UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2011/2012

COURSE NAME	:	MECHANICS OF MACHINES
COURSE CODE	:	BDA20303 / BDA2033
PROGRAMME	:	2 BDD
EXAMINATION DATE	:	JUNE 2012
DURATION	:	3 HOURS
INSTRUCTION	:	**PART A:** ANSWER **ALL** QUESTIONS
		PART B: ANSWER **ONE (1)** QUESTION ONLY

THIS PAPER CONTAINS SEVEN (7) PAGES

PART A (COMPULSORY)

Q1 (a) Indicate 'True' or 'False' for the following statements:

(i) The radial distance between pitch circle and root circle is called addendum.
(ii) The common point of contact of the pitch circles of two meshing gears is called pitch point.
(iii) Straight bevel gears are used to connect two intersecting co-planer shafts.
(iv) In a reverted gear train, the axes of the first gear and last gear are parallel.
(v) Train value of a gear train is equal to reciprocal of speed ratio of gear train.
(vi) The angle of contact in cross belt drive is more than that for open belt drive.
(vii) The ratio of tension of tight side to slack side in case of V-belt drive is $e^{\mu\theta \sec\beta}$.
(viii) In crossed belt drive, the directions of rotation of two pulleys connected by it are opposite.
(ix) Because of slip of the belt, the velocity ratio of the belt drive is decreases.
(x) If the initial tension in the belt is increased, the power transmitted by the belt increases.

(10 marks)

(b) A horizontal shaft running at 400 rpm is to drive a parallel shaft at 500 rpm. The diameter of the pulley on the driving shaft is 80 cm. If the belt is 8 mm thick, calculate the diameter of the driven pulley :

(i) Neglecting belt thickness
(ii) Taking belt thickness into account
(iii) Assuming in the latter case a slip of 5%

Given:

$$\frac{N_B}{N_A}=\frac{D_A}{D_B}, \qquad \frac{N_B}{N_A}=\frac{D_A+t}{D_B+t}, \qquad \frac{N_B}{N_A}=\frac{D_A+t}{D_B+t}\times\left(1-\frac{s}{100}\right)$$

(6 marks)

(c) What is velocity ratio? What is slip? Discuss the effect of belt thickness and slip on velocity ratio.

(9 marks)

Q2 (a) **FIQURE Q2** shows a system with three weights on rotating shaft. $W_1 = 40N\angle 90°$ at a 101.6 mm radius, $W_2 = 40N\angle 225°$ at 152.4 mm radius, and $W_3 = 26.7N\angle 315°$ at 254 mm radius. The balance weight in planes 4 and 5 are placed at a 76.2 mm radius. To dynamically balance the system, determine using the graphical method:

(i) The magnitudes of the balance weights in Newton (N)
(ii) The angles of the balance weights, measured counter clockwise from reference angle.

(10 marks)

(b) Base on theory of dry friction, discuss about static friction force and kinetic friction force. You may use some diagram to support your explanation.

(5 marks)

(c) A vertical screw threads of mean diameter 50 cm and 12 cm pitch. Given that the coefficient of friction between nut and screw is 0.15

Find;

(i) Torque required on the screw to raise a load of 25kN
(ii) Find the percentage efficiency.
(iii) If a Vee thread of $\beta = 10°$ is used to replace the present screw, what is the torque required on the screw and its efficiency?

Given:

$$\tan\alpha = \frac{p'}{\pi d} \qquad \eta\% = \frac{Wp'}{F\pi d} \qquad T = Fr \qquad \tan\phi = \mu$$

$$F = W\frac{\tan\alpha + \tan\phi}{1 - \tan\alpha\tan\phi} \qquad F_V = W\frac{(\cos\beta\tan\alpha + \tan\phi)}{(\cos\beta - \tan\alpha\tan\phi)}$$

(10 marks)

Q3 (a) What is inversion of mechanism in engineering words? List out three (3) examples of inversion mechanism.

(4 marks)

(b) In a slider crank mechanism shown in **FIGURE Q3**, the crank OA rotates clockwise about 'o' at 120 rpm.

(i) Find the linear velocity of slider B.
(ii) Find the linear velocity of point P located at a distance of 8 cm on the connecting rod extended.
(iii) Determine the velocity of rubbing at the pin of the crank shaft OA , if the diameter of it pins is 5 mm.
(iv) What would happen to the system if the rpm of crank OA is increased to 200rpm? Please briefly explain and verify your answer with calculation.

Given:

$$\omega = \frac{2\pi N}{60} \qquad V = \omega \times r$$

(21 marks)

PART B (OPTIONAL), ANSWER ONE(1) QUESTION ONLY

Q4 A kinematics of system is consists a cylinder of mass m, spring and inextensible cable suspended as shown in **FIGURE Q4**.

(a) Get the relationship between linear and rotation displacement $(x \text{ and } \theta)$, and between linear and rotation acceleration $(a \text{ and } \alpha)$ of the kinematics of the system,

(7 marks)

(b) Prove that the natural frequency is given by

$$\omega_n = \sqrt{\frac{8k}{3m}}$$

(15 marks)

(c) If the radius, r and mass, m of cylinder, and spring constant, k are $0.5m, 8kg$, and $60N/m$, respectively, determine the natural frequency of vibrations of the cylinder in Hz.

