Panchangam Calculations

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Ancient sages have established the relationship between planetary movements in the sky and the way they have influenced the destiny of life on earth, besides predicting auspicious and inauspicious times that are used to perform various activities in daily life. The calendar that contains all these times is called Panchangam, which, in literal sense means five limbs. The five limbs of astrological significance are (1) Tithi, (2) Vaaram, (3) Karanam, (4) Nakshatram, and (5) Yogam. According to our Hindu Panchangam the day is always reckoned from sunrise on a day to next day's sunrise whereas the Tithi, Nakshatram change at anytime during the 24 hours. In contrast to this, in the Gregorian calendar, which starts on 1st Jan and finishes on 31st Dec., the day and the date changes at midnight every day.

Usually the prevailing Nakshatram, Tithi, Karanam and Yogam on any day are calculated at the sunrise time of the day. Further, the ending times of Nakshatram, Tithi, Yogam and Karanam are also given. For calculating Nakshatram, Tithi, Karanam and Yogam, the exact longitudes (ecliptic positions) of Ravi and Chandra are needed. In addition, their daily motions are needed. We need precise positions of Ravi and Chandra. These are available from ephemeris (table of astronomical calculations). Indian ephemeris is published every year by Indian astronomical ephemeris.

The Panchangam calculation requires two important heavenly bodies – Ravi (Sun) and Chandra (moon). Different approaches are adopted to calculate the positions of Ravi and Chandra in the zodiac.

(1) The Vakyam is an ancient system where planetary motions are described in simple sentences (hence the vakya). Vakya Panchangam is computed based on Slokas or Vakyas handed down to the practitioners of this school. In addition to the Slokas, there are also Sutras, which help to make simple additions and subtractions. The Slokas and Sutras together provide the formulae required for the preparation of the Vakya Panchangam. Vakya Panchangam is Shastra based and accordingly has provisions to decide a ritual according to shastraas. Thus, to check on Sankashti, Ekadasi, Dwadasi or Pradosham and such other things for Anushtanam, Vakya Panchangam is sufficient. Astrologers who need to have as precise knowledge of planetary positions of day for astrological predictions, Vakya Panchangam may not be sufficient as there can be significant deviations between the positions of

planets as computed by Vakya Panchangam and those calculated from astronomical calculations.

(2) Another Panchangam based on Surya Siddhantham mentions that one should observe the sky and make necessary corrections to planetary formulae (Bija Samskar) in order to make an accurate Panchangam. Surya Siddhantham in the older days gave more accurate planetary positions but subsequent users did not know how to apply Bija Samskar and adjust for natural changes through the millennium resulting in calculated planetary positions deviating from the actual planetary positions in the sky.

(3) The modern astronomical method of Drik Ganitham or Drik Siddhantham allows validation of the calculated planetary positions using rigorous mathematical equations resulting in quite precise positions of the planets.

The longitudes of planets thus calculated are known as Sayana or tropical longitudes. In Hindu astrology, we use sidereal or Nirayana longitudes. To arrive at sidereal or Nirayana longitudes we need to have a knowledge of "Ayanamsa".

Ayanamsa

The Earth revolves anti-clockwise around the Sun in an elliptical orbit, and the plane of orbit is called the plane of the ecliptic. The Earth also rotates anti-clockwise on its own axis. The revolution of the Earth around the Sun causes the succession of years while the rotation of the Earth causes the continuous cycles of night and day. The Earth's axis is inclined to the pole of the plane of the ecliptic at 23.5°, and this is reflected in the ecliptic being inclined to the celestial equator (the projection of the Earth's equator on the celestial sphere) at the same angle. This inclination of earth is responsible for change of seasons. The March and September equinoxes (when duration of day equals that of night) are the points where the ecliptic intersects the celestial equator from south to north and north to south respectively. It may be mentioned that along the path of ecliptic are situated all the 12 zodiac signs from Mesham (Aries) to Meenam (Pisces). The March equinox occurs on or about 21 March while the September equinox occurs on or about 23 September every year. In ancient times, the March equinox used to coincide with Mesham 0^0 on the ecliptic. It is normal to expect that the equinoxes occur exactly at the same point of intersection of ecliptic and the celestial equator. This would be true as long as the earth has only the two types of motion as mentioned above (revolving around the sun and rotating on its

own axis). This however is not true. It has been observed that the earth not only rotates but also wobbles on its axis. Due to this, the axis of the earth describes a conical clockwise motion and the pole describes a circle, which roughly takes 26000 years to complete. Due to this wobbling, the March equinox gets receded westward by about 50.2 seconds every year and no longer coincides with Mesham 0^0 on the ecliptic. The ancient astronomers were able to discern this small difference when they compared the position of the March equinox and 0^0 of Mesham against a distant star in the stellar background ("Sidereal" position). This phenomenon is called precession of the equinoxes. This westward drift is cumulative and the extent of deviation from the original point of time in the past when the March equinox exactly coincided with the 0^0 of Mesham in the celestial zodiac to the current time is termed "Ayanamsa". Ayanamsa is a variable entity and is increasing every year by about 50.2 seconds.

The precession of equinoxes results in gradual shifting of seasons over the years from their expected dates of arrival. For example, the March equinox, which is also called spring equinox indicating the onset of spring season, would no longer coincide with Mesham 0^0.

One school of astrology namely tropical astrology addresses this by simply "moving" the zodiac every year by about 50.2 seconds so that the March equinox and Mesham 0^0 coincide each other. The longitudes thus obtained are called Tropical or "Sayana" longitudes. "Sayana" means "Sa + Ayana" meaning with Ayanamsa included. This is widely prevalent in West. Some Indian Astrologers too follow this school of Astrology.

The Hindu Astrology is based on the fact that celestial zodiac is fixed in space and should not be tampered with only to suit one's requirements. Instead of "moving" the zodiac, a correction to the extent of Ayanamsa is effected to the longitudinal positions of celestial bodies to arrive at the sidereal or "Nirayana" longitudes. "Nirayana" means "Ni + Ayana" meaning without Ayana (Ayanamsa not included).

Thus the Astrology system that considers the fixed zodiac is called the Nirayana (without Ayana!) system, while the one that considers the movable zodiac is called the Sayana (with Ayana!) system. *The Hindu system of astrology is known as Nirayana System* because this system uses the fixed zodiac as reference. The Nirayana values of planetary longitudes can be obtained by subtracting the Ayanamsa for a given time from the Sayana longitudes. But unfortunately it is not known at which point of time in the past these two zodiacs were exactly coinciding. Due to this uncertainty there are many Ayanamsas being used by different practitioners of Nirayana astrology.

In this Notes we use the following formulae to calculate Ayanamsa for a given date (do not get scared by the formulae!! They are easy to use):
For the beginning of the year:

$$A = -6.92416 + 16.90709 \times \frac{year}{1000} - 0.757371 \times \frac{year}{1000} \times \frac{year}{1000}$$

For any other date and month add the following also to get the correct Ayanamsa.

$$B = \left(Month - 1 + \frac{date}{30}\right) \times \frac{1.1574074}{1000}$$

Ayanamsa = A + B

Let us calculate the Ayanamsa for 15-7-2009 (15th July 2009)
We have year = 2009, month = 7 (July = 7), date = 15

First we will calculate the value of 'A'

$$A = -6.92416 + 16.90709 \times \frac{2009}{1000} - 0.757371 \times \frac{2009}{1000} \times \frac{2009}{1000}$$

A = -6. 92416 + 16.90709 x 2.009 – 0.757371 x 2.009 x 2.009
A = -6.92416 + 33.96634381 – 3.056810703
A = 23.9853731

Now we calculate the values of 'B'

$$B = \left(7 - 1 + \frac{15}{30}\right) \times \frac{1.1574074}{1000} \qquad B = (6 + 0.5) \times \frac{1.1574074}{1000}$$

