GX801

OLLSCOIL NA hÉIREANN
The National University of Ireland

National University of Ireland, Galway

Michaelmas Examinations, 2002/03

Second Year Mechanical. Second Year Electronic, and Third Year Industrial Engineering Examination

THEORY OF MACHINES

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Professor J.F. McNamara
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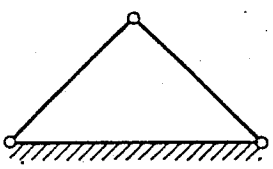
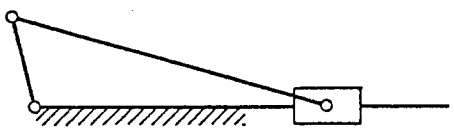
Attempt *Three* Questions.
Time Allowed: *2 Hrs.*
Graph Paper is available.

1(a) Explain what is meant by the following and illustrate your answer with sketches:
- Statically determinate and indeterminate structures; *(3)*
- Higher and lower kinematic pairs; *(3)*
- Degrees of freedom; *(3)*
- Toggle mechanisms; *(3)*

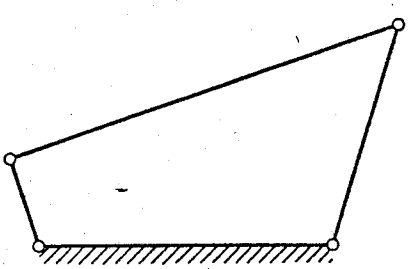
(b) Determine the mobility of the mechanisms shown in Figure 1(a), (b), (c) and (d). *(8)*



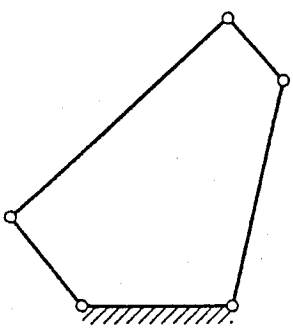
(a)



(b)



(c)



(d)

2(a) Sketch a design for a cam and follower which will give the follower simple harmonic motion. Derive equations to prove your design.

(b) A cam follower is to have a period of constant velocity motion during its outward travel and again on its return. Is it possible to use harmonic curves with these constant velocity curves and not have jerk becoming infinite? If so, recommend the curves to be used and sketch the displacement, velocity, acceleration and jerk graphs for the motion.

3(a) Derive an equation for the length of action Z for two spur gears in mesh. Indicate the interference points on your diagram.

(b) Two equal spur gears of 48 teeth mesh together with pitch radii of 96.0mm and addenda of 4mm. If the pressure angle is 20^0, calculate the length of action Z and the contact ration m_c *(10)*

4(a) Explain what the terms simple, compound and idler mean when applied to gear trains and show how velocity ratios are calculated in each case. *(6)*

(b) In the planetary gear train shown in Figure 5, gear A is the driver and gears B and D are compounded, i.e. they are integral. Gears C and E are internal gears and C is fixed. Calculate the velocity ratio using the tabular method. *(14)*

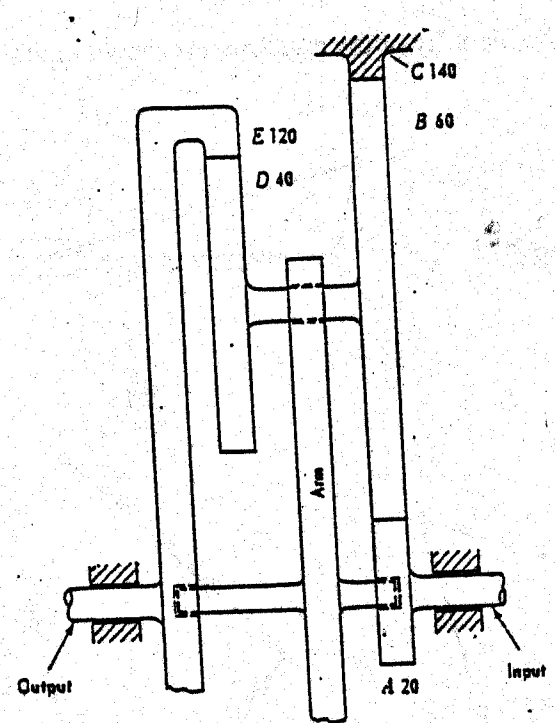


Figure 5

5. Sketch complete free body diagrams for the four bar linkage illustrated in Figure 5. What torque M_{12} must be applied to link 2 to maintain static equilibrium at the position shown? *(20)*

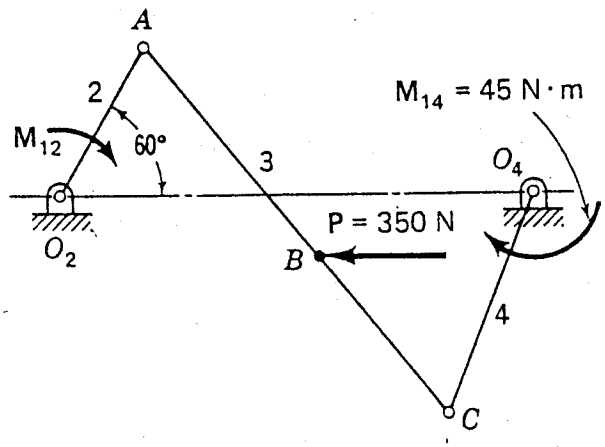


Figure 5

$AO_2 = 200$ mm; $BA = 400$ mm; $CO_4 = 350$ mm

$CA = 0_40_2 = 700$ mm; $\angle O_2O_4C = 70°$