(Paper Format)

Duration: 3 hrs. **SECOND MATE (F.G.)** Maximum Marks: 200

Pass Marks: 140

CELESTIAL NAVIGATION

Note: 1. Use nautical almanac 1992

2. Use of non-programmable scientific calculator is permitted, however, each step should be clearly shown

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE (30 MARKS EACH)

1.

2.

3.

Note: 1 At least one question will have a numerical component.

SECTION II- PRACTICAL NAVIGATION

QUESTION NO. 4 IS COMPULSORY. ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR (35 MARKS EACH)

4. STAGGERED / SIMULTANEOUS PLOTS

5. LONG BY CHRON SUN/MOON

6. INTERCEPT METHOD

7. COMPASS ERROR BY ABC TABLES &/OR ERROR BY AMPLITUDE &/OR TIMES OF RISING/ SETTING/ MERIDIAN PASSAGE / MERIDIAN ALTITUDE OF SUN

8. POLARIS / COMPUTATION OF ALTITUDE / EX-MERIDIAN

Please note that the above format is only an indicative of the examination paper. The candidates are advised to refer to detailed teaching syllabus and the course outline.

GOVERNMENT OF INDIA

PM PAPER **Date: - 4th Nov-2025**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: **(30 MARKS EACH)**

Q.1 a) Define the following:
i) GHA ii) Right Ascension iii) Declination iv) Amplitude v) Rational Horizon

b) In latitude 65°N, an observer attains a lower-meridian altitude of a celestial body as 20° bearing North. Calculate the altitude and bearing of the same celestial body at upper meridian passage.

Q.2 a) The amplitude of a rising star was E 25° S and its altitude when on the prime vertical was 42°. Find the approximate true altitude of the pole star at its position.
b) Explain why stars culminate about 4 minutes earlier each day?

Q.3 An unknown star rose bearing 123°T. When bearing East, it had a true altitude of 24° 30'. Find the observer's lat and the star's declination.

SECTION II – PRACTICAL NAVIGATION

QUESTION No. 4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 Following simultaneous observations were calculated using the DR 25° 40' N 140° 10' E.

Star X	Obs long 140° 15' E	Az 115° T
Star Y	Intercept 2' Toward,	Az 240° T
Polaris	Obs lat 25° 38' N	Az 001° T

Q.5 On 1st Sept.'92 at GMT 31d 22h 11m 36s, a ship in DR position 32° 10'S, 113° 25'E, the sextant altitude of star Procyon was 30° 58.1° IE was Nil, HE was 8m. Find the direction of the PL and the observed Long.

Q.6 On 31st August '92 in DR 60° 06' N, 066° 18' W the sextant altitude of Mars was 41° 32.4' at GMT 31D 08H 15M 02S. IF H.E. 10m. I.E. 1.2' on the arc. Calculate the direction of the PL and the intercept.

Q.7 a) On 13th Dec LHA Aries 323° 00.4', Sextant altitude of pole star 41° 26'. IE 2' on the arc. HE 10m, find the direction of the PL and the posn. through which to draw it.
b) On 14th June 1992, in DR 20°N 36°W the Moon rose bearing 116° C. If Variation 3°W find the deviation on the ship's head.

Q.8 On 4th March 1992, in DR. 27° 28' N 168° 10' W, the sextant altitude of the Sun's L.L. near the meridian was 56° 18.8' when the GPS showed 04d 23h 31m 43s GMT. H.E. was 11m and I.E. 2.6' on the arc, find the direction of PL and a position through which it passes.

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GOVERNMENT OF INDIA

AM PAPER **Date: - 4th Nov-2025**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Define and explain:
i) Sidereal hour Angle ii) Sensible Horizon iii) Equinoctial
b) What do you understand by "Precession of Equinoxes"? How it caused and what are its effects?

Q.2 a) How are season's caused?
b) To an observer, star bore 065° (T) when rising, its true altitude when on prime vertical east of the meridian was 42°, find observer's latitude.

Q.3 a) State the conditions required for solar eclipse and lunar eclipse.
b) In latitude 65°N, an observer obtain a lower meridian altitude of a celestial body as 20° bearing north. Calculate the altitude and bearing of the same celestial body at upper meridian passage.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.
(35 MARKS EACH)

Q.4 In D.R. position 30°15'N 026°40'W, an observation of sun gave a bearing of 110° T intercept 6.5' towards. The ship then steamed 245° T for 20 miles when latitude by meridian altitude of sun was found to be 30° N. Find ship's position at the time of second observation.

