P P SAVANI UNIVERSITY

Seventh Semester of B. Tech. Examination

December 2021

SEME4031 Design of Power Transmission Elements

08.12.2021, Wednesday **Time: 09:00 a.m. To 12:30 a.m.** **Maximum Marks: 60**

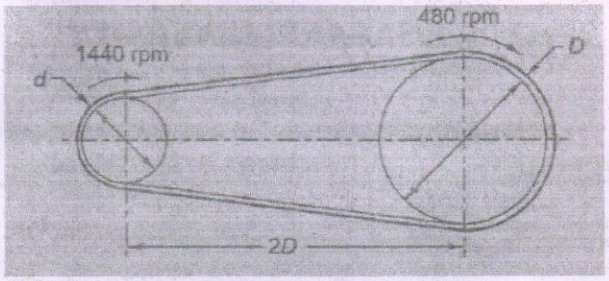
Instructions:

1. The question paper comprises of two sections.
2. Section I and II must be attempted in separate answer sheets.
3. Make suitable assumptions and draw neat figures wherever required.
4. Use of scientific calculator is allowed.

SECTION – I

Q - 1	Answer the Following: (Short Question)	**[05]**
(i)	Define stress.	
(ii)	Define strain.	
(iii)	Write short notes on spur gear.	
(iv)	Write down the names of parallel shaft gears.	
(v)	Define addendum.	
(vi)	Define dedendum.	
(vii)	Write down the examples of intersecting shaft gears.	
Q - 2 (a)	What are the various transmission drives? Explain.	**[05]**
Q - 2 (b)	Write short note on gear terminologies.	**[05]**
	OR	
Q - 2 (a)	Write down the advantages & disadvantages of V-belt.	**[05]**
Q - 2 (b)	Write down the selection criteria for V belt and flat belt.	**[05]**
Q - 3 (a)	What is creep in belts?	**[05]**
Q - 3 (b)	Distinguish between open and cross belt drives.	**[05]**
	OR	
Q - 3 (a)	What are the advantages and disadvantages of brakes?	**[05]**
Q - 3 (b)	What are the advantages and disadvantages of clutches?	**[05]**
Q - 4	Attempt anyone.	**[05]**
(i)	The layout of a leather belt drive transmitting 15kW of power is shown in the figure. The centre distance between the pulleys is twice the diameter of the bigger pulley. The belt should operate at a velocity of 20 m/s approximately and the stresses in the belt should not exceed 2.25 N/mm^2. The density of leather is 0.95 g/cc and the coefficient of friction is 0.35. The thickness of the belt is 5 mm. Calculate:	

a. The diameter of pulleys
b. The length and width of the belt
c. The belt tension



[Hint: $L = \{2C + [\pi(D+d)/2] + (D-d)^2/4C\}$, $[(P_1 - mv^2)/(P_1 - mv^2)] = e^{f\alpha}$,

(ii) What are the various power transmission drives? Explain

SECTION – II

Q - 1 Answer the Following: (Short Question) **[05]**

(i) What condition must be satisfied in order that a pair of spur gears may have a constant velcoity ratio?

(ii) What is a herringbone gear?

(iii) How the bevel gears are classified?

(iv) What do you understand by 'gear train'?

(v) Discuss the various types of gear trains.

Q - 2 (a) How are the gears classified and what are the various terms used in spur gear terminology? **[05]**

Q - 2 (b) A bronze spur pinion rotating at 600 r.p.m. drives a cast iron spur gear at a transmission ratio of 4:1. The allowable static stresses for the bronze pinion and cast iron gear are 84 MPa and 105 MPa respectively. The pinion has 16 standard 20° full depth involute teeth of module 8 mm. The face width of both the gears is 90 mm. Find the power that can be transmitted from the standpoint of strength. **[05]**

[Hint: Pitch circle diameter = m.T, Tooth form factor = 0.154 – (0.912/T), $\sigma_{allowable}$*tooth form factor, Tangential load = $\sigma_{allowable}$ *0.427*b*π*m*tooth form factor]

OR

Q - 2 (a) Define formative or virtual number of teeth on a helical gear. Derive the expression used to obtain its value. **[05]**

Q - 2 (b) A pair of helical gears are to transmit 15 kW. The teeth are 20° stub in diametral plane and have a helix angle of 45°. The pinion runs at 10 000 r.p.m. and has 80 mm pitch diameter. The gear has 320 mm pitch diameter. If the gears are made of cast steel having allowable static strength of 100 MPa; determine a suitable module and face width from static strength considerations and check the gears for wear, given Sigma es= 618 MPa. **[05]**

Q - 3 (a) For bevel gears, define the following : **[05]**
(i) Cone distance; (ii) Pitch angle; (iii) Face angle; (iv) Root angle; (v) Back cone distance

Q - 3 (b) A pair of cast iron bevel gears connect two shafts at right angles. The pitch diameters of the pinion and gear are 80 mm and 100 mm respectively. The tooth profiles of the gears are of 14 ½° composite form. The allowable static stress for both the gears is 55 MPa. If the pinion Transmits 2.75 kW at 1100 r.p.m., find the module and number of teeth on each gear from the standpoint of strength and check the design from the standpoint of wear. Take surface endurance limit as 630 MPa and modulus of elasticity for cast iron as 84 kN/mm² **[05]**

[Hint: $v = \pi DN/60$, $C_v = 6/(6+v)$, $\theta_1 = \tan^{-1}(1/VR)$, $\theta_2 = 90 - \theta_1$, $L = [(D_g/2)^2 + (D_p/2)^2]^{1/2}$,
Tangential load = $\sigma_{allowable} * C_v * b * \pi m * y' * [(L-b)/L]$,

$y'=[0.124-(0.684/T_{EP})]$

Design Check:

$W_D = W_T + [(21v(b.C + W_T)/(21v+(b.C + W_T)^{1/2}], C = K.e/ [(1/E_P)+(1/E_G)],$

$W_s = \sigma_e.b.\pi.m.y'.[(L-b)/L]$

Wear Load Check:

$W_w=[(D_P.b.Q.K)/\cos\theta_1]$

OR

Q - 3 (a) What are the various forces acting on worm and worm gears? **[05]**

Q - 3 (b) A worm drive transmits 15 kW at 2000 r.p.m. to a machine carriage at 75 r.p.m. The worm is triple threaded and has 65 mm pitch diameter. The worm gear has 90 teeth of 6 mm module. The tooth form is to be 20° full depth involute. The coefficient of friction between the mating teeth may be taken as 0.10. Calculate: **[05]**

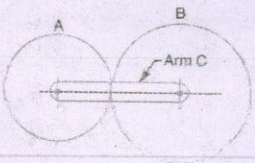
1. tangential force acting on the worm;
2. axial thrust and separating force on worm; and
3. efficiency of the worm drive.

{Hint: Torque = $[(P*60)/2\pi N]$}

Q - 4 Attempt any one. **[05]**

(i) Explain briefly the differences between simple, compound, and epicyclic gear trains. What are the special advantages of epicyclic gear trains?

(ii) In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 r.p.m. in the anticlockwise direction about the centre of the gear A which is fixed, determine the speed of gear B. If the gear A instead of being fixed, makes 300 r.p.m. in the clockwise direction, what will be the speed of gear B?



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