



MACHAKOS UNIVERSITY

University Examinations 2017/2018

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

FIRST YEAR FIRST SEMESTER EXAMINATION FOR DIPLOMA IN ELECTRICAL
ENGINEERING

EED 106: MECHANICAL SCIENCE

DATE: 18/12/2017

TIME: 8.30-10.30 AM

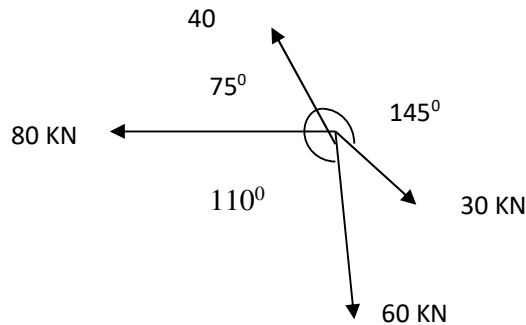
INSTRUCTIONS

This paper consists of *FIVE* questions

Answer question *ONE* (compulsory) and any other *TWO* questions

1. a) Define the following terms
 - i. Work
 - ii. Energy
 - iii. Power (3 marks)
- b) A body having a mass of 30kg is supported 50m above earth's surface.
 - i Calculate the potential energy of the body
 - ii If the body is allowed to fall freely, calculate its potential and kinetic energies when the body is 20 m above the ground and just before it touches the ground. (14 marks)
- c) A wagon of mass 4 tonnes is pulled on a horizontal frictionless track. After five minutes it is observed that the amount of power used is 8.2 kW, calculate:-
 - i. The average work done
 - ii. The distance travelled (6 marks)

- d) Four forces in one plane act at a point Q. Its magnitudes and direction being shown below. Determine graphically the magnitude and direction of the resultant force (7 marks)



2. a) Define the following terms
- Polygon of forces
 - Resultant of force
 - Equilibrium (3 marks)
- b) The forces 20 N, 30 N, 40 N, 50 N, and 60,N are acting at one of the angular points of a regular hexagon, towards the other five angular points, taken in order. Using resolution method, find the magnitude and direction of the resultant force. (17 marks)
3. a) Define the following terms
- Stress
 - Strain (2 marks)
- b) An aluminum alloy tie bar is 42mm diameter and 500mm long. A flat bottomed hole 100mm deep is to be drilled from one end of the bar. When the maximum axial tensile load is 65kN, Calculate a suitable diameter for the hole
- If the stress is not to exceed 85N/m^2
 - If the total extension of the bar is not to exceed 0.31mm.
- Take E for aluminum = 80MN/m^2 (11 marks)
- c) A bar 70 mm diameter has an overall length of 2 m. A quarter of its length is turned to a diameter of 42 mm and an axial tensile load of 44 kN then applied. Taking young modulus of elasticity to be 200GN/m^2 . Calculate the extension of the bar due to this load. (7 marks)
4. a) i State the law of consevation of energy (2 marks)

- ii Distinguish between potential energy and kinetic energy (3 marks)
- b) A vehicle of total mass 1600kg increases its speed uniformly from 36km/h to 72km/h by the action of an average accelerating force of 2.4kN. By how much will its kinetic energy have increased during the acceleration shown that this increases in kinetic energy is equal to the work done by the accelerating force. (15 marks)
- 5. a) A ball bearing is dropped on a rigid hard surface from height, h . It rebounds to height, h_1 . Find the co-efficient of restitution if, $h = 800\text{mm}$ and $h_1 = 650\text{mm}$ (7 marks)
- b) The two buffers at one end of a truck each require a force of 0.7 MN/m of compression and engage with similar buffers on the truck which it overtakes on a straight horizontal track. The truck has a mass of 10 tonnes and its initial speed is 1.8 m/s, while the second truck has a mass of 15 tonnes with initial speed 0.6 m/s, in the same direction.
 - i Find the common speed when moving together during impact
 - ii The kinetic energy then lost to the system and the compression of each buffer spring to store this
 - iii The velocity of each truck on separation if only half of the energy stored in the springs is returned. (13 marks)