Q.5 On 2nd May 1992, in DR 15° 36' S 080° 11' W, the sextant altitude of the Sun's L.L near the meridian was 58° 25.6' at GMT 02d 17h 37m 48s. If IE was 1.6' on the arc and HE was 15m, find the direction of the PL and the Latitude where it cuts the DR Long.

Q.6 On 2nd March 1992 in DR Long 32° 12'S 100° 24'E, the sextant altitude of Venus east of the meridian was 18° 05' when the GMT was 1st 22h 32m 58s. If the HE was 10m and IE 1.3' off the arc, find the direction of the PL and the position through which it passes using the Intercept Method?

Q.7 a) On 14th October 1992 in DR Long 105° 20' W, the sextant alt of Mars on the meridian was 62° 12.5' North of the observer. If HE was 12m and IE 3.0' on the arc: Find the observed latitude and position line.
b) On 14th June 1992, in D.R. Lat 20° N Long 036° W, the Moon rose bearing 116° C. If the variation was 3° W, find the deviation on the ship's head.

Q.8 On 4th March 1992, in DR 27° 28'N 168° 10'W, the sextant altitude of the Sun's L.L. near the meridian was 56° 18.8' when the GPS showed 04d 23h 13m 43s GMT. H.E. was 11m and I.E. 2.6' on the arc, find the direction of PL and a position through which it passes.

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GOVERNMENT OF INDIA

PM PAPER **Date: - 2nd Sept-2025**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: **(30 MARKS EACH)**

Q.1 a) What is International Date Line? Why is it necessary and how is the date on a ship crossing the International Date Line on an Easterly course affected?
b) Calculate the duration of astronomical twilight in Lat 35° N on the day of spring equinox?

Q.2 a) What are the conditions for a body to be circumpolar?
b) A stationary observer sees a star (declination 25°S) pass through his Zenith at the time of its meridian passage. Calculate its true bearing when rising and setting.

Q.3 An unknown star rose bearing 123° T. When bearing East, it had a true altitude of 24°30'. Find the observer's Lat and the star's declination.

SECTION II – PRACTICAL NAVIGATION

QUESTION No. 4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 In DR 39°30'S 110°30'E, an Ex-meridian sight gave an Observed latitude of 30°25'S and a PL of 094°-274° (T). After steaming 350° (T) for 75 M and 280° (T) for 75M an intercept of 4.0 M towards Azimuth 75° (T) was obtained working from the Observed Latitude. Find the position of the ship at the 2nd observation.

Q.5 On 6th March 1992 in DR 00°09.7'S, 070°45'W, the sextant altitude of the Moon's LL was 17°48' when GMT was 23h 10m 30s. If H.E. is 15m & I.E is 0.4' off arc, determine the direction of the PL and the Longitude where it cuts the DR Latitude.

Q.6 On 4th May 1992 at ship in DR 20°S 170°34.6'E Sextant altitude of star Sirius at GMT 04d 04h 18m 11s was 71°52'. If I.E was 2.0' off the arc and HE was 10 meters find the direction of position line and the intercept.

Q.7 a) On 10th Oct in DR 030°42'E, observed meridian altitude of sun's LL was 34°20', bearing N, (HE: 12m), find the ship's latitude and the direction of PL.
b) On 19th Jan 1992 in DR. 36°26'S 155°30'E, the azimuth of the sun was 035° (C) at 0920 ship's time. If the ship's time was 09 hours ahead of GMT and the variation was 2.0° E, find the deviation for the ship's head.

Q.8 a) Explain the corrections to be applied to the True Altitude of Polaris to obtain the observed latitude.
b) In month of October when GHA Aries was 130°20.0', in Longitude 20°32'W, the sextant altitude of the POLE STAR was 30°20', IE 2.0' off the arc and HE 15m. Find the latitude of the observer.

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GOVERNMENT OF INDIA

AM PAPER **Date: - 2nd Sept-2025**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: **(30 MARKS EACH)**

Q.1 a) Define:

i) Rational Horizon ii) Local Mean Time iii) First point of Libra

b) Explain sidereal day and compute the value of sidereal day.

Q.2 a) With help of a diagram explain why stars culminate 4 min earlier each day?

b) A ship in position 40° N 040° W, declination of Sun is 10° N and LHA Sun 30°. Calculate the Sun's G.P, also of a star whose declination is 20° S, and LHA 337°30'.

