Chinese Al-chemist KO HUNG 320 AD described a flying top that used spinning feather blades to become airborne.

1170 years later in 1490, Leonard Da Vinci designed a 'lifting screw' that he thought would some day lift a man. No real progress for the next 300 years.

Between 1784 and 1900 people from Europe and America experimented with steam engines and working models.

Germany's Nikolaus Otto's four-stroke cycle IC engine's power-to-weight rates made the helicopter possible.

First human fixed wing flight-1903

Paul Cornu of France made the first successful helicopter flight in 1907.

Production

In 1939 Igor Sikorsky a Russian Immigrant to America built a helicopter that was dependable and predictable enough to be mass produced.

In 1942 his company began production of a two passenger helicopter which marked the beginnings of the helicopter industry.

Important Performance Milestones

- max speed of 250mp/hr

- altitudes over 7 miles

- capability to take off and lift vertically 60 tons. This one is the most important

Making the helicopter fly has involved wrestling with a long catalogue of problems.

- It was necessary to invent the use of a tail rotor to stop the helicopter spinning around on the main rotor axis.

- It took the genius of Juan de la Cierra to devise a system of articulated blades to prevent the aircraft rolling over continuously. Blade articulation leads to sluggish control.

Remedy:

- Hingeless rotor$\longrightarrow$ aircraft stability is compromised.

- The helicopter can never fly fast judged by the fixed wing aircraft standards.

- Climbing is straight forward

- Descending involves turbulent, vortex laden wake.

- With any practical combination of stability and control characteristics the helicopter remains a difficult and taxing aircraft to fly and generally requires auto-stabilization to restrict the pilot work load to a safe and comfortable level.

Types	like fixed wings
Single-rotors-helicopter	
Tandem rotor	tilt-rotors
side-by-side rotors	tilt-wings
co-axial rotors	
tip-driven rotors	

Principle:

A rotor produces an upward thrust by driving a column of air downwards through the rotor plane.

Induced Power:

The work done on the air, represented by its change in kinetic energy per unit time is $1/2(\rho A v_i)V_\infty^2 = 2\rho A v_i^3 = T v_i$

$$P_i = T v_i = T^{3/2}/\sqrt{2\rho A}; \ C_{P_i} = C_T^{3/2}/\sqrt{2}$$

Induced power P_i is the major part of the total power absorbed by a rotor in hover.

Profile Power:

Power required to overcome the drag of the blades is the profile power P_o.
P_i is the power related to useful function of the rotor - producing lift.

Figure of Merit (M): Ratio of induced power (P_i) to total power ($P_i + P_o$) is a measure of rotor efficiency in hover.

$$M = P_i/(P_i + P_o) = (1 + P_o/P_i)^-1 = (1 + C_{P_o}\sqrt{2}/C_T^{3/2})^-1$$

Now for a given rotor blade the drag and hence the profile power, may be expected not to vary greatly with the level of thrust, provided the blade does not stall or experience high compressibility drag rise. Therefore M for a given rotor will generally increase as C_T increases.

A good Figure of Merit is around 0.75 considering other power required.

The same principles produce the lift necessary to raise both airplanes and helicopters off the ground. The cross-section of an airplane wing and helicopter rotor blade are airfoils.

It is the knowledge of aerodynamic control that makes the helicopter fly. A helicopter rises vertically from the ground and can move in any direction.

The pitch angle changes the thrust produced by the rotor. By changing the Collective pitch (the pitch of all the blades simultaneously equally) the pilot can control the amount of lift produced and thus the altitude to which the helicopter will rise.

Directional control

Through a swash plate mechanism, via the control stick, pitch of individual blades passing specific points can be changed creating differential lift on the blades and a resulting tilted resultant force.

Cyclic pitch is also used to compensate for the differential forces produced on the advancing and retreating sides.

Anti-torque device The fuselage das a tendency to rotate in a direction opposite to the rotor. The tail rotor generates a force that generates a torque opposing the main rotor torque. By varying the tail rotor thrust, the pilot can turn the helicopter to either side.

Auto-rotation:

When power fails the blades of the rotor are driven the action of the relative wind, much like a wind mill, as the helicopter heads down in a controlled descent. Collective pitch is used efficiently to control the speed.