1 Particle Kinematics

1.1 Weight dropped down a well: Rectilinear motion

1.2 Rotating crane: Polar coordinates

1.3 Car traveling along a path: Path coordinates

1.4 Kite problem: Velocity and Acceleration vectors in multiple coordinate systems

1.5 Slider Pin in Rotating Slider Arm†: Polar Kinematics with coordinate transformation into Cartesian and path.

2 Particle Kinetics

2.1 Skier: determine acceleration and corresponding ground forces on the skier

2.2 Boxes connected via pulley system on slopes†: Determine tension in cable and motion after specified time.

2.3 Sliding box with dip in the road: Conservation of energy and Work-Energy principles

2.4 Getting a box up a slope: Impulse-momentum

2.5 Masses swing and hit: Conservation of energy and momentum principles to determine how far box will travel along a surface that becomes rough.

2.6 Drop-hammer: Guided masses with plastic impact and supporting spring

2.7 Masses suspended on pulley system with spring†: Determine the EoM utilizing various equilibrium and energy approaches

2.8 Masses between pulley systems and inclined spring: Determine the nonlinear EoM

2.9 Dropping weight on a flexible platform: Determine EoM and corresponding initial conditions so as to find response of SDOF system

2.10 Response of vehicle traveling over harmonic path†: Determine the steady-state response and select damping to meet response criteria

2.11 Response of seismic response instrument†: Determine the EoM, system response and parameters

2.12 System with motor: Determine the EoM and response of SDOF system with a rotating unbalanced mass

2.13 Linked Pendulums: Determine linearized EoMs utilizing equilibrium and energy principles

2.14 Double Pendulum: Determine the nonlinear and linearize EoMs utilizing equilibrium and energy principles

2.15 Multi-degree of Freedom System with Motor and Support Motion: Determine the EoMs

3 Rigid Body Kinematics

3.1 Load Lifted by Pulley System†: Determine acceleration at various points using vector equations

3.2 Four Bar Linkage†: Determine response at specific time using vector equations

3.3 Linkage with Sliding Collar†: Determine generalized equations using geometric approach

4 Rigid Body Kinetics

4.1 Sliding Wardrobe: Determine normal force on rollers

4.2 Truck Bed: Force on truck bed exerted by hydraulic jack

4.3 Disk Pulled by Rope on Rough Surface: Check if disk rolls or slips

4.4 Rolling down the hill without slip: Comparison of solid disk vs. thin shell; checking no-slip assumption

4.5 Movable Rigid Body Pulley: Determine acceleration and movement of load supported by a movable pulley system

4.6 Sliding Block and Rotating Cylinder†: Determine EoM of MDOF System assuming cylinder rolls without slip

4.7 Compound Pendulum: Determine EoM of MDOF System

† Problem used with permission courtesy of Dr. Dara Childs from Dynamics in Engineering Practice, 10th Edition, CRC Press.