P P SAVANI UNIVERSITY

Seventh Semester of B. Tech. Examination
December 2022
SEME4031 Design of Power Transmission Elements

21.11.2022, Monday   Time: 10:00 a.m. To 12:30 p.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

			CO	BTL
Q - 1	Answer the Following:	[05]		
(i)	Explain stress-strain curve with neat labelled diagram for ductile and brittle material.		1	2
(ii)	Define velocity ratio of a belt drive		2	1
(iii)	State advantages for V-belt drive over a flat belt drive.		2	1
(iv)	Draw the cross section of wire rope of 6*19.		2	3
(v)	What is use of crowning for Pulley?		2	1
(vi)	What is viscosity index?		2	1
(vii)	What is a self-locking brake?		2	1
Q - 2 (a)	It is required to select a flat belt drive for a compressor running at 720 rpm, which is driven by a 25 kW, 1440 rpm motor. Space is available for a centre distance of 3 m. The belt is open-type.	[05]	1,2	3,4,5
(b)	The following data is given for an open-type V-belt drive: diameter of driving pulley = 200 mm; diameter of driven pulley = 600 mm; groove angle for sheaves = 34°; mass of belt = 0.5 kg/m; maximum permissible tension in belt = 500 N; coefficient of friction = 0.2; contact angle for smaller pulley = 157°; speed of smaller pulley = 1440 rpm; power to be transmitted = 10 kW. How many V-belts should be used, assuming each belt takes its proportional part of the load?	[05]	1,2	3,4,5

OR

			CO	BTL
Q - 2 (a)	It is required to design a V-belt drive to connect a 7.5 kW, 1440 rpm induction motor to a fan, running at approximately 480 rpm, for a service of 24 h per day. Space is available for a centre distance of about 1 m	[05]	1,2	3,4,5
(b)	It is required to design a chain drive to connect a 12 kW, 1400 rpm electric motor to a centrifugal pump running at 700 rpm. The service conditions involve moderate shocks.	[05]	1,2	3,4,5
	(i) Select a proper roller chain and give a list of its dimensions.			
	(ii) Determine the pitch circle diameters of driving and driven sprockets.			
	(iii) Determine the number of chain links.			
	(iv) Specify the correct centre distance between the axes of sprockets.			
Q - 3 (a)	A ball bearing with a dynamic load capacity of 22.8 kN is subjected to a radial load of 10 kN. Calculate	[05]	1,2,3	3,4,5
	(i) the expected life in million revolutions that 90% of the bearings will reach;			
	(ii) the corresponding life in hours, if the shaft is rotating at 1450 rpm; and			
	(iii) the life that 50% of the bearings will complete or exceed before fatigue failure			

(b)	A 360° hydrodynamic bearing operates under the following conditions: radial load = 50 kN journal diameter = 150 mm bearing length = 150 mm radial clearance = 0.15 mm minimum fi lm thickness = 0.03 mm viscosity of lubricant = 8 cP What is the minimum speed of operation for the journal to work under hydrodynamic conditions?	[05]	1,2	3,4,5

OR

Q - 3 (a)	A cylindrical roller bearing with bore diameter of 40 mm is subjected to a radial force of 25 kN. The coefficient of friction is 0.0012 and the speed of rotation is 1440 rpm. Calculate the power lost in friction.	[05]	1,2	3,4,5
(b)	The following data is given for a hydrostatic thrust bearing:	[05]	1,2	3,4,5

        Shaft speed = 720 rpm

        Shaft diameter = 400 mm

        Recess diameter = 250 mm

        Film thickness = 0.15 mm

        Viscosity of lubricant = 30 cP

        Specific gravity = 0.86

        Specific heat = 1.75 kJ/kg°C

        Supply pressure = 5 MPa

    Calculate

    (i) load carrying capacity of the bearing;

    (ii) flow requirement;

    (iii) pumping power loss;

    (iv) frictional power loss; and

    (v) Temperature rise.