Q.3 For a stationary observer, amplitude of the raising Sun was E10 S. When it was on Prime Vertical, its true altitude was 10° when bearing due East. Find the Latitude of observer, the Declination and LHA of the Sun at this point (on prime vertical).

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 A vessel steaming on a course of 302° (T) at 20 kts made following stellar observations,

i) at 1751, Star A, Az 135° (T), intercept 4.3' towards

ii) at 1812, Star B, Az 056° (T), intercept 1.5' away,

1800 DR was used for both sides which is 20° 15' S, 030° 36' W; Determine vessel's position at 1800 hrs.

Q.5 On 22nd Sept 1992 in DR 64°20'N sextant altitude of Moon UL East of meridian at GMT 22D 06H 12M 12S was 24°55.8'. If IE was 2.0' off the arc and HE was 10 m, find direction of position line and longitude.

Q.6 On 31st August '92 in DR 60°06' N, 066°18' W the sextant altitude of Mars was 41°32.4' at GMT 31d 08h 15m 02s. If H.E. 10m, I.E. 2.1' on the arc. Calculate the direction of the PL and the intercept.

Q.7 a) On 13th Dec LHA Aries 323°00.4', Sextant altitude of Pole star 41°26', IE 2' on the arc, HE 10m, find the direction of the PL and the position. Through which to draw it.

b) On 14th June 1992, in DR 20°N 36°W the Moon rose bearing 116° C. If Variation 3° W find the deviation on the ship's head.

Q.8 On 31st August 92 at Ship in DR 179°30'W Sextant Altitude of Pole star was 22°30' at GMT 31d 17h 22m 26s. If IE: 1.6 on the arc and HE: 12.5 meters find the direction of position line and latitude to draw it.

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GOVERNMENT OF INDIA

PM PAPER **Date: - 2nd July-2025**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: **(30 MARKS EACH)**

Q.1 a) Define Daylight Saving Time (DST). What is the purpose of DST?
b) Find the duration of Astronomical twilight for an observer in Lat 20° 00'S on the day of summer solstice.

Q.2 a) Describe the conditions for a heavenly body to be circumpolar. Substantiate your answer with a suitable sketch.
b) If the sun's declination is 12° 42'S, in what latitudes will there be:
i) Phenomenon of Midnight Sun ii) Twilight All Night iii) Continuous Night

Q.3 a) Write short notes on the following, with suitable sketches:
i) Sidereal Period of Moon ii) Rational Horizon iii) Elongation of an Interior Planet

b) A stationary observer sees a star (declination 30°S) pass through his Zenith at the time of its meridian passage. Calculate its amplitude when west of the meridian.

SECTION II – PRACTICAL NAVIGATION

QUESTION No. 4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 At 0440 hrs by ship's clock on a vessel in DR position 52° 21'N, 27° 50'W, an observation of star 'Deneb' on the meridian gave latitude 52° 26'N. A second sight, obtained at 0500 hrs of star 'Capella'. When worked using the original DR, gave azimuth 300° T, intercept 3M towards respectively. The ship was steering 000° (T), at 6 kts. Find by plotting the ship's position at 0500 hrs.

Q.5 On 20th July 1992 at ship in position at Equator obs. Altitude of Moon UL West of meridian at GMT 20d 06h 12m 45s was 51° 06.2'. If IE was 1.5' on the arc and HE was 12 meters find the direction of position line and position to draw the same.

Q.6 On 30th Nov 1992 at ship in DR 30° N, 165° 24' E sextant altitude of Sun UL at GMT 29d 22h 28m 42s was 29° 03'. If IE was 0.5' on the arc and HE was 12 meters find the direction of position line and position to draw the same by intercept method.

Q.7 a) On 14th Oct 92 in DR longitude 048° 36'W observed altitude of Sun UL North of observer was 78° 09.4'. If HE was 15 meters find the direction of position line and latitude to draw it.
b) On 19th January 92 in DR Lat 30°N 060°30'E Compass bearing of Moon at GMT 23h 10m 00s was 269° (C). If Variation was 2.7° W, find the deviation.

Q.8 a) On 6th March 1992 in EP 52° 12' N 170° 40'E, the sextant altitude of the Sun UL near the meridian was 31° 59.8' when the GMT showed 06d 01h 27m 30s. If the IE was 2.3' on the arc and the HE was 40m, calculate the direction of the PL, and position which it passes.
b) Find the approximate ex-meridian limits for the observation of Sun, using the information provided in question 8 (a).

