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Subject Code
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- Any -

Question Number
- Any -

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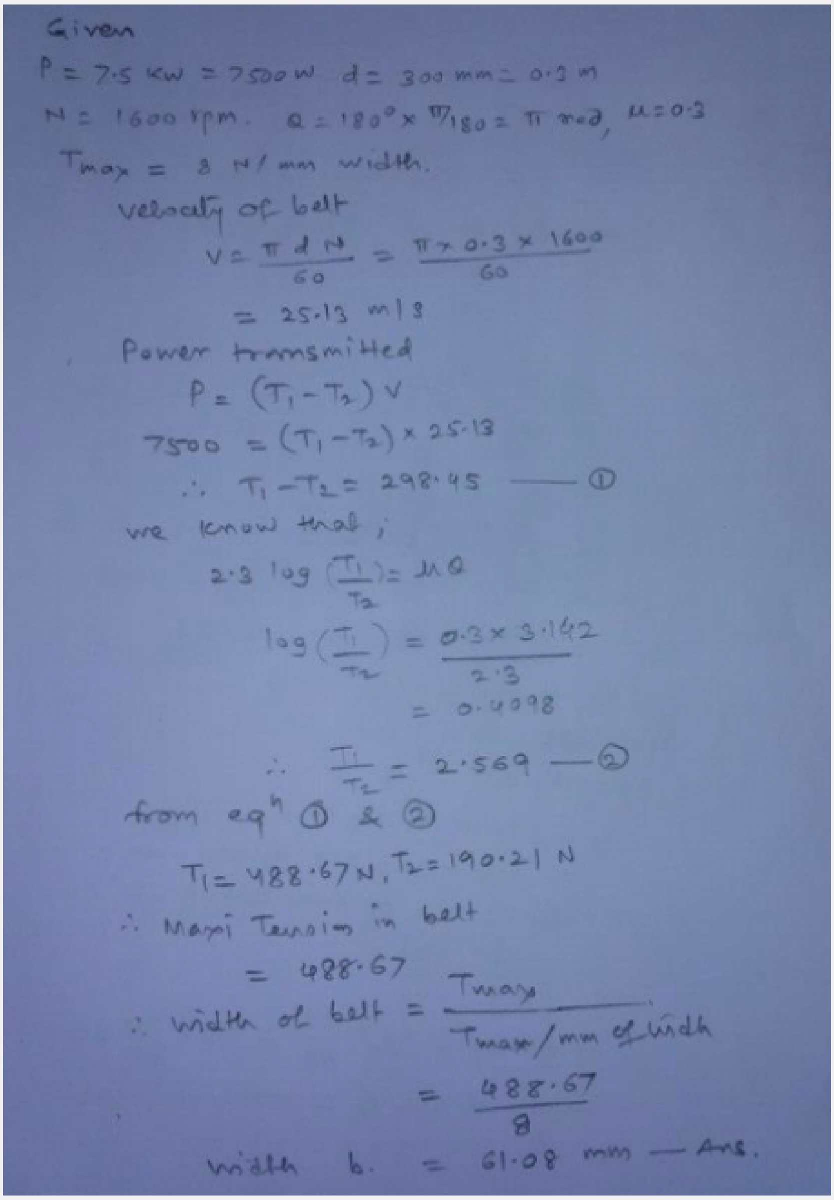
Examination: 2017 SUMMER

Que.No	Question/Problem	marks	Link
Q 2 f)	Question: **A multiplate clutch has three pairs of contact surfaces. The outer and inner radii of the contact surfaces are 100 mm and 50 mm respectively. The maximum axial spring force is limited to 1.25 kN. If the co-efficient of friction is 0.35 and assuming uniform wear, find the power transmitted by the clutch at 1600 rpm.** **Answer:**	4	view

<table>
<tr><th>Que.No</th><th>Question/Problem</th><th>marks</th><th>Link</th></tr>
<tr><td>Q 3 d)</td><td>Question:
Find the width of the belt, necessary to transmit 7.5 kW to a pulley 300 mm diameter, if the pulley makes 1600 rpm and the co-efficient of friction between the belt and pulley is 0.3. Assume the angle of contact as 180o and the maximum tension in the belt is not to exceed 8 N/mm width.
Answer:


