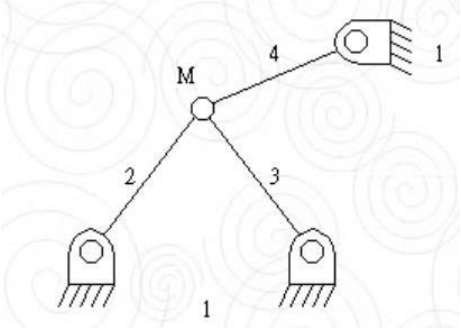
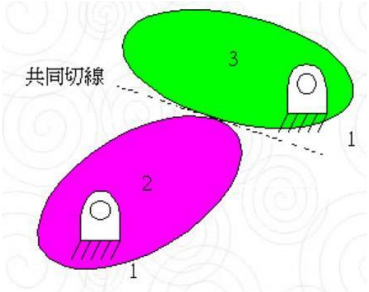
# Final Examination (Dynamics of Machine Systems)
## Upload deadline: 2021/6/23 24:00

1. **Calculate the Mobility (DOF) of the 2-D or 3-D mechanical system（10%）**

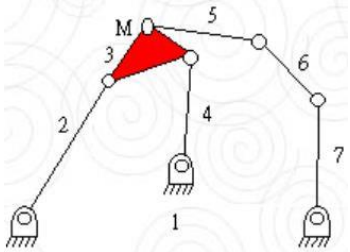
（a）



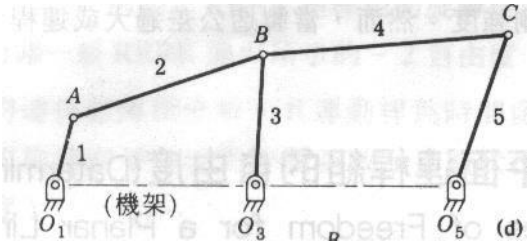

（b）



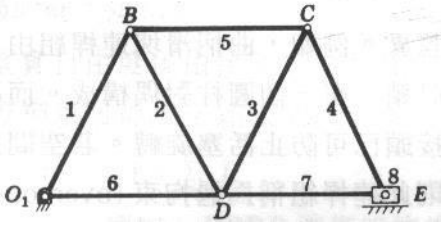

（c）




（d）




（e）




2. **In the offset slider crank mechanism shown in Fig. 1 below the constrained path of the pin on the slider does not extend through the center of rotation of the crank. Given the lengths $L_1$, $L_2$ and $L_3$ and the crank angle $\theta_2$, the position of the slider $L_4$ and the interior joint angles $\theta_3$ and $\gamma$ could be determined by the equations of f($L_1$, $L_2$ , $L_3$, $\theta_2$). Please derive these equations. (10%)**

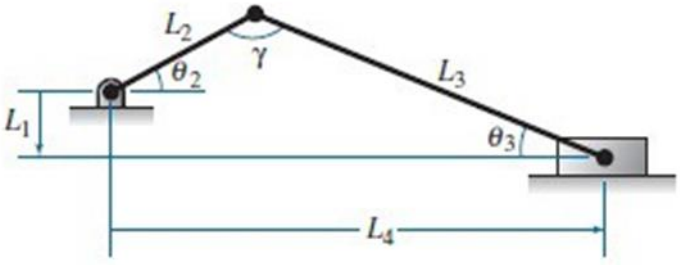



**Fig. 1**

3. **As shown in Fig. 2, the pendulum(AB) has the initial angle 30° with respect to horizontal positive x-axis. If the pendulum has mass $m$=2kg, length $l$=0.45m, gravity $g$=9.8m/s$^2$ and release from an initial angular velocity 3 rad/s(CCW). Please solve for the angular acceleration and reaction force of revolute joint A at the release instant. (10%)**

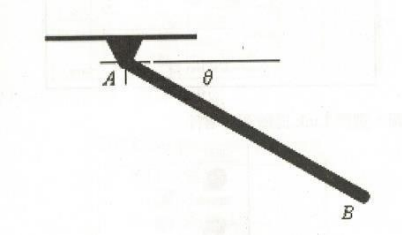



**Fig. 2**

4. **The 4-Bar-Linkage as shown in Fig. 3, Link#2 rotates with constant angular velocity $\omega_2$ = 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 $\omega_3$ and $\omega_4$, also the angular accelerations $\alpha_3$ and $\alpha_4$ 。 (10%)**

