THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A CONSTITUENT COLLEGE OF JKUAT)

Faculty of Engineering and Technology

DEPARTMENT OF MECHANICAL AND AUTOMOTIVE ENGINEERING

CERTIFICATE IN MECHANICAL ENGINEERING

EME 1204 : MECHANICAL SCIENCE II

YEAR I SEMESTER II

SUPPLEMENTARY/SPECIAL EXAMINATIONS

SERIES: MAY, 2011

TIME: 2 HOURS

Instructions to Candidates:

1. The paper consists of **FIVE** Questions.
2. Answer question **ONE** and any other **TWO** Questions.
3. All Questions carry equal marks.

Question ONE

(a) Define the following terms:

(i) Specific heat capacity

(ii) Specific latent heat of vaporization

(iii) Specific latent heat of fusion

(3 Marks)

(b) 2kg of water is contained in an aluminium pan having a mass of 0.2kg. The specific heat capacity of water is 4200J/KgK and that of aluminium is 920J/KgK.

(i) How much heat energy is needed to raise the temperature of pan by 50˚C.

(ii) How much heat energy is needed to raise the temperature of water by 50˚C.

(iii) How much heat is required to raise the temperature of pan full of water by 50˚C.

(iv) If in heating up of the pan full of water. Only 50% of the supplied energy actually heats the pan and water, the other being lost to the surrounding, how much heat is required to raise the temperature of pan full of water by 50˚C.

(6 Marks)

(c) 2kg of iron is placed in water at 100˚C and then quickly removed and placed in a 5kg of water at 30˚C. Taking the specific heat capacities of iron and water as 450J/KgK and 4200J/KgK respectively, determine the final temperature of the iron and water. (5 Marks)

(d) Two trucks travelling in the same straight line collide and remain locked together after impact. Truck A has a mass of 100kg and velocity 10m/s. Truck B has a mass of 150kg and velocity 5m/s. Determine:

(i) The magnitude of velocity after impact.
(ii) Kinetic energy before impact.
(iii) Kinetic energy after impact.

(6 Marks)

(e) A mass of 5kg moving at 7m/s strikes a spring inside a smooth cylindrical holder. The spring stiffness is 7N/mm compression of spring. Calculate the maximum amount of compression. (10 Marks)

Question TWO

(a) Define the following terms as applied to simple machines:

(i) Velocity ratio
(ii) Mechanical advantage
(iii) Efficiency
(iv) Ideal machine

(4 Marks)

(b) In an experiment with a simple machine of velocity ratio 20, an effort of 10N was required for a load of 100N while a load of 200N required an effort of 15N. Determine:

(i) The law of the machine,
(ii) The effort for a load of 1000N,
(iii) The efficiency for a load of 1000N.

(16 Marks)

Question THREE

(a) Define the following terms:

(i) Coefficient of linear expansion
(ii) Coefficient of superficial expansion
(iii) Coefficient of cubical expansion

(3 Marks)

(b) State any **TWO** effects of expansion. (2 Marks)

(c) Calculate the increase in length of a steel bar of length 6m when the temperature is increase from 20˚C to 80˚C. Take α for steel as 12×10^{-6}/K. (3 Marks)

(d) A volume of $500cm^3$ of Mercury is contained in a glass tube graduated in cm. Determine the increase in volume registered when the temperature rises from 20˚C to 200˚C. The Coefficients of expansion are:

σ	for Mercury	0.182×10^{-3}/K
α	for glass	8.3×10^{-6}/K

(12 Marks)

Question FOUR

(a) State the following gas laws:

(i) Boyle's law
(ii) Charles law

(4 Marks)

(b) An air compressor is to compress $40m^3$ of air at atmospheric pressure of 1.013 bar and initial temperature of 20˚C into a receiver having a capacity of $5m^3$:

(i) Determine the resulting pressure in the receiver after the air has cooled down to 20˚C.
(ii) If the air is compressed further until the pressure is 13bar gauge and no change in temperature of the air takes place determine the new volume of the air.

(9 Marks)

(c) (i) State the law of conservation of energy.

(ii) A construction man drops a hammer of mass 1.5kg from the floor of a building 30m high. Determine:

(I) The velocity with which it strikes the ground.
(II) The Kinetic energy at impact.

(7 Marks)

Question FIVE

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

(ii) State any **FOUR** laws of friction.

(8 Marks)

(b) A box of weight 80N is resting on a rough horizontal floor whose coefficient of friction is 0.25. Determine the force required to drag the body at constant speed along the surface if,

(i) The force is a pull applied at 30˚ above the horizontal.
(ii) The force is a push at 30˚ downwards.

(12 Marks)