MACHAKOS UNIVERSITY

University Examinations for 2021/2022

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

FIRST YEAR FIRST SEMESTER EXAMINATION FOR

DIPLOMA IN MECHANICAL ENGINEERING (PLANT, PRODUCTION AND AUTOMOTIVE OPTIONS) MODULE 1(TVET)

MECHANICAL ENGINEERING SCIENCE.

DATE: **TIME:**

INSTRUCTIONS

This paper contains FIVE questions

Answer all questions.

QUESTION ONE (20MARKS)

(a) State the following theorems with reference to forces

(i) Parallelogram law of forces. (2 marks)

(ii) Polygon law of forces. (2 marks)

(b) Three forces of magnitudes 140KN,160KN and 110KN act at angles of 70°,135° and 280°respectively from a reference point Using the analytical method of resolution of forces determine the magnitude and direction of their resultant force. (6 marks)

(c) (i) State two conditions for equilibrium of forces acting at a point. (2 marks)

(ii) State the law of moments. (2 marks)

(d) A uniform beam AB of length 8m is simply supported at its ends.It carries point loads of 4KN,5KN and 7KN at the positions 2m,5m,7m respectively from end A.If the reaction at B is 13KN calculate;

(i) The force due gravity on the beam. (3 marks)

(ii) The reaction at end A. (3 marks)

QUESTION TWO (20MARKS)

(a) Determine the magnitude and direction for the resultant force for the system of forces shown using the graphical method. (10 marks)

(b) Four forces of magnitudes 80N,40N, 95N and 50N act at angles of 0°,90°,255°and 300° respectively from a fixed point. Using the analytical method of resolution of forces determine the magnitude and direction of their resultant force. (10 marks)

QUESTION THREE (20 MARKS)

(a) A small bridge consists of a uniform horizontal beam supported by vertical pillars at each end.The mass of the beam is 1500kg and its length is 12m. Determine the reaction forces in the pillars when the bridge is loaded by;

(i) Masses of 500kg and 1000kg acting at the bridge centre. (5 marks)

(ii) When the 500kg and 1000kg masses act at distances of 2m and 8m respectively from one end.(Take g as 9.81N/kg). (5 marks)

(b) A uniform beam 4m long is simply supported at two points A and B,point A being 0.5m from the left hand end and B being 1.5m from the right hand end. The beam carries loads of 600N at the left hand end,800N at the centre and 400N at the right hand end.

(i) Determine the magnitude of the support reactions at A and B. (5 marks)

(ii) At what point should the load of 800N be applied to make the support reactions equal. (5 marks)

QUESTION FOUR (20 MARKS)

(a) A car starts from rest and travels with an acceleration of $1.55m/s^2$ for 15 seconds. It then travels with uniform velocity for 4 minutes and is finaly brought to rest with uniform retardation of $1.9m/s^2$.Draw the velocity –Time graph for this motion and determine;

(i) The maximum velocity in km/h
(ii) Time taken during retardation
(iii) Total distance travelled (10 marks)

(b) A car is travelling at a uniform speed of 60km/h.It maintains this speed for 120 seconds and is then uniformly accelerated to 100km/h in 60 seconds and then immediately retarded and brought to rest after a total 6 minutes travelling time.Draw a velocity-time graph and use it to find;

(i) Distance covered while accelerating.
(ii) Distance covered while braking.
(iii) Total Distance covered. (10 marks)

QUESTION FIVE (20MARKS)

(a) A wheel that is initially at rest is subjected to a uniform angular acceleration of 3.2 rad/s^2 for 80 seconds and is then immediately retarded uniformly until it comes to rest 132 seconds later. Calculate;

(i) The maximum angular velocity attained in rad/s. (3 marks)

(ii) The total number of complete revolutions made by the wheel. (4 marks)

(iii) The angular retardation in rad/s^2 (3 marks)

(b) The flywheel of an oil engine revolves at a constant speed of 600R.P.M.When the fuel supply is cut off the speed of the flywheel reduces to 100R.P.M with a constant retardation while turning 350 revolutions. A constant braking torque is then applied and the flywheel comes to rest with uniform retardation in a further 6 seconds.Determine using a velocity – time graph;

(i) The total time taken for the flywheel to come to rest.

(ii) The number of revolutions turned through during the braking period.

(ii) The angular retardation before and after braking. (10 marks)