

MOON-EARTH (TITHI – DAY) PLAN:

Vikrami Years 2062 thro 2081: 19-year Metonic Cycle

(Based on VGRCalendar: VIJ Tithi)

(20030521)

YEARS		MONTHS during the year												Adhika		
		2005						2006								
		(Revised: 20050710-14)														
Metonic !	Gregorian !	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th			
Cycle !	Years !	Magha	Phalguna	Chaitra	Vaisakha	Jyaishtha	Asadha	Shravan	Bhadra	Asvina	Kartika	Margshirsha	Pausa			
Days in (Hindu Calendar)		(30d)	(30d)	(30d)	(31d)	(31d)	(31d)	(31d)	(31d)	(30d)	(30d)	(30d)	(30d)			
Days in VGRCalendar		January	February	March	April	May	June	July	August	September	October	November	December			
		(31d)	(29d)	(31d)	(30d)	(31d)	(30d)	(30d)	(31d)	(30d)	(31d)	(30d)	(30d)+1d			
Year	!	Year	!	!	!	!	!	!	!	!	!	!	!	!	!	
Year 1	!	2005	!	~~	~~	~~	(9+21)T	31T	30T	30T	31T	30T	31T	30T	31Tithi	Lunation
Year 2	!	2006	!	31T	29T	31T	30T	31T	30T	30T	31T	30T	31T	30T	31T	
Year 3	!	2007	!	31T	29T	31T	30T	31T	30T	30T	31T	30T	31T	30T	31T	
Year 4	!	2008	!	31T	29T	31T	30T	31T	30T	30T	31T	30T	31T	30T	31T	
Year 5	!	2009	!	(1 st)	29T	31T	30T	31T	30T	30T	31T	30T	31T	30T	31T	29 ½T
Year 6	!	2010	!	31T	29T	31T	30T	31T	30T	30T	31T	30T	31T	30T	31T	
Year 7	!	2011	!	31T	29T	31T	30T	31T	30T	30T	31T	30T	31T	30T	31T	
Year 8	!	2012	!	31T	29T	31T	30T	31T	30T	30T	31T	30T	31T	(2 nd)	31T	30T
Year 9	!	2013	!	31T	29T	31T	30T	31T	30T	30T	31T	30T	31T	30T	31T	
Year 10	!	2014	!	31T	29T	31T	30T	31T	30T	30T	31T	30T	31T	30T	31T	
Year 11	!	2015	!	31T	29T	31T	30T	31T	30T	30T	31T	30T	31T	30T	31T	
Year 12	!	2016	!	31T	29T	31T	30T	31T	30T	30T	(3 rd)	30T	31T	30T	31T	29 ½T
Year 13	!	2017	!	31T	29T	31T	30T	31T	30T	30T	31T	30T	31T	30T	31T	
Year 14	!	2018	!	31T	29T	31T	30T	31T	30T	30T	31T	30T	31T	30T	31T	
Year 15	!	2019	!	31T	29T	31T	30T	31T	30T	30T	31T	30T	31T	30T	31T	
Year 16	!	2020	!	31T	29T	31T	30T	31T	(4 th)	30T	31T	30T	31T	30T	31T	30T
Year 17	!	2021	!	31T	29T	31T	30T	31T	30T	30T	31T	30T	31T	30T	31T	
Year 18	!	2022	!	31T	29T	31T	30T	31T	30T	30T	31T	30T	31T	30T	31T	
Year 19	!	2023	!	31T	29T	31T	30T	31T	30T	30T	31T	30T	31T	30T	31T	
20 th Year	!	2024	!	31T	29T	(5 th)	(next 19-yr cycle of 235 lunation)				~~	~~	~~	~~	29 ½T	

(20050510-14)

The duration of days during the months in the 19-year Metonic Cycle, for luni-solar adjustment.

1. 19-years = 6939.59603725839 days (6932 ½ Tithi each of RATIO 138W/965 = 1.00103626943 day). (5* 47 = 235 lunation) are accounted in blocks of 47th; 94th; 141st; 188th and 235th lunation, at the end of 19-year cycles. LAST ½T is ‘shortened by 2 hours’ for 19-year alignment. This count of Lunation started on 20050409 (solar Eclipse) as such 19-years overflow into Year 2024.