Given

$P = 7.5\ kW = 7500\ W$, $d = 300\ mm = 0.3\ m$

$N = 1600\ rpm$, $\theta = 180^\circ \times \pi/180 = \pi\ rad$, $\mu = 0.3$

$T_{max} = 8\ N/mm$ width.

velocity of belt

$v = \frac{\pi d N}{60} = \frac{\pi \times 0.3 \times 1600}{60}$

$= 25.13\ m/s$

Power transmitted

$P = (T_1 - T_2)\, v$

$7500 = (T_1 - T_2) \times 25.13$

$\therefore T_1 - T_2 = 298.45$ —— (1)

we know that;

$2.3 \log\left(\frac{T_1}{T_2}\right) = \mu\theta$

$\log\left(\frac{T_1}{T_2}\right) = \frac{0.3 \times 3.142}{2.3}$

$= 0.4098$

$\therefore \frac{T_1}{T_2} = 2.569$ —— (2)

from eqn (1) & (2)

$T_1 = 488.67\ N$, $T_2 = 190.21\ N$

$\therefore$ Maxi Tension in belt

$= 488.67$

$\therefore$ width of belt $= \frac{T_{max}}{T_{max}/mm\ of\ width}$

$= \frac{488.67}{8}$

width $b = 61.08\ mm$ — Ans.
</td><td>4</td><td>view</td></tr>
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Que.No	Question/Problem	marks	Link
Q 4 f)	Question: **A shaft has number of collars integral with it. The external diameter of the collars is 400 mm and the shaft diameter is 250 mm. If the uniform intensity of pressure is 0.35 N/mm2 and its co-efficient of friction is 0.05; find (i) power absorbed in overcoming friction when shaft rotates at 105 rpm and carries a load of 150 kN, and (ii) number of collars required.** **Answer:** Given : $d_1 = 400$ mm or $r_1 = 200$ mm ; $d_2 = 250$ mm or $r_2 = 125$ mm ; $p = 0.35$ N/mm^2 ; $\mu = 0.05$; $N = 105$ r.p.m or $\omega = 2\pi \times 105/60 = 11$ rad/s ; $W = 150$ kN $= 150 \times 10^3$ N 1. *Power absorbed* We know that for uniform pressure, total frictional torque transmitted, $T = \frac{2}{3} \times \mu . W \left[\frac{(r_1)^3 - (r_2)^3}{(r_1)^2 - (r_2)^2} \right] = \frac{2}{3} \times 0.05 \times 150 \times 10^3 \left[\frac{(200)^3 - (125)^3}{(200)^2 - (125)^2} \right]$ N-mm $= 5000 \times 248 = 1240 \times 10^3$ N-mm $= 1240$ N-m ∴ Power absorbed, $P = T.\omega = 1240 \times 11 = 13640$ W $= 13.64$ kW **Ans.** 2. *Number of collars required* Let n = Number of collars required. We know that the intensity of uniform pressure (p), $0.35 = \frac{W}{n \pi [(r_1)^2 - (r_2)^2]} = \frac{150 \times 10^3}{n \pi [(200)^2 - (125)^2]} = \frac{1.96}{n}$ ∴ $n = 1.96/0.35 = 5.6$ say 6 **Ans.**	4	view

Examination: 2016 SUMMER

Que.No	Question/Problem	marks	Link
Q 2 f)	Question: **A shaft runs at 80 rpm & drives another shaft at 150 rpm through belt drive. The diameter of the driving pulley is 600 mm. Determine the diameter of the driven pulley in the following cases: (i) Taking belt thickness as 5 mm. (ii) Assuming for belt thickness 5 mm and total slip of 4%.** **Answer:** **Ans.: Given data; N1 = 80 rpm. N2 =150 rpm. D1= 600 mm. S = 4 % To find; D2 =?;** **(i) Case I: Taking t = 5 mm. Velocity ratio, (V.R.) N2/N1 = (D1 + t)/ (D2 + t)** **150/80 = (600 + 5)/ (D2 + 5)** **Therefore, diameter of driven pulley D2 = 317.66 mm ~ 318mm** **(ii) Case II: Assuming for belt thickness 5 mm and total slip of 4%.** **Velocity ratio, (V.R.) N2/N1 = {(D1 + t)/ (D2 + t)} × {1- (S/100)}** **150/80 = {(600 + 5) / (D2 + 5)} × {1- (4/100)}** **Therefore, diameter of driven pulley D2 = 304.76 mm ~ 305 mm**	4	view