B = 6.5 x 1.1574074/1000

= 7.5231481/1000

B = 0.0075231481

Ayanamsa = A + B = 23.9853731 + 0.0075231481 = 23.9928962
We get the value of Ayanamsa in degrees. Converting it into degrees, minutes and seconds we get
23.9972165= 23 degrees + 0.9928962 x 60 minutes
That is 23 degrees and 59.57377 minutes
That is 23 degrees, 59 minutes and 0.57377 x 60 seconds
That is 23 degrees, 59 minutes and 34 seconds.
It is represented as 23^0-59'-34'' or simply 23-59-34

This Ayanamsa value is very close to Lahiri Ayanamsa or Chtrapaksha Ayanamsa. The Government of India Calendar's reform committee recommends Chitrapaksha Ayanamsa.
(Subtracting 6 minutes from Chitrapaksha Ayanamsa we get KP Krishnamurthy Ayanamsa (KP Ayanamsa). So KP Ayanamsa = 23 – 53 – 34)

Please note that if we use Indian Astronomical ephemeris to get the longitudinal positions of Ravi and Chandra at 5:30 AM IST, there is no need to use Ayanamsa. The positions are already corrected for Ayanamsa. The Ayanamsa subtracted longitudes are called Nirayana or sidereal longitudes. We always use Nirayana longitudes in our Panchangam.

But if we use Swiss ephemeris to get the longitudinal positions of Ravi and Chandra at 0-0 hours Universal Time (UT) which corresponds to 5:30 AM IST, we have to subtract Ayanamsa for the day to get the Nirayana or sidereal longitudes of Ravi and Chandra. Let us compare the two ephemeris and calculate the Nirayana longitudes of Ravi and Chandra.

Nirayana Longitude of Sun and Moon at 5^h 29^m IST

Date	Julian Date	Longitude	
		Sun	Moon
1-7-2009	2455013.5	75° 19' 1''.1744	183° 42' 13''.494
2-7-2009	2455014.5	76° 16' 13''.0621	196° 21' 33''.1112
3-7-2009	2455015.5	77° 13' 24''.6163	208° 45' 56''.3341
4-7-2009	2455016.5	78° 10' 35''.9018	220° 58' 13''.0836
5-7-2009	2455017.5	79° 7' 47''.0174	233° 1' 1''.0454
6-7-2009	2455018.5	80° 4' 58''.011	244 ° 56' 44''.5314
7-7-2009	2455019.5	81° 2' 8''.9737	256 ° 47' 37''.8818
8-7-2009	2455020.5	81° 59' 19''.9913	268 ° 35' 51''.8045
9-7-2009	2455021.5	82° 56' 31''.1381	280 ° 23' 41''.1422
10-7-2009	2455022.5	83° 53' 42''.4868	292 ° 13' 32''.2825
11-7-2009	2455023.5	84° 50' 54''.1305	304 ° 8' 9''.3299
12-7-2009	2455024.5	85° 48' 6''.1239	316 ° 10' 37''.4465
13-7-2009	2455025.5	86° 45' 18''.5601	328 ° 24' 22''.3351
14-7-2009	2455026.5	87° 42' 31''.5045	340 ° 53' 4''.3885
15-7-2009	2455027.5	88° 39' 44''.991	353 ° 40' 26''.2796
16-7-2009	2455028.5	89° 36' 59''.0932	6 ° 49' 52''.0513
17-7-2009	2455029.5	90° 34' 13''.8337	20 ° 23' 57''.993
18-7-2009	2455030.5	91° 31' 29''.2568	34 ° 23' 56''.2704
19-7-2009	2455031.5	92° 28' 45''.3746	48 ° 48' 57''.3403
20-7-2009	2455032.5	93° 26' 2''.1527	63 ° 35' 41''.2694

Indian Astronomical Ephemeris, Published by Positional Astronomy Centre, Plot 8, Block AQ, Sector 5, Salt Lake, Mahish Bathan, Kolkata 700 091
WEB Source: **http://www.packolkata.org/body.htm**

SWISS EPHEMERIS for the year 2009

JULY 2009

00:00 UT

Day	Sid.t	☉	☽	☿	♀	♂	♃	♄	♅	♆	♇	☊	☊	⚸	⚷
W 1	18 36 44	9♋18'42	27♎42	24♊32	25♉17	22♉ 6	26°R37	16♍35	26°R37	26°R12	1°R47	0°R25	1♒23	19♑48	25°R44
T 2	18 40 40	10°15'54	10♏22	26°27	26°22	22°49	26♒34	16°39	26♓37	26♒11	1♑46	0♒23	1°20	19°55	25♒42
F 3	18 44 37	11°13'06	22°46	28°24	27°27	23°32	26°31	16°44	26°37	26°10	1°44	0°20	1°16	20° 2	25°40
S 4	18 48 33	12°10'17	4♐58	0♋23	28°32	24°14	26°28	16°48	26°37	26° 9	1°43	0°18	1°13	20° 8	25°38
S 5	18 52 30	13° 7'28	17° 1	2°25	29°37	24°57	26°24	16°53	26°37	26° 8	1°41	0°15	1°10	20°15	25°36
M 6	18 56 27	14° 4'40	28°57	4°29	0♊43	25°40	26°20	16°57	26°37	26° 7	1°40	0°13	1° 7	20°22	25°34
T 7	19 0 23	15° 1'51	10♑48	6°34	1°48	26°23	26°16	17° 2	26°37	26° 6	1°38	0°11	1° 4	20°28	25°32
W 8	19 4 20	15°59'02	22°36	8°41	2°54	27° 5	26°12	17° 7	26°36	26° 5	1°37	0°10	1° 0	20°35	25°30
T 9	19 8 16	16°56'14	4♒24	10°49	4° 0	27°48	26° 8	17°12	26°36	26° 3	1°35	0°D10	0°57	20°42	25°28
F 10	19 12 13	17°53'25	16°14	12°58	5° 6	28°30	26° 4	17°17	26°36	26° 2	1°34	0°11	0°54	20°48	25°26
S 11	19 16 9	18°50'37	28° 8	15° 7	6°12	29°13	25°59	17°22	26°35	26° 1	1°32	0°12	0°51	20°55	25°24
S 12	19 20 6	19°47'49	10♓11	17°17	7°19	29°55	25°54	17°27	26°35	26° 0	1°31	0°13	0°48	21° 1	25°21
M13	19 24 2	20°45'01	22°25	19°26	8°25	0♊37	25°49	17°32	26°34	25°59	1°29	0°14	0°45	21° 8	25°19
T 14	19 27 59	21°42'14	4♈53	21°35	9°32	1°19	25°44	17°37	26°34	25°57	1°28	0°14	0°41	21°15	25°17
W15	19 31 56	22°39'28	17°41	23°44	10°39	2° 1	25°39	17°42	26°33	25°56	1°27	0°R15	0°38	21°21	25°14
T 16	19 35 52	23°36'42	0♉50	25°52	11°46	2°43	25°33	17°48	26°32	25°55	1°25	0°15	0°35	21°28	25°12
F 17	19 39 49	24°33'57	14°24	27°59	12°53	3°25	25°28	17°53	26°31	25°53	1°24	0°14	0°32	21°35	25° 9
S 18	19 43 45	25°31'13	28°24	0♌ 5	14° 1	4° 7	25°22	17°59	26°31	25°52	1°22	0°14	0°29	21°41	25° 7
S 19	19 47 42	26°28'29	12♊49	2° 9	15° 8	4°49	25°16	18° 4	26°30	25°51	1°21	0°13	0°26	21°48	25° 4
M20	19 51 38	27°25'46	27°36	4°12	16°16	5°31	25°10	18°10	26°29	25°49	1°20	0°13	0°22	21°55	25° 1

WEB Source
http://www.astro.com/swisseph/ae/2000/ae_2009.pdf
http://www.astro.com/swisseph/swepha_e.htm

From Indian Astronomical ephemeris we straightaway get the Nirayana longitudes for Ravi and Chandra at 5:29 AM IST on 15-7-2009. The values are:

Ravi = 88^0-39′-45′
Chandra = 353^0-40′-26″

Now if we recall that each zodiac sign represents 30^0 of celestial ecliptic, Ravi is in Mithuna Rasi. In this rasi he already traveled 28^0.
Chandra is in Meena Rasi. Meena Rasi starts at 330^0. Chandra already traversed 23^0 in Meena rasi. In Meena rasi first 3^0-20′ we have Purvabhadra Nakshatram 4^{th} padam. Next 13^0-20′ (that is 3^0-20′ to 16^0-40′) we have Uttarabhadra Nakshatram. Last 13^0-20′ are assigned to Revathi Nakshatram. So Chandra is in Meena rasi and Revathi Nakshatram.

