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MATRIC NO: 18/ ENG05/003

DEPT: MECHATRONICS

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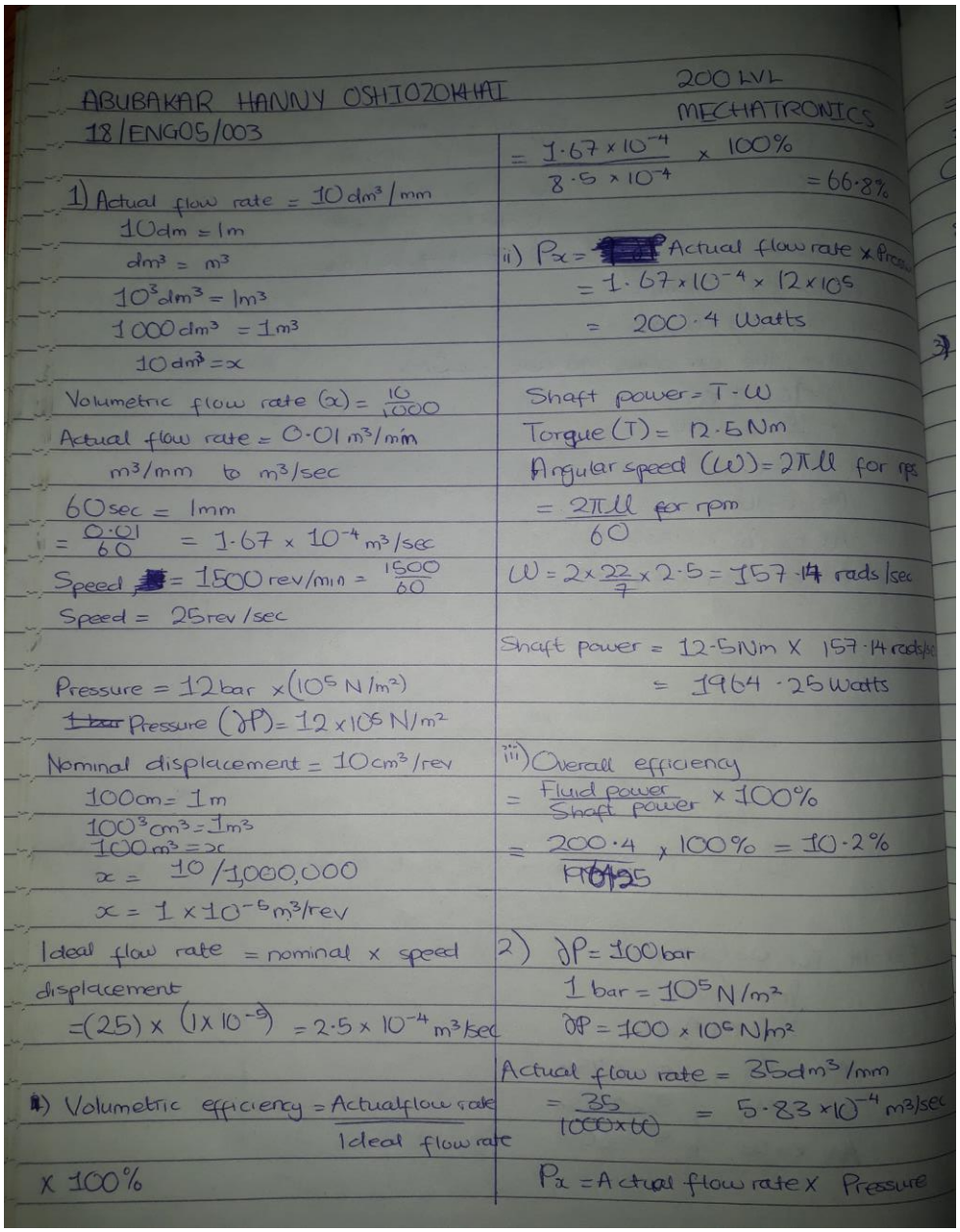

