^0.75) $[\frac{2\pi N Q^{0.5}}{60(gNPSH)^{0.75}}]$

ρ = Density in kg/m3

g = gravitational acceleration = 9.81m/s^2

H = Pump Total Head in m

Q = Flowrate in m^3/s

N = Rotational Speed in rpm (rev/min)

NPSH = Net Positive Suction Head in m