TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

UNIVERSITY SPECIAL/SUPPLEMENTARY EXAMINATION FOR:

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EMG 2413: MACHINE DESIGN

END OF SEMESTER EXAMINATION

SERIES: DECEMBER 2016

TIME: 2 HOURS

DATE: Pick Date Dec 2016

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID Pocket Calculator

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

Do not write on the question paper.

Question ONE (a)

i. Give disadvantages of welded over riveted joints **(4 marks)**

ii. A catalog lists the basic dynamic load rating for a ball bearing to be 33800N for a rated life of 10^6 revolutions. What would be the expected L_{10} life of the bearing if it were subjected to 15000N and determine the life in hours that this corresponds to if the speed of rotation is 2000 rpm. Comment on its suitability for a machine. **(4 marks)**

b) Give the criteria used that determine the selection of a packing **(5 marks)**

c) Explain the procedure for selecting a bearing to bear combined thrust and radial loads. **(9 marks)**

d) A double riveted double cover butt joint in plates 20 mm thick is made with 25 mm diameter rivets at 100mm pitch. The permissible stresses are: $\sigma_t = 120MPa$ $\tau = 100MPa$ $\sigma_c = 150MPa$ Determine the efficiency of joint taking the strength of the rivet in double shear as twice than that of single shear. **(7 marks)**

Question TWO

a) Given the torque transmitted by shaft III in Fig 2a) is T_3=3.46kNm. The analysis of the loads and reactions on the shaft is given in fig 2(b) below and the preselected bearing on the supports. Take service factor for both bearings as 1.05.

$\alpha = 20°\ \ F_{tA} = 9131N;\ \ F_{tB} = 31600N\ \ F_{rA} = 3323N;\ \ F_{rB} = 11500N\ \ F_{tD} = 4228N; F_{tC} = 26000\ N; F_{rC} = 9038\ N\ F_{rD} = 860\ N$

n_3= 310 min^{-1}

For the shaft III:

i) Draw the horizontal, vertical, combined and equivalent moments on the shaft.

ii) Evaluate the preselected bearing for the shaft checking their viability and life.

Bearing No.	d (mm)	D (mm)	C_0 (kN)	C(kN)	k_T	k_b	V	X	y
7516A(radial)	80	140	155000	176000	1	1.3	1.2	0.44	1

(20 marks)

Question THREE

a) Fig 2a) is a schematic design of a helicopter transmission system. Design the shafts *I, II* & *III* in the schematic diagram given the following parameters:

$P_I = 546kNm\ \ \frac{d}{D} = 0.85,\ \tau_{\max} = 80MPa\ , T_{II} = 0.7T_I\ , T_{III} = 0.87T_{II}\ \ T_{life} = 1000hrs$ **(6 marks)**

b) b) Given T_2=1.738kNm the pitch diameter of the gears for is d=252.5mm & d=110mm respectively, the pressure angle α=20° for both gears and the length of the shaft for the shaft design as a beam is given in Fig 3(b) for the shaft II,

i) find the reactions at the bearing support A & B.

ii) Draw the horizontal, vertical, combined and equivalent bending moments of the shaft II **(14 marks)**

Question FOUR

a) Explain the effect of keyways on shafts. **(5marks)**

b) A 15kW, 960 rpm motor has a mild steel shaft of 40mm diameter and the extension being 75 mm. The permissible shear and crushing stresses for the mild steel key are 56MPa and 112MPa. Design the keyway in the motor shaft extension. Check the shear strength of the square key against the normal strength of the shaft. Take least key width dimension to be 0.25 of shaft diameter. **(15 marks)**

Question FIVE

a) Discuss the advantages of roller bearings over sliding bearing **(7 marks)**

b) A clutch is required for transmission of power between a four-cylinder internal combustion engine and a small machine. Determine the radial dimensions for a single face dry disc clutch with a molded lining which transmit 5 kW at 1800 rpm, Base the design on the uniform wear assumption.

Take service factor of 2. Coefficient of friction molded lining μ=0.35 (8marks)

c) With the help of a diagram derive maximum bending stress for a circular fillet weld subjected to bending moment. (5 marks)