[Note: 47 lunation = 1387.9376407 days i.e. 3 yrs 292 d 5h.0657206].

2. Vikrami-Gregorian Rhyme Calendar, for luniSolar adjustments, may have a day outside of Calendar Format by removing a day from

SHRAVAN (making it of 30 days); like shifting July (31), and shifting THIS day to Phalgun/February (of 29 days). Last day i.e. the 365th day (December 31) is kept outside of Calendar Format, as the World Day — between December 30 & January 01. A Leap Day is inserted between June 30 & July 01 during years divisible by four (4) BUT SKIPPED during years divisible by 128 (counted using: $[(2000 - 80) + 128]/128^{\text{th}}$, since year 2000 was taken to be a YEAR with Leap Day.

3. (47x29 T =1363Tithi* 5) +118 T = 6940.18445595855 days. Note: A ½ Tithi need be short accounted during 19th years).

4. 8910-YEAR SAROS =10-year Cycle of Metric In-diction *27-year Lunar Cycle *33-year Solar Cycles can replace (15*19*28) 7980-years cycle. 8911-YEARS =469*19-year cycles (110215 lunation). Also, Each cycle of 47 lunation: is $[(10*138) + 1]$ weeks.

5. Observation of ‘certain religious sections’ i.e. days OUTSIDE of the year’s format (such as: the World Day & Leap Day) are a compromise to accept – a break in SABBATH CYCLE; my working of 294 VG Years (293-yrs/3624 lunation) provide the solution – using a span of 107016 days; and accounting 3 ‘short Tithi’ once in 1208 lunation to align luni-solar ‘epact counting’. This, however, shifts the START of the New Year (Winter Solstice). A better option for using THIS smaller cycle is possible with 293-yrs/52 LWks, as explained in Leap Week plans.

TITHI – DAY (19-year Cycle): Distribution

1/59th of TWO lunation =
 $2*29.5305881 = 59.0611762 \text{ days}/59 = 1.001036884745762711864406779661 \text{ day}$
 $[59.0611762 - 59.061139896373068 = 0.000036303626932 \text{ d (or } 8.71287046368 \text{ d}_s)]$

1 Tithi = 138 Week/965 = 1.0010362694300518134715025906736 day

1 Tithi = 1.001036269430052 day	2 Tithi = 2.002072538860104 day	3 Tithi = 3.003108808290156 day
4 Tithi = 4.004145077720208 day	5 Tithi = 5.00518134715026 day	6 Tithi = 6.006217616580312 day
7 Tithi = 7.007253886010364 day	8 Tithi = 8.008290155440416 day	9 Tithi = 9.009326424870468 day
10 Tithi = 10.01036269430052 day	11 Tithi = 11.011398963730572 day	12 Tithi = 12.012435233160624 day
13 Tithi = 13.013471502590676 day	14 Tithi = 14.014507772020728 day	14½ Tithi = 14.515025906735754 day
15 Tithi = 15.01554404145078 day		
16 Tithi = 16.016580310880832 day	17 Tithi = 17.017616580310884 day	18 Tithi = 18.018652849740936 day
19 Tithi = 19.019689119170988 day	20 Tithi = 20.02072538860104 day	21 Tithi = 21.021761658031092 day
22 Tithi = 22.022797927461144 day	23 Tithi = 23.023834196891196 day	24 Tithi = 24.024870466321248 day
25 Tithi = 25.0259067357513 day	26 Tithi = 26.026943005181352 day	27 Tithi = 27.027979274611404 day
28 Tithi = 28.029015544041456 day	29 Tithi = 29.030051813471508 day	29½ Tithi = 29.530569948186534 day
30 Tithi = 30.03108808290156 day		(1 st Lunation)
1 Tithi = 31.032124352331612 day	32 Tithi = 32.033160621761664 day	33 Tithi = 33.034196891191716 day
34 Tithi = 34.035233160621768 day	35 Tithi = 35.03626943005182 day	36 Tithi = 36.037305699481872 day
37 Tithi = 37.038341968911924 day	38 Tithi = 38.039378238341976 day	39 Tithi = 39.040414507772028 day
40 Tithi = 40.04145077720208 day	41 Tithi = 41.042487046632132 day	42 Tithi = 42.043523316062184 day
43 Tithi = 43.044559585492236 day	44 Tithi = 44.045595854922288 day	45 Tithi = 45.04663212435234 day
46 Tithi = 46.047668393782392 day	47 Tithi = 47.048704663212444 day	48 Tithi = 48.049740932642496 day
49 Tithi = 49.050777202072548 day	50 Tithi = 50.0518134715026 day	51 Tithi = 51.052849740932652 day
52 Tithi = 52.053886010362704 day	53 Tithi = 53.054922279792756 day	54 Tithi = 54.055958549222808 day