What does the Swiss ephemeris give?
See the table given above. Also please note that the positions are given at 00:00 UT corresponding to 5:30 AM IST. Follow the line corresponding to the date 15-7-2009. Under Ravi the position given is 22^0-39′-28″. If we look at Ravi's position on 1-7-2009, we can see that he is in Karkataka rasi. So the absolute longitude of Ravi from Aries 0^0 is 112^0-39′-28″ (Check!)

Now remember that Swiss ephemeris give Sayana or tropical longitudes. We have to subtract Ayanamsa to get Nirayana or sidereal longitude. Subtracting Ayanamsa for 15-7-2009 from Tropical longitude of Ravi we get

112^0-39′-28″
- 23^0-59′-34″

88^0-39′-54″ which is same as that we obtained from Indian astronomical ephemeris.

Chandra's longitude is 17^0-41′ in Aries. Subtracting Ayanamsa we get 353^0-41′-26″ very near to that we obtain from Indian ephemeris.

Recap
Normally in Panchangams, it is a normal practice to give the positions of planets at a particular time of the day. In India the time chosen is usually 5:30 AM. Indian astronomical ephemeris also give the planets for 5:30 AM. And more important, Indian ephemeris gives Nirayana longitudes of the planets. Swiss ephemeris gives Sayana Longitudes at GMT 0:0 hrs (or universal time 0:0 h). This corresponds to 5:30AM IST. If we use Swiss ephemeris, we have to deduct ayanamsa from the longitudes to get the nirayana longitudes.

Notation used for depicting longitudes of planets

There are mainly three ways of indicating a planet's position in the zodiac.

1. Absolute method: Starting from 0^0 of zodiac (Mesha rasi or Aries) we indicate the exact position of the Planet. For example, Ravi's position is given above as 88^0- 40'-20''. That is Ravi is posited a little over 88^0 away from the starting point of zodiac (Mesha rasi or Aries 0^0). Let us recall that minimum longitude a planet can have is 0^0 (beginning of Mesha rasi) and the maximum longitude is 359.99999999^0 (Last of Meena rasi).
2. Rasi-over method: In this method we indicate the number of zodiac signs which are already traversed by the planet and the degreecal position in the rasi in which he is posited. Taking again the above example of Ravi (88^0- 40'-20''), we notice that for every 30^0, one sign is traversed. To reach 88^0, we need to traverse completely 2 signs (2 x 30^0 = 60^0) and another 28^0 in the third sign that is Mithuna rasi. So we write Ravi's position as 2s-28^0-40'-20'' or simply 2-28^0-40'-20'', indicating that 2 signs have already passed.
3. In-Rasi method: In this method we indicate the Rasi in which the planet is posited and then give its degreecal position. Again taking the above example, we know that Ravi is in Mithuna Rasi, we indicate his position as 28♊-40-20.

Let us see for Chandra's position as given above. It is 353^0-41'-52". This is absolute longitude of Chandra. What is the notation based on other methods? Answers are given. It can be verified.

Rasi-over method: 11s-23^0-41'-52''or 11-23^0-41'-52''

In-Rasi method: 23^0♓-41'-52''

Addition and Subtraction of longitudes

In astrological calculations it becomes necessary to either add or subtract one longitude from another. For example, to know the Yoga on a day we have to add longitudes of Chandra and Ravi. To know Tithi of a day we need to subtract longitude of Chandra from that of Ravi. Even though it is trivial, for completion sake we will explain how it is done.

Addition is straightforward. If the sum of the longitudes of Chandra and Ravi comes more than 360^0, subtract 360^0 from the sum. Take the resultant value for finding out the Yoga.

Example:

Chandra's longitude = 353^0-41'-52''

Ravi's longitude = 284^0-40'-20''

353^0-41′-52″
284^0-40′-20″
(+) ----------
638^0-22′-12″

As the sum is more than 360^0, subtract 360^0

638^0-22′-12″
360^0-00′-00″

278^0-22′-12″

For subtraction, if Chandra's longitude is greater than that of Ravi, the calculation is straightforward. But if longitude of Chandra is less than that of Ravi, add 360^0 to Chandra's longitude and proceed with subtraction.

Chandra's longitude = 23^0-52′-33″ Ravi's longitude = 344^0-33′-15″

Note that Chandra's longitude is less than that of Ravi. So add 360^0 to Chandra's longitude. That is 23^0-52′-33″ + 360^0 = 383^0-52′-33″ Now proceed to subtraction.

383^0-52′-33″
344^0-33′-15″

39^0-19′-18″

Let us take another example.

Chandra's longitude = 3s-29^0-15′-13″

Ravi's longitude = 5s-14^0-10′-9″

Notice that the longitudes are given based on Rasi-over method. We have to take the number of signs already traversed. In Chandra's case it is 3 signs and in Ravi's case it is 5 signs. So actual longitudes of Chandra and Ravi are:

Chandra = 3 x 30^0 + 29^0-15′-13″ = 90^0 + 29^0-15′-13″ = 119^0-15′-13″

Ravi = 5 x 30 + 14^0-10′-9″ = 150^0 + 14^0-10′-9″ = 164^0-10′-9″

We can see that again Chandra's longitude is less than that of Ravi.

Chandra's longitude = 9^0♎-15′-13″

Ravi's longitude = 14^0♉-10′-9″

Which is greater? Chandra's longitude? Or Ravi's?

Chandra's longitude is greater than that of Ravi by 145^0-5′-4″. (Check!)

Daily motion of Ravi and Chandra

We have to look up in the ephemeris and note down the longitude of any planet for the day and next day. The difference between the two gives the daily motion of the planet. Let us find out the daily motion of Ravi and

Chandra on July 15, 2009. Look up in the Swiss ephemeris. The required data is given below at 00-00 UT (5:30 IST):

Date	Ravi	Chandra
15-7-2009	22♋39-28	17♌41
16-7-2009	23♋36-42	00♉50

Strictly speaking we should consider the longitudes of the planets at sunrise time. But the error introduced by considering 5:30 IST is not significant. We see that Ravi is in Karkatakam on both the days while Chandra changed sign. He moved from Mesha Rasi to Vrishabha Rasi.

Daily motion of Ravi on 15-7-2009 is

(23♋36-42) – (22♋39-28) = 00-57-14 (57 minutes, 14 seconds)

Daily motion of Chandra is

(00♉50) – (17♌41) = (30-50) – (17-41) = 13-09-00 (13 degrees 9 minutes).

It may be mentioned that we have used Swiss ephemeris to compute daily motions. In fact even if we have used Indian astronomical ephemeris we would have obtained the same result.

Normally the daily motion of Ravi is about 1^0 (about 60 minutes) and that of Chandra is about 12^0.

Now that we have all information to compute the different limbs of Panchangam, let us go ahead and compute!

