Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024

COURSE NAME	:	MECHANIC OF MACHINE
COURSE CODE	:	BNJ 20303
PROGRAMME CODE	:	BNG & BNM
EXAMINATION DATE	:	JULY 2024
DURATION	:	3 HOURS
INSTRUCTIONS	:	1. ANSWER **ALL** QUESTIONS 2. THIS FINAL EXAMINATION IS CONDUCTED VIA ☐ Open book ☒ Closed book 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 (a) **Figure Q1.1** shows 4 kg of AOB bar. It has 100 mm of centrifugal radius that is measured from O to B. Two springs K1 and K2 are attached at A and B points with the stiffness coefficient is 5000 N/m. The point B also has a 1 kg mass connected between the spring and end bar.

(i) Draw the free body diagram of the force acting and determine the displacement. Assume the system oscillates at O, with rotation θ.

(3 marks)

(ii) Calculate the natural frequency in rad/s using the 2nd Newton Law Method.

(5 marks)

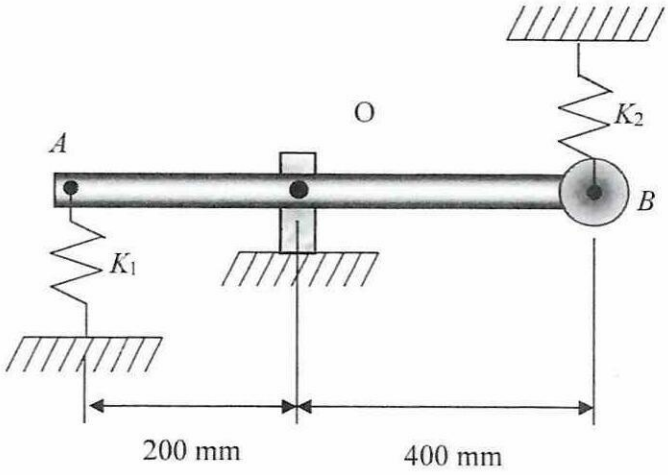

Figure Q1.1

Q1 (b) A mass of 2 kg is suspended by a spring passing over the pulley as shown in **Figure Q1.2**. The system is supported horizontally by a spring of stiffness of 500 N/m. Given the mass of the pulley, M = 15 kg, radius, R = 100 mm, and the existence of spring from the center of gravity, x = 50 mm. Calculate the natural frequency in rad/s and Hz of the vibration system by energy method.

(12 marks)

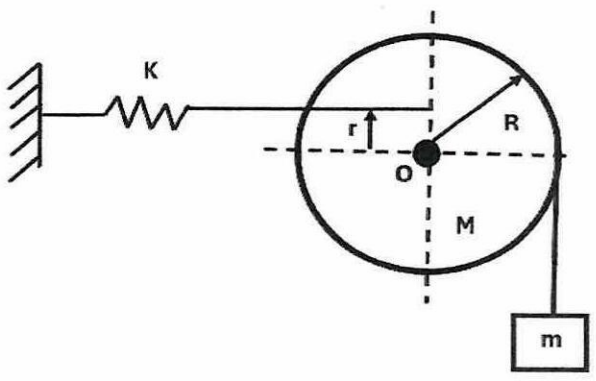

Figure Q1.2

Q2 **Figure Q2.1** shows the firing order in a six-cylinder vertical four-stroke in line engine is 1-4-2-6-3-5. The piston stroke is 100 mm, the crankshaft radius is 50 mm and the length of each connecting rod is 200 mm. The pitch distances between the cylinders are 100 mm, 100 mm, 150 mm, 100 mm, and 100 mm, respectively. The reciprocating mass per cylinder is 1 kg and the engine runs at 3000 rpm. Taking reference distance at the middle between cylinders of 3 and 4.

(i) Interpret the data balancing for this system.

(6 marks)

(ii) Determine the unbalanced primary and secondary forces using the Vector Diagram method on the graph paper. Use scale, 3 cm = 50 kgmm.

(6 marks)

(iii) Determine the unbalanced primary and secondary moment using the Vector Diagram method on the graph paper Use scale, 1.5 cm = 3750 kgmm^2.

(8 marks)

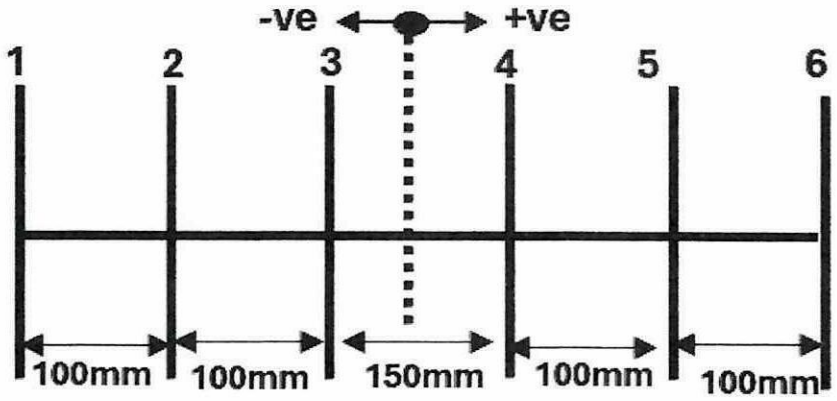

Figure Q2.1

Q3 (a) A body of mass 50 kg and with a surface for which on the same plane, the friction coefficient is 0.15, is to be moved by a force P directed at an angle 15° to the plane, i.e at 35° to the horizontal. Calculate the value of P which will cause downward movement becomes possible. Any formulae used should be established or explained by vector diagrams of forces.

