# MACHAKOS UNIVERSITY COLLEGE

**(A Constituent College of Kenyatta University)**
**University Examinations for 2015/2016**

**SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING**

**FIRST SEMESTER EXAMINATION FOR DIPLOMA IN MECHANICAL ENGINEERING**

**MECHANICS OF MACHINES I**

**DATE: 3/8/2016** **TIME: 2:00 – 4:00 PM**

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**INSTRUCTIONS:**

***Answer all questions in Section A and any other TWO questions in Section B***

***SECTION A (COMPULSORY)***

1. a) Derive an expression from first principles for the relationship between linear impulse and momentum of a body. (7 marks)

   b) An 18 tonne truck has a maximum speed of 3km/h on a track which the resistance to motion is 250nN/tonne and the engine exerts a pull of 6kN. Determine;

   (i) The momentum

   (ii) The time taken to reach full speed from rest. (13 marks)

   c) A wheel rotating about a fixed at 20rpm is uniformly accelerated for 70 seconds during which it makes 50 revolutions, find;

   (i) The angular velocity at the end of interval

   (ii) The time required for speed to reach 100rpm (10 marks)

**SECTION B: ANSWER ANY TWO QUESTIONS**

2. a) Derive the mass moment of inertia and radius of gyration of a solid disc or cylinder about an axis passing through the centre along the length. (12 marks)

   b) a fly wheel together with its shaft has a total mass of 300kg and its radius of gyration is 900mm. If the effect of bearing friction is equivalent to a couple of 70Nm, calculate the braking torque required to bring the flywheel to rest from a speed of 12r.p.s in 8 seconds. (8 marks)

3. A body moves along a straight line and its acceleration, f which varies with time t is given by f = 2 – 3t. after 5 seconds from the start of observation, its velocity is observed to be 20m/s. After 10 seconds from start of observation, the body was 85 metres from the origin, determine;

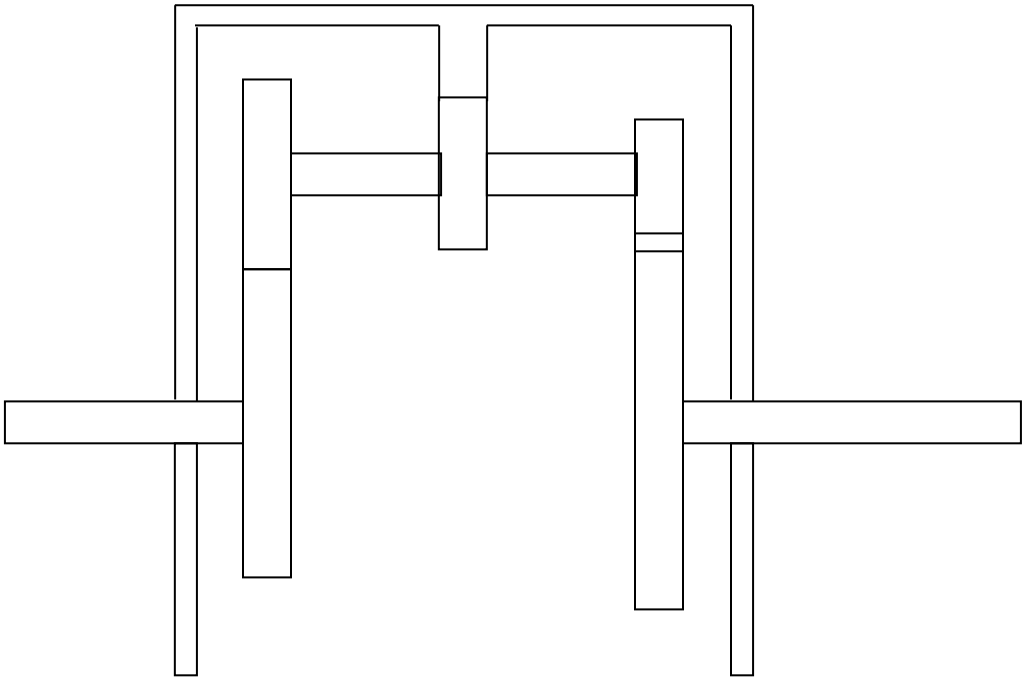
   a) The acceleration, velocity and distance from the origin at the start of observation. (12 marks)

   b) The time after the start of observation in which the velocity becomes zero and its distance from the origin. (8 marks)

4. Figure 1 shows part of an epicyclic gear box. $P_1$ $P_2$ is a compound planet wheel free to rotate about a pin carried by by an arm integral with the output shaft C. the annulus wheel shaft A is rotating at 1820 r.p.m in an anticlockwise direction. Determine;

   a) Speed and direction of rotation of the output shaft C if B is fixed. (10 marks)

   b) The torque necessary to fix the casing if the input shaft supplies 5200 W. The gear box efficiency is 82% (10 marks)



5. Show that the torque, T transmitted by a friction plate clutch is given by;

$$T = \frac{2\mu W(r_1^3 - r_2^3)}{3(r_1^2 - r_2^2)}$$

Where;

$\mu$ = coefficient of friction

W = axial thrust

$R_1$ and $r_2$ = outer and inner radii (11 marks)

b) A plate clutch has three discs on the driving shaft and two on the driven shaft with 240 mm external diameter and 120 mm internal diameter. The power to be transmitted is 25kw at 1575 rpm and the coefficient of friction is 0.3. If there are 6 springs each of the rate 13kN/m and each of the contact surface has worn away by 1.25mm, calculate ;

(i) The total spring load pressing the plates together assuming uniform pressure

(ii) The maximum power that can be transmitted at the same speed, assuming uniform wear. (9 marks)