

# OLLSCOIL NA hÉIREANN

*The National University of Ireland*

National University of Ireland, Galway

*Michaelmas Examinations, 2000/01*

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

### THEORY OF MACHINES

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**Attempt Five Questions.**

**Time Allowed: 3 Hrs.**

*Graph Paper is available.*

- 1(a) List the sciences or divisions that may be said to be subsets of mechanics and describe each one. (6)
- (b) What is the difference between a mechanism and a machine? (6)
- (c) Show examples of the following mechanisms; crank lever reciprocating drive; slider crank; bell crank; four bar linkage (8)
- 2(a) What is meant by a statically determinate body as opposed to a statically indeterminate body? (6)
- (b) Sketch examples of planar mechanisms which are: statically indeterminate; statically determinate; have one degree of freedom; have two degrees of freedom. (8)
- (c) What is the Kutzbach Criterion? (6)
3. Explain using diagrams or sketches how, in a direct contact mechanism, angular velocity ratio is determined by the ratio in which the line of transmission or common normal cuts the line of centers. (20)

- 4(a) What is an Oldham coupling, how does it work and what are its advantages and disadvantages? (10)
- (b) Explain the difference between a Hooke or Cardan Joint and a Bendix Weiss joint. (10)
- 5(a) Using sketches to illustrate your answer list cam and follower types that are in common use. (5)
- (b) Show displacement, velocity, acceleration and jerk diagrams for the following cams:
- (i) Circular Disc Cam - Simple Harmonic Motion
  - (ii) Disc cam – dwell ( $30^\circ$ ), followed by parabolic rise ( $150^\circ$ ), followed by dwell ( $60^\circ$ ), followed by parabolic fall ( $120^\circ$ )
  - (iii) Disc cam - dwell ( $30^\circ$ ), followed by cycloidal rise ( $150^\circ$ ), followed by dwell ( $60^\circ$ ), followed by cycloidal fall ( $120^\circ$ ) (15)
- 6(a) Derive an equation for the length of action Z for two spur gears in mesh. Indicate the interference points on your diagram. (10)
- (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  $20^\circ$ , calculate the length of action Z and the contact ratio  $m_c$ . (10)

7(a) Explain what the terms simple, compound and idler mean when applied to gear trains.

(5)

(b) For the automobile transmission shown in Figure 7, the car equipped with this transmission has a rear axle reduction ratio of 3:1 and a tyre outside diameter of 0.7m. Determine the engine speed under the following conditions:

- i) First gear and car speed 20 km/h
- ii) Second Gear and car speed 40 km/h
- iii) Top gear and car speed 100 km/h
- iv) Reverse gear and car speed 10 km/h

1st gear - Gears in train 1463  
2nd gear - Gears in train 1452  
3rd gear - Gears in train 12, clutch teeth mesh  
Reverse gear - Gears in train 14783

(15)

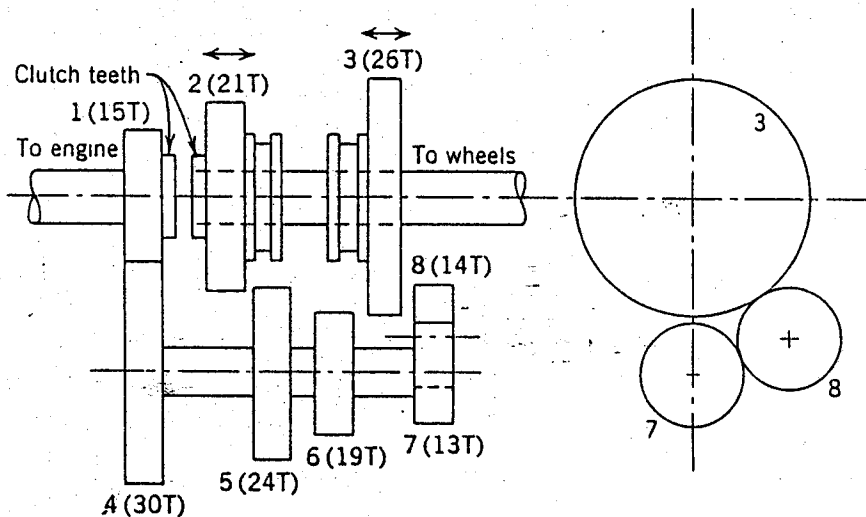


FIGURE 7