THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

A CONSTITUENT COLLEGE OF JKUAT

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND AUTOMOTIVEENGINEERING

DIPLOMA IN MECHANICAL ENGINEERING (PLANT OPTIONS)

DIPLOMA IN MECHANICAL ENGINEERING (PRODUCTION OPTION)

DIPLOMA IN AUTOMOTIVE ENGINEERING

EME 2304
MECHANICS OF MACHINES III

YEAR III SEMESTER I

SUPPLEMENTARY/SPECIAL EXAMINATIONS

SERIES: MARCH, 2012

TIME: 2 HOURS

INSTRUCTION TO CANDIDATES

1. You should have the following for this examination
   - Drawing instruments
   - Scientific Calculator

- Answer booklet

2. This paper consists of **FIVE** questions.
3. Answer any **THREE** questions
4. Maximum marks for each part of a question are as shown**.**
5. This paper consists of ***FOUR printed pages.***

Q1. a) Illustrate a hoist used for hauling coal from an underground mine;

b) A winding drum raises a cage of mass 500kg through a height of 120m. The winding drum has a mass of 250 kg, an effective radius of 0.5m, and a radius of gyration of 0.36 m. The mass of the winding rope is 3 kg/m. The cage has at first an acceleration of 1.5 m/s^2 until a velocity of 9 m/s is reached, after which the velocity is constant until the cage nears the top, when the final retardation is 6 m/s.
Determine:

(a) the time taken for the cage to reach the top;
(b) the torque which must be applied to the drum at starting ; the power at the end of the acceleration period

Q2 A drum of mass 200 kg external diameter 380 mm, and a radius of gyration 150 mm, rotates on frictionless bearing with a speed of 250 rpm; a stationary drum B of mass 50 kg, external diameter 200 mm, and radius of gyration 80 mm, mounted on a frictionless axis parallel to that of A, is brought into contact with A, the two being pressed together with a force of 90 N. If the coefficient of friction of 0.25, determine:

(a) the time of slipping and the final speeds of A and B
(b) the time of slipping if a torque is applied of A to maintain a constant speed of 250 rpm.

Q3. a) Using usual notations derive an expression of the equivalent moment of inertia of two gears in mesh but of different radii;

b) An electric motor exerts a torque equal to $1.5-2.4\times10^{-3}\omega\, Nm$,

where ω is the angular velocity in rad/s. The motor accelerates a gear train whose equivalent moment of inertia is 3.33 $\times 10^{-3} kg\,m^2$ at the motor coupling . Assuming that friction and motor inertia are negligible, determine:

(i) the speed at which the power is a maximum and the magnitude of the maximum power;
(ii) the time taken to accelerate the gear train from rest to the speed for maximum power.

Q4 a) Define the following as used in general dynamics:

(i) work
(ii) impulse
(iii) angular momentum
(iv) radius of gyration

b) State Newton's law of impact and show that to perfectly elastic will obey this law.

c) A stationary truck of total mass 9t is set in motion by the action of a shunting locomotive which provides an impulse of 30kNs. The truck travels freely along a level truck for a period of 15s when it collide with a truck of mass 12t which is moving at 0.6m/s in the same direction. The track resistance is 65N/t. Both trucks move on together after collision. Determine:

(i) Their common speed
(ii) Loss of energy at the impact

Q5. The mass of the main girders and end cradles of an electric travelling crane is 7.5t. The cross carriage with lifting crab has a mass of 2.5t. The lifting gear has an efficiency of 75 % when raising a load of 10t, and the efficiency of the travelling gear is 65% . A 10t load is being raised with an acceleration of 0.15 m/s^2 , while the crane is being accelerated forward at the same rate. At the instant when the hoisting speed is 30 m/min and the travelling speed is 55

m/min, the hoisting motor is developing eight times the power developed by the travelling motor.
Calculate:

a) the power developed by each motor;
b) the rail resistance, in N/t;
c) the kinetic energy of the load.