

JK LAKSHMIPAT UNIVERSITY, JAIPUR
INSTITUTE OF ENGINEERING AND TECHNOLOGY
EndTerm Examination (Regular/Backlog), Nov.-Dec.2016
B. Tech in Mechanical Engineering, Semester V

Roll No.....

ME 504: Design of Machine Elements - I

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Use of Design data hand book is permitted. Assume suitable data wherever required and mention clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1: Objective Questions

20 Marks

1. Hardness is mechanical property which show:
(a) Surface strength (b) Intensive strength
(c) Shock absorbing capacity (d) Fatigue strength
2. Toughness is
(a) Surface strength (b) Intensive strength
(c) Shock absorbing capacity (d) Fatigue strength
3. Simple Leavers have
(a) high effort input (b) lower load output
(c) high mechanical advantage (d) Fatigue strength
4. Screw jack efficiency maximum at
(a) $\alpha = \left(45 - \frac{\phi}{2}\right)$ (b) $\alpha = \left(45 + \frac{\phi}{2}\right)$
(c) $2\alpha = \left(45 + \frac{\phi}{2}\right)$ (d) $\alpha = (90 - \phi/2)$
5. Maximum efficiency of screw jack is
(a) $\eta = \frac{1 - \sin\phi}{1 + \sin\phi}$ (b) $\eta = \frac{1 + \sin\phi}{1 - \sin\phi}$
(c) $\eta = \frac{\sin\phi + \sin\alpha}{\sin\phi - \sin\alpha}$ (d) None of these
6. Self-locking jack is
(a) $\phi \geq \alpha$ (b) $\phi > \alpha$
(c) $\phi < \alpha$ (d) $\phi \leq \alpha$
7. Efficiency of square thread power depends on
(a) Friction angle (b) Coefficient of friction
(c) Both (a) and (b) (d) Overhauling
8. Power transmission is shaft is due to
(a) Shear force resistance (b) Crushing force resistance
(c) Tensile stress (d) Momentum transfer
9. Oldham coupling used to connect

- (a) Parallel shafts (b) Counter shafts
(c) Non-axial shafts (d) Axial shafts
10. Shafts are made up of
(a) Ni-Cr steel (b) Mild steel
(c) Chromium steel (d) Carbides
11. For maximum power in belts, which is correct expression?
(a) $T = T_C / 3$ (b) $T_C = T / 3$
(c) $T = T_C + 2T$ (d) $T = T_C - 2T$
12. Clutches have number of pressure plate (N), the how many friction plates will be there
(a) $N - 1$ (b) $N + 1$
(c) N (d) N^2
13. Which kind of pair is belt derive
(a) Higher pair (b) Wrapping pair
(c) Lower pair (d) None of these
14. Angle of contact in cross belt is
(a) $\alpha = (180 + 2\beta)$ (b) $\alpha = (180 - 2\beta)$
(c) $\alpha = (360 - 2\beta)$ (d) $\alpha = (360 - \beta)$
15. Belt velocity for max power transmission
(a) $V = \sqrt{\frac{P}{3m}}$ (b) $V^2 = P \times 3m$
(c) $V = \sqrt{\frac{P}{m}}$ (d) $V^2 = \frac{P}{3m} \times m$
16. Length of belt for open drive is
(a) $L = 2C + \frac{\pi(D+d)}{2} + \frac{(D-d)^2}{4C}$ (b) $L = 2C + \frac{\pi(D-d)}{2} + \frac{(D-d)^2}{4C}$
(c) $L = 2C - \frac{\pi(D-d)}{2} + \frac{(D-d)^2}{4C}$ (d) $L = 2C + \frac{\pi(D-d)}{2} - \frac{(D-d)^2}{4C}$
17. Maximum power transmission depend on which factor in belts
(a) Friction (b) Distance
(c) Velocity (d) Centrifugal force
18. Flywheels are used to
(a) Store energy (b) For balancing
(c) Both of above (d) None of these
19. Energy are known as
(a) $E = \frac{I}{2}\omega^2$ (b) $E = \frac{1}{2} I(\omega_{\max}^2 - \omega_{\min}^2)$
(c) $E = \frac{1}{2} I_{\max}\omega^2$ (d) $E = \frac{1}{2} I_{\min}\omega^2$
20. Coupling are known as
(a) Permanent connection (b) Weak connections
(c) Positive connection (d) Negative connection