Tithi

Tithi is calculated from the distance between Chandra and Ravi. For every 12^0 distance of Chandra from Ravi Tithi changes. Tithi starts from Sukla (Suddha) Padyami for the first 12^0 distance and continues further; next 12^0 is Sukla Vidiya and so on. Between 168^0 and 180^0 it is Poornima (Punnama). Afterwords Krishna (Bahula) Paksham starts from Krishna (Bahula) Padyami and so on. From 348^0 to 360^0 it is Amavaasya. Table of Tithis gives the relevant information.

Let us find out the Tithi on July 15, 2009. We note from Swiss ephemeris that the longitudes of Chandra and Ravi, respectively are:

Chandra = 17♌41 and Ravi = 22♋39-28

Notice that Chandra is in Mesha Rasi and Ravi is in Karkatakam (in-Rasi notation!). The absolute longitudes are given below:

Chandra = 17-41-00 and Ravi = 112-39-28 (how?)

We should always subtract Ravi's longitude from that of Chandra for computing Tithi.

Chandra = 17-41-00 and Ravi = 112-39-28
We see that Chandra's longitude is less than that of Ravi. So add 360^0 to Chandra's value and proceed with subtraction.

Chandra = 377-41-00
Ravi = 112-39-28

265-01-32

Look up the Table 1. It is seen that 265^0 is covered in 23^{rd} Tithi. It is more than 180^0 and hence it is Krishna Paksham. From the Table it is seen that it is in fact Krishna (Bahula) Ashtami.

We can also compute the Tithi from the distance between Chandra and Ravi. In the example given above the difference in the longitudes of Chandra and Ravi is 265^0-01'-32''. Converting minutes and seconds into degrees we have 265.0555555556^0. Divide this by 12.

12)265.0255555556(22 (Quotient)
264.0000000000

1.0255555556 (Remainder)

The quotient is 22 and the remainder is 1.025555556^0
Quotient indicates number of Tithis elapsed.
Prevailing Tithi is quotient + 1. That is 22 + 1 = 23. It is Bahula Ashtami. Please note that Bahula Ashtami starts when Chandra is exactly 264^0 away from Ravi. In this case, Bahula Ashtami started and 1.0255555556^0 has already elapsed. On July 15, 2009 at 5:30 IST Tithi is Bahula Ashtami.

To find out the ending time of Tithi

From the Table of Tithis it is seen that Bahula Ashtami lasts from 264^0 to 276^0. The difference in the longitudes of Chandra and Ravi is 265.02555556^0.
So the remaining distance (RD) for Ashtami Tithi = 276^0- 265.025555556^0.
That is for Ashtami to complete still 10.974444444^0 have to be covered. To find out the time taken to complete this distance, we make use of the daily motion of Chandra and Ravi.
As given previously, the daily motion of Chandra and Ravi on July 15, 2009 is
Daily Motion of Chandra (DMC) = 13-09-00 (13 degrees 9 minutes) per 24 hours
Daily motion of Ravi (DMR) = 0-57-14 (57 minutes, 14 seconds) per 24 hours.
Time taken to cover 10.974444444^0 is given by

Table of Tithis

Please note that starting point of Tithis is relative and depends on the positions of Chandra and Ravi. Starting point of first Tithi Sukla (Suddha) Padyami is always counted from the longitude of Ravi irrespective of where he is posited in the celestial zodiac.

S.No.	Tithi	Distance between Chandra and Ravi (starting from longitude of Ravi)	
		In degrees	In minutes
1	Sukla (Suddha) Padyami	00 to 12	00 to 720
2	Sukla (Suddha) Vidiya	12 to 24	720 to 1440
3	Sukla (Suddha) Tadiya	24 to 36	1440 to 2160
4	Sukla (Suddha) Chavithi	36 to 48	2160 to 2880
5	Sukla (Suddha) Panchimi	48 to 60	2880 to 3600
6	Sukla (Suddha) Sashti	60 to 72	3600 to 4320
7	Sukla (Suddha) Saptami	72 to 84	4320 to 5040
8	Sukla (Suddha) Ashtami	84 to 96	5040 to 5760
9	Sukla (Suddha) Navami	96 to 108	5760 to 6480
10	Sukla (Suddha) Dasimi	108 to 120	6480 to 7200
11	Sukla (Suddha) Ekadasi	120 to 132	7200 to 7920
12	Sukla (Suddha) Dwadasi	132 to 144	7920 to 8640
13	Sukla (Suddha) Triodasi	144 to 156	8640 to 9360
14	Sukla (Suddha) Chaturdasi	156 to 168	9360 to 10080
15	**Poornima (Punnama)**	**168 to 180**	**10080 to 10800**
16	Krishna (Bahula) Padyami	180 to 192	10800 to 11520
17	Krishna (Bahula) Vidiya	192 to 204	11520 to 12240
18	Krishna (Bahula) Tadiya	204 to 216	12240 to 12960
19	Krishna (Bahula) Chavithi	216 to 228	12960 to 13680
20	Krishna (Bahula) Panchimi	228 to 240	13680 to 14400
21	Krishna (Bahula) Sashti	240 to 252	14400 to 15120
22	Krishna (Bahula) Saptami	252 to 264	15120 to 15840
23	Krishna (Bahula) Ashtami	264 to 276	15640 to 16560
24	Krishna (Bahula) Navami	276 to 288	16560 to 17280
25	Krishna (Bahula) Dasimi	288 to 300	17280 to 18000
26	Krishna (Bahula) Ekadasi	300 to 312	18000 to 18720
27	Krishna (Bahula) Dwadasi	312 to 324	18720 to 19440
28	Krishna (Bahula) Triodasi	324 to 336	19440 to 20160
29	Krishna (Bahula) Chaturdasi	336 to 348	20160 to 20880
30	**Amavaasya**	**348 to 360**	**20880 to 21600**

When Chandra is placed opposite to Ravi, we have Poornima (punnama).
If they are conjunct in the same Rasi, we have Amavaasya.

$$\text{Time(hours)} = \frac{\text{RD}}{\text{DMC} - \text{DMR}} \text{x} 24$$

$$\text{Time(hours)} = \frac{10.9744444}{(13-09-00)-(00-57-14)} \text{x} 24$$

Converting into minutes and solving we get

$$\text{Time(hours)} = \frac{658.4666664}{(789)-(57.233333)} \text{x} 24 \quad \text{Time(hours)} = \frac{658.4666664}{731.7666667} \text{ x } 24$$

= 21.595954 hours (21-35-45)

Thus ending time of Ashtami is 21-35-45 hours from 5:30 IST (why?)

Ashtami will be over at 5-30-00 + 21-35-45 = 27-05-45 hrs (2-5-45 hours after midnight of 15-7-2009)

Instead of using Swiss ephemeris, if we had used Indian astronomical ephemeris to compute Tithi, what result would we be obtaining?

The difference between the two ephemeris is the Ayanamsa. Subtracting Ayanamsa from the Swiss ephemeris, which gives Sayana longitudes, we get Nirayana longitudes, which is what Indian astronomical ephemeris gives. As the Tithi is difference between two longitudes, we should get the same Tithi and its ending times whether Swiss ephemeris or Indian astronomical ephemeris is used. I leave to the readers to check this out.

Karana

We know that each Tithi lasts for 12^0 duration of distance of Chandra from Ravi. Each Tithi is divided into two halves of 6^0 duration. First half is ruled by one Karana and the second half up to the end of the Tithi is ruled by next Karana. Table of karanas given below lists all the Karanas and the corresponding Tithi. In the example given above the Tithi is Bahula Ashtami and first half of it is prevailing (Chandra's longitude is between 264^0 and 270^0). From the Table it is seen that the prevailing karana is Baalava, which will be followed by Kaulava karana.

Table of Karanas

Please note that there are two karanas per Tithi.
As each Tithi lasts 12^0, first Karana lasts up to first 6^0 of Tithi and the second Karana lasts up to the end of Tithi (scond half).

