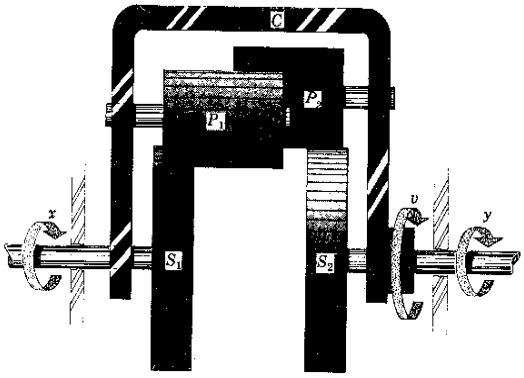
Final Examination (Dynamics of Machine Systems)

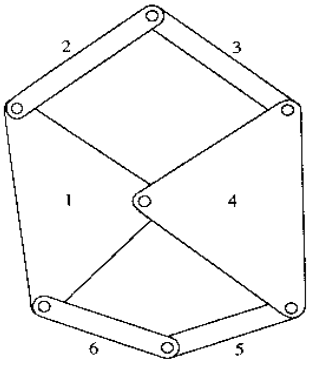
Upload deadline: 2026/6/23 24:00

1. **Calculate the Mobility (DOF) of the 2-D or 3-D mechanical system：(15%)**

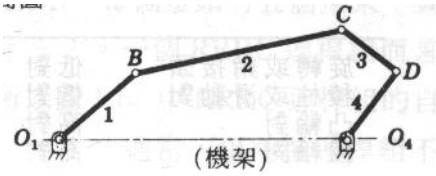
(a) Spur-gear differential



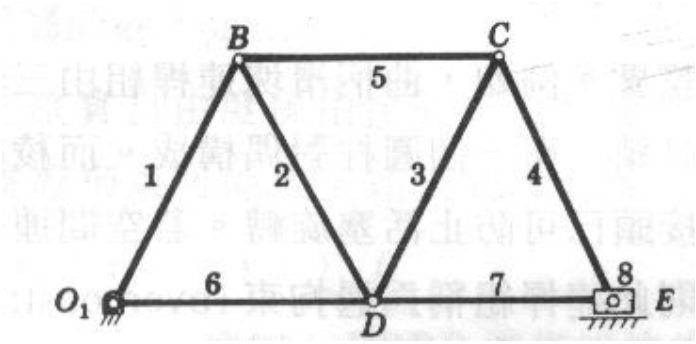
(b) Watt six-bar linkage



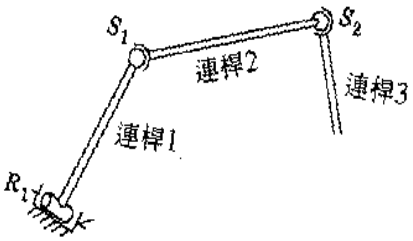
(c) Five-bar linkage



(d)Truss structure



(e) Spatial robotics



2. **Find the 4-bar linkage with the dimensions of (a) and (b). Please use Grashoff's theorem to determine the type of four-bar mechanism, if the link#1 is fixed. Please also solve for the transmission angle and output angle. (20%)**

(a) r_1=1m，r_2=2m，r_3=1.5m，r_4=3.5m；when θ_2=120°，solve for the transmission angle and output angle。

(b) r_1=5cm，r_2=10cm，r_3=15cm，r_4=15cm；when θ_2=270°，solve for the transmission angle and output angle。

3. **As shown in the Fig. 1, the pendulum(OA) has the initial angle 210° with respect to horizontal positive x-axis. If the pendulum has mass m=5kg, length l=10m, gravity g=9.8m/s^2 and release from an initial angular velocity 1 rad/s. Please solve for the angular acceleration and reaction force of revolute joint O at the release instant. (10%)**

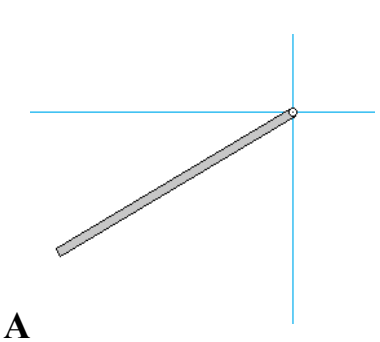


Fig. 1

4. **The 4-Bar-Linkage as shown in Fig. 2, Link#2 rotates with constant angular velocity ω_2 = 1 rad/s(CCW). If O_2O_4=20mm, O_2A=20mm, O_4B=40mm. Link#2(O_2A) and Link#4(O_4B) are perpendicular to the horizontal axis. Please use complex analysis method to solve for Link#3(AB) and Link#4(O_4B) angular velocities ω_3 and ω_4, also the angular accelerations α_3 and α_4 。 (15%)**