55 Tithi =55.05699481865286 day
58 Tithi =58.060103626943016 day

56 Tithi =56.058031088082912 day
59 Tithi =59.061139896373068 day

57 Tithi =57.059067357512964 day
½ TITHI =**0.500518134715026 day**
(2nd Lunation)

ONE Lunation = 29.5305881 days
FOUR Lunation =118.1223524 days
SEVEN Lunation =206.7141167 days
TEN Lunation =295.305881 days

TWO Lunation =59.0611762 days
FIVE Lunation =147.6529405 days
EIGHT Lunation =236.2447048 days
ELEVEN Lunation =295.305881

THREE Lunation =88.5917643 days
Six Lunation =177.1835286 days
NINE Lunation =265.7752929 days
TWELVE Lunation =354.3670572 days

SOLAR Year – LUNAR Year = 365.242189669781 – 354.3670572 =10.875132469781 days. This over-flow amount to:

1-year =10.875132469781 days; 2-years =21.750264939562 days; 3-years =32.625397409343 days 4-year =43.500529879124 days;
5-years =54.375662348905 days; 6-years =65.250794818686 days 7-years =76.125927288467 days; 8-years =87.001059758248 days;
9-years =97.876192228029 days 10-years =108.75132469781 days; 11-years =119.6264571676 days; 12-years =130.501589637372 days
13-years =141.376722107153; 14-years =152.251854576934 days; 15-years = 163.12698704672 days; 16-years =174.0021195165 days;
17-years =184.877251986277 days; 18-years =195.752384456058 days **19-years =206.627516925839 days (6.9970674552 lunation) .**

January: 30T+1T (31d)

February: 29T (29 d)

March: 30T+1T (31d)

April: 30 T (30 d)

May: 30T+1T (31d)

June: 30 T (30 d)

July: 30 T (30 d)

August: 30T+1T (31d)

September: 30 T (30 d)

October: 30T+1T (31d)

November: 30 T (30 d)

December: 30T+1T (31d)

This is 365 Tithi (in 365.378238341968912 days, BUT 12.37287375059 lunation).

Also, 52-weeks = 364-days =363.6231884057971 Tithi and 53-weeks =371-days =370.6159420289855 Tithi

NOTE: During 19-YEAR cycle difference between [6932½ T - 19-years] =6939.68393782383412 d - 6939.601603725839 d =0.08233409799512 d (or 1^h.97601835188288). Thus, EACH (46+1) lunation =47*29.5305881 (1387.9376407 d) =**1386½ T (3^y 292^d 5^h.06572).**

THIS over-accounts 1^h.97602 during 19-years, and alignment between Solar calendar and Lunar calendar, cycles can be achieved when *LAST lunar Tithi during 19th –year is shortened to last for 10^h.036415 (instead of 12^h.012435). A block of 1388 days is 198 weeks +2 days.

19-years =991 weeks +2.601603725839 d [235 lunation in 991 weeks + 2.6882035 d]. This is also, [19*52+3 LWks (on div6) basis] – keeping **balance epacts on mind** for luniSolar alignment.