S.No.	Tithi	Karana-1(First half of Tithi)	Karana-2 (Second half of Tithi)
1	Sukla (Suddha) Padyami	Kimstugna	Bava
2	Sukla (Suddha) Vidiya	Baalava	Kauvala
3	Sukla (Suddha) Tadiya	Taitila	Gara
4	Sukla (Suddha) Chavithi	Vanija	Vishti (Bhadra)
5	Sukla (Suddha) Panchimi	Bava	Baalava
6	Sukla (Suddha) Sashti	Kauvala	Taitila
7	Sukla (Suddha) Saptami	Gara	Vanija
8	Sukla (Suddha) Ashtami	Vishti (Bhadra)	Bava
9	Sukla (Suddha) Navami	Baalava	Kauvala
10	Sukla (Suddha) Dasimi	Taitila	Gara
11	Sukla (Suddha) Ekadasi	Vanija	Vishti (Bhadra)
12	Sukla (Suddha) Dwadasi	Bava	Baalava
13	Sukla (Suddha) Triodasi	Kauvala	Taitila
14	Sukla (Suddha) Chaturdasi	Gara	Vanija
15	**Poornima (Punnama)**	**Vishti (Bhadra)**	**Bava**
16	Krishna (Bahula) Padyami	Baalava	Kauvala
17	Krishna (Bahula) Vidiya	Taitila	Gara
18	Krishna (Bahula) Tadiya	Vanija	Vishti (Bhadra)
19	Krishna (Bahula) Chavithi	Bava	Baalava
20	Krishna (Bahula) Panchimi	Kauvala	Taitila
21	Krishna (Bahula) Sashti	Gara	Vanija
22	Krishna (Bahula) Saptami	Vishti (Bhadra)	Bava
23	Krishna (Bahula) Ashtami	Baalava	Kauvala
24	Krishna (Bahula) Navami	Taitila	Gara
25	Krishna (Bahula) Dasimi	Vanija	Vishti (Bhadra)
26	Krishna (Bahula) Ekadasi	Bava	Baalava
27	Krishna (Bahula) Dwadasi	Kauvala	Taitila
28	Krishna (Bahula) Triodasi	Gara	Vanija
29	Krishna (Bahula) Chaturdasi	Vishti (Bhadra)	Sakuna
30	**Amavaasya**	**Chatushpada**	**Naga**

Nakshatram

Nakshatram prevailing on any day is obtained from the absolute longitude of Chandra. This is counted from 0^0 Mesha Rasi. Please remember that we need the absolute longitude of Chandra to compute Nakshatram. We should use sidereal or Nirayana longitudes and not Sayana or tropical longitudes. That is we should make use of Ayanamsa-corrected longitudes. If we use Swiss ephemeris we should subtract Ayanamsa from the longitude of Chandra. We can use Indian astronomical ephemeris directly as these are already corrected for Ayanamsa. Table of Nakshatrams given below gives the span of each Nakshatram.

Nakshatram is an important concept in Hindu astrology. Most of the auspicious functions and marriage alliances are based on Nakshatram. If we know the Nakshatram of the day, in general we can know the Rasi in which Chandra is placed (except for Nakshatrams belonging to Ravi, Kuja, and Guru as these Nakshatrams span two adjacent Rasis). Further, each Nakshatram is ruled by a planet. The Dasha period at the time of birth of an individual is decided by Lord of Nakshatram of that day. Each Nakshatram is further divided into four Padams (quarters) another important concept in oriental astrology. Navamsa chart (a divisional chart) is constructed based on this.

Nakshatrams and their Lords

Nakshatras (each measures 13°-20′ arc)			Lord
1. Aswini	10. Makha	19. Moola	KE (☋)
2. Bharani	11. Pubba	20. Purvashadha	SU (♀)
3. Krithika	12. Uttara	21. Uttarashadha	RA (☉)
4. Rohini	13. Hasta	22. Sravanam	CH (☾)
5. Mrigasira	14. Chitta	23. Dhanista	KU (♂)
6. Ardra	15. Swathi	24. Satabhisham	RH (☊)
7. Punarvasu	16. Visakha	25. Purvabhadra	GU (♃)
8. Pushyami	17. Anuradha	26. Uttarabhadra	SA (♄)
9. Aslesha	18. Jyesta	27. Revathi	BU (☿)

To know the Nakshatram prevailing on any day look up in the ephemeris and note down the longitude of Chandra. If it is Swiss ephemeris, subtract Ayanamsa. If it is Indian astronomical ephemeris, note down the longitude of Chandra. There is no need to subtract Ayanamsa. See the Table of Nakshatrams and find out the Nakshatram corresponding to this longitude. For the example given previously, the sidereal or Nirayana longitude of Chandra is 353^0-41′-52″. So at 5-30 IST on 15-7-2009, Revathi is the Nakshatram and Rasi is Meenam.

Table of Nakshatrams

S.No.	Name of Nakshatram	Rasi	Span within Rasi ^{0} – ` to $^0$ – `	Absolute span in Zodiac ^{0} – ` to $^0$ – `
1	Aswini	Mesham	00-00 to 13-20	00-00 to 13-20
2	Bharani	Mesham	13-20 to 26-40	13-20 to 26-40
3	Krithika	Mesham Vrishabham	26-40 to 30-00 00-00 to 10-00	26-40 to 30-00 30-00 to 40-00
4	Rohini	Vrishabham	10-00 to 23-20	40-00 to 53-20
5	Mrigasira	Vrishabham Mithunam	23-20 to 30-00 00-00 to 6-40	53-20 to 60-00 60-00 to 66-40
6	Ardra	Mithunam	6-40 to 20-00	66-40 to 80-00
7	Punarvasu	Mithunam Karkatakam	20-00 to 30-00 00-00 to 3-20	80-00 to 90-00 90-00 to 93-20
8	Pushyami	Karkatakam	3-20 to 16-40	93-20 to 106-40
9	Aslesha	Karkatakam	16-40 to 30-00	106-40 to 120-00
10	Makha	Simham	00-00 to 13-20	120-00 to 133-20
11	Pubba	Simham	13-20 to 26-40	133-20 to 146-40
12	Uttara	Simham Kanya	26-40 to 30-00 00-00 to 10-00	146-40 to 150-00 150-00 to 160-00
13	Hasta	Kanya	10-00 to 23-20	160-00 to 173-20
14	Chitta	Kanya Thula	23-20 to 30-00 00-00 to 6-40	173-20 to 180-00 180-00 to 186-40
15	Swathi	Thula	6-40 to 20-00	186-40 to 200-00
16	Visakha	Thula Vrischikam	20-00 to 30-00 00-00 to 3-20	200-00 to 210-00 210-00 to 213-20
17	Anuradha	Vrischikam	3-20 to 16-40	213-20 to 226-40
18	Jyesta	Vrischikam	16-40 to 30-00	226-40 to 240-00
19	Moola	Dhanus	00-00 to 13-20	240-00 to 253-20
20	Poorvashada	Dhanus	13-20 to 26-40	253-20 to 266-40
21	Uttarashada	Dhanus Makaram	26-40 to 30-00 00-00 to 10-00	266-40 to 270-00 270-00 to 280-00
22	Sravanam	Makaram	10-00 to 23-20	280-00 to 293-20
23	Dhanista	Makaram Kumbham	23-20 to 30-00 00-00 to 6-40	293-20 to 300-00 300-00 to 306-40
24	Satabhisham	Kumbham	6-40 to 20-00	306-40 to 320-00
25	Poorvabhadra	Kumbham Meenam	20-00 to 30-00 00-00 to 3-20	320-00 to 330-00 330-00 to 333-20
26	Uttarabhadra	Meenam	3-20 to 16-40	333-20 to 346-40
27	Revathi	Meenam	16-40 to 30-00	346-40 to 360-00

Note that Krithika, Mrigasira, Punarvasu, Uttara, Chitta, Visakha, Uttarashada, Dhanista and Purvabhadra extend their span to two Rasis.

