DISTURBED MOTION OF ARTIFICIAL SATELLITE OF THE MOON IN THE PROJECT "UKRSELENA". Yu. V. Alexandrov, Department of Physic of Kharkiv Karazin National University (Sqr. Svobody 4, Kharkiv 61077, alex@astron.kharkov.ua)

Introduction: Proposals on creation of the Ukrainian artificial satellite of the Moon (ASM) "UKRSELENA" are presented in [1]. The main goals of the satellite are supposed to be global imaging of the Moon's surface at the millimeter wavelengths with the side-view radar, and spectropolarimetric investigation of the lunar surface in the UV and visual wavelengths. The satellite orbit should have an altitude of 200 km in periselene, and a period of rotation of six hours that corresponds to the orbit eccentricity of about 0.5. The inclination of the orbit to the plane of the lunar equator should be $90^o \pm 2^o$.

The basic perturbing factor affecting the ASM motion is the perturbing action of the Earth. As is known, an orbit with an inclination close to 90^o with respect to the plane of the perturbing body orbit, may be unstable. Therefore, it is of interest to investigate the disturbed motion of the ASM in an orbit with the parameters that have been proposed in the project "UKRSELENA".

Results and Discussion: The analysis of equations of disturbed motion [2] shows that at the inclination of an orbit close to 90^o, the secular perturbation of the node longitude is small, while the secular perturbations of eccentricity and inclination are small for a pericenter distance close to zero. The pericenter distance is most affected by perturbation, and the larger it deviates from zero, the larger will be the difference in the satellite altitudes above the lunar poles.

As is known, one of the Kassini laws describing forward-rotational motion of the Moon says that the lines where three planes cross each other, – those of the lunar equator, ecliptic and lunar orbit, - coincide. Therefore, we shall count longitudes from a node of the Earth orbit with respect to the Moon. Then a node longitude Ω_1 of a perturbing body orbit equals zero. If we orient the plane of the satellite orbit in such a way that it would cross a plane of the lunar equator along this common line where the planes are crossing, then the longitude of its orbit Ω will also be equal to zero.

Secular perturbation of eccentricity goes to 0 at $\omega = 0$. With this in view, it is reasonable: a) to choose the initial value of pericentric distance ω_o to be negative and to have such a value that ω be positive and equal ω_o in modulus at the end of the time interval under consideration; b) to choose the time moment of the satellite ascent into an orbit so that the long-periodic perturbation caused by the eccentricity of the Earth's orbit relatively to the Moon be maximal in the middle of a considered time interval, i.e., that the Earth be in pericynthian.

The basic scientific tasks of the project "UKRSELENA" assume that the life time of the ASM in its orbit should be two or three months. Accept this time to equal 2.5 calendar months, that is 75 days or 300 passes. With the duration of animalistic month (27.55d) taken into account, one will find that the moment of the satellite ascent into the orbit should 9.95 days precede the next passage of the Moon through the perigee of its orbit.

At initial values of the ASM orbit elements – eccentricity $e_o = 0.5$, altitude in pericynthian h_{p0} =200 km, a node longitude $\Omega_1 = 0^o$, an inclination of the orbit $i_0 = 90^o$ (a semiaxis is then $a = 3882$ km, and the period of rotation $T = 6.03^h$), and under the conditions formulated above, the values of osculating eccentricity of the satellite orbit e were calculated, as well as the values of its altitudes above equator, southern and northern poles of the Moon, h_E, h_S and h_N, respectively. Perturbations of elements Ω and i do not exceed 0.5º. Estimates of the perturbing effects of the Sun show that they do not exceed one kilometer in the altitude above the equator and three kilometers above the poles of the Moon.

Thus, one may argue that, with the amendments presented above, the orbit of the polar artificial satellite of the Moon proposed in the project "UKRSELENA" is stable enough and provides good capability both for performance of scientific problems, and for information transfer to the Earth.

Conclusion: Summarizing, we would like to note that a set of countries, which are carrying out or planning exploration of the Moon by means of the rocket-and-space techniques, is presently extending quickly. Apart for the USA, it is the European Union, Japan, China, Russia, and India. And if Ukraine does not use its scientific and technical potentials in this field, it may happen to find itself at a roadside of a new and important stage in studying and exploring the Moon.

References: [1] Shkuratov Yu. G. et al. (2003) *Adv. Space Res. 31,* 2341-2345. [2] Lidov M. L. (1961). *Artifical Satellites of Earth. 8*. 5 - 45.