(3 marks)

Q5 (a) A mass of $5kg$ is suspended on a spring and set to oscillate. It is observed that the amplitude reduces to 5% of its initial value after 2 oscillations. It takes 0.5 seconds to do that process.

Calculate the following:

(i) The damping ratio
(ii) The natural frequency
(iii) The actual frequency
(iv) The spring stiffness
(v) The critical damping coefficient
(vi) The actual damping coefficient

(7 marks)

(b) A mass of $5kg$ is suspended on a spring of stiffness $4kN/m$. The system is fitted with a damper with a damping ratio of 0.2. The mass is pulled down $50mm$ and released.

Calculate the following:

(i) The damped frequency
(ii) The mass displacement after 0.3 seconds
(iii) The mass velocity after 0.3 seconds
(iv) The mass acceleration after 0.3 seconds

(7 marks)

(c) A mass of 30 kg as shown as in **FIGURE Q5** is hung from a spring of stiffness, $k = 2.5\times10^5$ N/m which is attached to an aluminum beam (Young's modulus, $E = 71$ GPa and density, $p = 2700$ kg/m^3) of moment of inertia, $I = 3.5\times10^{-8}$ m^4 and of length 35 cm. The beam is supported at its free end by a circular aluminum cable of diameter 1 mm and length 30 cm.

(i) Develop a model for the system shown in **FIGURE Q5** as a mass – spring system.
(ii) Analyze the equivalent stiffness for the system.
(iii) Draw the free body diagram and derive a differential equation governing in the motion of the mass.

(11 marks)

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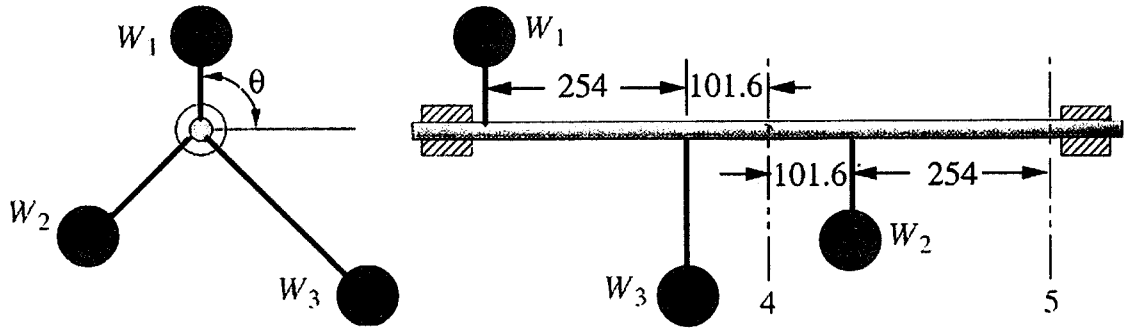

FIGURE Q2

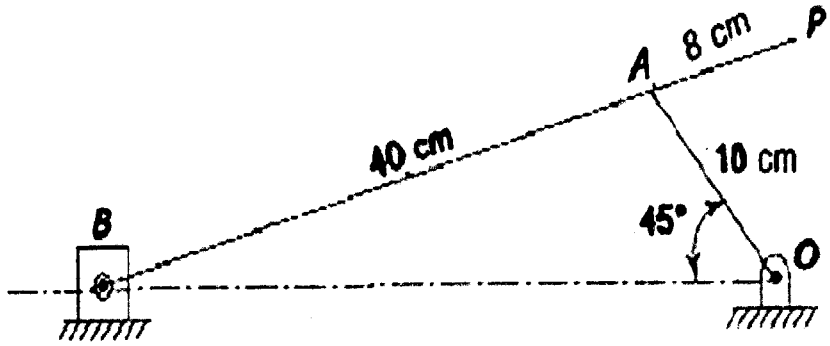

FIGURE Q3

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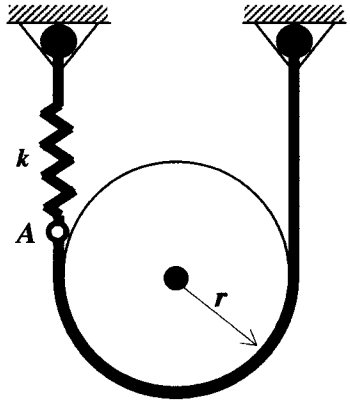

FIGURE Q4

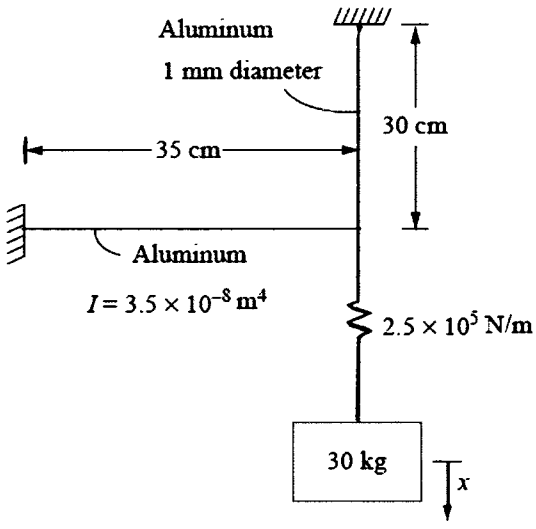

FIGURE Q5