1 A translating flat-face follower is to move through a distance h with cycloidal motion during 180° of clockwise cam rotation. Determine expressions for the x and y coordinates of that portion of a cam profile that will produce this motion. For a travel of 50 mm and a base circle radius of 100 mm, calculate and plot the cam profile. Based on this portion of the cam design, what is the minimum allowable width of the follower face? (20%)

2 A standard 20°, full-depth pinion has 15 teeth and a module of 2 mm. What is the maximum number of teeth that a meshing gear may have without interference occurring? (15%)

3 A reverted gear train is to be designed similar to that of Figure 1 with input and output shafts colinear. The distance from the input shaft (gear 1) to the countershaft (gears 2 and 3) is 112.5 mm. Module $m = 5$ mm. Find gear diameters for minimum and maximum values of speed ratio if no gear is to have less than 20 teeth. (15%)

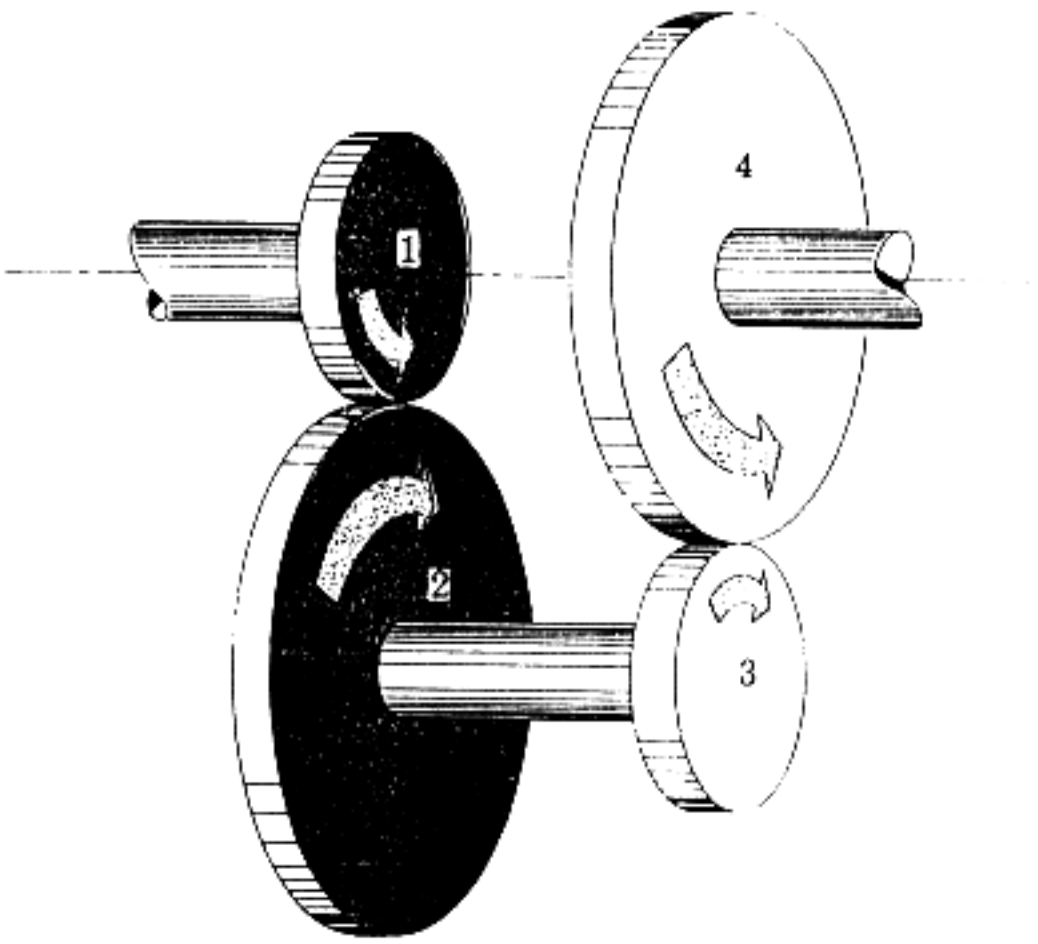

Figure 1

4. For the mechanism with 6 links and **one** degree of freedom and the joints are all **revolute** joints, please determine all the **possible combinations** of the number and type of links (i.e. how many binary links, ternary links, quaternary links, and etc.?), and draw the sketch of each combinations. **(10%)**

5. For the mechanism shown in Fig. 2, if link 2 is the input link. It is required to analyze the position of each moving link of the mechanism with the **vector-loop approach**. Please (1) define an appropriate **reference coordinate system**, (2) define appropriate **vectors and parameters** on the links, (3) give all the **scalar equations** needed for the position analysis (4) indicate which of the parameters within the equations are the **known constants**, the **known variable** (or variables if there are more than one), the **dependent variables** (if there is any), and the **independent unknown variables**, (5) conclude whether the problem is solvable or not. **(15%)**

6. For the mechanism shown in Fig. 3, link 2 rotates with an angular velocity of 150 rad/s (counter clockwise) and an angular acceleration of 300 rad/s^2 (clockwise). Please determine the **velocity and acceleration of link 4**. **(15%)**

7. If it is required to design a slider-crank mechanism to drive the ram of a **mechanical press**, what are the **specifications** (such as its **performances, design constraints**, ..., etc.) you need to specify? **(10%)**

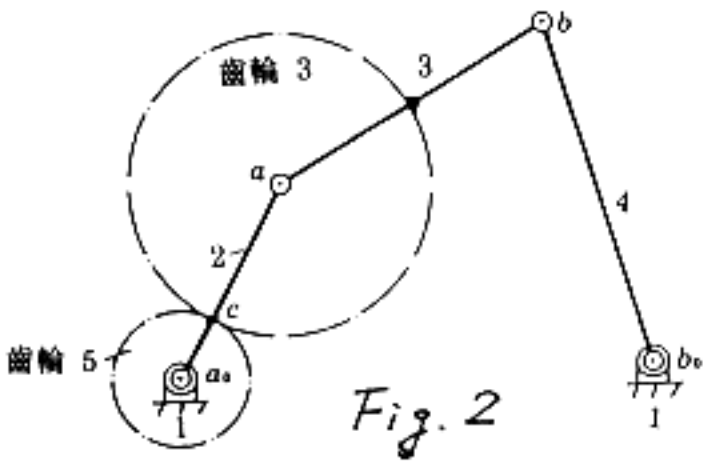

Fig. 2

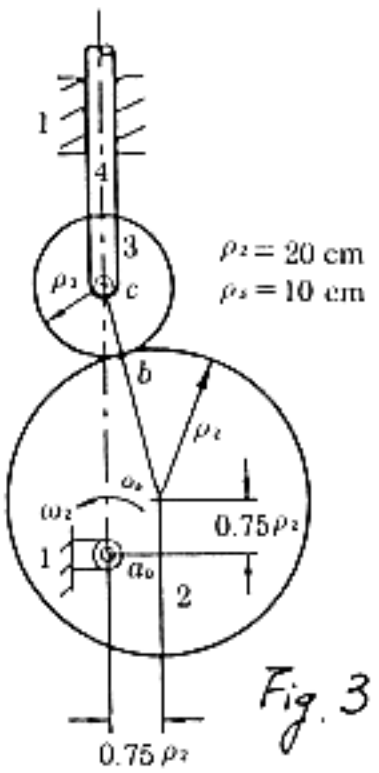

Fig. 3