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GOVERNMENT OF INDIA

AM PAPER **Date: - 2nd July-2025**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Define the following:
i) Geographical position ii) Azimuth iii) Obliquity of ecliptic
b) If the latitude was 64°27'S and declination of a star was 39°47'S, find out if the body is circumpolar. If so calculate the upper and lower meridian altitudes.

Q.2 a) The amplitude of a rising star was E 25°N and its altitude when on the prime vertical was 42°. Find the approximate true altitude of the pole star at its position.
b) Explain why stars culminate about 4 minutes earlier each day?

Q.3 a) Parallax in Altitude = horizontal parallax X Cos app alt.
b) To an observer, star with decl 29° 44.6'S bore south when on the meridian. If its true altitude when at the maximum azimuth was 26° 03', find observer's latitude.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.
(35 MARKS EACH)

Q.4 At 0440 hrs by ship's clock on a vessel in DR position 52° 21'N, 027° 50'W, an observation of star 'Deneb' on the meridian gave latitude 52° 26'N. A second sight, obtained at 0500 hrs of star 'Capella', when worked using the original DR, gave azimuth 300° T, intercept 3M towards respectively. The ship was steering 000° (T), at 6 kts. Find by plotting the ship's position at 0500 hrs.

Q.5 On 22nd Sept 1992 in DR 24° 30'N sextant altitude of Moon UL East of meridian at GMT 22d 06h 17m 18s was 35° 45.4'. If IE was 2.2' off the arc and HE was 15 mtrs. Find direction of position line and position to draw it.

Q.6 On 1st May 1992 PM at ship in DR 30° 10'S 010° 30'E sext alt of star Sirius at GMT 01d 19h 10m 45s was 36° 49.2'. If IE was 2.1' on the arc and HE was 11 meters find the direction of position line and position to draw it by intercept method.

Q.7 a) On 2nd September 1992 moon set bearing 26° (C) in DR 35° 06'S 074° 12'E. If variation was 12°W, find the deviation.
b) On 1st September 1992 DR equator, 50° 27'E sextant meridian altitude of sun's UL was 82° 10.4'. IE 2.4' on the arc, HE=17m. Find the observed latitude and the direction of PL.

Q.8 On 2nd May 1992 a ship was in DR position 57° 55'N 094° 35'W. Compute the sextant angle to set for star vega at the commencement of morning twilight. HE is 24m and IE is 2.2' on the arc.

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GOVERNMENT OF INDIA

PM PAPER **Date: - 2nd May-2025**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: **(30 MARKS EACH)**

Q.1 Explain and show in case of Polaris:
a) Latitude True Altitude +/- small correction.
b) Explain in detail three main systems of defining a position on the celestial sphere.

Q.2 a) State the conditions required for solar eclipse and lunar eclipse.
b) In latitude 65°N an observer obtains a lower meridian altitude of a celestial body as 20° bearing north. Calculate the altitude and bearing of the same celestial body at upper meridian passage.

Q.3 a) Explain with a diagram why Venus is called morning or evening star?
b) To a stationary observer, an unknown star bore 000° T with True altitude 78°12'. After 12 hours, the same star bore 180° T with True altitude 18°54'. Calculate the observer's Latitude and the declination of the star.

SECTION II – PRACTICAL NAVIGATION

QUESTION No. 4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 Due to engine failure while drifting to a SWly current @ 2 Kts, at 0800 hrs Sun sight using DR Lat 00°05'N, gave Obs longitude 179°55'W Azimuth 100°T. Then again at 1300 hrs an Ex-meridian sight using longitude 179°55'W gave observed latitude 00°05'N, azimuth 355°T. Find ship's position at the time of second observation.

Q.5 On 5th March 1992, in DR 38°16'S 151°14'E the sextant altitude of the sun's Lower Limb East of the Meridian was 36°01.2' at GMT 4th March 22h 55m 40s. If IE was 0.8' on the arc and HE 30M find the direction of position line and the observed longitude.

Q.6 On 30th November 1992, PM at ship in DR Posn 35°20'S, 120°15'W observed altitude of Venus was 28°39.6' GMT 1st December 03h 36m 16s HE 15m. Find the direction of position line and the intercept.

Q.7 a) On 1st September 1992 DR equator, 50°27'E, sextant meridian altitude of sun's UL was 82°10.4'. IE:2.4' on the arc, HE = 17m. Find the observed latitude and the direction of PL.
b) On 19th Jan 1992 in DR 40°16'S 175°31'E, the azimuth of the sun was 262°(C) at 1618 ship's time. If the ship's time difference was 11h 30m from GMT and the variation was 2.3°E, find the deviation for the ship's head.

