SUMMARY

This course covered the two main objectives of Classical Mechanics:

a) Description of motion of objects (Kinematics).

b) Laws that govern the mechanical action on objects(Dynamics).

Two Physical Models

a) If, during the motion, each part of object get the same displacement vector, one models the object as a "single material point".

b) If, during the motion, different parts of object get different displacement vectors, one models the object as a "set of material points".

Reference frames and Units of measurements

a)This course make use of "inertial Cartesian frames".

b) All units of physical parameters in this course refer to International System of Units (SI system).

Two types of vector parameters to measure the "action" over an object

a) One uses the vector of " force" to measure a translational action.

b) One uses the vector of "torque" to measure a rotational action.

Two types of scalar parameters to measure the "inertia".

Inertia is the propriety of an object to keep its state of motion i.e. its existing velocity.

a) One uses "inertial mass" or simply the "mass" to measure this propriety in translational motion.

b) One uses the "inertia moment" to measure this propriety in rotational motion.

Kinematics

a) Translational kinematics applies to the model of "a single material point". It makes use of parameters: time, position, displacement, velocity, acceleration, travelled distance, speed.

b) Rotational kinematics applies to the model of "a single material point in rotation" or "a set of material points in rotation". It makes use of parameters:
time, angle (vs. a fixed direction), angular displacement , angular velocity, angular acceleration.

Dynamics

a) Translational dynamics applies to the model of "a single material point". It is based on the three Newton's laws. The main formula used is $\vec{F}_{Net} = m\vec{a}$.

b) Rotational dynamics applies to the model of "a single material point in rotation" or "a set of material points in rotation. The main formula used is $\vec{\tau}_{Net} = I\vec{\alpha}$.

c) One calculates the work done by a force as $W = \vec{F} * \vec{s}$ and work done by a torque as $W = \tau * \Delta\theta$.

Systems of objects

a) If two or more objects interact between them one may use the concept of " system " .

b) One uses the energy, work, linear momentum and angular momentum to study the motion in a system.

c) There are three laws that apply in case of a system :

- Mechanical Energy Conservation $\Delta E_{sys} = W_{Net}^{Ext}$. If $W_{Net}^{Ext} = 0$ then $\Delta E_{sys} = 0$
- Linear Momentum Conservation $\Delta\vec{P}_{Sys} = \vec{F}_{Net}^{Ext}$. If $\vec{F}_{Net}^{Ext} = 0$ then $\Delta\vec{P}_{Sys} = 0$
- Angular Momentum Conservation $\frac{d}{dt}\vec{L}_{sys} = \vec{\tau}_{Net}^{Ext}$. If $\vec{\tau}_{Net}^{Ext} = 0$ then $\Delta\vec{L}_{Sys} = 0$

If there is no exterior actions on the objects of a system one says that this is an isolated system .

In the case of an isolated system, $E_{sys} = constant$; $\vec{P}_{Sys} = constant$ and $\vec{L}_{Sys} = constant$.