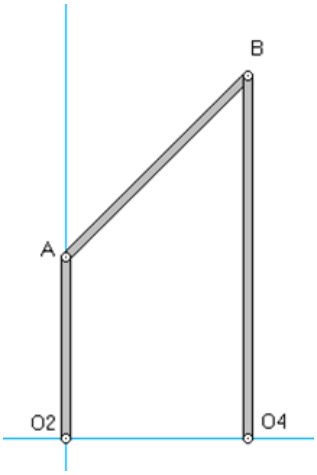



**Fig. 3**

5. **As shown in Fig. 4, a single degree of freedom mass-spring system consists of a *m*=5kg mass suspended by a linear spring which has a stiffness coefficient of *k*=500N/m. The mass is given an initial displacement of 0.5m and released from the initial velocity condition $v_0$=10m/s. Determine the system (a)Differential equation of motion, (b)Circular Natural Frequency, Natural Frequency and Period, (c)Dynamic response. (10%)**

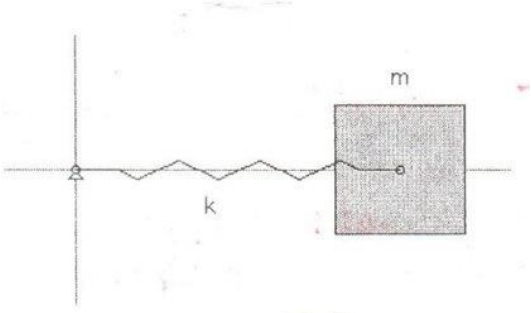



**Fig. 4**

6. **As shown in Fig. 5, a single degree of freedom mass-spring system consists of a *m*=10kg mass suspended by a linear spring which has a stiffness coefficient of *k*=250N/m. The system is subjected to a harmonic forcing function which has the amplitude 10N and frequency 5rad/s (F(t)=10sin(5*t)). The mass is given an initial displacement of 1m and released from the rest condition. Determine the system (a)Differential equation of motion, (b)Circular Natural Frequency and Period, (c)Dynamic response. (10%)**

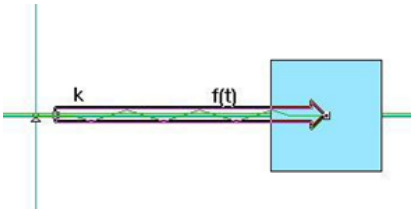



**Fig. 5**

7. **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)Contact Ratio. (10%)**

8. **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%)**

9. **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%)**

10. **A planetary gear train for a two-speed aircraft supercharger drive is shown in Fig. 6. 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%)**

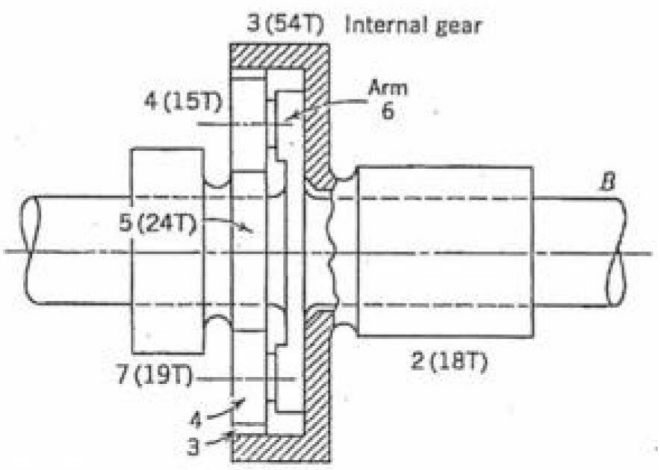



**Fig. 6**

11. **In the planetary reduction unit shown in Fig. 7, gear 2 turns at 300 rpm in the direction indicated. Determine the speed and direction of rotation of gear 5. (10%)**

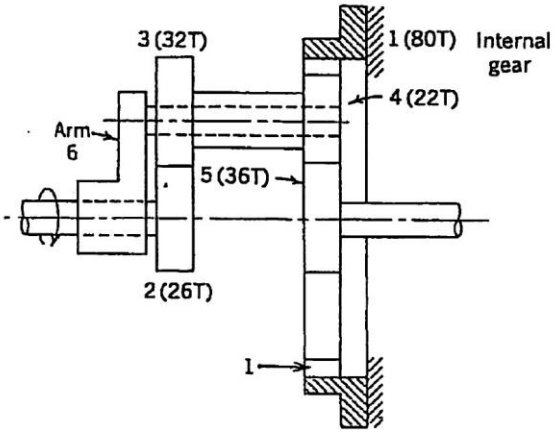



**Fig. 7**

1. **Please submit the solution of final examination as soon as possible.**

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.**

**Host Name: 140.130.17.62**
**User ID: msd**
**Password: msd**

**Please go to directory \Final-Examination, you can use your student ID to create a subdirectory. Finally, you should upload your files to your student ID subdirectory.**