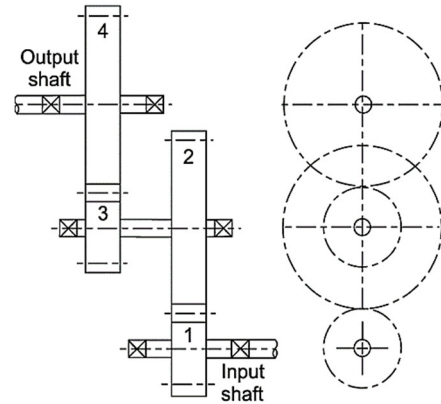
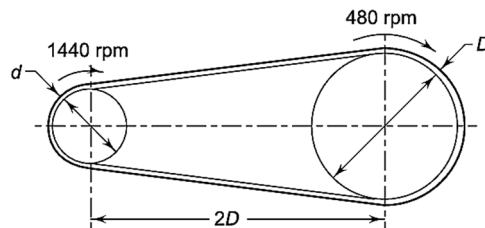


[4]

- Q.5 i. What are the advantages of helical gears over spur gears? **3**
- ii. A train of spur gears is shown in Figure. Gear 1 is the driving gear and transmits 5 kW power at 720 rpm. The number of teeth on gears 1, 2, 3 and 4 are 20, 50, 30 and 60 respectively. The module for all gears is 4 mm. The gears have a 20° full-depth involute profile. Calculate the tangential and radial components of the tooth force between
- (a) Gears 1 and 2 and
(b) Gears 3 and 4



- OR iii. The layout of a leather belt drive transmitting 15 kW of power is shown in 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; and
(c) The belt tensions.



- Q.6 Attempt any two:
- i. Explain the following terms of the spring- **5**
(a) Free length (b) Solid height (c) Spring index;
- ii. Explain the principle of self-aligning bearing with diagram. **5**
- iii. Write short notes: **5**
(a) Hydrodynamic lubrication (b) Hydrostatic lubrication

Total No. of Questions: 6

Total No. of Printed Pages: 4

Enrollment No.....



Faculty of Engineering
End Sem Examination May-2024

RA3CO43

Design of Machine Elements & Transmission Systems
Programme: B.Tech. Branch/Specialisation: RA

Duration: 3 Hrs.

Maximum Marks: 60

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

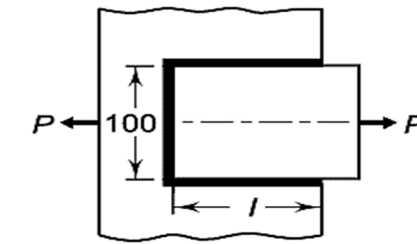
- Q.1 i. According to Indian standard specifications, a grey cast iron designated by "FG 200" means that the: **1**
a) Carbon content is 2%
b) Maximum compressive strength is 200 N/mm^2
c) Ultimate tensile strength is 200 N/mm^2
d) Maximum shear strength is 200 N/mm^2
- ii. The maximum energy that can be stored in a body due to external loading upto the elastic limit is called- **1**
(a) Resilience (b) Proof resilience
(c) Strain energy (d) Modulus of resilience
- iii. The centre to centre distance between two consecutive rivets in a row, is called- **1**
(a) Margin (b) Pitch (c) Back pitch (d) Diagonal pitch
- iv. The size of the weld in butt welded joint is equal to- **1**
(a) $0.5 \times$ Throat of weld (b) Throat of weld
(c) $\sqrt{2} \times$ Throat of weld (d) $2 \times$ Throat of weld
- v. Two shafts will have equal strength, if- **1**
(a) Diameter of both the shafts is same
(b) Angle of twist of both the shafts is same
(c) Material of both the shafts is same
(d) Twisting moment of both the shafts is same
- vi. A keyway lowers- **1**
(a) The strength of the shaft (b) The rigidity of the shaft
(c) Both (a) and (b) (d) The ductility of the material of the shaft

P.T.O.

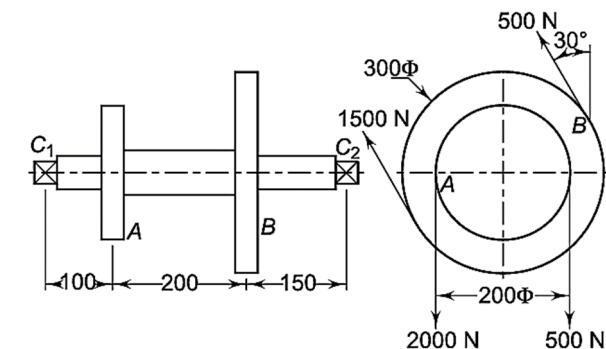
[2]

