UNIVERSITY OF BERGAMO

FACULTY OF ENGINEERING

Programme of the course:

MECHANICAL SYSTEMS ENGINEERING AND DRIVES

[9 cfu]

1. MACHINE DYNAMICS

Brief remarks on: mechanical quantities and units; kinematics and dynamics of a particle and of a rigid body; relative motion theorem; the Principle of d'Alembert; work and energy. Principle sketch of a machine. Work energy theorem. Work energy equation for a machine in steady state operation. Forward and backward power in a machine. Characteristic curves of motors and their typical parameters. Motor's running in four quadrants. Motor-load coupling: transmissions and speed variators. Wasted energy in transmission: forward and backward efficiency. Static friction, kinetic friction, rolling resistance and relevant wasted power. Work energy equation for a machine in transient operation with forward and backward power flux. Starting time of a machine. Periodic running of a machine. Flywheel design.

2. KINEMATIC AND DYNAMIC ANALYSIS OF SINGLE DEGREE OF FREEDOM MECHANICAL SYSTEMS

Classification of motion. Laws of motion. Transmission of motion: variable transmission ratios. Coriolis' theorem and Rival's theorem. Graphical, analytical and numerical methods for the kinematic analysis of mechanical systems. Dynamic analysis of mechanical systems: dynamic equilibrium equation and energy methods.

3. MECHANISMS

Mechanisms classification and nomenclature. Planar single degree of freedom mechanical linkages: four-bar linkage, crank-slider mechanism and relevant kinematic inversions. Gears, transmission belts. Cam mechanisms. Methods for analysis and synthesis of mechanisms.

4. DRIVES FOR MECHANICAL SYSTEMS

Principle sketch of a drive system: control system configuration, power system configuration. Classification of drive systems as regard the kind of energy: electrical drives, pneumatic drives, hydraulic drives.

Electrical drives: mechanical and operational characteristics of the most widespread electrical motors.

Pneumatic drives: compressed air generation and treatment; linear pneumatic actuators, pneumatic motors, directional control valves and auxiliary valves; valve's coefficients; end-stroke valves and pneumatic sensors; motion-step diagram.

Hydraulic drives: volumetric pumps; accumulators; directional control valves, pressure control valves, flow control valves; hydraulic actuators; fluid's compressibility; stiffness of an hydraulic linear actuator; open and closed loop hydrostatic transmissions.