

# Mechanics of Textile Machinery - Web course

## COURSE OUTLINE

### Machine elements and drives

Introduction to drives, selection of drives, primary machine elements, special purpose drives and devices

### Belt drives

Types of drives, selection of drives; Flat belt- leather and reinforced belts, analysis of belt tensions, positions of slack and tight sides, condition for maximum power transmission, selection of belt and pulley diameter, V belt- construction, force analysis; Round belt-friction spinning machine; Reversing drives; Drives for out of plane pulleys-friction spinning machine; Clutching action in card; Variable speed drives in textile machines- cone and stepped pulleys, conical discs; Adjustment of belt tensions- movable motor in main drives of textile machines, swinging motor in bale opener, tension pulleys in card and friction spinning machine; Comparison of flat and V belts; Toothed belt drives- air-jet texturing, characteristics; Tapes. Applications of belt drives in textile machines

### Chain drives

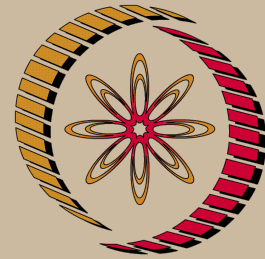
Classification, construction of roller chain, lubrication, chain tension and bending force on shaft; Geometrical relationships in chain drive-polygonal effect; Characteristics of chain drives; Applications of chain drives in textile machines

### Spur gears

Design aspects- nomenclature, basic relationship; conjugate action; Involute properties- involute profile of teeth; Construction of tooth with involute profile; Contact ratio-arc of action; Pressure angle; Interference- elimination of interference, periodic faults in fibre assemblies-defective gears; back lash; Internal gears & rack and pinion in textile machines; force analysis in spur gear train, torque and power transmission; face width of gear; lubrication of gears

### Helical, bevel and worm gears

Helical gears- notation of hand, Parallel helical gears- geometry, force analysis; thrust loads; Crossed helical gears-



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Textile  
Engineering

### Pre-requisites:

Exposure to spinning and weaving.

### Coordinators:

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card & roving machines; thrust loads; Herringbone gears; Bevel gears- straight bevel gears; spiral, hypoid, other bevel gears; comparison of bevel gears; Worm gears- features, terminology, single and double envelop worms; Applications of helical, bevel & worm gears in textile machines.

### **Gear trains**

Gear trains- simple, compound, reverted; Epicyclic/ planetary-speeds of element of gear train, tabulation and formula methods; two degrees of freedom; Epicyclic gear trains in roving machine- bobbin diameter and speeds of bobbin, roving stretch, relation between bobbin speed and bottom cone pulley speed, Epicyclic gear train in combing machine- motion of detaching roller, combing cycle index, web movement in one cycle of combing.

### **Cone pulleys**

Cone pulleys in roving machine- design aspects, steps to design, hyperbolic and straight cone pulleys, shifting of belt, belt slippage and corrections for belt position, belt shifting mechanism for straight cone pulleys, finer adjustment of belt shifting; Cone pulleys for piano-feed regulation.

### **Transmission shafts and drafting rollers**

Material properties; factor of safety and allowable stress; Stress-strain relationships of materials- tensile, shear, bending and torsional stresses; Design of transmission shaft- against static load, maximum shear stress theory of failure, design using A.S.M.E code, design for torsional and lateral rigidity; Design of bottom drafting rollers- design and processing perspectives, design against torsional and lateral rigidity.

### **Clutches**

Mechanical lockup clutches- characteristics, applications in card, sliver doubling, roving and ring spinning machines; Friction clutches- single disk/plate clutch, torque transmitting capacity-old and new clutches, uniform pressure, uniform wear, delayed start of drafting in ring spinning; Multi disk friction clutch- torque transmission capacity, bale opener, fabric roll-up; Cone clutches- torque transmission capacity, bobbin carriage; Centrifugal clutches-operating principle, torque transmission capacity, applications; Materials for friction lining.

