301 (A) Mechatronics and Flexible Manufacturing

Unit 1
Defining mechatronics, its characteristics, scope and key issues, advantages and development of CNC horizontal and vertical machining centers, tool monitoring on CNC machines, differentiation between FMC, FMS and CIM, benefits of FMS and suitability to batch production.

Unit 2
Design of CNC machines, structure, guide-ways, feed drives, and spindle bearings, measurement and control systems, software and user interfaces, gauging and tool monitoring systems, assembly techniques for guide-ways, ball-screw and nut, spindle bearings, feedback elements and hydraulics.

Unit 3
Review of electrical and electronic devices; Drives, spindle and feed drives, servo principle, drive protection and optimization, selection criteria for drives, power supply, electrical cabinets and air cooling, electrical standards.

Unit 4
CNC systems, configuration of CNC systems, interfacing, monitoring and diagnostics, compensation for machine accuracies, machine data, Programmable Logic Controllers (PLC), Direct Numerical Control (DNC); testing of CNC machine tools, verification of technical specifications and functional aspects, Idle running tests, machine tool and work-piece accuracies, metal removal capability and safety aspects.

Unit 5
Programming and operations of CNC machines, part programming, coordinate system, dimensioning, axes and motion nomenclature, structure of part programs, G02/ G03 circular interpolation, tool compensation, subroutines/ macro, canned cycles (G81/ G89), mirror imaging,parametric programming and R-parameters, constant speed and constant cutting speed (G97/ G96), machining cycles, examples of machine center programming, case studies.

References:
1. HMT edited; Mechatronics; TMH.
2. Kuttan Appu KK; Introduction to Mechatronics; Oxford press
3. Mahalik NP; Mechatronics principles, concepts and applications; TMH
4. Smaili A and Mrad F; MechatronicsIntegrated Technology; Oxford Press
5. Singh and Joshi; Mechatronics; PHI

302 (A) Fluid Film Lubrication

Unit 1
Classification of bearings, basic theory of hydrodynamic lubrication, derivation of generalized Reynolds equations from continuity and momentum equation.

Unit 2
Hydrodynamic Journal bearing, Reynold equation for (i) Infinite slider bearing, (ii) Rayliegh step journal bearing,(iii) lnfinitely long full journal bearing, boundary conditions, Full Sommerfeld conditions, Half Sommerfeld conditions, Reynolds condition, static performance characteristics, journal bearings-Friction forces; Load carrying capacity, Attitude angle, Eccentricity, Sommerfeld number, Oil flow, Thermal Equilibrium, Extent of fluid film, pressure distribution Kingsbury analogy.

Unit 3
Hydrostatic Journal Bearings: Introduction, Theoretical Analysis, Boundary conditions, Static performance characteristic, Load, friction coefficient parameter, oil-flow, temperature rise parameter, Non-Circular Journal Bearings: Introduction, geometry of different types of non-circular bearings, boundary conditions, behavior of non-circular bearings.

Unit 4
Gas Bearings: Introduction, Difference between gas and oil bearings, Static characteristics of gas bearings, Equations governing the behaviour of gas bearings, Numerical Methods For Solution of Fluid Film Equations For Bearing (introduction only), Collection Method, Least Square Method, Orthogonality Method, Galerkin and Rayleigh-Ritz Finite Element Method, Finite Difference Method.

Unit 5 Rolling Element Bearings: Characteristics and application of rolling element bearings, classification of bearings, Life prediction, friction, lubrication, bearing temperature, high speed consideration.

References:
1. Basu, Sengupta, Ahuja; Fundamentals of tribology; PHI
2. Sahoo Prasanta; Engineering tribology; PHI.
3. Khonsari MM, Booser ER; Applied tribology bearing design and lubrication; Wiley Inter-Sc
4. MACHINE DESIGN - BLACK
5. TRIBOLOGY