Advanced Higher Applied Mathematics (Mechanics)

Unit 1

Outcome 1.1 Motion In A Straight Line	**NS**	**OT**	**VG**
I know the meaning of *position, displacement, velocity, acceleration, uniform speed, uniform acceleration, scalar quantity, vector quantity*.			
I can draw, interpret and use distance/time, velocity/time and acceleration/time graphs.			
I know the area under a velocity/time graph represents the distance travelled.			
I know the rates of change $v = \frac{dx}{dt} = \dot{x}$ and $a = \frac{d^2x}{dt^2} = \frac{dv}{dt} = \dot{v} = \ddot{x}$			
I can derive, by calculus, and use the equations for motion in a straight line with **constant acceleration**, namely $v = u + at, s = ut + \frac{1}{2}at^2$ and from these $v^2 = u^2 + 2as, s = \frac{(u+v)}{2}t$			
I can solve analytically problems involving motion in one dimension under constant acceleration, including vertical motion under constant gravity.			
I can solve problems involving motion in one dimension where the acceleration is dependent on time i.e. $a = \frac{dv}{dt} = f(t)$			

Outcome 1.2 Relative Position and Velocity	**NS**	**OT**	**VG**
I know the meaning of the terms *relative position, relative velocity and relative acceleration, air speed, ground speed* and *nearest approach*.			
I am familiar with notation for relative position, velocity and acceleration vectors of 2 objects.			
I can resolve vectors into components.			
I can differentiate and integrate vector functions in time.			
I can use position, velocity and acceleration vectors to solve practical problems.			
I can solve problems involving collision courses and nearest approach.			

Outcome 1.3 Motion of Projectiles in a Vertical Plane	**NS**	**OT**	**VG**
I know the meaning of the terms *projectile, velocity, angle of projection, trajectory, time of flight, range* and *constant gravity*.			
I can solve the vector equation $\ddot{r} = -gj$ to obtain **r** in terms of its horizontal and vertical components.			
I can obtain and solve the equations of motion $\ddot{x} = 0, \ddot{y} = -g$, obtaining expressions for $\dot{x}, \dot{y}, x$ and y in any particular case.			
I can find the time of flight, greatest height reached and the range of a projectile.			
I can find the maximum range of a projectile on a horizontal plane and the angle of projection to achieve this.			
I can find, and use, the equation of the trajectory of a projectile.			
I can solve problems in two-dimensional motion involving projectiles under a constant gravitational force and neglecting air resistance.			

Outcome 1.4 Forces and Newton's Laws of Motion	**NS**	**OT**	**VG**
I can understand the terms *mass, force, weight, momentum, balanced and unbalanced forces, resultant force, equilibrium* and *resistive forces*.			
I know Newton's first and third laws of motion.			
I can resolve forces in two dimensions to find their components.			
I can combine forces to find a resultant force.			
I can understand the concept of static and dynamic friction and limiting friction.			
I understand the terms frictional force, normal reaction, coefficient of friction μ, angle of friction λ, and know the equations $F = \mu R$ and $\mu = \tan\theta$.			
I can solve problems involving a particle or body in equilibrium under the action of certain forces.			
I know Newton's second law of motion, that force is the rate of change of momentum, and derive the equation $F = ma$.			
I can use this equation to form equations of motion to model practical problems on motion in a straight line.			
I can solve such equations modelling motion in one dimension, including cases where the acceleration is dependent on time.			
I can solve problems involving friction and problems on both rough and smooth inclined planes.			