- vii. A spur gear with pitch circle diameter D has number of teeth T . The module m is defined as- **1**
 (a) $m = D / T$ (b) $m = T / D$ (c) $m = \pi D / T$ (d) $m = D.T$
- viii. The centrifugal tension in the belt- **1**
 (a) Increases the power transmitted
 (b) Decreases the power transmitted
 (c) Has no effect on the power transmitted
 (d) Is equal to maximum tension on the belt
- ix. A leaf spring in automobiles is used- **1**
 (a) To apply forces
 (b) To measure forces
 (c) To absorb shocks
 (d) To store strain energy
- x. In thrust bearings, the load acts- **1**
 (a) Along the axis of rotation
 (b) Parallel to the axis of rotation
 (c) Perpendicular to the axis of rotation
 (d) In any direction
- Q.2 i. Differentiate between sequential design and concurrent engineering. Draw neat and clean diagram with suitable example. **3**
 ii. A forged steel bar, 50 mm in diameter, is subjected to a reversed bending stress of 250 N/mm^2 . The bar is made of steel 40C8 ($S_{ut} = 600 \text{ N/mm}^2$). Calculate the life of the bar for a reliability of 90%. **7**
- OR iii. What is the difference between the Gerber curve and Soderberg and Goodman lines? Draw neat and clean diagram with proper symbols and notations. **7**
- Q.3 i. What is leg and throat of fillet weld? **2**
 ii. What are the advantages and disadvantages of threaded joints? **2**
 iii. A steel plate, 100 mm wide and 10 mm thick, is joined with another steel plate by means of single transverse and double parallel fillet welds, as shown in Figure. The strength of the welded joint should be equal to the strength of the plates to be joined. The permissible tensile and shear stresses for the weld material and the plates are 70 and 50 N/mm^2 respectively. Find the length of each parallel fillet weld. Assume the tensile force acting on the plates as static. **6**

[3]



- OR iv. A double riveted double cover butt joint in plates 20 mm thick is made with 25 mm diameter rivets at 100 mm pitch. The permissible stresses are: **6**
 $\sigma_t = 120 \text{ MPa}$; $\tau = 100 \text{ MPa}$; $\sigma_c = 150 \text{ MPa}$
 Find the efficiency of joint, taking the strength of the rivet in double shear as twice than that of single shear.
- Q.4 i. What is Kennedy key? What are the advantages and disadvantages of Kennedy key over flat key? **3**
 ii. A rigid coupling is used to transmit 50 kW power at 300 rpm. There are six bolts. The outer diameter of the flanges is 200 mm, while the recess diameter is 150 mm. The coefficient of friction between the flanges is 0.15. The bolts are made of steel 45C8 ($S_{yt} = 380 \text{ N/mm}^2$) and the factor of safety is 3. Determine the diameter of the bolts. Assume that the bolts are fitted in large clearance holes. **7**
- OR iii. A transmission shaft, supporting two pulleys A and B and mounted between two bearings C_1 and C_2 is shown in Figure. Power is transmitted from the pulley A to B. The shaft is made of plain carbon steel 45C8 ($S_{ut} = 600$ and $S_{yt} = 380 \text{ N/mm}^2$). The pulleys are keyed to the shaft. Determine the shaft diameter using the ASME code if, $k_b = 1.5$ and $k_t = 1.0$ Also, determine the shaft diameter on the basis of torsional rigidity, if the permissible angle of twist between the two pulleys is 0.5° and the modulus of rigidity is $79\,300 \text{ N/mm}^2$. **7**



Marking Scheme

Design of Machine Elements and Transmission Systems (T) - RA3CO43 (T)

- Q.1
- According to Indian standard specifications, a grey cast iron designated by "FG 200" means that the:
 - Ultimate tensile strength is 200 N/mm²
 - The maximum energy that can be stored in a body due to external loading upto the elastic limit is
 - proof resilience
 - The centre to centre distance between two consecutive rivets in a row, is called
 - pitch
 - The size of the weld in butt welded joint is equal to.
 - Throat of weld
 - Two shafts will have equal strength, if
 - twisting moment of both the shafts is same
 - A keyway lowers
 - both the strength and rigidity of the shaft
 - A spur gear with pitch circle diameter D has number of teeth T. The module m is defined as
 - $m = D / T$
 - The centrifugal tension in the belt
 - has no effect on the power transmitted
 - A leaf spring in automobiles is used
 - to absorb shocks
 - In thrust bearings, the load acts
 - along the axis of rotation
- Q.2
- Differentiate between sequential design and concurrent engineering. Draw neat and clean diagram with suitable Example.