1st thro (46+1) 48th -Lunation = 47*29.5305881 (1387.9376407 d) =**1386½ T (3^y 292^d 5^h.06572)**

2005 Apr.09 thro 2009 January 27 [1388 d - (265+365+365+366+27 d)]: ‘Dark Moon’ on 2009-01-26 CE 07:56

1st thro (94+1) 95th -Lunation = 94*29.5305881 (2775.8752814 d) =**2773 T (7^y 219^d 4^h.27794)**

2009 January 27 thro 2012 November 14: [1388 days – (339+365+365+318)]: Dark Moon on 2012-11-13 CE 22:03

1st thro (141+1) 142nd -Lunation =141*29.5305881 (4163.8129221 d) =**4159½ T (11^y 146^d 3^h.57206)**

2012 November 14 thro 2016 September 01: [1388 d – (48+365+365+366+244)]: ‘Dark Moon’ 2016-09-01 CE 08:54

1st thro (188+1) 189th -Lunation = 188*29.5305881 (5551.7505628 d) = **5546 T (15^y 73^d 2^h.82523)**

2016 September 01 thro 2020 June 20: [1388 d – (121+365+365+365+172)]: ‘Dark Moon’ 2020-06-21 CE 06:50

1st thro (235+1) 236th -Lunation =235*29.5305881 (6939.6882035 d) =**6932½ T (19^y 00^d 2^h.07839)**

2020 June 20 thro 2024 April 08: [(1388 d – (194+365+365+365+99)]: ‘Dark Moon’ on 2024-04-08 CE 18:12

ECLIPSES (Solar): 2004-10-14 CE 02:53;

2005 April 09: 2005-04-08 CE 20:36;

2005-10-03 CE 10:32;

T2006-03-29 CE 10:12

(Total Lunar): 2004-10-28 CE 03:13;

2007-03-03 CE 23:21;

2007-08-28 CE 10:38;

2008-02-21 CE 03:25

T-UNIT (Or, X-Unit =1741 s_a) CALCULATIONS

Mean Lunation and ‘short tithi’: 834-yr cycle (304612 days/10315 Lunation), gives Mean Lunation =29.5309743093 days. This is achieved, using 2L/59th=1.00103688475 day (for each tithi/Phase) & close enough to ratio 966/965=1.00103626943 day (good for SOFTWARE development); OR

also using 19/6932.5th year (1 Tithi =1.0010243928923 day). Mean Lunation, over longer period, for (19*834 =15846-years) cycle can be improved to: 578762774/19598755= 29.53058 8754 day”.

All three values ‘for use of Tithi’ are important, and conducive to use in achieving the final aim, 2L/59th day:

1 TITHI = 19/6932.5 year =1.0010243928923 day;

1 TITHI = 2L/59th = 1.001036884745763 day; and

1 TITHI = 966/965 =1.001036269430052 day.

Using 19-year Metonic cycle, *ONLY three tithi* need be omitted during years 284th, 549th & 834th (or as felt necessary by astronomy experts). One tithi need be removed after 4464 years for alignment when using ‘ratio 966/965’.

Using *19/6932.5-yr tithi’ causes a differential of 0.000012491853463 d, between the this and ‘2L/59th tithi’ to cause ONE tithi over 80134.176714 229361 tithi (in 219 years 228 days 5.4254 hours). This is FOUR times in 874 years (say every 834-year cycle). Now, 834-years =304611.986184597354 days (in 10315.13443461010362 Lunations) =304300.26315789338846 tithi (of 19/6932.5 yr each)

=304296.465820997969101741 (tithi of 2L/59th lunation)

=304296.65286556562301926 (tithi of ratio 966/965)

My choice for ‘ratio 966/965’ is obvious over ‘6932-1/2 tithi in 19-yr cycle’ that I used during my earlier calculations. Tithi (ratio 966/965) to Tithi (2L/59th) difference over 834-yr cycle is 0.187044567653917519 d; this accumulates to ONE tithi over 4463.450926035 years. ALTERNATELY, this correction can be achieved, using Tithi/138 – intervals =0.007253890467 d and short accounting ‘26 tithi differentials of T/138’ once every 32 years (as TITHI SHORT). This may pose difficulty for ‘software development’ using ratio tithi.