ABUBAKAR HANNY OSHIOZOKHAI 200 LVL
18/ENG05/003 MECHATRONICS

1) Actual flow rate = $10\,dm^3/mm$

$10\,dm = 1m$

$dm^3 = m^3$

$10^3\,dm^3 = 1m^3$

$1000\,dm^3 = 1m^3$

$10\,dm^3 = x$

Volumetric flow rate $(x) = \frac{10}{1000}$

Actual flow rate $= 0.01\,m^3/mm$

m^3/mm to m^3/sec

$60\,sec = 1mm$

$= \frac{0.01}{60} = 1.67 \times 10^{-4}\,m^3/sec$

Speed = $1500\,rev/min = \frac{1500}{60}$

Speed = $25\,rev/sec$

Pressure = $12\,bar \times (10^5\,N/m^2)$

~~1 bar~~ Pressure $(\partial P) = 12 \times 10^5\,N/m^2$

Nominal displacement = $10\,cm^3/rev$

$100cm = 1m$

$100^3\,cm^3 = 1m^3$

$100m^3 = x$

$x = 10/1{,}000{,}000$

$x = 1 \times 10^{-5}\,m^3/rev$

Ideal flow rate = nominal x speed

displacement

$= (25) \times (1 \times 10^{-5}) = 2.5 \times 10^{-4}\,m^3/sec$

i) Volumetric efficiency = $\frac{\text{Actual flow rate}}{\text{Ideal flow rate}} \times 100\%$

$= \frac{1.67 \times 10^{-4}}{8.5 \times 10^{-4}} \times 100\% = 66.8\%$

ii) P_x = [redacted] Actual flow rate x Pressure

$= 1.67 \times 10^{-4} \times 12 \times 10^5$

$= 200.4$ Watts

Shaft power = $T \cdot \omega$

Torque $(T) = 12.5\,Nm$

Angular speed $(\omega) = 2\pi ll$ for rps

$= \frac{2\pi ll}{60}$ for rpm

$\omega = 2 \times \frac{22}{7} \times 2.5 = 157.14\,rads/sec$

Shaft power = $12.5\,Nm \times 157.14\,rads/s$

$= 1964.25$ Watts

iii) Overall efficiency

$= \frac{\text{Fluid power}}{\text{Shaft power}} \times 100\%$

$= \frac{200.4}{1964.25} \times 100\% = 10.2\%$

2) $\partial P = 100\,bar$

$1\,bar = 10^5\,N/m^2$

$\partial P = 100 \times 10^5\,N/m^2$

Actual flow rate = $35dm^3/mm$

$= \frac{35}{1000 \times 60} = 5.83 \times 10^{-4}\,m^3/sec$

P_x = Actual flow rate x Pressure

$= 5.83 \times 10^{-4} \times 100 \times 10^5$

$= 5830$ Watts

Overall efficiency $= \frac{\text{Fluid power}}{\text{Shaft power}} \times 100\%$

Shaft power $= \frac{5830 \times 100}{87}$

$= 6.701 \times 10^3$ watts

Nominal displacement $= 50 cm^3/rev$

$x = 50/1,000,000$

$x = 5 \times 10^{-5} m^3/rev$

Actual flow rate $= 35 dm^3/min$

$= \frac{35}{1000 \times 60} = 5.83 \times 10^{-4} m^3/sec$

$\Delta P = 100$ bar

$= 100 \times 10^5 N/m^3$

$P.f = 5.83 \times 10^{-4} \times 100 \times 10^5$

$= 5830$ Watts

Overall efficiency $= \frac{\text{Fluid Power}}{\text{Shaft Power}} \times 100\%$

$= \frac{5830}{15,000} \times 100\%$

Overall efficiency $= 38.87\%$

Speed $= \frac{850 rpm}{60} = 14.17 rps$

Ideal flow rate $= 5 \times 10^{-5} \times 14.17$

$= 7.085 \times 10^{-4} m^3/sec$

Volumetric efficiency $=$

$\frac{\text{Actual flow rate}}{\text{Ideal flow rate}} \times 100\%$

$= \frac{5.85 \times 10^{-4}}{7.085 \times 10^{-4}} \times 100\%$

$=$ Volumetric efficiency $= 82.29\%$