Exercice engrenage corrigé 4eme

Un réducteur de vitesse à roue dentée à arbre creux est composé d'un engrenage parallèle à denture droite. Cela permet la transmission d'un mouvement de rotation à des vitesses différentes entre l'arbre moteur (plein) et l'arbre récepteur (creux). ... and the video - We call "gear" the entire set of two toothed wheels engaging with each other and allowing to transmit a movement or power with an invariable speed ratio. - Among the most used, resistant, and durable systems for transmitting movement and power; - They are standardized, which allows their interchangeability and reduces their manufacturing cost; - The wheel with the smallest number of teeth is called "pinion" and it generally receives the motor's power; - A combination of gears is called a "gear train". - Gears can be divided into three families according to the position and relative orientation of their axes: In each of these families, we find different types of gears; These types are presented in the following slides: - The trees are parallel, and the teeth of both gears are also parallel to the rotation axis of the trees; - They are the simplest and most economical. - The teeth of both gears are inclined relative to the rotation axis of the trees; - At equal size, they are quieter and more efficient for transmitting power and torque; - The inclination of the tooth generates axial forces. - The teeth are cut on conical surfaces; - They are used to transmit movement between convergent, perpendicular, or non-perpendicular axes; - The tooth can be straight but also helical or spiral. - One wheel resembles a screw and the other a helical gear; - The rotation direction of the wheel depends on that of the screw as well as the inclination of the tooth, left-handed or right-handed thread; - Irreversibility is possible. - The crown is also called an internal gear. - The geometry of gears is entirely described by a set of parameters also used for their standardization. Primitive circle: Circle where the contact points of the gears are located. Base circle: Circle tangent to the normal line tangent to the pressure line at the contact points on the teeth (called pressure line). Pressure angle α: Angle of the pressure line that characterizes the shape of the teeth as well. Head circle: Circle corresponding to the maximum diameter of the gear. Foot circle: Circle corresponding to the minimum diameter of the gear. These last two circles are not used in gear calculations, however. - The primitive circle serves as a reference for defining tooth dimensions and other parameters: Ha height: Difference between the radii of the head circle and the primitive circle. Hf hollow: Difference between the radii of the primitive circle and the foot circle. Height h: Difference between the radii of the head circle and the foot circle. It is also the sum of the ha height and hf hollow – The following parameters are frequently used in various formulas describing gear geometry... Given text here: Pas primitif p : Longueur d'arc entre deux dents successives mesurée sur le cercle primitif. Module m: Quotient du pas exprimé en mm par le nombre π. L'épaisseur de la dent et sa résistance dépendent du module. – En plus des paramètres présentés précédemment, il faut aussi définir les variables suivantes : Vitesse angulaire ω. Nb. de tours/minute n. Nombre de dents Z. Rayon primitif r . Diamètre primitif d. Entraxe a.. Note : À chaque variable peut être associé un indice permettant associé un indice permettant de distinguer les deux engrenages. Formules de base – Formules relatives à un engrenage seul : – Formules relatives au fonctionnement d'une paire d'engrenages : Où a : entraxe (mm), m : module (mm), d : diamètre primitif (mm), Z : nombre de dents, ω : vitesse angulaire (rad/s.), n : vitesse en tours/minutes, r : rayon primitif, T : couple transmis. Commentaire relatif aux rapports de vitesse ou de couple : Cas des roues intérieures – Les formules précédentes s'appliquent à l'exception de l'entraxe a. Cas d'une crémaillère – Les formules relatives aux paires d'engrenages ne peuvent plus s'appliquer ici. Phénomène d'interférence – Selon le nombre de dents des engrenages, il peut y avoir des problèmes d'interférence au niveau du pied des dents. Pour éviter ce type de problèmes, il faut respecter le tableau suivant : Module m: Quotient du pas exprimé en mm par le nombre π. Engrenages droits à denture hélicoïdale – Ils transmettent le mouvement entre deux arbres parallèles; l'angle d'inclinaison de la denture ou angle d'hélice β, est le même pour les deux roues mais en sens inverse. Comparaison avec engrenages à denture droite – Avantages : transmission plus souple, plus progressive et moins bruyante (plus l'angle d'hélice β est élevé, plus c'est vrai). Inconvénients : force axiale générée par l'angle d'hélice et rendement un peu moins bon. Angle d'hélice β – L'angle d'hélice β mesure l'inclinaison de la denture par rapport à l'axe de la roue (valeurs usuelles entre 15° et 30°). Engrenages coniques ou à axes concourants – Permet de transmettre le mouvement entre deux arbres dont les axes sont concourants. Les surfaces primitives ne sont plus des cylindres mais des cônes qui sont tangents sur une ligne de contact MM' et avec un sommet commun correspondant au point S. For the first part, one must consider the angle of the noise, which is typically around 35 degrees. Then, there are hypoid gears, a complex variant of the previous ones, with axes of the wheels being orthogonal but not concurrent, resulting in high friction. Moving on to the main parameters, the equations for cylindrical gears also apply here. Instead of cylinders or circles, we're dealing with cones, and some additional angles are defined to characterize the relationship between the axes of the two wheels. In the second part, we're discussing gear trains and infinite screws. The transmission occurs between two orthogonal shafts, allowing for large reduction ratios (up to 1/200) and offering possibilities for irreversibility. However, this also leads to poor efficiency due to significant friction. When it comes to formulas, the main difference lies in the calculation of the pitch circle radius. Moving on to gear quality classes, we have a range from Class 1 to 4, which features exceptional precision and high speeds (V > 30 m/s). These gears are standard for turbines and other high-precision applications. On the other hand, Class 5 and 6 gears have rectified or rasé teeth, suitable for higher-speed applications like machinery and automobiles. Classes 7 to 9 feature good-quality gears with varying levels of precision, while Class 10 involves common manufacturing processes, including plastic gears. Finally, Classes 11 and 12 cater to slow-moving gears (V < 2 m/s) or those with large modules. In the last part, we're discussing gear trains. The representation of normal gear trains is standardized. When it comes to single-gear trains, the reduction formulas apply. However, a negative sign indicates a change in rotation direction between input and output. In double-gear trains, there are two pairs of wheels in series, with the overall reduction ratio being the product of each pair's individual ratios. For double-gear trains with an inversion wheel, the final rotation direction is altered without affecting the transmission ratio. The inversion wheel could be placed between any two wheels to achieve the same result. Finally, the general case involves N gear trains, and a formula is provided for this scenario. The conclusion has been reached, marking the end of the discussion.