



# MACHAKOS UNIVERSITY

University Examinations 2016/2017

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

SECOND YEAR SECOND SEMESTER EXAMINATION FOR DIPLOMA

IN BUILDING AND CIVIL ENGINEERING

BCE CD 112: APPLIED MATHEMATICS

**DATE: 2/6/2017**

**TIME: 2:00 – 4:00 PM**

**INSTRUCTION TO CANDIDATES:**

Answer Question **one** and any other **two** questions

**QUESTION ONE (30 MARKS)**

- a) Define the following terms
- i) Kinetic Energy
  - ii) Moment of force
  - iii) Resultant force
  - iv) Collision (4 marks)
- b) State the SI units of the following physical quantities
- i) Momentum
  - ii) Frequency
  - iii) Density
  - iv) Power (4 marks)
- c) Differentiate between elastic collision and inelastic collision (3 marks)
- d) Show that force is the rate of change of momentum if a body of mass ( $m$ ) is acted upon by an average force ( $f$ ) for time ( $t$ ) (5 marks)
- e) State the three laws of motion. (6 marks)

- f) A shunting locomotive provides an impulse of 80kNs to set in motion a stationary 16tons wagon which then moves freely at a velocity of (u) against a track resistance of 120N/t and finally reaches a velocity of (v) after 40sec. Find the value of (u) and (v). (6 marks)
- g) Name the forces acting on the following bodies
- i) Mass suspended on a spring balance
  - ii) A moving car negotiating a corner (2 marks)

### QUESTION TWO (20 MARKS)

- a) i) State two conditions of a simple harmonic motion as a periodic motion (2 marks)
- ii) State the following terms as used in the simple harmonic motion
- Amplitude
  - Period
  - Frequency of oscillation (6 marks)
- b) A body with simple harmonic motion has a velocity of 3m/s when 375mm from the mid-position and an acceleration of  $1\text{m/s}^2$  when 250mm from the mid-position. Calculate the periodic time. (5 marks)
- c) A body performs simple harmonic motion in a straight line. Its velocity is 4m/s when the displacement is 150mm and 3m/s when the displacement is 100mm. The displacement being measured from the mid-position. Calculate the frequency and the amplitude of the motion. What is the acceleration when the displacement is 75mm? (7 marks)

### QUESTION THREE (20 MARKS)

- a) Define the following terms
- i) Energy (1 mark)
  - ii) Law of conservation of energy (2 marks)
- b) A man of mass 60kg dives vertically downwards into a swimming pool from a tower of the height of 20m. He was found to go down in the water by 2m and then started rising. Find the average resistance of the water. (7 marks)
- c) A truck of mass 20tonnes travelling at 1.6m/s impacts with a buffer spring which comprises 1.25mm per KN. Find the maximum compression of the spring. (7 marks)
- d) Explain the following terms as used in the simple harmonic motion
- Amplitude
  - Period
  - Frequency of oscillation (3 marks)

#### QUESTION FOUR (20 MARKS)

- a) Define the term co-efficient of friction (4 marks)
- b) State the formulae for the coefficient of friction (2 marks)
- c) A body oscillates along a straight line with simple harmonic motion. The frequency is  $0.8\text{m/s}$  and the amplitude is  $60\text{N/M}$ . Find the displacement of the body  $0.6\text{s}$  after leaving the position of maximum displacement. (8 marks)
- d) A composite spring has two close coiled springs A and B in series A has a stiffness  $s_1=200\text{N/M}$  and B has a stiffness  $s_2=800\text{N/M}$  the composite spring carries a mass weight  $50\text{N}$  and oscillated freely in the vertical direction. Find the frequency. (6 marks)

#### QUESTION FIVE (20MKS)

- a) State the three Newtons laws of motion. (3 marks)
- b) A minibus of mass  $1500\text{kg}$  is travelling at a constant speed of  $72\text{km/hr}$  collides with a stationary car of mass  $900\text{kg}$ . The impact takes  $2\text{seconds}$  before the two moves together at a constant speed for  $20\text{ seconds}$ .
- Calculate
- i) the common velocity
  - ii) the distance moved after the impact
  - iii) the impulse force
  - iv) the change in kinetic energy. (8 marks)
- c) i) Define the term impulse (2 marks)
- ii) Show that he force (F) is equal to the rate of change of momentum. (3 marks)
- iii) A truck of mass  $3000\text{kg}$  starts from rest on horizontal rails. Find the speed  $4\text{ seconds}$  after starting if the tractive force by the engine is  $2000\text{N}$  (4 marks)