**3a.**

A solid shaft of diameter rotating at delivers a power of determine (assume Shear Modulus for the shaft, )

1. The Shear Stress in the shaft
2. The angular twist of the shaft as a result of the Shear Stress from part (i)

* The important parameters to note here are

Power,

Diameter of shaft (needs to be in metres),

Radius of shaft,

Rotational speed (needs to be in radians per second),

rads/s

Shear Modulus,

* (i) First we need to use the Power-Torque equation {1} to determine the Torque in the shaft

{1}

So re-arranged to derive the Torque in the shaft

We now need to use the equation {2} for the polar second moment of area,

for a solid shaft

{2}

One now knows and shaft radius so we use the Torque-Shear

Stress, equation {3} to determine the maximum Shear stress, in the shaft

{3}

* (ii) For the angle of twist we need to use the Angle (in radians)-Shear stress equation{4} to determine angular twist in the shaft over length, , for Shear Modulus,

{4}

rads

You can convert to degrees if you want noting the conversion factor (

**3b.**

Find the diameter of a solid shaft resulting in a transmission Torque of for a maximum allowable Shear Stress in the shaft of

The important parameters to note here are

Transmission Torque,

Maximum allowable Shear stress in shaft

* We need to use the equation {2} for the polar second moment of area,

for a solid shaft

{2}

And equation {3} relating Shear stress to Torque and radius of shaft

{3}

Noting that radius and substituting {2} in {3} we get

{5}

Simplifying {5}

{6}

Rearranging {6} to make the subject

{7}

Putting in given values to {7} we get

**3c.**

Calculate the power delivered by a rotating hollow shaft with an outer diameter of , an inner diameter of , rotating at a speed of for maximum Shear Stress of

The important parameters to note here is that the shaft is hollow so we need to use equation {8} defining the polar second order of area for a hollow tubular shaft of outer diameter and inner diameter

{8}

We are told outer diameter,

Inner diameter,

Using {8} then

We can now use equation {3} to work out the maximum Torque, on the shaft for maximum Shear stress,

{3}

Putting in values noting that the value radius value, in the above relates to the radius of the outer diameter which is

Maximum Torque

We now can use equation {1} to determine the maximum power delivered by this shaft where the given angular velocity of shaft is and where

{1}