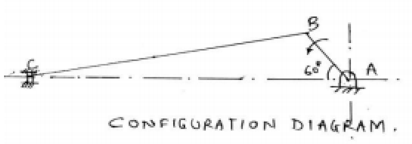
<table>
<tr><th>Que.No</th><th>Question/Problem</th><th>marks</th><th>Link</th></tr>
<tr><td>Q 3 b)</td><td>

Question:

In a slider crank mechanism, crank AB = 20 mm & connecting rod BC = 80 mm. Crank AB rotates with uniform speed of 1000 rpm in anticlockwise direction.
Find (i) Angular velocity of connecting rod BC
(ii) Velocity of slider C. When crank AB makes an angle of 60 degrees with the horizontal.
Draw the configuration diagram also.
Use analytical method.

Answer:

Data- Crank AB=20mm; Connecting rod BC=80mm; N_{BA}= 1000 rpm (anticlockwise)
Crank angle = $\theta = 60^0$; n = l/r = 80/20 =4



[1 Mark]

Angular velocity of crank = $\omega_{BA} = 2\pi N/60 = \frac{2 X \pi X 1000}{60} = 104.71$ rad/sec

Angular velocity of connecting rod = $\omega_{BC} = \frac{\omega \cos\theta}{n}$

$= \frac{104.71 X \cos 60^0}{4} = 13.08$ rad/sec ...[1 Mark]

Velocity of slider C = Vc = ω r $\left[sin\theta + \frac{\sin 2\theta}{2n}\right]$

$= 104.71 X .02[\sin 60 + \frac{\sin 120}{2 X 4}]$
= 2.04 m/s .... [2 Marks]

</td><td>4</td><td>view</td></tr>
<tr><td>Q 4 e)</td><td>

Question:

A multiplate disc clutch transmits 55 kW of power at 1800 rpm. Coefficient of friction for the friction surfaces is 0.1. Axial intensity of pressure is not to exceed 160 kN/m2 . The internal radius is 80 mm and is 0.7 times the external radius. Find the number of plates needed to transmit the required torque.

Answer:

Data:- Power=P = 55 KW = $55X10^3$ W ; N= 1800 rpm ; p = 160 KN/m^2 = 160 X 10^3 N/m^2
Internal radius R2 = 80 mm; External radius R1= 80/0.7 =114.28 mm
Coefficient of friction μ = 0.1
No. of plates needed to transmit torque = n = ??
Now using formula of power,

$P = \frac{2\pi NT}{60}$

$55X10^3 = \frac{2 X 3.14 X 1800 X T}{60}$

T= 291.79 N-m ....[1 Mark]

Considering uniform wear theory, for clutches, maximum pressure intensity is at minimum radius, i.e. $R_{min} = R_2$
$p_{max} = C / R_2$
160 X 10^3 = C/ 0.08

C= 12800 ....[1 Mark]

Axial load W = $2\pi C(R1 - R2)$
= 2 X 3.142 X 12800 X(0.1142-0.08)

W =2756.96 N ....[1 Mark]

Considering uniform wear theory, Torque transmitted by clutch

$T = \frac{1}{2}\mu W(R1 + R2) X n$

291.79 =$\frac{1}{2}$ X 0.1 X 2756.96 X (0.1142+0.08) X n

$n = 10.89 \approx 11$

This is Number of pairs in contact.