Ending time of Nakshatram

Let us again take the above example. Chandra's longitude is 353^0-41'-52'' and the Nakshatram is Revathi. From the Table it is seen that Revathi Nakshatram starts from 345^0-40' and lasts up to 360^0. So at 5-30 IST on July 15, 2009, already 7^0-1'-52'' of Revathi elapsed. The remaining degrees (RD) are

(360^0-00'-00'') – (353^0-41'-52'') = 6^0-18'-8''.

The daily motion of Chandra on 15-7-2009 as mentioned above is 13^0-9'-00''

$$\text{Ending time of Nakshatram} = \frac{\text{RD}}{\text{DMC}} \text{ x } 24 \qquad = \frac{6^0\text{-}18'\text{-}8''}{13^0\text{-}9'\text{-}00''} \text{ x } 24$$

Converting into minutes and solving we get

$$\text{Ending time of Nakshatram} = \frac{378.133333}{789} \text{ x } 24 \qquad = 11.5022 \text{ hours}$$

= 11-30-8 hours from 5-30 IST (why?)

Revathi Nakshatram ends at 5-30-00 + 11-30-8 = 17-00-08 hours on 15-7-2009.

Important note
Please note that the Nirayana longitude of Chandra is obtained by subtracting Ayanamsa from the Sayana longitude. Depending on the Ayanamsa value used, different Nirayana longitude is obtained. Even though Nakshatram may not change, the degreecal position may change. Hence there can be different ending times for the Nakshatram. This is because for Nakshatrams, we deal with the absolute longitudes. Ending times of Tithis remain the same irrespective of the Ayanamsa used, as Tithi is a relative distance between Chandra and Ravi. Yoga duration and ending time of Yoga also depends on the value of Ayanamsa used. (See below for Yoga computation).

Yogas

There are different types of Yogas in Panchangam as well as in birth chart. Birth chart Yogas depend on the placement of planets with respect to each other and also their relative placement in different zodiac Rasis. The Yogas we come across in Panchangam are again of different type. Yoga as defined by conventional Panchangam refers to one of its five limbs and can be computed from the longitudes of Chandra and Ravi. There are 27 Yogas and each Yoga's span is 13^0-20', making a total of 360^0. To compute Yoga,

1. Add the longitudes of Chandra and Ravi.
2. If the sum is greater than 360^0, subtract 360^0 from the sum.
3. Divide the resultant sum by 13^0-20'.

4. Quotient gives the number of Yogas elapsed and quotient + 1 gives the current Yoga. Remainder gives the degrees elapsed in the current Yoga.

Please note that we should take Nirayana longitudes (Ayanamsa-corrected) for computation. Let us find out the Yoga on July 15, 2009. The Nirayana longitudes of Chandra and Ravi are:

Chandra = 353-41-26
Ravi = 88-39-54
(+) ----------
442-21-20
(-) 360-00-00 (why subtraction?)

82-21-20

See the Table of Yogas. It is seen that 82-21-20 are covered in the span of 80-00 to 93-20 corresponding to 7^{th} Yoga namely Sukarma Yoga. You may also note that already 2-21-20 of Sukarma Yoga has lapsed. Still (93-20) – (82-21-20) = 10-58-40 have to be covered for the Yoga to be over.

We can also compute Yoga mathematically. First convert minutes and seconds into degrees.

82-21-20 = 82.349816^0 Divide the sum obtained by 13^0-20′ (13.333333^0)

13.3333333)82.349816(6
79.999998

2.349818

Quotient indicates number of Yogas over. Quotient + 1 gives the current Yoga. Remainder gives number of degree already completed in the current Yoga.

Ending time of Yoga

From the Table of Yogas it is seen that Sukarma Yoga lasts from 80^0 to 93^0-20′. The sum of the longitudes of Chandra and Ravi is 82^0-21′-20″. So the remaining distance (RD) for Sukarma Yoga is given as:

(93^0-20′) – (82^0-21′-20″) = 10^0-58′-40″ (10.9777778^0).

That is for Sukarma Yoga to complete still 10.97777778^0 have to be covered. To find out the time taken to complete this distance, we make use of the daily motion of Chandra and Ravi.

As given previously, the daily motion of Chandra and Ravi on July 15, 2009 is

Daily Motion of Chandra (DMC) = 13^0-09′-00″ (13 degrees 9 minutes) per 24 hours

Table of Yogas

Please note that starting point of first Yoga (Vishkambha) is always 0^0 Mesham (Aries). The other Yogas follow.

S.No.	Sum of the longitudes of Chandra + Ravi		Name of the Yoga
	^{0} – ‘ to ^{0} – ‘	In minutes	
1	00-00 to 13-20	000 to 800	Vishkambha
2	13-20 to 26-40	800 to 1600	Priti
3	26-40 to 40-00	1600 to 2400	Ayushman
4	40-00 to 53-20	2400 to 3200	Soubhagya
5	53-20 to 66-40	3200 to 4000	Sobhana
6	66-40 to 80-00	4000 to 4800	Atiganda
7	80-00 to 93-20	4800 to 5600	Sukarma
8	93-20 to 106-40	5600 to 6400	Dhrithi
9	106-40 to 120-00	6400 to 7200	Soola
10	120-00 to 133-20	7200 to 8000	Ganda
11	133-20 to 146-40	8000 to 8800	Vriddhi
12	146-40 to 160-00	8800 to 9600	Dhruva
13	160-00 to 173-20	9600 to 10400	Vyaghata
14	173-20 to 186-40	10400 to 11200	Harshana
15	186-40 to 200-00	11200 to 12000	Vajra
16	200-00 to 213-20	12000 to 12800	Siddhi
17	213-20 to 226-40	12800 to 13600	Vyatipata
18	226-40 to 240-00	13600 to 14400	Variyana
19	240-00 to 253-20	14400 to 15200	Parigha
20	253-20 to 266-40	15200 to 16000	Siva
21	266-40 to 280-00	16000 to 16800	Siddha
22	280-00 to 293-20	16800 to 17600	Sadhya
23	293-20 to 306-40	17600 to 18400	Subha
24	306-40 to 320-00	18400 to 19200	Sukla
25	320-00 to 333-20	19200 to 20000	Brahma
26	333-20 to 346-40	20000 to 20800	Eindra (Indra)
27	346-40 to 360-00	20800 to 21600	Vaidhrthi

Daily motion of Ravi (DMR) = 0^0-57’-14’’ (57 min, 14 sec) per 24 hours.
Time taken to cover 10.97777778^0 is given by

$$\text{Time(hours)} = \frac{RD}{DMC + DMR} x24 \quad = \quad \frac{10.97777778^0}{(13^0 - 09' - 00'') + (00^0 - 57' - 14'')} x24$$

$$\frac{10.97777778^0}{(13.15^0) + (0.9538889^0)} x24 \quad = \quad \frac{10.97777778^0}{14.1038889^0} x24$$

= 18.680436 hours from 5-30-00 IST (why?)

That is Sukarma Yoga ends at (5-30-00) + (18-40-50) = 24-10-50 hours
Thus Sukarma Yoga ends after midnight of July 15, 2009 at 00-10-50 hours on July 16, 2009.