Q.8 On 6th March '92 in DR 51° 55'N, 171° 10'E, the sextant altitude of the Sun's UL near the meridian was 32° 01.2' when the GPS showed 06d 01h 02m 30s GMT. IE 2' on the arc, HE 30m. Find the direction of the PL and the position through which it passes.

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GOVERNMENT OF INDIA

AM PAPER **Date: - 2nd May-2025**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Explain Synodic period and Sidereal period of the moon.
b) In what Latitude will the ratio of day to night be 1:3 at the time of winter Solstice in Northern Hemisphere.

Q.2 a) Describe how seasons are caused with the help of a diagram.
b) To an observer in a certain latitude the sun bore 076°T at theoretical sun rise. Find the lat of the observer if the decl. of the sun was 12°14'N.

Q.3 a) If the earth's axis were perpendicular to the plan of its orbit, what would be the effect on seasons. Any? Give reasons.
b) To an observer the sun bore 090°T with an altitude of 32° 12' when it had a declination of 6°12'S and GHA of 44°06.2'. Find the observer's position.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.
(35 MARKS EACH)

Q.4 In DR 56°11'N 072°23'E an intercept of 6.3' away from Az 130°T was obtained by astronomical observation. Ship then steamed 243°T for 43 miles, when another astronomical observation gave intercept of 2.2' towards Az 210°T. The DR used for second observation was obtained directly by allowing the run from the first DR. Find the position of the ship at second observation.

Q.5 On 1st Sept. '92 at GMT 31d 22h 11m 36s, a ship in DR position 32°10'S, 113°25'E, the sextant altitude of star Procyon was 30°58'. I.E. was Nil, HE was 8m, find the direction of the PL and observed Long,

Q.6 On 31st August'92 in DR 60°06'N, 066°18'W the sextant altitude of Mars was 41°32.4' at GMT 31D 08H 15M 02S. If H.E. 10m, I.E. 2.1' on the arc. Calculate the direction of the PL and the intercept.

Q.7 a) On 13th Dec LHA Aries 323°00.4', Sextant altitude of pole star 41°26', IE 2' on the arc, HE 10m, find the direction of the PL and the posn. through which to draw it.
b) On 14th June 1992, in DR 20°N 36'W the Moon rose bearing 116°C. If variation 3°W, find the deviation on the ship's head.

Q.8 On 1st Sept. 1992, in DR 23°18'N 165°02'E, the sextant altitude of the sun's UL near the meridian was 75°01.7' at GMT 00h 49m 12s, if IE was 3.2' off the arc and HE was 20M, find the direction of position line and the latitude through which it passes.

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GOVERNMENT OF INDIA

PM PAPER **Date: - 4th Mar-2025**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: **(30 MARKS EACH)**

Q.1 a) Define the following:

i) GHA ii) Right Ascension iii) Declination
iv) Amplitude v) Rational Horizon

b) In latitude 65°N, an observer attains a lower meridian altitude of a celestial body as 20° bearing North. Calculate the altitude and bearing of the same celestial body at upper meridian passage.

Q.2 a) Explain with a diagram why Venus is called a morning or evening star?

b) To a stationary observer, an unknown star bore 000° T with True altitude 78°12'. After 12 hours, the same star bore 180° T with True altitude 18°54'. Calculate the observer's Latitude and the declination of the star.

Q.3 An unknown star rose bearing 123°T. When bearing East, it had a true altitude of 24°30'. Find the observer's latitude and the star's declination.

SECTION II – PRACTICAL NAVIGATION

QUESTION No. 4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 Following simultaneous observations were calculated using the DR: 25° 40'N 140° 10'E.

- Star X: Obs long 140° 15'E, Az 115° T
- Star Y: Intercept 2' Towards, Az 240° T
- Polaris: Obs lat 25° 38'N, Az 001° T.

Find vessel's position.

Q.5 a) On 21st Jan 1992, in DR 24° 36'S 110° 20'W, the sextant altitude of the Sun's LL on the meridian was 85°05.5'. If IE was 1.6' off the arc and HE was 10 m, find the Latitude.

b) On 5th March 1992, in DR 32° 12'N 178° 16'E, the rising sun bore 100°C. If variation was 3°E, find the deviation of the compass.