Q.2 (a) Draw stress-strain curve and explain properties at every point. 5marks

Q.2 (b) Explain odd and even materials of loading condition. 5Marks

Q.3 Design a muff coupling to connect two steel shafts transmitting 25 kW power at 360 rpm. The shafts and key are made of plain carbon steel 30C8 ($S_{yt} = S_{yc} = 400 \text{ N/mm}^2$). The sleeve is made of factor of safety for the shafts and key is 4. For the sleeve, the factor of safety is 6 based on ultimate strength. 10Marks

Or

Q.3 Design procedure of rigid flange coupling. 10Marks

Q.4 Derive the expression for torque transmission by clutches for uniform pressure theory. 10Marks

Or

Q.4 A plate clutch consists of one pair of contacting surfaces. The inner and outer diameters of the friction disk are 100 and 200 mm respectively. The coefficient of friction is 0.2 and the permissible intensity of pressure is 1 N/mm^2 . Assuming uniform-wear theory, calculate the power-transmitting capacity of the clutch at 750 rpm. 10Marks

Q.5 Derive maximum efficiency for power screw. 10Marks

Or

Q.5 The nominal diameter of triple threaded square screw is 50 mm, while the pitch is 8 mm and inner diameter is 65 mm. The coefficient of friction at the thread surface as well as the collar surface can be taken as 0.15. The screw is used to raise a load of 15 kN. Using the uniform wear theory for collar friction. Calculate:

- (i) Torque required to raise the load;
- (ii) Torque required to lower the load; and
- (iii) The force required to raise the load, if applied at a radius of 500 mm.

10Marks

Q.6 Derive the design procedure of cotter joint. 10Marks

Or

Q.6 Two rods are connected by means of a cotter joint. The inside diameter of the socket and outside diameter to the socket collar are 50 and 100 mm respectively. The rods are subjected to a tensile force of 50 kN. The cotter is made of steel 30C8 ($S_{yt} = 400 \text{ N/mm}^2$) and the factor of safety is 4. The width of the cotter is five times of thickness. Calculate:

- (i) Width and thickness of the cotter on the basis of shear failure; and
- (ii) Width and thickness of the cotter on the basis of bending failure.

10Marks

Q.7 Derive the expression for maximum tension ratio flat belt.

10Marks

Or

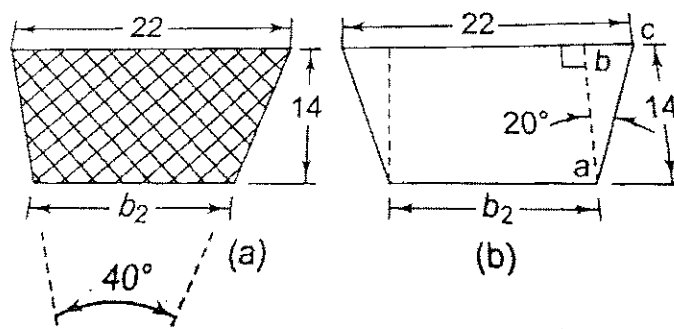
Q.7 The following data is given for a V-belt drive connecting a 20 kW motor to a compressor.

	Motor-Pulley	Compressor-Pulley
Pitch diameter(mm)	33	900
Speed (rpm)	1440	480
Coefficient of friction	0.2	0.2

The center distance between pulleys is 1 m and the dimensions of the cross-section of the belt are given figure. The density of the composite belt is 0.97 g/cc and the allowable tension per belt is 850 N.

How many belts are required for this application?

10Marks



Q.8 A right angled bell-crank lever is to be designed to raise a load of 5 kN at the short arm end. The lengths of short and long arms are 100 and 450 mm respectively. The lever and the points are made of steel 30C8 ($S_{yt} = 400 \text{ N/mm}^2$) and the factor of safety is 5. The permissible bearing pressure on the pin is 10 N/mm^2 . The lever has a rectangular cross-section and the ratio of width to thickness is 3:1. The length to diameter ratio of the fulcrum pin is 1.25:1. Calculate:

- The diameter and the length of the fulcrum pin
- The shear stress in the pin
- The dimensions of the boss of the lever at the fulcrum
- The dimensions of the cross section of the lever

Assume that the arm of the bending moment on the lever extends up to axis of the fulcrum.

10Marks

Q.9 Derive the expression for maximum power transmission in belt drives.

10Marks

Or

Q.9 A solid cast iron disk, 1 m in diameter and 0.2 m thick, is used as a flywheel. It is rotating at 350 rpm. It is brought to rest in 1.5 s by means of a brake. Calculate:

- The energy absorbed by the brake; and
- The torque capacity of the brake.

10Marks