The Open University of Sri Lanka
Faculty of Engineering Technology

Study Programme	:	Bachelor of Technology Honours in Engineering
Name of the Examination	:	Final Examination
Course Code and Title	:	**DMX4204/DMX4576/MEX4276 Machine Dynamics**
Academic Year	:	2019/20
Date	:	28th July 2020
Time	:	09:30 to 12:30
Duration	:	3 hours

General instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Eight (8)** questions in **Four (4)** pages.
3. Answer any **Five (5)** questions only. All questions carry equal marks.
4. Answer for each question should commence from a new page.
5. This is an Open Book Test **(OBT)** / Closed Book Test **(CBT).**
7. Answers should be in clear hand writing.
8. Do not use red colour pen.

QUESTION 01:

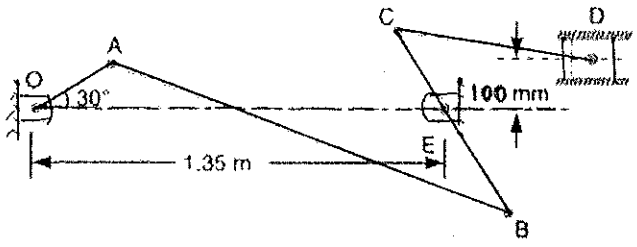

Fig.Q1

The mechanism shown in Fig.Q1 has the following dimensions:

OA = 200 mm; AB = 1.5 m; BC = 600 mm; CD = 500 mm; OE = 1.35 m and BE = 400 mm.

If crank OA rotates uniformly at 120 r.p.m. clockwise, find

a) the velocity of points B, C and D
b) the angular velocity of the links AB, BC and CD.

Use graphical method

(20 marks)

QUESTION 02:

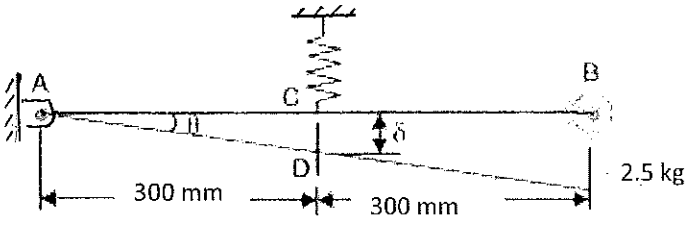

Fig.Q2

A uniform thin rod (AB), as shown in Fig.Q2, has a mass of 1 kg and carries a concentrated mass of 2.5 kg at B of its free end. The rod is hinged at A and is maintained in the horizontal position by a spring of stiffness 1.8 kN/m at its centre, C.

Find the frequency of oscillation (for small angles), neglecting the effects of the mass of the spring.

(20 marks)

QUESTION 03:

a) Show that the effort applied at the circumference of the screw to lift the load **P** is

$$P = W\left[\frac{tan\,\alpha + tan\,\emptyset}{1 - tan\,\alpha\,tan\,\emptyset}\right]$$

Where W = Load to be lifted

α = Helix angle

$\emptyset$ = Friction angle

(10 marks)

b) A square threaded bolt of root diameter 22.5 mm and pitch 5 mm is tightened by screwing a nut whose mean diameter of bearing surface is 50 mm. If the coefficient of friction for nut and bolt is 0.1 and that for nut and bearing surface is 0.16, find the force required at the end of a spanner 500 mm long when the axial load on the bolt is 10 kN.

(10 marks)

QUESTION 04:

a) For gears, explain with suitable sketches the terms

(i) Module (ii) Pressure angle (iii) Addendum (iv) Dedendum

(10 marks)

b) Obtain an expression for the path of contact in terms of addendum circle radii, pitch circle radii and pressure angle.

(10 marks)

QUESTION 05:

a) What is the function of a flywheel? How does it differ from a governor? Give two examples, where a flywheel is integrated into mechanical systems.

(06 marks)

b) The turning moment diagram for a multi-cylinder engine has been drawn to a scale 1 mm = 500 Nm vertically and 1 mm = 4^0 horizontally. The intercepted areas between the output torque curve and the mean resistance line, taken in order from left to right of the diagramme are as follows:

+52, -124, +92, -140, +85, -72 and +107 mm^2, when the engine is running at a speed of 500 r.p.m. If the total fluctuation speed is not exceeded ± 1.5% of the mean, find the necessary mass of the flywheel of radius 0.5 m.

(14 marks)

QUESTION 06:

a) Explain why balancing of rotating parts is necessary for high speed engines.

(05 marks)

b) A, B, C and D are four masses carried by a rotating shaft at radii 100, 125, 200 and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the mass of B, C and D are 10 kg, 5 kg and 4 kg respectively.
Find the required mass A and the relative angular setting of the four masses so that the shaft shall be in complete balance.

(15 marks)

QUESTION 07:

a) If I is the mass moment of inertia and Ω is the mean speed of the flywheel, prove that the maximum fluctuation of energy can be expressed as

$$E_{max} = \frac{K_s I \Omega^2}{100}$$

Where K_s is the coefficient of fluctuation of speed expressed as a percentage of mean speed.

(08 marks)

b) A two-stroke twin–cylinder engine with single acting has its cranks set at right angles and it runs at 1500 rev/min. The torque-angle diagram is a triangle for the power stroke with a maximum value of 200 Nm at 60^0 after top dead center of the corresponding crank. The torque on the return stroke is negligible. Sketch the torque-crank angle diagram, and hence find

(i) the power developed

(ii) the torque on the load

(12 marks)

QUESTION 08:

A Porter governor has two equal arms, each 250 mm long and pivoted on the axis of rotation. Each ball has a mass of 5 kg and the mass of the central load on the sleeve is 25 kg. The radius of rotation of the ball is 150 mm when the governor begins to lift and 200 mm when the governor is at its maximum speed. Find the minimum and maximum speeds and range of speed of the governor.

(20 marks)

END