ME 352 Mid-semester exam, September 17, 2017

Instructions: Answer all questions. Start each answer on a fresh page. Show enough detail to communicate your thinking processes. Calculators allowed. No sharing of calculators. No mobile phones, even if switched off. Full marks: 50.

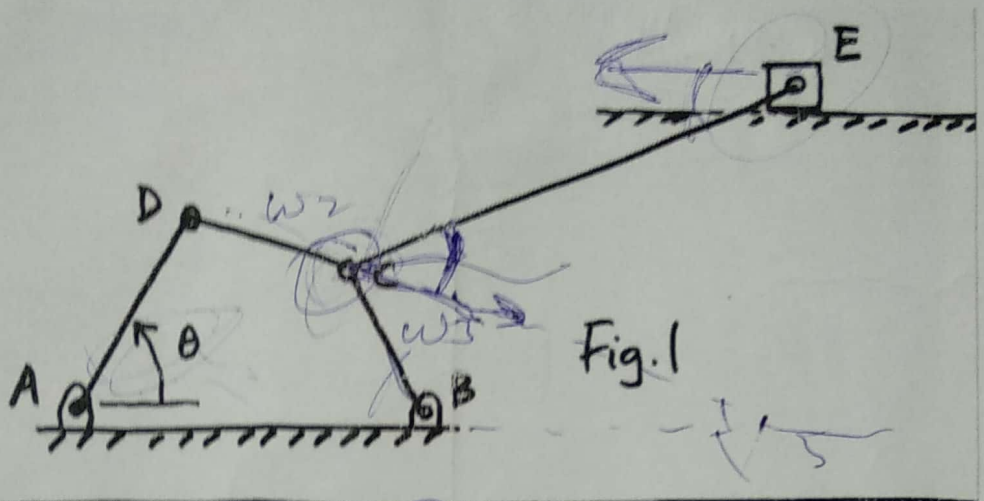

Fig. 1

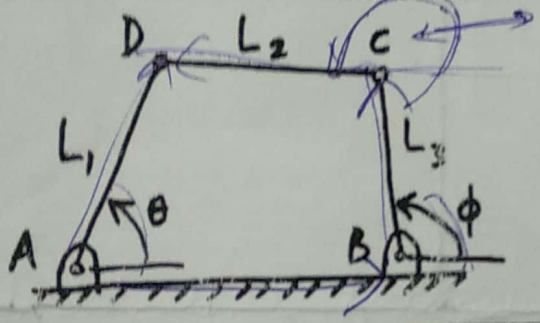

Fig. 2

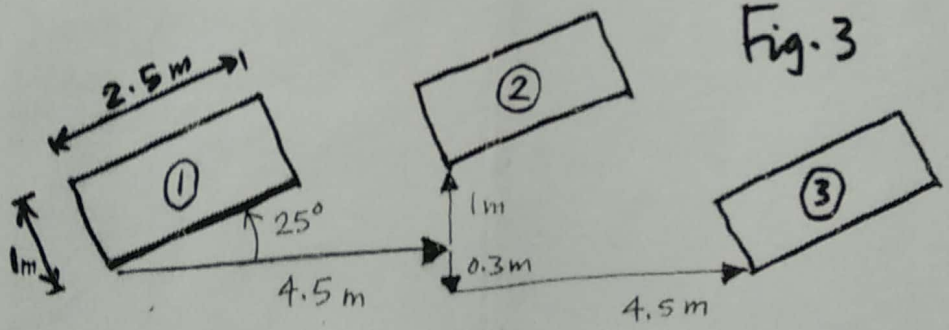

Fig. 3

1. See figure 1. AB is horizontal, the *x* axis is along AB, and A is at the origin. The coordinates of B, C and D are (1,0), (0.7,0.6) and (0.3,0.7) respectively at some instant of interest. At that same instant, the coordinates of slider E are (4.0,1.2), and E can move horizontally only. The angle θ increases at a constant rate of 1 rad/s. Find the velocity and acceleration of slider E. (10 marks)
2. What is the range of horizontal motion of slider E for the above linkage? (10 marks)
3. See figure 2. AB has length unity. We will try function generation by matching three points. At $\theta = 1.22$, 1.75 and 2.09 radians, we want $\phi = 1.75$, 2.44 and 2.97 radians respectively. Find the lengths L_1, L_2, and L_3. Sketch the resulting linkage when $\theta = 1.22$ radians. (10 marks)
4. What are the limits of motion for link L_1 (angle θ) for the above linkage? (5 marks)
5. A rectangular object of size 1 m by 2.5 m has to be moved through three positions as shown in figure 3. The angular orientation is the same at all three positions. The motion is to be achieved using a four-bar linkage. Choose two hinge points on the moving object, and find appropriate fixed hinge points on ground, so that the desired motion can be achieved. Compute locations using a calculator *and* show all relevant quantities on a sketch. (10 marks)
6. What is kinematic inversion? Explain with two examples of inversion of any linkage of your choice, with sketches, and in about 5-8 lines. (5 marks)