Q - 4	Attempt any one/two.	[05]		
(i)	A plate clutch of one pair of contacting surfaces. The inner and outer pair diameter of friction disk are 100 and 200 mm respectively. The coefficient of friction is 0.2 and the permissible intensity of pressure is 1N/mm². Assume uniform wear theory, calculate the power transmitting capacity of the clutch at 750rpm		2	3,4,5
(ii)	A four-wheeled automobile car has a total mass of 1000 kg. The moment of inertia of each wheel about a transverse axis through its centre of gravity is 0.5 kg-m². The rolling radius of the wheel is 0.35 m. The rotating and reciprocating parts of the engine and the transmission system are equivalent to a moment of inertia of 2.5 kg-m2, which rotates at five times the road-wheel speed. The car is traveling at a speed of 100 km/h on a plane road. When the brakes are applied, the car decelerates at 0.5 g. There are brakes on all four wheels. Calculate: (i) the energy absorbed by each brake; and (ii) the torque capacity of each brake.		2	3,4,5

SECTION – II

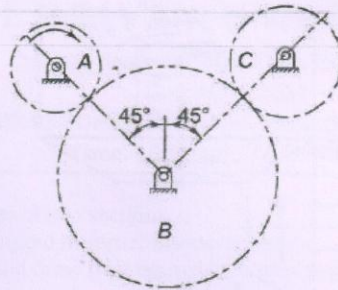|				
Q – 1 (a)	Define addendum, Addendum circle, dedendum and dedendum circle in spur gear. Why dedendum value is more than addendum value	[05]	3	1
(b)	The pitch circles of a train of spur gears are shown in Fig. 1	[07]	2,3	3,4,5

Fig.1

Gear A receives 3.5 kW of power at 700 rpm through its shaft and rotates in the clockwise direction. Gear B is the idler gear while the gear C is the driven gear. The number of teeth on gears A, B and C are 30, 60 and 40 respectively, while the module is 5 mm. Calculate

(i) The torque on each gear shaft; and

(ii) The components of gear tooth forces.

(iii) Draw a free-body diagram of forces and determine the reaction on the idler gear shaft.

Assume 20° involute system for the gears.

OR

Q – 1 (a) A pair of parallel helical gears consists of a 20 teeth pinion meshing with a 40 teeth gear. The helix angle is 25° and the normal pressure angle is 20°. The normal module is 3 mm. Calculate

(i) The transverse module;

(ii) The transverse pressure angle;

(iii) The axial pitch;

(iv) The pitch circle diameters of the pinion and the gear;

(v) The centre distance; and

(vi) The addendum and dedendum circle diameters of the pinion. **[07] 2,3 3,4,5**

(b) What are the effects of increasing and decreasing the pressure angle in gear design? **[01] 3 4**

(c) State advantages of helical gears over spur gears **[04] 2,3 1**

Q - 2 (a) A pair of worm gear is designated as 1/30/10/8. Calculate: (i) Centre distance (ii) speed reduction (iii) dimensions of the worm (iv) dimensions of the worm wheel **[05]   3,4,5**

(b) What are the advantages and drawback of worm gear? **[05] 2,3 1**

OR

Q – 2(a) What is cross helical gear and why it is not used for power transmission? **[02] 2,3 1,2**

(b) When is bevel gear preferred? **[02]   1,3**

(c) A pair of bevel gear transmitting 7.5 kW at 300 rpm is shown in Fig 2. The pressure angle is 20 deg. Determine the components of the resultant gear tooth force and also draw the FBD diagram of the forces acting on the pinion and gear. **[06]   3,4,5**
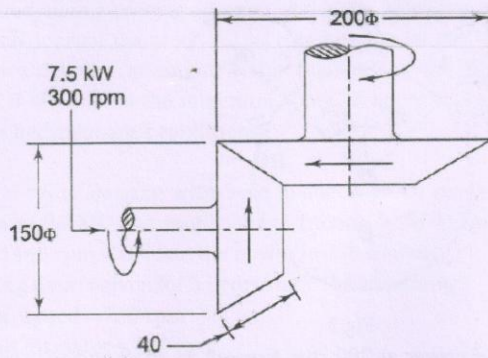
Fig. 2

Q - 3 (a)	Write short notes on the following: (a) Speed Diagram (b) Kinematic Arrangement	[05]	2	1
(b)	What is Gear Train? Explain briefly any one type of Gear Train.	[03]	/2	1

OR

Q - 3	A nine speed gear box used as a head stock gear box of turret lathe, is to provide a speed range of 180 rpm to 1800 rpm. Using standard step ratio, draw a speed diagram and the kinematic layout. Also find and fix the number of teeth on all gears.	[08]	2	3,4,5

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CO   : Course Outcome Number   BTL   : Blooms Taxonomy Level

Level of Bloom's Revised Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create