THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A CONSTITUENT COLLEGE OF JKUAT)

Faculty of Engineering and Technology

DEPARTMENT OF MECHANICAL AND AUTOMOTIVE ENGINEERING

DIPLOMA IN MECHANICAL ENGINEERING

EME 2118 : MECHANICAL SCIENCE II

YEAR I SEMESTER II

SUPPLEMENTARY/SPECIAL EXAMINATIONS

SERIES: MAY, 2011

TIME: 2 HOURS

Instructions to Candidates:

1. You should have the following for this examination:

   - Answer booklet
   - Drawing instruments
   - Calculator

2. This paper consists of **FIVE** Questions.
3. Question **ONE** is **COMPULSORY.**
4. Answer any other **TWO** Questions.

Question ONE

(a) A bar 5m long is made up of two materials, joined in series. The first is 1.7m long of brass material and 7.5cm^2 in cross section. The second is steel and is 6.0cm^2 in cross section. The bar is in tension under a load of WN, and the total elongation is 0.12cm. Taking E_s = 200GN/m^2 and E_b = 80GN/m^2, determine:

(i) The extension for each material.
(ii) The load W.

(10 Marks)

(b) An engine exerts a force of 35KN on a train of mass 240 tonne and draws it up a slope of 1 in 200 against a resistance of 60N/tonne. Find:

(i) The acceleration of the train.
(ii) The braking force required on the return journey to prevent the acceleration exceeding 0.01m/s^2.

(10 Marks)

(c) A flywheel of mass 145kg and radius of gyration of 480mm is acted upon by a torque of 50Nm which increases the flywheel speed from 300rev/min to 680rev/min. There is a constant resisting torque of 5Nm. Determine:

(i) The time taken by the flywheel when accelerating.
(ii) The number of revolutions made while accelerating.
(iii) The change in kinetic energy of the fly wheel.

(10 Marks)

Question TWO

(a) State any **TWO** advantages and **TWO** disadvantages of friction. (4 Marks)

(b) A body of mass 1.2tonne is pulled at a constant velocity of 0.15m/s up a track inclined at 30˚ to the horizontal by a force 'P' inclined at 20˚ to and above the track. If the coefficient of friction is 0.25. Calculate:

(i) The value of the force 'P'.
(ii) The power required.

(11 Marks)

(c) A shaft of weight 'w' is supported in a plain journal bearing of diameter'd'. The shaft is rotating with a constant angular velocity 'ω' and the coefficient of friction is 'μ' . Derive an expression for the power lost in the bearing due to friction. (5 Marks)

Question THREE

A simple machine used for lifting was under test and gave the following results.

Load W (N)	250	500	750	1000	1500	2500
Effort P(N)	42.5	62.5	82.5	105	142.5	220

The velocity ratio of the machine is 18.

(i) Plot a graph showing the relation between effort and load.
(ii) Determine law of the machine.
(iii) Determine the effort and efficiency for a load of 2KN.
(iv) Find the maximum efficiency.
(v) Find the effort to overcome machine friction when the load is 2KN.

(20 Marks)

Question FOUR

(a) A car of mass 1.2 tonne moves up an incline of 1 in 8. The resistance to motion is constant at 500N. Using the energy Method, calculate the effort required to move the car from rest to a speed of 45km/h in 30m. (10 Marks)

(b) A shaft together with its load has a mass of 250kg and a radius of gyration of 500mm. It is running freely at 650rev/min. If the shaft is connected by a clutch to another shaft at rest whose moment of inertia is 35kgm^2, calculate:

(i) The final speed of rotation of the two shafts after slipping has ceased.
(ii) The loss of kinetic energy due to engagement.

(10 Marks)

Question FIVE

(a) (i) Using a sketch explain the operation of a Burdon gauge used in pressure measurements.

(ii) Show that for a liquid column:

$P = h\rho g$

Where : P = pressure (gauge)
h = height of liquid column
g = acceleration due to gravity
ρ = density of the liquid

(10 Marks)

(b) A tank contains oil of specific gravity 0.8 to a depth of 2.8m. It discharges through a 20mm diameter straight pipe at a point 8m below the bottom of the tank. Taking specific weight of water as 9.8KN/m^2, Calculate:

(i) The discharge in litre/s and tonnes/h.

(ii) The oil pressure at a point half way along the pipe.

(10 Marks)