THE UNIVERSITY OF ZAMBIA
SCHOOL OF ENGINEERING
DEPARTMENT OF MECHANICAL ENGINEERING

TERM 3 – JULY 2017
EEE 3112 - ELECTRICAL ENGINEERING PRACTICE

ANSWER ALL QUESTIONS TIME ALLOWED 2 HOURS
CLOSED BOOK

Question 1
A 4m long beam supported by pin joints at its ends, carries two 40kg motors at ¼ and 3/4 of the span of the beam. All motors rotating in the same direction, deliver 60kw at 3000rpm to downstream applications. Find:

(a) The reactions at the pin joints (6 marks)
(b) expressions for the slope of the beam at each end in terms of EI. (10 marks)
(c) expression for the maximum deflection in terms of EI. (9 marks)

Question 2
You are designing the suspension for a new light truck. The net weight of the pick up is 1900kg, distributed 40% on the rear axle and 60% on the front axle. When fully loaded an additional 3000kg is added to the light truck, distributed 60% on the rear axle and 40% on the front axle. You are using, on the front axle 2 identical helical close coiled springs in parallel, and on the rear axle 2 identical leaf springs in parallel. Your design constraint is, completely unloaded to fully loaded, the maximum static deflection on either axle should not exceed 10 cm. given for:

Helical spring:

Mean coiled diameter	=	10cm
Modulus of rigidity	=	82.5 GN/m^2
Wire diameter	=	15mm

Leaf spring:

Length	=	90cm
Number of leaves	=	5
Width to thickness ratio	=	9:1
Elastic modulus	=	120 GN/m^2

Find:

(a) the number of complete coils required in the helical springs (6 marks)
(b) the width of the leaf springs (6 marks)
(c) the deflection at both axles when acted upon the net weight of the pickup only. (6 marks)
(d) If the distance between the rear and front axle is 6 m what is the magnitude and direction of the shift in the centre gravity of the pickup when loaded with the additional 3000kg. (7 marks)

Question 3

A hollow 1m shaft of outside radius 60 mm, inside radius 55mm and density 7 g/cm^3 carries 4 unbalanced masses spaced as follows:

Masses A, B, C, and D are 10, 12, 14, and 16kg respectively, rotating at radii 16, 14, 12, 10cm respectively, and spaced from one end of the shaft at 30, 45, 60, and 75 cm respectively. the angular spacing from A to B, C, and D are 90, 180, and 270° respectively.

(a) Balance the shaft using two 10 kg masses at either end (9 marks)

(b) If before balancing, the shaft rotated at 3000 rpm what will be its rotation after balancing. (7 marks)

(c) If all masses are removed from the shaft and the power transmitted is 165 kW, determine the maximum shear stress on the shaft. (9 marks)

Note: Uniform disc or cylinder, radius r. I about the central axis is $\frac{mr^2}{2}$ and $k = \frac{r}{\sqrt{2}}$

Question 4

You are designing the spring damper system for a 1850 kg 4X4 Luxury vehicle. The test road is sinusodially undulated with a maximum displacement of 36cm. If the maximum allowable displacement of the vehicle relative to the road is 42cm, determine:

(a) the damping ratio and state whether it is over, critically or under damped (6 marks)

If the length of one undulation is 2m, and the damping coefficient is 9500kg/s, determine:

(b) the stiffness of the suspension (5 marks)

(c) the speed in km/h of the vehicle at maximum displacement (7 marks)

(d) the maximum displacement of the vehicle if the and the vehicle is moving a 140km/h (7 marks)

END OF TEST