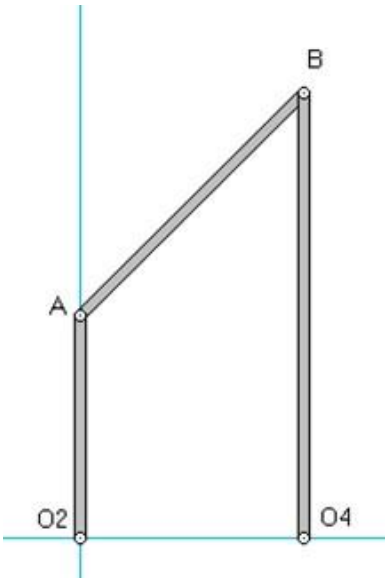


Fig. 2

5. **A 3mm module, 20^O pinion of 18 teeth drives a gear of 45 teeth. The pinion rotates with an angular velocity 9 rad/s(CCW). Calculate (A)Radius of pitch circle (B)Radius of base circle (C)Dedendum (D)Addendum (E)Diametral pitch (F)Center distance (G)The angular velocity of gear(magnitude and direction) (H)Base pitch (I)Length of action (J)Contact Ratio. (20%)**

6. **A 0.3-module pinion of 34 teeth drives a gear with 60 teeth. If the center distance is increased by 0.127 mm, compare the backlash produced with pressure angles of 14.5^o, 20^o, and 25^o. (10%)**

7. **A three-threaded worm drives a 35-tooth worm gear having a pitch diameter of 207.8 mm and a helix angle of 21.08^o. If the shafts are at right angles, calculate the lead and the pitch diameter of the worm. (10%)**

8. **A planetary gear train for a two-speed aircraft supercharger drive is shown in Fig. 3. Gear 2 is driven by a 63-tooth gear (not shown) which operates at 2400 rpm. At high speed, gear 2 connects to the supercharger shaft through additional gearing. At low speed, gear 7 is held stationary and shaft B is connected to supercharger shaft with the same gear ratio as was used between gear 2 and the supercharger shaft. If the supercharger operates 24000 rpm at high speed, calculate the low speed value. (10%)**

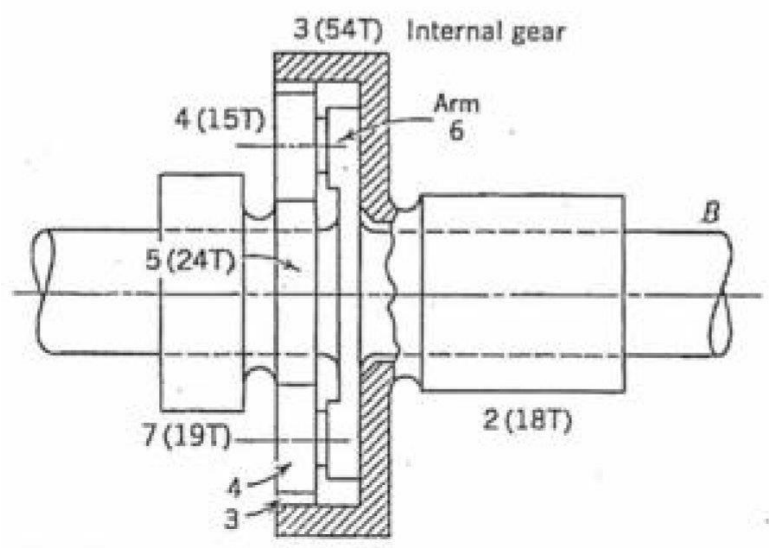


Fig. 3

9. In the planetary reduction unit shown in Fig. 4, gear 2 turns at 300 rpm in the direction indicated. Determine the speed and direction of rotation of gear 5. (10%)

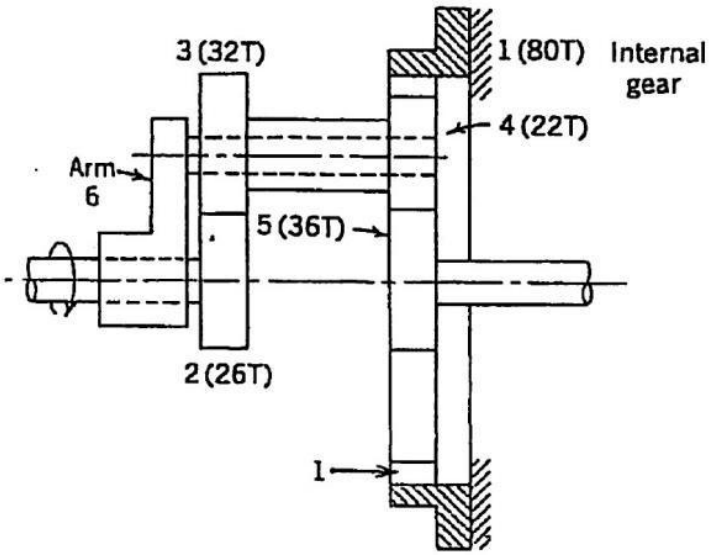


Fig. 4

1. **Please submit the solution of final examination before 2026/6/23 24:00.**

2. **Please upload your document file(*.docx) and insert hand-writing file（please scan to the image file save as JPG file）to the following website.**

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