(8 marks)

(b) A vertical screw with single start square threads 50 mm mean diameter and 12.5 mm pitch is raised against a load of 10 kN by means of a hand wheel, the boss of which is threaded to act as a nut. The axial load is taken up by a thrust collar which supports the wheel boss and has a mean diameter of 60 mm. If the coefficient of friction is 0.15 for the screw and 0.18 for the collar and the tangential force applied by each hand to the wheel is 100 N, determine suitable diameter of the hand wheel.

(12 marks)

Q4 (a) A plate clutch has two discs on the driving shaft and two discs on the driven shaft. Given an external diameter of 240 mm and 120 mm internal diameter. Assuming uniform pressure.

(i) Calculate the ratio between the torque and centrifugal force if the friction coefficient is assumed equal to one.

(2 marks)

(ii) Determine the torque if the total spring load pressing the plates together to transmit 30 kW at 2000 rev/min.

(2 marks)

(iii) Referring to **Q4(a)(i)** and **Q4(a)(ii)**, determine the centrifugal force if the friction coefficient given is 0.25.

(3 marks)

Q4 (b) **Figure Q4.1** shows a gear train system used to hoist a load of 50 kg. The radius of the hoist is 1.0 m. Neglect the moment of inertia of the shaft, gear, and friction effect. The efficiency of the gear train is $\eta_{G1/2} = 92$ %. Determine the torque of the motor needed to bring the load up with an acceleration of 2 m/s^2.

(13 marks)

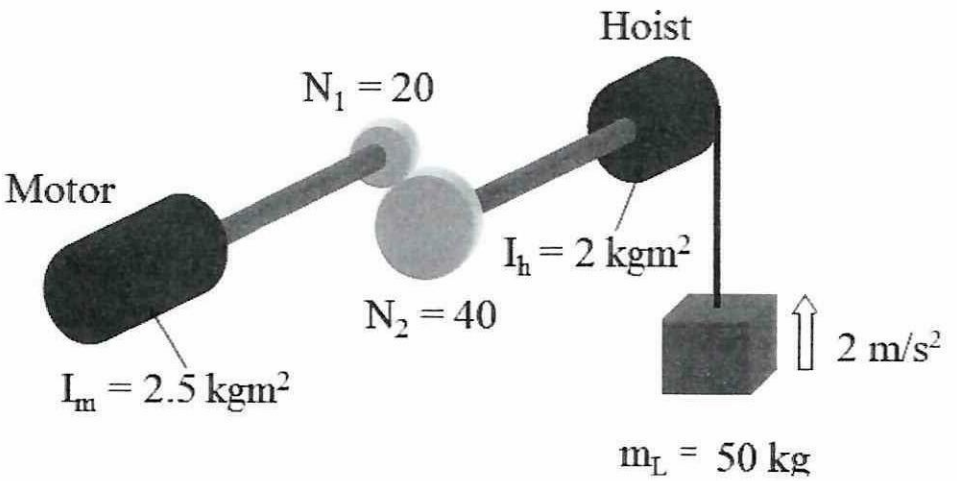

Figure Q4.1

Q5 **Figure Q5.1** shows a flat type of pulley with a diameter of 200 mm rotating at a speed of 1750 rpm drives another pulley with a diameter of 800 mm using an open belt type arrangement. The distance between the shafts centre is 1 meter and the mass of the belt material is 0.5 kg/m. The coefficient of friction between the belt and the pulley's contact surface is 0.3. When in operation, the belt tension at the slack side is 300 N.

(i) State **THREE (3)** advantageous and **THREE (3)** disadvantageous of belt drive system over gear drive system.

(6 marks)

(ii) For an open belt drive system, express that

$$\theta = (180^{o} - 2\alpha)\frac{\pi}{180} \text{ rad}$$

(4 marks)

(iii) If the belt's maximum permissible tension is 350 N, analyze what will happen to the belt.

(10 marks)

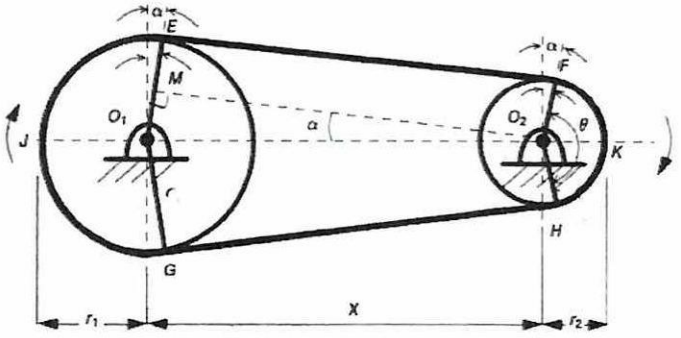

Figure Q5.1

- END OF QUESTIONS -