TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
Department of Mechanical & Automotive Engineering
UNIVERSITY EXAMINATION FOR:
SCHOOL BASED
BSc. Mechanical Engineering
EMG 2304 : Mechanics of Machines II
END OF SEMESTER EXAMINATION
SERIES: APRIL 2017
TIME: 2 HOURS
DATE: Pick Date **Mar 2017**

Instruction to Candidates:

You should have the following for this examination

- *Answer booklet*
- *Non-Programmable scientific calculator*

This paper consists of **FIVE** questions. Attempt any **THREE** questions.
Maximum marks for each part of a question are as shown.
Do not write on the question paper.

Question ONE

A racing car of mass 2500 kg has a wheel base of 2.5m and track of 1.5m. The centre of gravity is located at 0.5m above the ground level, 1.5m from the rear axle. Each wheel has an effecting diameter of 80cm and a moment of inertia of 0.75 kg m^2. The back axle ratio is 4. The drive shaft engine flywheel and transmission are rotating in clockwise direction when viewed from the front with equivalent mass of 150 kg with radius of gyration 15 cm. Determine the load distribution on the wheels if the car is rounding a curve of 100m radius at 100 km/hr. Investigate for right turn rounding and also for left turn rounding. (20 marks)

Question TWO

In a Hartnell governor, the lengths of ball and sleeve arms of the bell crank lever are 150mm and 120mm respectively. The pivot axis is 160mm from the governor axis. Mass of each governor ball is 3 kg. When the sleeve arm is horizontal and the ball arm is

vertical, the mean speed of governor is 500 r.p.m . The sleeve moves by 12mm up for an increase of speed of 5%. Determine:

i. The minimum equilibrium speed for a total sleeve movement of 24mm,
ii. The spring rate
iii. The sensitiveness of governor, and
iv. the spring rate if the governor is isochronous at 500 r.p.m. (20 marks)

Question THREE

An uncoupled locomotive has three cylinders. The two outside cranks are 2130mm apart and the third one is in the centre. Each crank is 330 mm long and set at 120^o apart from the others. All the revolving masses are balanced. The reciprocating masses of each cylinder are 450 kg and 66.66% of these are balanced by revolving masses placed at radius 800mm, **in** the plane of the wheels 1525mm apart. The static load on each wheel is 8000g Newtons. Find the lowest speed in km/hr at which each wheel lifts from the rails. The diameter of the wheel tread is 1950mm.(20 marks)

Question FOUR

A marine engine shaft and propeller are equivalent to a torsional-system as in Fig.Q4. Determine the frequency of torsional vibration and the position of the nodes and find the amplitudes of vibrations for both the nodes of vibrations. $G=84x10^9 N/m^2$.

Question FIVE

a) Determine the frequency of SHM oscillations of a simple pendulum of string length L and bob mass M. (4 marks)

b) Determine the natural frequency of small oscillations of the bell crank lever ABC shown, Fig Q5b. The lever is light but has a mass M fixed at C. BC is horizontal when the system is in the equilibrium position. (8 marks)

c) Derive the differential equation of motion for the system shown in Fig Q5c in terms of the variable x_1. The mass of the linkage is negligible. State the natural frequency in rad/s for the case $k_1=k_2=k$ and $m_1=m_2=m$. Assume small oscillations throughout. (8 marks)

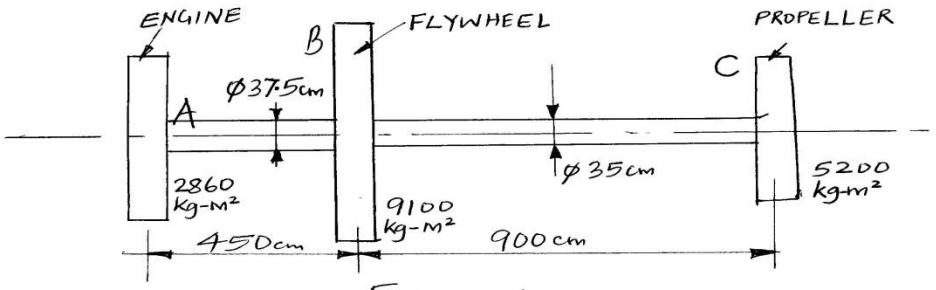

FIG Q4

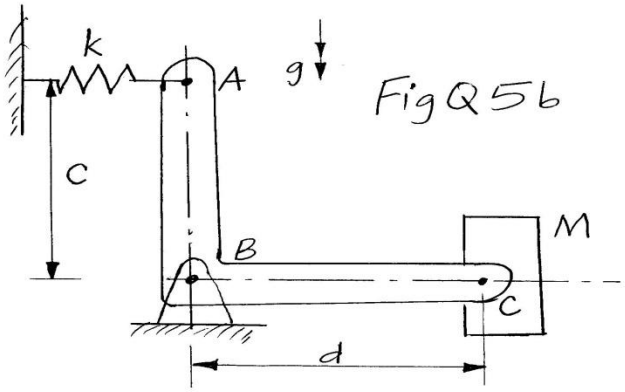

Fig Q5b

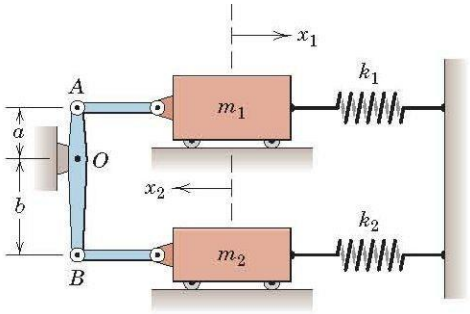

Fig Q5 c