Amrita Gadiyas and Varjyam (Tyajyam)

Amrita Gadiyas and Varjyam (also known as Tyajyam) depend on the Nakshatram of the day and its duration. Amrita gadiyas by name indicates auspicious time for initiating any activity. Varjyam indicates the time interval, which should be avoided for initiating any activity. Each of these lasts for $1/15^{th}$ duration of Nakshatram of the day and if the duration of Nakshatram is 24 hours, then each of them lasts for $1/15^{th}$ of 24 hours that is 1 hour-36 minutes. Depending on the duration of Nakshatram, the duration of these two changes proportionately. For a given Nakshatram, following formulae may be used to arrive at the starting times of Amrita gadiyas and Varjyam:

$$\text{Starting time} = \text{Starting time of Nakshatram} + \frac{x}{24}(\text{duration of Nakshatram})$$

where x is a number that depends on the Nakshatram of the day.

$$\text{Duration} = \text{Duration of Nakshatram} \times \frac{1.6}{24}$$

See the Table of Amrita Gadiyas and Varjyam for the starting times for each Nakshatram. The Table lists the timings in hours. The Table lists the starting time of Amrita Gadiyas or Varjyam when the duration of Nakshatram is 24 hours. It should be understood that starting time (x) as given in the Table should be added to the starting time of Nakshatram to arrive at the starting time of Amrita Gadiyas or varjyam as the case may be.

For example, the value of 'x' for Aswini Nakshatram is 16.8 Hours for Amrita gadiyas and 20 Hours for Varjyam. That means Amrita Gadiyas start after 16.8 Hours of starting of Aswini. Similarly Varjyam starts after 20 hours of starting of Aswini. Let us suppose that Aswini Nakshatram starts on a day at 6:30 AM and ends at 8:00 AM next day. The duration of time Aswini lasts is 25:30 hrs.

Amrita Gadiyas start at $6.5 + \frac{16.8}{24}(25.5) = 6.5 + 17.85 = 24.35$ hrs. As the Nakshatra started at 6:30 AM, 24.35 hrs is 21 minutes past midnight. That is Amrita gadiyas start at early hours (0:21 AM) next day.

Duration of Amrita Gadiyas = 25.5 x 1.6/24 = 1.7 hrs = 1h-42m

Varjyam starts at 6.5 + $\frac{20}{24}$(25.5) = 6.5 + 21.25 = 27.75 hrs. That is 27:45 hrs. As the Nakshatra started at 6:30 AM, 27.75 hrs is 3.75 hrs past midnight. That is varjyam starts at early hours (3:45 AM) next day.
Duration of Varjyam = 25.5 x 1.6/24 = 1.7 hrs = 1h-42m

Table of Amrita Gadiyas and Varjyam starting timings for a 24 hour-day

Nakshatram	Amrita Gadiyas(X) (Hours)	Varjyam (X) (Hours)
Aswini	16.8	20
Bharani	19.2	9.6
Krittika	21.6	12
Rohini	20.8	16
Mrigasira	15.2.	5.6
Aridra	14	8.4
Punarvasu	21.6	12
Pushya	17.6	8
Aslesha	22.4	12.8
Makha	21.6	12
Pubba	17.6	8
Uttara	16.8	7.2
Hasta	18	8.4
Chitta	17.6	8
Swati	15.2	5.6
Visakha	15.2	5.6
Anuradha	13.6	4
Jyeshta	15.2	5.6
Moola	17.6	8, 22.4
Poorvashadha	19.2	9.6
Uttarashadha	17.6	8
Sravana	13.6	4
Dhanishta	13.6	4
Satabhisha	16.8	7.2
Poorvabhadra	16	6.4
Uttarabhadra	19.2	9.6
Revati	21.6	12

Kalams and Durmuhurtham

There are three more "kalams" which are normally indicated in Panchangams. These are Gulika, Yama Gandam, and Rahu Kalam. The starting times and duration of all these kalams depend on the day as well as duration of the day and night of that day. We must have seen in almost every Panchangam published in India invariably mentioning that these

"Kalams" are given assuming that the sunrise is at 6:00 AM and sunset is at 6:00 PM. This assumption may be true for places near the equator (e.g. in Sri Lanka and Tamil Nadu in India). In addition, Panchangams also indicate Durmuhurtham starting times.

Table for Rahu Kalam, Gulika, Yama gandam and Durmuhurtham

Day	Starting time of Rahu Kalam	Starting time for Gulika Kalam	Starting time for Yama Gandam	Starting time for Durmuhurtham
Sunday	4:30 PM	3:00 PM	12:00 Noon	4:24 PM
Monday	7:00 AM	1:30 PM	10:30 AM	12:24 PM and 2:48 PM
Tuesday	3:00 PM	12:00 Noon	9:00 AM	8:24 AM and 10:48 PM
Wednesday	12:00 Noon	10:30 AM	7:30 AM	11:36 AM
Thursday	1:30 PM	9:00 AM	6:00 AM	10:00 AM and 2:48 PM
Friday	10:30 AM	7:30 AM	3:00 PM	8:24 AM and 12:24 PM
Saturday	9:00 AM	6:00 AM	1:30 PM	7:36 AM

Please note that the above timings assume that the sunrise at 6: 00 AM and sunset is at 6:00 PM. The duration of Rahu Kalam, Gulika Kalam and Yama Gandam is 1:30 hours. Durmuhurtham lasts for 48 minutes.

For other sunrise times and durations of day and night, following formulae may be used:

Rahu Kalam

Day	Starting time (Hrs)	Duration (Hrs)
Sunday	Sunrise + duration of the day x 0.875	Duration of the day x 0.125
Monday	Sunrise + duration of the day x 0.125	
Tuesday	Sunrise + duration of the day x 0.75	
Wednesday	Sunrise + duration of the day x 0.5	
Thursday	Sunrise + duration of the day x 0.625	
Friday	Sunrise + duration of the day x 0.375	
Saturday	Sunrise + duration of the day x 0.25	

Gulika Kalam

Day	Starting time (Hrs)	Duration (Hrs)
Sunday	Sunrise + duration of the day x 0.75	Duration of the day x 0.125
Monday	Sunrise + duration of the day x 0.625	
Tuesday	Sunrise + duration of the day x 0.5	
Wednesday	Sunrise + duration of the day x 0.375	
Thursday	Sunrise + duration of the day x 0.25	
Friday	Sunrise + duration of the day x 0.125	
Saturday	Sunrise	

Yama Gandam

Day	Starting time (Hrs)	Duration (Hrs)
Sunday	Sunrise + duration of the day x 0.5	Duration of the day x 0.125
Monday	Sunrise + duration of the day x 0.375	
Tuesday	Sunrise + duration of the day x 0.25	
Wednesday	Sunrise + duration of the day x 0.125	
Thursday	Sunrise	
Friday	Sunrise + duration of the day x 0.75	
Saturday	Sunrise + duration of the day x 0.625	

Starting time and duration of Durmuhurthams

Day	Starting time (from sunrise)	Duration
Sunday	Duration of the day x 10.4/12	Duration of the day x 0.8/12
Monday	1st. Duration of the day x 6.4/12 2nd. Duration of the day x 8.8/12	
Tuesday	1st. Duration of the day x 2.4/12 **2nd. Duration of the night x 4.8/12 (starting from sunset)**	
Wednesday	Duration of the day x 5.6/12	
Thursday	1st. Duration of the day x 4/12 2nd. Duration of the day x 8.8/12	
Friday	1st. Duration of the day x 2.4/12 2nd. Duration of the day x 6.4/12	
Saturday	Duration of the day x 1.6/12	

Let us find out the Panchangam for Sunday, 21-6-2009 four places Shillong, Rajahmundry, Cuddapah, and Mumbai; all in India.
We will use Indian Astronomical ephemeris.

