**Q1: Design a 6-speed gearbox**

1. Define Requirements:

* Minimum Speed (n1): 60 rpm
* Maximum Speed (n6): 2000 rpm
* Number of speeds (N): 6
* Gear ratio (GR): n6/n1

2. Select Gearbox Structure:

* Choose between {2(X1) 3(X2)} and {2(X2) 3(X1)}.
* Calculate transmission ratios for each structure.

For {2(X1) 3(X2)}:

* Gear Ratios: 3/2,32 /22, 32 /23 ,…

For {2(X2) 3(X1)}:

* Gear Ratios: 2/3,22 /32, 32 /33 ,...

3. Calculate Gear Teeth:

* Choose gear types (spur, helical, etc.).
* Use gear ratio formulas: GR=*T*1/*T*2​=*n*2/*n1*​.
* Solve for the number of teeth (*T*1 and *T*2).

4. Kinematic Layout:

* Draw a kinematic layout showing the arrangement of gears.
* Ensure proper meshing and alignment.

5. Determine Standard 𝜙 Value:

* Select a standard 𝜙 value (commonly 14.5° or 20°) based on gear type.

**Q2: Transmit 10KW Power**

1. Power Calculation:

* *P*=10 kW

2. Shaft Diameter:

* Use the formula: *P*=2*πnT*​/60,000 to find torque (*T*).
* Use standard formulas to calculate the required shaft diameter.

3. Material Selection:

* Choose alloy steel for gear material.
* Consider factors like hardness, toughness, and fatigue resistance.

4. Gear and Shaft Center Distance:

* Use standard formulas to calculate center distances between gears for each pair.

5. Check for Bending and Wear:

* Ensure the calculated dimensions meet bending and wear strength requirements.

6. Calculate Number of Teeth for Each Gear:

* Use standard formulas to calculate the number of teeth for each gear based on the power transmitted.

7. Check Gear Tooth Strength:

* Verify that the calculated gears can withstand the transmitted power without failure.

8. Calculate *λ*:

* Use the given value of *λ* (10) for the material.

**Some additional things on above**

**Q1: Design a 6-Speed Gearbox**

Assumptions:

* Gear type: Helical gears for smoother operation.
* Pressure angle *ϕ*=20∘.

Gearbox Structure:

* Selected Structure: {2(X1) 3(X2)}.

Gear Ratios:

* Speed Ratios:
  + GR2=32GR2​=23​
  + GR3=(32)2GR3​=(23​)2
  + GR4=(32)3GR4​=(23​)3
  + GR5=(32)4GR5​=(23​)4
  + GR6=(32)5GR6​=(23​)5

Gear Teeth Calculation:

* Assume T1=20*T*1​=20 teeth for the first gear (input).
* Calculate Ti= GR*i*​×*T*1​ for each speed.

Kinematic Layout:

* Draw a kinematic layout with helical gears in the selected structure.
* Ensure proper meshing and alignment.

Standard 𝜙 Value:

* Use *ϕ*=20∘ for helical gears.

**Q2: Power Transmission and Gearbox Dimensions**

Power Calculation:

* Given power *P*=10 kW.

Shaft Diameter:

* Use the power formula to find torque ***T***.
* Assume a speed *n*=1500 rpm (mid-range speed).
* Calculate shaft diameter using standard formulas.

Material Selection:

* Choose alloy steel for gears due to its favorable mechanical properties.

Gear and Shaft Center Distance:

* Calculate center distances using standard formulas for each gear pair.

Bending and Wear Check:

* Verify that the calculated dimensions meet bending and wear strength requirements.

Calculate Number of Teeth:

* Use standard formulas to calculate the number of teeth for each gear based on the transmitted power.

Gear Tooth Strength Check:

* Ensure that the calculated gears can withstand the transmitted power without failure.

Calculate *λ*:

* Given *λ*=10 for the material.