Sequential design	- 1 Mark	3
Concurrent engineering	- 1 Mark	
Diagram with suitable Example	- 1 Mark	
 - A forged steel bar, 50 mm in diameter, is subjected to a reversed bending stress of 250 N/mm². The bar is made of steel 40C8 ($S_{ut} = 600 \text{ N/mm}^2$). Calculate the life of the bar for a reliability of 90%.

Calculate endurance strength (S_e)	- 3 Marks	7
Construction of S-N diagram	- 2 Marks	
Calculate Fatigue life of bar	- 2 Marks	

- OR
- What is the difference between the Gerber curve and Soderberg and Goodman lines? Draw neat and clean diagram with proper symbols and notations.

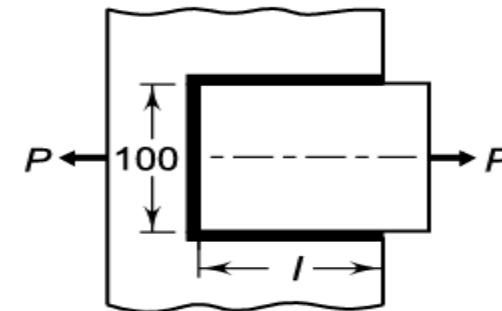
Gerber Curve	- 1.5 Mark	7
Soderberg line	- 1.5 Mark	
Goodman lines	- 2 Mark	
diagram with proper symbols and notations	- 2 Mark	

- Q.3
- What is leg and throat of fillet weld?

leg of fillet weld	- 1 Mark	2
throat of fillet weld	- 1 Mark	
 - What are the advantages and disadvantages of threaded joints?

Two advantages of threaded joints	- 1 Mark	2
Two disadvantages of threaded joints	- 1 Mark	
 - A steel plate, 100 mm wide and 10 mm thick, is joined with another steel plate by means of single transverse and double parallel fillet welds, as shown in Figure. The strength of the welded joint should be equal to the strength of the plates to be joined. The permissible tensile and shear stresses for the weld material and the plates are 70 and 50 N/mm² respectively. Find the length of each parallel fillet weld. Assume the tensile force acting on the plates as static.

	6	
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- | | | |
|--------------------------------------------------|----------|--|
| Tensile strength of plate | - 1 Mark | |
| Strength of transverse and parallel fillet welds | - 3 Mark | |
| Length of parallel fillet weld | - 2 Mark | |
- OR
- A double riveted double cover butt joint in plates 20 mm thick is made with 25 mm diameter rivets at 100 mm pitch. The permissible stresses are :
 $\sigma_t = 120 \text{ MPa}$; $\tau = 100 \text{ MPa}$; $\sigma_c = 150 \text{ MPa}$
 Find the efficiency of joint, taking the strength of the rivet in double shear as twice than that of single shear.

Tearing resistance of the plate	- 1.5 Marks	6
Shearing resistance of the rivets	- 1.5 Marks	
Crushing resistance of the rivets	- 1.5 Marks	
Efficiency of the joint	- 1.5 Marks	

[2]

- Q.4 i. What is Kennedy key? What are the advantages and disadvantages of Kennedy key over flat key? **3**

Kennedy key - **1 Mark**

2 advantages of Kennedy key over flat key - **1 Mark**

2 disadvantages of Kennedy key over flat key - **1 Mark**

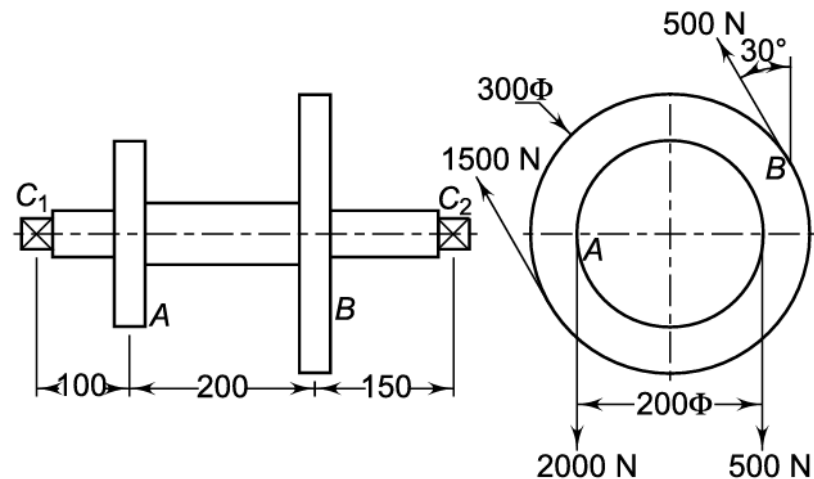
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Calculate Permissible tensile stress - **1 Mark**