No. of plates needed is $n + 1 = 12$.......Ans ....[1 Mark]

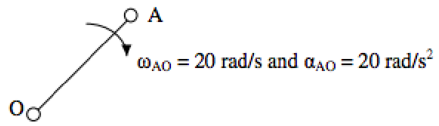
</td><td>4</td><td>view</td></tr>
</table>

Que.No	Question/Problem	marks	Link
Q 4 f)	Question: **A rotor having the following properties :** **m1 = 4 kg r1 = 75 mm θ1 = 45o** **m2 = 3 kg r2 = 85 mm θ2 = 135o** **m3 = 2.5 kg r3 = 50 mm θ3 = 240o** **Determine the amount of the countermass at a radial distance of 75 mm required for the static balance.** **Answer:** **Data :** m1= 4 kg r1= 75 mm θ1 = 45° m1r1= 300 kg-mm m2= 3kg r2= 85 mm θ2 = 135° m2r2 = 265 kg-mm m3= 2.5 kg r3= 50 mm θ3 = 240° m3r3 = 125 kg-mm Radius of balance mass = r = 75 mm Let m=Balancing mass Resolving horizontally, $\sum H = m1r1cos\theta1 + m2r2cos\theta2 + m3r3cos\theta3$ = 300cos 45°+265 cos 135° +125 cos 240° = -37.87 kg-mm [1 M] Resolving vertically, $\sum V = m1r1sin\theta1 + m2r2sin\theta2 + m3r3sin\theta3$ = 300sin 45°+265 sin 135° +125 sin240° 291.25 kg-mm [1M] Resultant R= $\sqrt{(\Sigma H)^2 + (\Sigma V)^2}$ =$\sqrt{(-37.87)^2 + (291.25)^2}$ = 293.70 kg-mm We know that m X r = R m = $\frac{293.70}{75}$ = 3.91 kg ……**counterbalance** mass [2 M]	4	view

Examination: 2016 WINTER

Que.No	Question/Problem	marks	Link
Q 1b)(iii)	Question: **The central distance two shaft is 4m having two pulleys with diameter having 500mm and 700mm respectively find the length of belt required -** **(1) for open belt drive** **(2) for cross belt drive** **Answer:** Central distance between two shafts; C = 4 Meters; = 4000 mm. Smaller pulley diameter = d = 500 mm; Smaller pulley radius = r= 250 mm; Larger pulley diameter = d = 700 mm; lager pulley radius = r= 350 mm; Angle subtended by each tangent β **a) Length of open belt drive** Angle subtended by each tangent $\beta = \sin^{-1}$ (R-r /C) = $\sin^{-1}$((350-250)/4000) B = 0.025 radians $L_O = \pi (R + r)2x\ \beta\ (R-r) + 2\ C\ x \cos \beta = 9.889$ m **$L_O = 9.889$ m** **b) Length of cross belt drive** Angle subtended by each tangent $\beta = \sin^{-1}$ (R+ r/C) = $\sin^{-1}$((350+250)/4000) β = 0. 01575 radians $L_C = \pi (R + r)2x\ \beta\ (R-r) + 2\ C\ x \cos \beta = 9.903$ m **$L_C = 9.903$ m**	4	view
Q 2 f)	Question: **A pulley is driven by the flat belt running at speed of 600m/min. and transmit 4 kW. The coefficient of friction between belt and pulley is 0.3 and angle of lap is 160°. Find maximum tension in the belt.** **Answer:** **Flat belt speed = V = 600 m/min = 600/60 m/sec = 10 m/sec;** **Power transmitted = P = 4 kW ;** **Coefficient of friction =μ = 0.3;** **Angle of lap = θ =1600** **Belt tension ratio = T1/ T2 = eμθ = e 0.3(160x π/180) = 2.31;** **T1/ T2 = 2.31;** **T1= T2 x 2.311-------------------------------(1)** **P = (T1 - T2) x V ; -------------------------------(2)** **P = (T2 x 2.31- T2)x 10; Putting value of power** **P = 4 kW 4 x1000 = (T2 x 2.31 - T2)x 10;** **T2 = 305.34 N** **T1 = 705.34N**	4	view
Q 3 d)	Question: **Three masses 10 kg, 20 kg and 15kg are attached at a point at radii of 20 cm, 25cm and 15 cm respectively. If the angle between successive masses is 60° and 90°. Determine analytically the balancing mass to be attached at radius of 30cm.** **Answer:**	4	view