The sunrise (SR) and sunset (SS) times are

Date	Shillong 25N35 91E53		Rajahmundry 17N0 81E46		Cuddapah 14N30 78E47		Mumbai 19N1 72E51	
	SR	SS	SR	SS	SR	SS	SR	SS
21-3-2009	5:25	17:33	6:6	18:14	6:19	18:26	6:42	18:50
21-6-2009	4:32	18:16	5:31	18:39	5:47	18:46	6:03	19:19
21-9-2009	5:10	17:20	5:52	18:00	6:04	18:12	6:28	18:36
21-12-2009	6:04	16:37	6:27	17:35	6:35	17:51	7:07	18:07

Date	Shillong		Rajahmundry		Cuddapah		Mumbai	
	Day time	Night time	Day time	Night time	Day time	Night time	Day time	Night time
21-3-2009	12:08	11:52	12:08	11:52	12:07	11:53	12:08	1:52
21-6-2009	13:44	10:15	13:08	10:52	12:59	11:01	13:19	10:41
21-9-2009	12:10	11:50	12:08	11:52	12:08	11:52	12:08	11:52
21-12-2009	10:33	13:27	11:08	12:52	11:16	12:44	11:00	13:00

Nirayana Longitudes of Ravi and Chandra at 5:30 AM IST

Date	Sun Longitude	Moon Longitude
21-3-2009	336° 31' 3''	270° 59' 0''
22-3-2009	337° 30' 39''	282° 56' 30''
21-6-2009	65° 46' 37''	40° 17' 00''
22-6-2009	66° 43' 53''	55° 11' 9''
21-9-2009	154° 9' 18''	183° 13' 36''
22-9-2009	155° 8' 00''	196° 42' 6''
21-12-2009	245° 14' 38''	294° 20' 38''
22-12-2009	246° 15' 45''	306° 8' 15''

Date	Ravi's daily motion	Chandra's daily motion
21-3-2009	00-59-36	11-57-30
21-6-2009	00-57-16	14-54-09
21-9-2009	00-58-42	13-28-30
21-12-2009	01-01-07	11-47-37

<u>21-6-2009, Shillong</u>

Tithi = ((40-17-00) – (65-46-37))/12 = (334-31-23)/12 = 334.5230556/12 = 27.876921 = 28th Tithi = Bahula Triodasi

From the Table of Tithis it is seen that Bahula Triodasi ends when the distance between Chandra and Ravi is 336^0. Hence the remaining degrees is $(336^0) - (334.5230556^0) = 1.476944^0$
Ending time of the Tithi = 5-30-00 + 1.476944 x 24/((14-54-09)-(00-57-16)) = 5-30-00 + 2.541333 = 5-30-00 + 2-32-29 = 8-02-29 AM IST
Please note that we have not corrected for Ayanamsa. Why?
It may be shown that irrespective of the place the Tithi and its ending times will remain the same. I leave to the readers to check this out.

Karana = it is seen that the current Tithi longitude is in the second half and hence the Karana is Vanija.

Nakshatram = the absolute longitude of Chandra on 21-6-2009 is 10♉17.
Which notation is used to indicate the longitude? (It is in-Rasi method)
The absolute longitude is 40-17-00.
From the Table of Nakshatrams it is seen that this longitude belongs to 4^{th} Nakshatram namely Rohini.
Rohini Nakshatram spans between 40^0 and 53^0-20'
The longitude is 40-17-00. Hence Rohini Nakshatram started a little earlier.
Ending time of Rohini = For Rohini to over still 13^0-3' have to be covered.
Ending time of Rohini = 5-30-00 + $(13^0$-3') x 24/(14^0-54'-09'') = 21h-1m
That is Rohini ends at 26-31 hours or 2-31 hours past midnight on 21-6-2009 (that is early hours of 22-6-2009).

It may be seen that at 5-30 IST, the Chandra's longitude is 40^0-17'-00''. Let us find out the time when Rohini started. Obviously it started before 5-30 IST as Chandra is already 17' into Rohini's span at 5-30 IST.
Convert 17' into degrees. It is 0.28333333^0.
Starting time of Rohini = (5-30-00) – (0.28333333^0) x 24/(14^0-54'-09'')
(5-30-00) – 0.456299 Hrs = (5-30-00) – (00-27-23) = 5-02-37 IST.
Rohini started at 5-02-37 IST on 21-6-2009.
In Shillong, on 21-6-2009, sunrise time is 4-32 IST.
<u>So on 21-6-2009, at sunrise time in Shillong, the prevailing Nakshatram is Krittika and not Rohini.</u>
For the remaining three places (Rajahmundry, Cuddapah and Mumbai) at sunrise time on 21-6-2009 it is already Rohini Nakshatram.
It is therefore desirable to have Panchangam computed for the place one is residing. Panchangam computed for other places, unless corrections to take care of local parameters are carried out, may not be used.

Please note that Nakshatram ending times depend on the Ayanamsa used for arriving at the Nirayana longitude.

Yoga: on 21-6-2009 Ravi's longitude = 65^{o} 46' 37''
Chandra's longitude = 40^{o} 17' 00''

65^{o}-46'-37''
40^{o} 17'-00''
(+) ----------
106^{0}-03'-37''

From the table of Yogas it seen that the above sum is covered in the span 93-20 to 106-40 corrsponding to Dhrithi Yoga.

Amrita gadiyas and varjyam

Nakshatram	Startimg time (X) for Amrita gadiyas	Starting time (X) for varjyam
Krittika	21.6	12
Rohini	20.8	16

Amrita Gadiyas: From the table of Amrita Gadiyas and Varjyam it is seen that for Rohini Nakshatram Amrita gadiyas start after 20.8 Hrs of starting and varjyam is after 16 hours. Even though at sunrise time in Shillong it is krittika, as Rohini comes within one hour of sunrise, we should consider Rohini fir computing Amrita gadiyas and varjyam.
Duration of Rohini = (26-31) – (5-3) = 21-28 hrs. (Please note that the starting time of Rohini is 5-2-37. But it is rounded off to 5-3)
Starting time of Amrita gadiyas: Duration of Nakshatram x 20.8/24
= (5-3) + (21-28) x 20.8/24 = (5-3) + (18-36) = 23-39 Hrs.
Duration of Amrita gadiyas = (21-28) x 1.6/24 = 1-26
Amrita gadiyas start at 23-39 and end at 25 – 5 Hrs (1-05 on 22-6-2009)

Starting time of Varjyam: Duration of Nakshatram x 16/24
= (5-3) + (21-28) x 16/24 = (5-3) + (14-19) = 19-22 Hrs.
Duration of Varjyam = (21-28) x 1.6/24 = 1-26
Varjyam starts at 19-22 and ends at 20 –48 Hrs

On 21-6-2009 it is Sunday.
Rahu Kalam = sunrise time + duration of the day x 0.875
= 4-32 + (13-44) x 0.875 = 4-35 + 12.01666667 = 16-37 Hrs.

Duration of Rahu Kalam = duration of the day x 0.125 = (13-44) x 0.125 = 1-43
On 21-6-2009, in Shillong Rahu kalam starts at 16-37 and ends at 18-20

Gulika Kalam = sunrise time + duration of the day x 0.75
= 4-32 + (13-44) x 0.75 = 4-35 + 10.3 = 14-53 Hrs.
Duration of Gulika Kalam = duration of the day x 0.125 = (13-44) x 0.125 = 1-43
On 21-6-2009, in Shillong Gulika Kalam starts at 14-53 and ends at 16-36

Yama Gandam = sunrise time + duration of the day x 0.5
= 4-32 + (13-44) x 0.5 = 4-35 + 6-52 = 11-27 Hrs.
Duration of Yama Gandam = duration of the day x 0.125 = (13-44) x 0.125 = 1-43
On 21-6-2009, in Shillong Yama Gandam starts at 11-27 and ends at 13-10

Durmuhurtham = sunrise time + Duration of the day x 10.4/12
= 4-32 + (13-44) x 10.4/12 = 4-32 + 11-54 = 16-26
Duration of Durmuhurtham = Duration of the day x 0.8/12 = 13-44 x 0.8/12 = 0-55
On 21-6-2009, in Shillong Durmuhurtham starts at 16-26 and ends at 17-21

For other places also similar calculations may be carried out.