This may not be a serious issue for EXPERT programmers to align 834-year cycles, and produce desired results. I, therefore, remain in favour of *ratio 966/965 tithi OVER tithi value 19/6932.5-yr* to achieve the target value of 2L/59th ‘tithi’ value.

Tithi UNIT and T/138, as X-unit:

ONE lunation =29.5305881 days; One Tithi =2L/59th = 1.00103688474576271186440677966102 d

ONE T-unit =T/138 = 0.00725389 d = 1740.93371260132645541635961680177 decimal second

(Or, X-Unit =1741 s_d)

1 Decimal minute (m_d) =0.0574404408830584718358521278484122 T-units

1 HOUR = 100 m_d =5.74404408830584718358521278484122 T-units

12-Hours =68.9285290596701662030225534180946 T-units

1 Day = 137.857058119340332406045106836189 T-units

7 days or 1 Week = 964.999406835382326842315747853325 T-units

364 days (52 weeks) = 50179.9691554398809958004188883729 T-units

371 days (53 weeks) = 51144.9685622752633226427346362262 T-units

ONE Year = 365.242189669781 days = 635862.441260449681839711127487516 T-units

128-years = 46751.000277731968 days = 1583.138138645195758902 lunation

(6444957.3203873236857728 ‘T/138 or X-Units’)

293-years = 107015.961573245833 (364*294) days = 14752905.6343 T-units

417-years =152305.993092298677 days =265154638.005607517327159540162294 T-units

834-years = 304611.986184597354 days (in 10315.13443461010362 Lunations)

= 530309276.011215034654319080324588 T-units

LONG CYCLE of 373632-years =(128x7x417) =(128x2919) =(896x417) YEARS

=136466169.810699614592 days =4621180.22670532642023475313043292 Lunation

=18812824702.9173838567756799939939 (say, 18812824703) T-Units

Mean Year =136466170 ÷373632 =365.2421901764303 days; and

Mean Luration =136466170/4621180 =29.530589589671902 days (29^d 12^h 73m_d.415015213)

or =29^d 12^h 44^m 2^s.940547668

My choice for 'ratio 966/965' is obvious over the one at (a) '6932-1/2 tithi in 19-yr cycle'; which I used during my earlier calculations. Tithi (ratio 966/965) to Tithi (2L/59th) difference over an 834-yr cycle is 0.187044567653917519 d; this accumulates to ONE tithi over 4463.450926035 years. OR, this correction can be achieved, using Tithi/138 (i.e. intervals =0.007253890467 d) and short accounting '26 tithi' once every 32 years (as TITHI SHORT). This may pose difficulty for 'software development' using **ratio tithi**.

In Brief:

1 T-Unit (T/138) =X-Unit =1741 s_d;

1 Decimal minute = 0.06 X; 1 Hour =5.744 X; 6 Hours = 34.4643 X; 12 Hours =68.9285 X;

24 Hours = 137.8571 X; One Week (7-days) = 964.9994 X; 52 Weeks (364-days) =50179.9692 X;

53Weeks (371-days)= 51144.9686 X; ONE Year = 365.242189669781 days =635862.44126 X

128-years =46751.000277731968 day =6444957.3203873236857728 X;

417-years =21018227 X; 834-years =42036454 X and 373632-years =18812824703 T-Units

It may not be difficult for *Astronomy experts* to see through the utility of 'T-units' that link Moon's motion with the motion of Earth and Sun for 'Ephemeris Astronomy and Calendar construction'.

Planck length: a unit of distance representing the scale at which gravity, and perhaps space itself, becomes quantized (discrete) rather than continuous. This is the shortest distance that is meaningful in our understanding of the laws of physics. The 'plank length' is defined to be the square root of Gh/c^3 , where G is the universal gravitational constant, h is Planck's constant, and c is the speed of light. This makes the plank length about 4.051×10^{-35} metre.

Planck time: a unit of time equal to the time required for a photon moving at the speed of light to travel the distance of 'One plank length'. This is the shortest time that is meaningful in our understanding of the laws of physics, representing the scale at which time itself may become quantized (discrete) rather than continuous. The plank time is about 1.351×10^{-43} second ($3.7527778 \times 10^{-43}$ s_d).