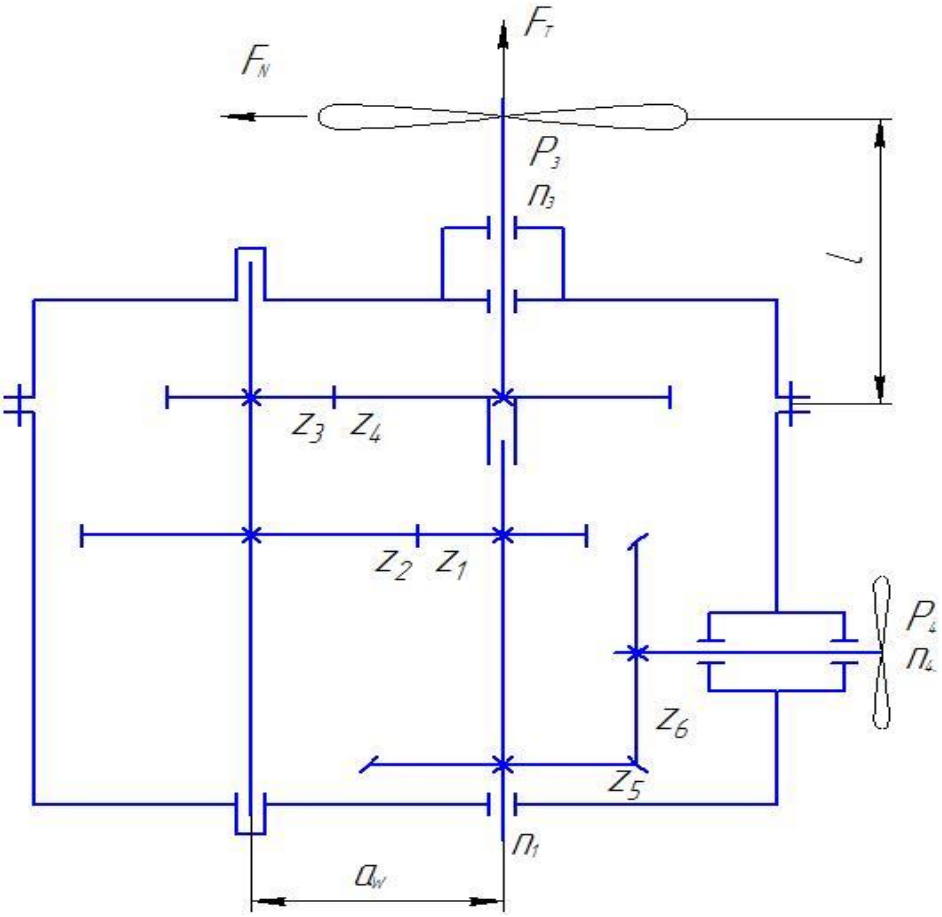

Fig 2(a)

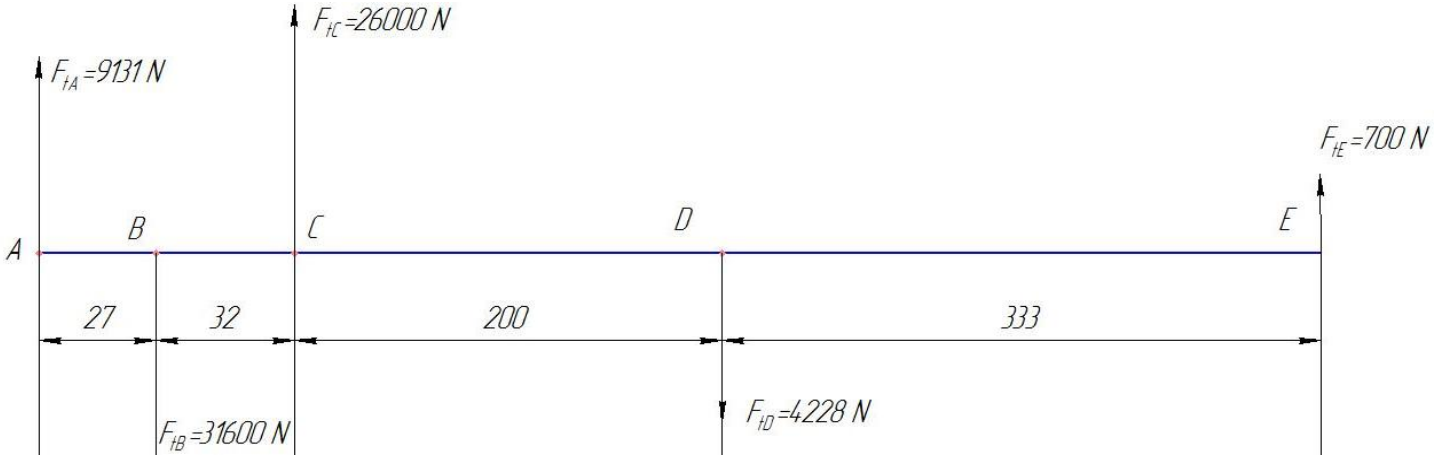

Fig 2(b)

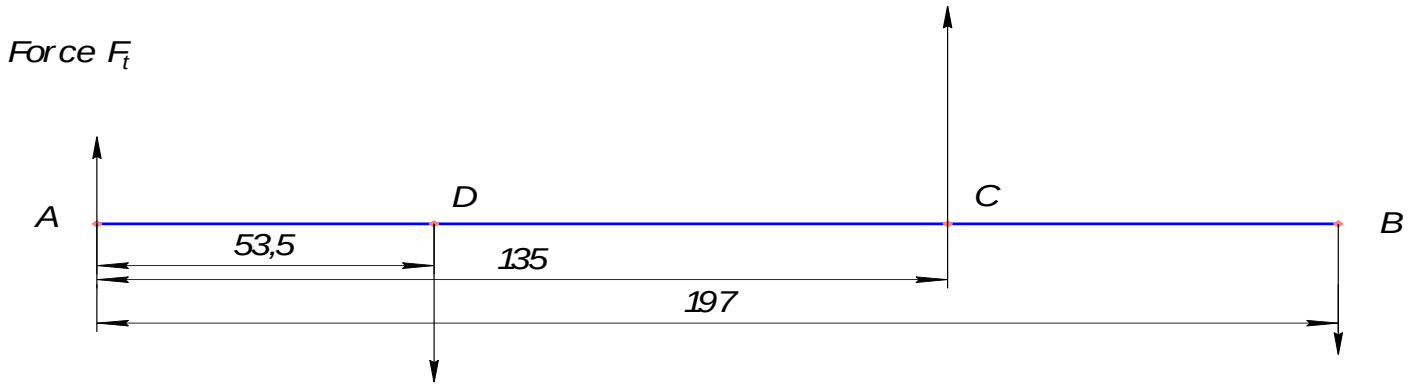

Fig 3(b)