TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
Department of Mechanical & Automotive Engineering
UNIVERSITY EXAMINATION FOR:
BSc. Mechanical Engineering
EME 2304 : Mechanics of Machines II
SPECIAL/SUPPLEMENTARY EXAMINATION
SERIES: SEPTEMBER 2018
TIME: 2 HOURS
DATE: Sep 2017

Instruction to Candidates:

You should have the following for this examination

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

This paper consists of **FIVE** questions. Attempt question **ONE** and any other **TWO** questions.

Maximum marks for each part of a question are as shown.

Do not write on the question paper.

Question ONE

A test bench is suspended from a built-in beam by a set of springs. On top of the bench is mounted a testing instrument. The effective stiffness of this set of springs is 12kN/m with effective mass of bench and instrument being 95kg. The motion of the bench is damped by a frictional resistance which is proportional to the velocity and is equal to 100Ns/m.

If the beam vibrates vertically ±30mm about a mean position with a frequency of 18Hz; determine from first principle the amplitude of the forced vibrations of the bench:

(a) Taking account of the damping force,
(b) neglecting the damping force
(c) comment on two calculated values in (a) and (b).

(20 marks)

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Question TWO

The following are particulars are given for a motor vehicle: total mass, 1,5 t; wheel base 3.2 m track width, 1.5 m; centre of gravity 1.8 m behind the front axle and 0.05 m above road level; moment of inertia of two front wheels, 10 kg/m^2; wheel diameter, 0.64 m, gear ratio from engine to road wheels, 10 to 1. The engine turns in a clockwise direction when viewed from the front of the vehicle. The vehicle travels at a constant speed of 80 km/h and enters a right-hand curve of 150 m radius. Determine:

(a) the vertical load on each wheel, taking into account:
    (i) gravitational effects;
    (ii) centrifugal effects
    (iii) the gyroscopic effects due to the engine;
(b) the rolling couple acting on the vehicle due to the gyroscopic effect of the road wheels

Question THREE

(a) A uniform beam of mass 31 kg/m, is simply supported on a span of 3.6 m. Taking EI for the beam as 7 MN/m^2, Calculate the frequency of transverse vibrations
(b) The frequency of the beam in (a) is to be reduced by 40% by fixing three equal masses to the beam at the mid-point and the quarter points. Calculate the value of the three masses.

Question FOUR

A four-stroke engine has five identical cylinders with their centre-lines in one plane and spaced at equal intervals of 150 mm. the reciprocating parts per cylinder have a mass of 1.5 kg, the pistons have a stroke of 100 mm and the connecting rods are 175 mm long centres. The cylinders are numbered consecutively from one end of the engine and the firing order is 1—4—5—3—2 at equal intervals. The engine speed is 600 rev/min.

(a) Show that the engine is in complete balance with respect to primary and secondary forces,
(b) Determine the maximum primary couple and the maximum secondary couple acting on the engine and state all the positions of crank No. 1 from its inner position at which these maximum values occur.

Question FIVE

A shaft AB, 150mm diameter and 3 m long, runs in spherical bearings at A and B, and carries two loads, each 2 t, symmetrically placed at 0.9 m from the ends. Determine:

(a) the whirling speed'

(b) the whirling speed if the an end thrust of 1/10 of the Euler critical load is impressed on the shaft.