Q.6 On 31st August 1992, PM at ship in DR 10° 11'S 000° 00', the sextant altitude of the Sun's LL was 39° 15' when the GMT was 31d 15h 09m 50s. If IE was 2.5' on the arc and HE was 17m, find the direction of the PL and the Longitude through which to draw it.

Q.7 On 19 Jan 1992, at about 1900 hrs at ship in DR 00° 02'N 170° 50'E, the sextant altitude of the star Betelgeuse was 43° 11.1' at GMT 19d 07h 33m 44s. If HE was 18m and IE was 1.3' off the arc, required the direction of position line and the intercept.

Q.8 On 6th March 1992 in DR 51° 55'N, 171° 10'E, the sextant altitude of the Sun's UL near the meridian was 32°01.2' when the GPS showed 06d 01h 02m 30s GMT. If IE was 2' on the arc, HE 30m, find the direction of the PL and the position through which it passes.

**********X**********X**********

GOVERNMENT OF INDIA

AM PAPER **Date: - 4th Mar-2025**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Explain why Venus is visible as a morning or evening star.
b) Explain with suitable sketches how seasons are caused, giving appropriate dates and duration.

Q.2 a) Prove: Sin Amp. = Sin Decl × Sec Lat
b) Explain why the duration of twilight varies with the change of latitude.

Q.3 a) Write short notes on the following:
i) Sidereal Period of the Moon ii) Rational Horizon iii) Elongation of an Inferior Planet
b) A stationary observer sees a star (declination 30° S) pass through his Zenith at the time of its meridian passage. Calculate its amplitude when west of the meridian.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.
(35 MARKS EACH)

Q.4 An observation of a heavenly body gave an intercept 6.7' towards Az 053°T. The DR used for working this sight was 35° 45'S, 46° 44'E. After this sight, the vessel steamed 129°T for 45' when the second observation was made, which gave an intercept 3.7' towards Az 318°T. Find the position of the vessel at the time of the second observation if the second sight was worked from ITP run up.

Q.5 On 17th Jan '92 PM in DR 11° 05'N, 110° 55'E, the sextant altitude of the Sun's LL was 50° 27' at GMT 17d 06h 19m 57s. HE 14.1m, IE 2.5' on the arc. Find the direction of the PL and the long where it crosses the DR Lat.

Q.6 On 31st August '92, at ship in DR 33° 43'S, 03° 40'W, the sextant altitude of Spica was 49° 18.5' when the GMT showed 31d 17h 28m 42s. If IE was 3.2' on the arc and HE 14.9m, find the direction of the PL and the position through which it passes using the Intercept Method.

Q.7 a) On 2nd March 1992, in DR 22° 22'N, 175° 15'E, the rising sun bore 102°C. If Variation was 3°E, find the deviation of the compass.
b) On 1st May '92 AM, at a ship in DR 40° 26'N, 060° 40'E, Mars bore 096°C at 30d 23h 05m 20s GMT. Variation 5°W. Calculate the deviation of the compass.

Q.8 On 23rd Sept. '92, in DR 23° 40'N, 161° 56'E, compute the sextant altitude of the Sun's LL on the meridian if IE 2.3' on the arc, HE 25m.

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GOVERNMENT OF INDIA

PM PAPER **Date: - 2nd Jan-2025**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: **(30 MARKS EACH)**

Q.1 Explain the procedure for change of seasons with suitable diagrams. How would it affect the seasons if the earth's axis was perpendicular to its orbit?

Q.2 a) Describe the conditions for a heavenly body to be circumpolar. Substantiate your answer with a suitable sketch.
b) If the sun's declination is 12°42' S, in what latitudes will there be:
i) Phenomenon of Midnight Sun;
ii) Twilight All Night;
iii) Continuous Night.

Q.3 Find observer's position if True altitude of Sun 44°10' when bearing 090°T and Decl 11°3'N and GHA Sun 00°08.3'.

SECTION II – PRACTICAL NAVIGATION

QUESTION No. 4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 A vessel steaming on a course of 302°(T) at 20 kts made following stellar observations:
i) at 1751, Star A, Az = 135°(T) intercept 4.3' towards;
ii) at 1812, Star B, Az = 056°(T) intercept 1.5' away.
1800 hrs DR was used for both sides which is 20°15'S, 030°36'W: Determine vessel's position at 1800 hrs.