Calculate Preload in bolts - **4 Marks**

Diameter of bolts - **2 Marks**

- OR iii. A transmission shaft, supporting two pulleys A and B and mounted between two bearings C1 and C2 is shown in Figure. Power is transmitted from the pulley A to B. The shaft is made of plain carbon steel 45C8 ($S_{ut} = 600$ and $S_{yt} = 380 \text{ N/mm}^2$). The pulleys are keyed to the shaft. Determine the shaft diameter using the ASME code if, $k_b = 1.5$ and $k_t = 1.0$ Also, determine the shaft diameter on the basis of torsional rigidity, if the permissible angle of twist between the two pulleys is 0.5° and the modulus of rigidity is $79\,300 \text{ N/mm}^2$. **7**



Calculate Permissible shear stress - **1 Mark**

Calculate Torsional moment - **1 Mark**

Calculate Bending Moment - **3 Mark**

Calculate Shaft Diameter - **2 Marks**

- **1 Mark**

- **1 Mark**

- **3 Mark**

- **2 Marks**

[3]

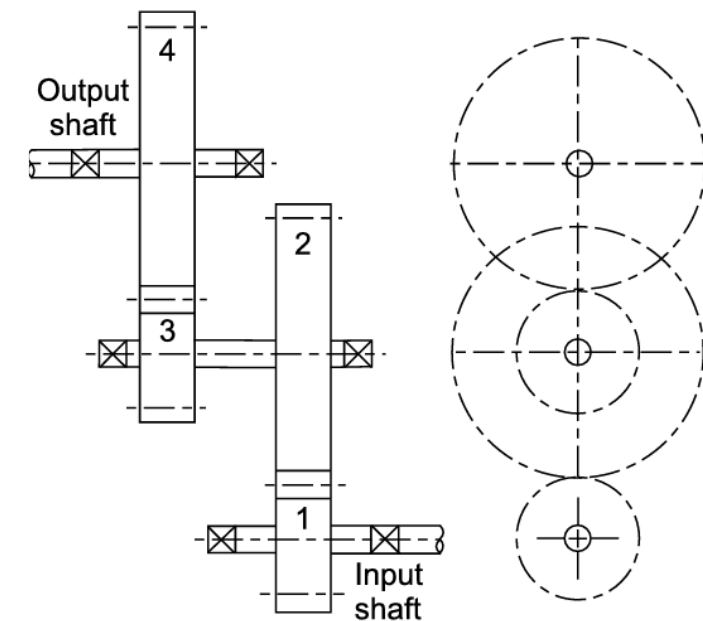
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2 advantage of helical gear over spur Gear - **2 Marks**

- ii. A train of spur gears is shown in Figure. Gear 1 is the driving gear and transmits 5 kW power at 720 rpm. The number of teeth on gears 1, 2, 3 and 4 are 20, 50, 30 and 60 respectively. The module for all gears is 4 mm. The gears have a 20° full-depth involute profile. Calculate the tangential and radial components of the tooth force between **8**

(i) Gears 1 and 2 and

(ii) Gears 3 and 4



Calculate diameter of each gear - **2 Marks**

Calculate torque on each shaft - **2 Marks**

Calculate force components - **4 Marks**

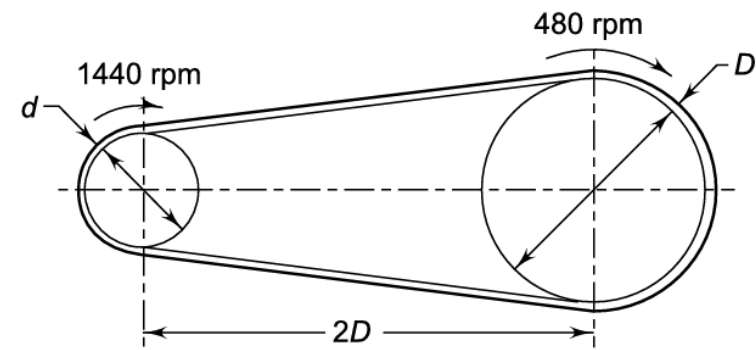
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(i) the diameter of pulleys;

(ii) the length and width of the belt; and

(iii) the belt tensions.

[2]



- Calculate Diameter of pulleys - 2 Marks
 Calculate Belt length - 1 Marks
 Calculate Belt width and belt tensions - 5 Marks

[3]

Q.6

Attempt any two:

- i. Explain the following terms of the spring 5
 - (i) Free length; - 1.5 Marks
 - (ii) Solid height; - 1.5 Marks
 - (v) Spring index; - 2 Marks
- ii. Explain the principle of self-aligning bearing with diagram. 5

principle of self-aligning bearing - 3 Marks

diagram - 2 Marks
- iii. Write short notes: 5
 - (i) hydrodynamic lubrication - 2.5 Marks
 - (ii) hydrostatic lubrication - 2.5 Marks
