MACHAKOS UNIVERSITY

University Examinations for 2020/2021

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

FIRST YEAR SECOND SEMESTER EXAMINATION FOR

DIPLOMA IN MECHANICAL ENGINEERING MODULE I

(PLANT, PRODUCTION AND AUTOMOTIVE OPTIONS)

MECHANICAL ENGINEERING SCIENCE I

DATE: 8/9/2021 **TIME: 8:30 – 11:30 AM**

INSTRUCTIONS
This paper contains FIVE questions

Answer all questions.

QUESTION ONE (20 MARKS)

a) Define the following terms with reference to angular motion; stating their S.I units.

(i)Angular velocity. (2 marks)
(ii)Angular acceleration (2 marks)

b) A wheel that is initially at rest is subjected to a uniform angular acceleration of 2.2rad/s^2 for 60 seconds and is then immediately retarded uniformly until it comes to rest 80 seconds later. Using a velocity –Time graph calculate;
(i) Maximum angular velocity in rad/s. (3 marks)
(ii) Total number of complete revolutions. (4 marks)
(iii) Angular retardation in rad/s^2 . (3 marks)

c) A wheel of diameter 1.2m is accelerated from rest to a speed of 750rev/min in 15 seconds. It is then maintained at this speed for a further distance of 1250 revolutions. Sketch on angular – velocity time graph and determine;

(i)The angular acceleration of the wheel. (2 marks)

(ii) Angle turned through in radians. (4 marks)

QUESTION TWO (20 MARKS)

(a) A wheel rotates at a speed of 1500 revs/min.When brakes are applied the wheel comes to rest with uniform retardation and covers 350 revolutions. Determine using an angular – velocity time graph the;

(i)Time taken to bring the wheel to rest. (5 marks)

(ii)The angular retardation. (3 marks)

(b) A rotating shaft of diameter 72 mm experiences an angular acceleration of15 rad/s^2 over a duration of 10 seconds. If the angular displacement is 820 radians, determine the initial and the final angular velocities. (6 marks)

(c) A large gear rotating at 50rev/min has an angular retardation of 0.02rad/sec^2.Calculate;

(i)Its angular velocity after 40 seconds

(ii) The number of complete revolutions it makes in 60 seconds

(iii) Its linear speed at the 40 seconds if its diameter is 0.15m. (6 marks)

QUESTION THREE (20 MARKS)

a) Define the following terms.

(i)Energy

(ii)Power

(iii)Kinetic energy. (6 marks)

b) A lathe rotates at 60rev/min while turning a 150mm diameter cylinder. The force on the tool is 2.4KN and the efficiency of the lathe is 80%. Determine the power required to drive the motor (6 marks)

c) In a drop- forging operation, the top die and its holder, with a total mass of 40kg,fall freely for 3m before contacting the metal resting on the bottom die. Calculate the;

(i) Velocity and kinetic energy of the top die at impact. (3 marks)

(ii) Force exerted on the metal if the top die is brought to rest in 20 mm after impact.(take g=9.81 m/s^2.) (5 marks)

QUESTION FOUR (20 MARKS)

a) Define the following terms with reference to lifting machines

(i) Mechanical advantage. (2 marks)

(ii) Velocity ratio. (2 marks)

(iii) Efficiency (2 marks)

b) The law connecting the effort (E) and the load (W) of a lifting machine is E=Aw+b where a and b are constants. The machine has a velocity ratio of 40.The efficiencies when lifting loads of 2000N and 8000N are 25% and 40% respectively. The maximum permitted load on the machine is 18000N.By determining the constants a and b,Find the efficiency of the machine when lifting its maximum load. (6 marks)

(c) During a lifting operation an effort of 200N was found to lift a load of 1200N while an effort of 230N lifted a load of 2700N.Given that the velocity ratio of the machine is 30, Determine;

(i) The law of the machine (2 marks)

(ii) The limiting mechanical advantage (2 marks)

(iii) Effort and efficiency when lifting a load of 2000N (4 marks)

QUESTION FIVE (20 MARKS)

(a) A lifting machine has a velocity ratio of 4 and can lift a load of 981N when the effort applied is 327N.Find;

(i) The efficiency

(ii) Effort to overcome friction at this load.

(iii) The work done against friction when the load is lifted 2m. (8 marks)

(b) In a certain weight lifting machine a weight of 1 KN is lifted by an effort of 25N .While the weight moves up by 100 mm,the point of application of the effort moves up by 8m.Find;

(i)The mechanical advantage.

(ii)Velocity ratio.

(iii)Machine efficiency. (6 marks)

(c) In a chain-operated lifting gear,the chain moves 6 m when lifting an engine through a vertical distance of 100 mm.The mass of the engine is equivalent to a force of 4KN.If the steady pull exerted by the operator was 200 N,Calculate;

(i)The movement ratio.

(ii)The force ratio

(iii)The efficiency of the machine. (6 marks)