Q.5 On 6th March 1992 in DR 00°09.7'S, 070°45'W the sextant altitude of the Moon's LL was 17°48' when GMT was 23h 10m 30s. If H.E is 15m & I.E is 0.4' off the arc, determine the direction of the PL and the longitude where it cuts the DR latitude.

Q.6 On 16th January 1992 PM, at ship in DR 35°10'S 127°45'E at GMT 11h 19m 10s, the sextant altitude of the Star SIRIUS was 43°24.1'. If the I.E. is 0.4' on the arc and H.E. was 15m, find the direction of the PL and the point through which it passes using Intercept method.

Q.7 On 22nd Sept. 1992, in DR long 090°06'E, observed altitude of star Rigel on the meridian was 73°24.2' north of the observer. If dip was 15m find the latitude and direction of PL.

Q.8 On 10th Oct. 1992, what sextant altitude should be set for observation of Polaris, at the beginning of PM Nautical twilight. Given that DR 30°N, 150°W; HE was 10m and IE 2.0' off the arc. Also find the compass error if observed Az was 001°(C).

**********X**********X**********

GOVERNMENT OF INDIA

AM PAPER **Date: - 2nd Jan-2025**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: **(30 MARKS EACH)**

Q.1 a) Define the following:
i) Geographical position ii) Azimuth iii) Obliquity of ecliptic
b) If the latitude was 64°27'S and declination of a star was 39°47'S, find out if the body circumpolar. Calculate the upper and lower meridian altitudes.

Q.2 a) The amplitude of a rising star was E 25°N and its altitude when on the prime vertical was 42°. Find the approximate true altitude of the pole star at its position.
b) Explain why stars culminate about 4 minutes earlier each day.

Q.3 a) Parallax in Altitude = horizontal parallax × Cos app alt.
b) To an observer, star with decl 29°44.6'S bore south when on the meridian. If its true altitude when at the maximum azimuth was 26°03', find observer's latitude.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 At 0440 hrs by ship's clock on a vessel in DR position 52°21'N, 027°50'W, an observation of star 'Deneb' on the meridian gave latitude 52°26'N. A second sight, obtained at 0500 hrs of star 'Capella', when worked using the original DR, gave azimuth 300°T, intercept 3M towards respectively. The ship was steering 000°(T) at 6 kts. Find by plotting the ship's position at 0500 hrs.

Q.5 On 22nd Sept 1992 in DR 24°30'N sextant altitude of Moon UL East of meridian at GMT 22d 06h 17m 18s was 35°45.4'. If IE was 2.2' off the arc and HE was 15 metres. Find direction of position line and position to draw it.

Q.6 On 2nd March 1992 in DR 32°12'S 100°24'E, the sextant altitude of Venus east of the meridian was 18°05' when the GMT was 1d 22h 32m 58s. If the HE was 10m and IE 1.3' off the arc, find the direction of the PL and the position through which it passes using the Intercept Method.

Q.7 a) On 14th October 1992 in DR Long 105°20'W, the sextant alt of Mars on the meridian was 62°12.5' North of the observer. If HE was 12m and IE 3.0' on the arc. Find the observed latitude and position line.
b) On 14th June 1992, in D.R. lat 20°N long. 036°W, the Moon rose bearing 116° C.T. If the variation was 3° W, find the deviation on the ship's head.

Q.8 On 4th March 1992, in DR 27°28'N 168°10'W, the sextant altitude of the Sun's LL near the meridian was 56°18.8' when the GPS showed 04d 23h 13m 43s GMT. HE was 11m and IE 2.6' on the arc. Find the direction of PL, and a position through which it passes.

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GOVERNMENT OF INDIA

PM PAPER **Date: - 4th Nov-2024**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: **(30 MARKS EACH)**

Q.1 a) Define Twilight, Define Civil, Nautical and Astronomical twilight. Explain cause of the Twilight, reason why it lasts longer in higher latitudes.

b) To an observer, star bore 065(T) when rising, its true altitude when on prime vertical east of the meridian was 42 deg, find observer's latitude.

Q.2 a) State and explain Kepler's law.

b) In what latitude would the longest day be 5 hours more than the shortest day?

Q.3 a) Prove Parallax in Altitude – Horizontal parallax X Cos app alt.

b) To an observer, star with declination of 29°44.6'S bore south when on the meridian. If its true altitude when at the maximum azimuth was 26°03', find observer's latitude.