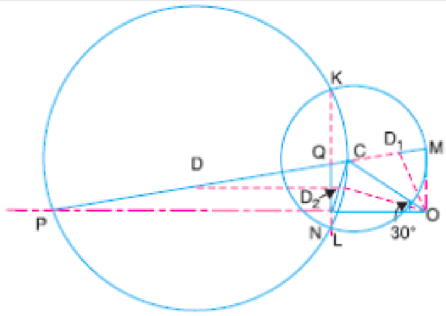
Examination: 2015 SUMMER

Que.No	Question/Problem	marks	Link
Q 2 f)	Question: **The central distance between two shaft is 4 m having two pulleys with diameter having 500 mm and 700 mm respectively. Find length of belt required (i) for open belt drive (ii) for cross belt drive** **Answer:** **f) Problem on belt drive (02 marks each length)** i) for open belt $L = \pi/2\,(d_1 + d_2) + 2x + (d_1 - d_2)^2 / 4\,x$ = 9.8865 m ii) for cross belt $L = \pi/2\,(d_1 + d_2) + 2x + (d_1 + d_2)^2 / 4\,x$ = 9.974 m	4	view
Q 3 f)	Question: **Crank OA of a mechanism is hinged at ‘O’ and rotates at an angular velocity of 20 rad/sec. and angular acceleration of 25 rad/sec2 . If crank OA is 50 mm long determine linear velocity, centripetal acceleration and tangential acceleration of a point A.** **Answer:**  Angular velocity ω_{AO} = 20 rad /sec, α_{AO} = 20 rad /s^2 , OA = 50 mm Linear velocity $V_{AO} = \omega_{AO}$ x OA =20 x 50 /1000 = 1 m/s Centripetal acceleration = $a^r_{AO} = a_B = \omega^2_{AO}$ x OA = 20 x 20 x 0.05 =20 m/s^2 Tangential acceleration = $\alpha^t_{OA} = a^t_{AO}$ / OA a^t_{AO} = OA x α^t_{OA} = 0.05 x 20 = 1 rad / s^2	4	view

Que.No	Question/Problem	marks	Link
Q 4 e)	Question: **Three masses 10 kg, 20 kg and 15 kg are attached at a point at radii of 20 cm, 25 cm and 15 cm respectively. If the angle between successive masses is 60° and 90°. Determine analytically the balancing mass to be attached at radius of 30 cm.** **Answer:** Given : $m_1 = 10$ kg ; $m_2 = 20$ kg ; $m_3 = 15$ kg ; $r_1 = 0.2$ m ; $r_2 = 0.25$ m; $r_3 = 0.15$ m; $r = 0.30$m $\theta_1 = 0°$; $\theta_2 = 60°$; $\theta_3 = 150°$ Let m = Balancing mass, and θ = The angle which the balancing mass makes Since the magnitude of centrifugal forces are proportional to the product of each mass and its radius, therefore $m_1 \cdot r_1 = 10 \times 0.2 = 2$ kg-m $m_2 \cdot r_2 = 20 \times 0.25 = 5$ kg-m $m_3 \cdot r_3 = 15 \times 0.15 = 2.25$ kg-m Resolving $m_1.r_1$, $m_2.r_2$, $m_3.r_3$ and $m_4.r_4$ horizontally, $\Sigma H = m_1 \cdot r_1 \cos\theta_1 + m_2 \cdot r_2 \cos\theta_2 + m_3 \cdot r_3 \cos\theta_3$ $= 2 \cos 0° + 5 \cos 60° + 2.25 \cos 150°$ $= \boxed{2.55 \text{ kg-m}}$ Now resolving vertically, $\Sigma V = m_1 \cdot r_1 \sin\theta_1 + m_2 \cdot r_2 \sin\theta_2 + m_3 \cdot r_3 \sin\theta_3$ $= 2 \sin 0° + 5 \sin 60° + 2.25 \sin 150°$ $= \boxed{5.455 \text{ kg-m}}$ $\therefore$ Resultant, $R = \sqrt{(\Sigma H)^2 + (\Sigma V)^2} = \boxed{6.02 \text{ kg-m}}$ We know that $m \cdot r = R = 6.02$ m = 6.02 / 0.30 = 20.067 kg and $\tan\theta' = \Sigma V / \Sigma H$ = $\boxed{\theta' = 64.94°}$	4	view