### **Brakes**

Mechanical brakes- block brake with short shoe, analysis of forces acting on drum, Block brake in lap former; Pivoted block brake with long shoe, spindle brake; brake on warp beam, Internal expanding brake; Band brakes, brake for warp let-off, differential band brake; disk brakes; Non-friction brakes; Disc clutch & disc brakes-multi-disc clutch and brake; Hysteresis clutch and brake.

### **Bearings**

Sliding contact bearings-types, Lubrication in bush bearings-thick & thin film lubrication, Coefficient of friction in boundary & hydrodynamic regions, hydrostatic & hydrodynamic bearings; Materials of bearings; Rolling contact bearings-conformity, types of ball and roller bearings, Applications of rolling contact bearings in textile machines-ball, needle, roller, self-aligning ball, spherical roller & thrust bearings; Static and dynamic load capacity, equivalent bearing load, load-life relationship, Comparison of bush and rolling contact bearings

### **Cam devices**

Classification of cam mechanisms; Cam device for cop building in ring spinning machines, profiles of displacement, velocity; Cam device for shifting of belt on straight cone pulleys in roving machine.

### **Balancing of machines**

Unbalance, causes; Production and field balancing; Imaginary heavy spot, Centrifugal force of heavy spot, Relating unbalance to vibrations; static balancing; Types of unbalance-static unbalance; quasi-static unbalance; couple unbalance; dynamic unbalance- opening and cleaning roller, grooved winding drum; Plane transposition- balancing of card cylinder; Trial weights; Run out; Unbalance due to eccentricity in mounting shaft and non-uniform mass distribution of rotor; Dynamic balancing of single and multi-plane rotors; Practical aspects of balancing- maintenance activity related to shaft fit, removing and adding weights.

### **COURSE DETAIL**

<b>S. No.</b>	<b>Topics</b>	<b>No. of lectures</b>
1	Machine elements and drives, Belt drives	4
2	Chain drives	2
3	Spur gears	4
4	Helical, bevel and worm gears	3
5	Gear trains	4
6	Cone pulleys	2

7	Transmission shafts and drafting rollers	4
8	Clutches	4
9	Brakes	3
10	Bearings	4
11	Cam devices	2
12	Balancing of machines	4
	Total	40

### References:

1. Mechanics of Machines, J. Hannah and R. C. Stephens, Edward Arnold (Publishers) Ltd., London, 1984.
2. Design of machine Elements, V. B. Bhandari, Tata McGraw-Hill, New Delhi, 1994.
3. Machine Design, Mubeen, Khanna Publishers, Delhi, 1998.
4. Machine Design: Theory and Practice, A. D. Deutschman, W. J. Michels and C. H. Wilson, Macmillan Publishing Co., Inc., New York, 1975.
5. Mechanism Design: Analysis and Synthesis Vol. 1, A. G. Erdman, and G. N. Sandor, Prentice-Hall, Inc., New Jersey, 1984.
6. Mechanics of Machinery, C. W. Ham, E. J. Crane and W. L. Rogers, McGraw-Hill Book Co, Inc., New York, 1958.
7. Machine Design: An Integrated Approach, Robert L. Norton, Prentice-Hall, New Jersey, 1996.
8. Mechanical Engineering Design, J. E. Shigley, C. R. Mischke, McGraw-Hill, 1989.
9. Design of Machine Elements, V. M. Faires, The Macmillan Co, New York, 1955.
10. Manual of Textile Technology: A Practical Guide to Combing and Drawing Vol. 3., W. E. Klein, The Textile Institute, Manchester, 1987.
11. Technical Manual for comber model E7/4, Lakshmi Machine Works Ltd., Coimbatore, India, 1985.
12. Technical Manual for Speed Frame Model LF 1400A, Lakshmi Machine Works Ltd., Coimbatore, India, 1998.
13. Mechanical Engineering Design, J. E. Shigley, McGraw-Hill, 1981.
14. Theory of Machines, W. G. Green, Blackie and Son Ltd., London, 1962.
15. Machinery Vibration: Balancing, Victor Wowk, McGraw-Hill, Inc. New York, 1995.

16. Mechanics of Spinning Machines, R. S. Rengasamy,  
NCUTE, New Delhi, 2002.



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