CHAPTER VII FRICTION

1- The block brake consists of a pin-connected lever and friction block at B. The coefficient of static friction between the wheel and the lever is \( \mu_s \) and a torque of 5 N·m is applied to the wheel. Determine if the brake can hold the wheel stationary when the force applied to the lever is (a) \( P = 30 \) N, (b) \( P = 70 \) N.

((a) \( P = 30 \) N < 39.8 N No, b) \( P = 70 \) N > 39.8 N Yes)

2- If a torque of \( M = 300 \) N.m is applied to the flywheel, determine the force that must be developed in the hydraulic cylinder \( CD \) to prevent the flywheel from rotating. The coefficient of static friction between the friction pad at B and the flywheel \( \mu_s = 0.4 \).

(\( F_{CD} = 3050 \) N = 3.05 kN)
3- The cam is subjected to a couple moment of 5 N.m. Determine the minimum force $P$ that should be applied to the follower in order to hold the cam in the position shown. The coefficient of static friction between the cam and the follower is $\mu_s = 0.4$. The guide at $A$ is smooth.
4- The 5-kg cylinder is suspended from two equal-length cords. The end of each cord is attached to a ring of negligible mass that passes along a horizontal shaft. If the rings can be separated by the greatest distance \( d = 400 \text{ mm} \) and still support the cylinder, determine the coefficient of static friction between each ring and the shaft.

\[ \mu_s = 0.354 \]

5- A 35-kg disk rests on an inclined surface for which \( \mu_s = 0.3 \). Determine the maximum vertical force \( P \) that may be applied to link \( AB \) without causing the disk to slip at \( C \).

\[ P = 371.4 \text{ N} \]
6- If $\theta=30^0$ determine the minimum coefficient of static friction at $A$ and $B$ so that equilibrium of the supporting frame is maintained regardless of the mass of the cylinder $C$. Neglect the mass of the rods.

$$0.577$$

7- The coefficient of static friction between the 150-kg crate and the ground is $\mu_s=0.3$, while the coefficient of static friction between the 80-kg man’s shoes and the ground is $\mu_s'=0.4$. Determine if the man can move the crate.
8- The spool of wire having a mass $M$ rests on the ground at $A$ and against the wall at $B$. Determine the forces acting on the spool at $A$ and $B$ for the given force $P$. The coefficient of static friction between the spool and the ground at point $A$ is $\mu_s$. The wall at $B$ is smooth. Given: $P=800 \text{ N}$, $a=0.45 \text{ m}$, $M=150 \text{ kg}$, $b=0.25 \text{ m}$, $\mu_s=0.35$. ($F_A=444 \text{ N} < F_{A_{\text{max}}}=515 \text{ N}$)

9- The beam $AB$ has a negligible mass and thickness and is subjected to a triangular distributed loading. It is supported at one end by a pin and at the other end by a post having a mass of 50 kg and negligible thickness. Determine the minimum force $P$
needed to move the post. The coefficients of static friction at B and C are \( \mu_B = 0.4 \) and \( \mu_C = 0.2 \) respectively.

\( (P = 355 \text{ N}) \)

10- Determine the greatest angle so that the ladder does not slip when it supports the 75-kg man in the position shown. The surface is rather slippery, where the coefficient of static friction at A and B is \( \mu_s = 0.3 \)

\( (33.4^\circ) \)
11- Determine the largest angle that will cause the wedge to be self-locking regardless of the magnitude of horizontal force $P$ applied to the blocks. The coefficient of static friction between the wedge and the blocks is $\mu_s = 0.3$. Neglect the weight of the wedge.

\[
33.4^\circ
\]

12- Determine the minimum applied force $P$ required to move wedge $A$ to the right. The spring is compressed a distance of 175 mm. Neglect the weight of $A$ and $B$. The coefficient of static friction for all contacting surfaces is $\mu_s = 0.35$. Neglect friction at the rollers.
13- The smooth beam is being hoisted using a rope which is wrapped around the beam and passes through a ring at $A$ as shown. If the end of the rope is subjected to a tension $T$ and the coefficient of static friction between the rope and ring is $\mu_s = 0.3$, determine the angle of $\theta$ for equilibrium.

\[ (99.2^\circ) \]
14- Determine the smallest force $P$ required to lift the 40-kg crate. The coefficient of static friction between the cable and each peg $\mu_s = 0.1$.

$(736 \text{ N})$

15- If a force of $P = 200 \text{ N}$ is applied to the handle of the bell crank, determine the maximum torque $M$ that can be resisted so that the flywheel does not rotate clockwise. The coefficient of static friction between the brake band and the rim of the wheel is $\mu_s = 0.3$

$(TA = 616.67 \text{ N} \; TC = 150.00 \text{ N})$