Student Exam No:- _____

GANPAT UNIVERSITY

B. Tech. Semester V Mechatronics Engineering

Regular Examination Nov – Dec 2015

2MC503 Design of Machine Elements

[Time: 3 Hour] [Total marks: 70]

Instructions:

(1) All questions are compulsory.
(2) Right figure indicate full marks.
(3) Assume suitable data if necessary.
(4) Only scientific calculator is allowed.

SECTION-I

Que.1

(a) Derive an expression for torque capacity of centrifugal clutches. **[05]**

(b) An oil immersed multi-clutch, with molded asbestos on one side and steel disks on the other, is used in an application. The torque transmitted by the clutch is 75 N-m. The coefficient of friction between the asbestos lining and the steel plate in the wet condition is 0.1. The permissible intensity of pressure on the asbestos lining is 500 kPa. The outer diameter of the friction lining is kept as 100 mm due to space limitation. Assuming uniform wear theory. Calculate the inside diameter of disks, the required number of disks and the clamping force. **[07]**

OR

Que.1

(a) Determine the optimum diameter ratio for torque transmission, considering uniform wear theory for plate clutch. **[05]**

(b) A centrifugal clutch, transmitting 18.5 kW at 720 rpm consists of four shoes. The clutch is to be engaged at 75% of the running speed. The inner radius of the drum is 165 mm, while the radius of centre of gravity of each shoe, during engaged position is 140 mm. The co-efficient of friction is 0.25. Calculate the mass of each shoe. **[07]**

Que.2

(a) Highlight the thermal consideration in the design of brake and also explain significance of 'pv' value in the design of brake. **[05]**

(b) A pivoted double block brake has two shoes each of which subtend an angle of 120° at the centre of the brake drum. The diameter of the brake drum is 450 mm and the width of the friction lining is 75 mm. The coefficient of friction is 0.2 and the maximum intensity of pressure between the lining and the break drum is 0.5 N/mm^2. The pivot of each shoe is located in such a manner that the moment of frictional force on shoe about the pivot is zero. Assuming that the same actuating force is applied on both shoes, calculate: **[06]**
(i) The distance of the pivot from the axis of the brake drum
(ii) The braking torque capacity of the brake, and
(iii) The pivot reaction.

OR

Que.2

(a) For the pivoted block brake find the distance 'h' of the pivot from the center of the brake drum: **[05]**

$$h = \frac{4.R.\sin\theta_1}{2\theta_1 + \sin 2\theta_1}$$

(b) A caliper disk brake is to be designed for the front wheels of sports car. The required braking capacity of each brake is 400 N-m^2. The inner and outer radius of the friction pads are 100 mm and 150 mm respectively. The coefficient of friction between the pads and rotating disk is 0.35, while the limiting intensity of pressure is 1 N/mm^2. Determine the required no. of pads, if: [06]

(i) The pads are annular segments with subtended angle of 60° per pad at the centre of the disk; and

(ii) The pads are circular.

Que.3 Attempt Any THREE. [12]

(a) What is importance of manufacturing consideration in design?

(b) Explain the requirement of good friction clutch.

(c) What are the advantages of disk brake over shoe brake?

(d) Explain manufacturing considerations for welding processes.

SECTION – II

Que:4

(a) Explain Goodman criteria with neat sketch. [05]

(b) A plate made of steel 20C8 (S_{ut} = 440 N/mm^2) in hot rolled and normalized condition as shown in **fig 1**. It is subjected to a completely reversed axial load of 30 kN. The notch sensitivity factor can be taken as 0.8 and the expected reliability is 90% for which reliability factor is 0.897. Theoretical stress concentration factor is 2.5. The factor of safety is 2. The size factor can be taken as 0.85. Determine the plate thickness for infinite life. [07]

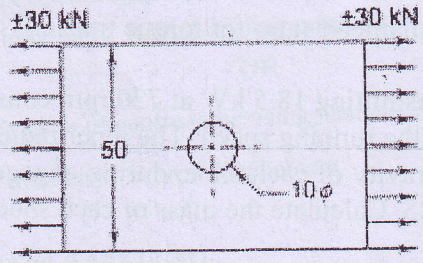

Fig. 1

OR

Que:4

(a) What is stress concentration? Explain its effect in fatigue loading. Also explain method of reducing the effects of stress concentration. [06]

(b) A machine component is subjected to valuable stress which fluctuates between +300 MN/m^2 and -150 MN/m^2. Determine the value of minimum ultimate strength according to (i) Gerber relation, (ii) modified Goodman relation and (iii) Soderberg relation. Take yield strength = 0.55 ultimate strength, endurance strength = 0.5 ultimate strength and factor of safety = 2. [06]

Que:5

(a) Derive the equation of length of belt for open belt drive. [05]

(b) Select a standard V-belt for the following drive condition: [06]

Drive = AC motor, high torque, high slip repulsion-induction, Motor speed = 1200 rpm, Power = 20 kW, Driven = Saw mill, Saw mill speed = 600 rpm, Duty = Continuous service, Correction factor for loading = 1.6, Centre distance = 1400 mm,

Rotation of pulleys: (1) Smaller = CW, (2) Larger = CW, consider section of belt as C.

Use the relevant design data from the tables.

OR

Que:5

(a) Write the procedure to select V belt from manufacturer's catalogue. [05]

(b) A leather belt 9 mm X 250 mm is used to drive a cast iron pulley 900 mm in diameter at 336 rpm. If the active arc on the smaller pulley is 1200 and the stress in tight side is 2 MPa. Find the power capacity of the belt. The density of leather may be taken as 980 kg/m^3, and the Coefficient of friction of leather on cast iron is 0.35. [06]

Que:6 Attempt following.

(a) Explain various factors for correcting endurance limit. [04]

(b) Explain Slip and Creep in Belt. [04]

(c) A spindle made of steel runs at 900 rpm and transmits 5 kW power. The angular deflection should not exceed 0.25° per meter of the spindle. Find the diameter of the spindle and shear stress induced in it, if the modulus of rigidity for the material of the spindle is 84×10^3 N/mm^2. [04]

Table 1 Dimensions and proportions of different V-belt sections

Belt section	Top width W (mm)	Thickness T (mm)	Min. dia. of pulley (mm)	Δ (mm)
A	13	8	125	36
B	17	11	200	43
C	22	14	300	56
D	32	19	500	79
E	38	23	630	92

Table 2 Power rating of V- belts

Section A	Dia.	80	90	100	110	120	125 & Over	
	KW_R	1.40	1.84	2.28	2.65	2.94	3.02	
Section B	Dia.	130	140	150	160	170	180 & Over	
	KW_R	3.16	3.68	4.19	4.56	4.92	5.22	
Section C	Dia.	180	200	220	240	260	280	300 & over
	KW_R	4.78	6.33	7.58	8.53	9.41	9.15	10.81

Table 3 Correction factor for arc of content F_D

Angle of wrap (deg)	154	157	160	163	166	169	171	174	177	180	
F_D	0.93	0.94	0.95	0.96	0.97	0.97	0.98	0.99	0.99	1.00	

Table 4 Correction factor for lengths F_L

Inside length L_i (mm)	Belt section				
	A	B	C	D	E
3150	-	-	0.97	-	-
3251	1.14	1.08	0.98	0.87	-
3404	-	-	0.99	-	-
3658	1.14	1.11	1.00	0.90	-
4013	-	1.13	1.02	0.92	-
4115	-	1.14	1.03	0.92	-
4394	-	1.15	1.04	0.93	-
4572	-	1.16	1.05	0.94	-
4953	-	1.18	1.07	0.96	-

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