



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 1m/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 0.8m/s and the amplitude is 60N/M. Find the displacement of the body 0.6s 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 50N 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 1500kg is travelling at a constant speed of 72km/hr collides with a stationary car of mass 900kg. The impact takes 2seconds before the two moves together at a constant speed for 20 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 3000kg starts from rest on horizontal rails. Find the speed 4 seconds after starting if the tractive force by the engine is 2000N (4 marks)