Que.No	Question/Problem	marks	Link
Q 4 f)	Question: **A thrust shaft of a ship has 6 collar of 600 mm external diameter and 300 mm internal diameter. The total thrust from the propeller shaft is 100 kN. If the coefficient of friction is 0.12 and speed of engine 90 rpm. Find power absorbed in friction at the thrust block using uniform pressure intensity condition.** **Answer:** **N =6, d_1 =600 mm, r1 =300 mm, d2 =300 mm, r2 =150 mm, W =100 kN =100 x 10^3 N μ = 0.12, N = 90 rpm, ω = 2 x π x N /60 = 2 x π x 90/ 60 =9.426 rad / sec** *1. Power absorbed in friction, assuming uniform pressure* We know that total frictional torque transmitted, $T = \frac{2}{3} \times \mu W \left[\frac{(r_1)^3 - (r_2)^3}{(r_1)^2 - (r_2)^2} \right]$ $= \frac{2}{3} \times 0.12 \times 100 \times 10^3 \left[\frac{(300)^3 - (150)^3}{(300)^2 - (150)^2} \right] = 2800 \times 10^3$ N-mm = 2800 N-m ∴ Power absorbed in friction, $P = T.\omega = 2800 \times 9.426 = 26\,400$ W = 26.4 kW **Ans.** *2. Power absorbed in friction assuming uniform wear* We know that total frictional torque transmitted, $T = \frac{1}{2} \times \mu W (r_1 + r_2) = \frac{1}{2} \times 0.12 \times 100 \times 10^3 (300 + 150)$ N-mm $= 2700 \times 10^3$ N-mm = 2700 N-m ∴ Power absorbed in friction, $P = T.\omega = 2700 \times 9.426 = 25\,450$ W = 25.45 kW **Ans.**	4	view
Q 6a)(i)	Question: **(i) Define 'Gear Train'. State its purpose and types of gear train.** **Answer:** **Definition: When two or more gears are made to mesh with each other to transmit power from one shaft to another. Such a combination is called gear train** **Purpose: The purpose of the train used is** **To obtain correct & required velocity ratio between driver & driven shafts.** **To decide upon the relative position of the axes of shafts.** **To decide upon amount of power to be transmitted between shafts** **Types: Following are the different types of gear trains, depending upon the arrangement of wheels :** **1. Simple gear train,** **2. Compound gear train,** **3. Reverted gear train, and** **4. Epicyclic gear train.**	4	view

Examination: 2015 WINTER

Que.No	Question/Problem	marks	Link
Q 5 a)	Question: **The crank and connecting rod of a reciprocating engine are 200 mm and 700 mm respectively. The crank is rotating in clockwise direction at 120 rad/s. Draw Klein's construction and find** **(i) Velocity and acceleration of the piston** **(ii) Angular velocity and angular acceleration of the connecting rod at the instant when the crank is at 30° to IDC (inner dead centre).** **Answer:** **Construction :**  *1. Velocity and acceleration of the piston* We know that the velocity of the piston P, $v_P = \omega \times OM = 120 \times 0.127 = 15.24$ m/s **Ans.** and acceleration of the piston P, $a_P = \omega^2 \times NO = (120)^2 \times 0.2 = 2880$ m/s² **Ans.** *3. Angular velocity and angular acceleration of the connecting rod* We know that the velocity of the connecting rod PC (*i.e.* velocity of P with respect to C), $v_{PC} = \omega \times CM = 120 \times 0.173 = 20.76$ m/s ∴ Angular acceleration of the connecting rod PC, $\omega_{PC} = \frac{v_{PC}}{PC} = \frac{20.76}{0.7} = 29.66$ rad/s **Ans.** We know that the tangential component of the acceleration of P with respect to C, $a^t_{PC} = \omega^2 \times QN = (120)^2 \times 0.093 = 1339.2$ m/s² ∴ Angular acceleration of the connecting rod PC, $\alpha_{PC} = \frac{a^t_{PC}}{PC} = \frac{1339.2}{0.7} = 1913.14$ rad/s² **Ans.**	4	view