Engineering Mechanics - Video course

'M' denotes the module and 'L' the lecture under that module.
M1 Basics of Statics

L1 Fundamental principles & concepts: Vector algebra, Newton's laws, gravitation, force (external and internal, transmissibility), couple, moment (about point and about axis), Varignon's theorem, resultant of concurrent and non-concurrent coplanar forces, static equilibrium, free body diagram, reactions.
L2 Problem formulation concept; 2-D statics, two and three force members, alternate equilibrium equations, constraints and static determinacy; 3-D statics.
M2 Analysis of Structures – I (Trusses, Frames, Machines)
L3 Trusses: Assumptions, rigid and non-rigid trusses; Simple truss (plane and space), analysis by method of joints.
L4 Trusses (contd): Analysis of simple truss by method of sections; Compound truss (statically determinate, rigid, and completely constrained).
L5 Analysis of frames and machines.
M3 Analysis of Structures – II (Beams, Cables)
L6 Internal forces; Beams: types of loading and supports; shear force, bending moment, and axial force diagrams.
L7 Beams (contd): shear force and bending moment diagrams and equations relating them with external load.
L8 Cables (coplanar): assumptions, parabolic and catenary cables.
M4 Friction - I
L9 Coulomb dry friction laws, simple surface contact problems, friction angles, types of problems, wedges.
L10 Disk friction (thrust bearing); Belt friction (flat, V).
L11 Square-threaded screw (self locking, screw jack).
M5 Friction - II
L12 Journal bearings (axle friction).
L13 Wheel friction and rolling resistance.
M6 Center of Mass & Area Moments of Inertia
L14 First moment of mass and center of mass, centroids of lines, areas, volumes, composite bodies.
L15 Area moments- and products- of inertia, radius of gyration, transfer of axes, composite areas.
L16 Rotation of axes, principal area-moments-of-inertia, Mohr's circle.
M7 Mass Moment of Inertia
L17 Second moment of mass, Mass moments- and products- of inertia, radius of gyration, transfer of axes, flat plates (relation between area- and mass- moments- and products- of inertia), composite bodies.
L18Rotation of axes, principal mass-moments-of-inertia.
M8 Virtual Work and Energy Method - I
L19 Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom.
L20 Active force diagram, systems with friction, mechanical efficiency.
M9 Virtual Work and Energy Method - II
L21 Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium.
L22 Applications of energy method for equilibrium.
L23 Stability of equilibrium.
M10 Review of particle dynamics

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Mechanical Engineering

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L24 Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates).
L25 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates).
L26 Work-kinetic energy, power, potential energy.
L27 Impulse-momentum (linear, angular); Impact (Direct and oblique).

M11 Plane kinematics of rigid bodies - I

L28 Rotation; Parametric motion.
L29 Relative velocity, instantaneous center of rotation.
L30 Relative acceleration, rotating reference frames.

M12 Plane kinematics of rigid bodies - II

L31 Rotating reference frames, 3-part velocity and 5-part acceleration relations, Coriolis acceleration.
L32 Applications of rotating reference frames.

M13 Plane kinetics of rigid bodies - I

L33 Kinetics of system of particles and derivation of moment equation.
L34 Translation.
L35 Fixed axis rotation; General planar motion.
L36 General planar motion.

M14 Plane kinetics of rigid bodies – II

L37 Work – kinetic energy, potential energy.
L38 Potential energy (contd.), power; Impulse-momentum.
L39 Impulse-momentum (contd.), impact; Combination problems.

M15 Introduction to vibration

L40 Free vibration (damped, undamped)
L41 Forced vibration (damped, undamped)
L42 Mechanical displacement meter and accelerometer; Vibration of rigid bodies
L43 Vibration of rigid bodies (contd.)
L44 Energy methods for undamped problems.

Books to be followed:

1. J. L. Meriam and L. G. Kraige, 'Engineering Mechanics: Statics (V.1), Dynamics (V.2)', 5th edition, Wiley 2002.
2. I. H. Shames, 'Engineering Mechanics: Statics & Dynamics', 4th edition, PHI, 1996.
F. P. Beer and E. R. Johnston, 'Vector Mechanics for Engineers: Statics (V.1), Dynamics (V.2)', 3rd SI edition, TMH, 1998