SECTION II – PRACTICAL NAVIGATION

QUESTION No. 4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 An observation of a heavenly body gave an intercept 6.7° towards Az 053°T. The DR used for working this sight was 35°45'S 46°44'E. After this sight the vessel steamed 129°T for 45' when the second observation was made which gave intercept 3.7' towards Az 318°T. Find the position of the vessel at the time of the second observation if the second sight was worked from ITP run up.

Q.5 At 1530 hrs ship's time on a vessel in DR 15°20'S 179°50'W an observation of Sun bearing 260°(T) gave an observed long 179°55'W. The vessel then sailed on a course of 265°(T) at 15 knots. At 1900 hrs an observation of Venus gave an intercept of 4' away and azimuth 165°(T). If the observation of Venus was calculated using DR obtained by allowing run on DR latitude and observed longitude at 1530 hrs, find the position of the ship at 1900 hrs.

Q.6 On 05th Mar 1992 AM, in DR 38°11'S 151°10'E, the sextant altitude of the Sun's LL at GMT 04d 22h 55m 40s was 35°59.1'. If the IE 1.3' off the arc and HE was 30m. Find the direction of PL and the Longitude where it crosses the DR Lat.

Q.7 On 20th July 1992 a ship in position at equator observed the altitude of Moon UL West of meridian 51°06.2' at GMT 20d 06h 12m 45s. If IE was 1.5' on the arc and HE was 12 meters. Find the direction of PL and position to draw position line by intercept method.

Q.8 On 23rd Sept. '92 in DR 23°40'N, 161°56'E compute the Sextant altitude of the Sun's LL on the meridian if IE 2.3' on the arc, HE 25m.

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GOVERNMENT OF INDIA

AM PAPER **Date: - 4th Nov-2024**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: **(30 MARKS EACH)**

Q.1 a) Explain why Venus is visible in mornings or evenings.

b) What should be the position of Sun's LL when taking amplitude & why?

Q.2 a) Define

i) Elongation ii) Opposition iii) Inferior conjunction

b) Find observer's position of Altitude if Sun is 44°10' when bearing 090° True and its declination at that instant is 11°13'N and GHA Sun is 0°06.3'.

Q.3 a) A vessel sails on a RHUMB LINE course of 144^{O}(T) from latitude 15°40'N and makes a D'long of 47°50'. Find the distance covered and the latitude reached?

b) Define i) Age of Moon ii) Lunar Month iii) Sidereal Period of Moon

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 At 0600 hrs in DR 00°10'S 135°12'W a stellar observation bearing 125°T gave longitude of 135°00'W. Ship steered course 290°T at 15 Kts through a current setting SW at 3 knots throughout. At 1130 hrs an ex-meridian sight of Sun gave observed latitude 00°03'S, Azimuth 185°T. Find the ship's position at the time of second observation.

Q.5 On 30th April 1992 PM, in DR 12°37'N 179°12'W, the sextant altitude of sun's UL, was 31°18'. GMT 03h 59m 24s on 1st May, I.E. 3.2' on the arc and HE was 18.7m. Find the direction of PL and the Longitude where it crosses the DR Lat.

Q.6 a) On 21st Jan 1992, at 0320 ship's time, in DR 44°12'N, 122°18'E, the star DENEB bore 031.5°(C). If the variation was 5°E, and the difference between ship's time and GMT is 7 hrs, find the deviation.
b) On 25th Feb 1992, in DR 10°05'N, 103°16'E, the sextant meridian altitude of the Moon's UL was 56°14.9'. If IE was 1.6' on the arc and HE was 12m, find the latitude and the PL.

Q.7 On 31st Aug 92 at ship in DR 179°30'W Sextant Altitude of Pole Star at GMT 31d 17h 22m 26s was 22°40'. If IE: 1.6' on the arc and HE: 12.5 meters, find the direction of position line and latitude to draw it.

Q.8 On 1st May 1992, PM at the ship in DR 27°54'S, 179°18'W an intercept was worked using Jupiter. The sextant altitude of Jupiter was 46°25.5' at GMT 06h 20m 42s if IE was 1.3' off the arc and HE 19m, find the direction of the PL and the intercept through which it passes.

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GOVERNMENT OF INDIA

PM PAPER **Date: - 3rd Sept-2024**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: **(30 MARKS EACH)**

Q.1 a) Define and explain:

i) Sidereal hour Angle ii) Sensible Horizon iii) Equinoctial

b) What do you understand by "Precession of Equinoxes"? How it caused and what are its effects?

Q.2 a) How are Season's caused?

b) To an observer, star bore 065(T) when rising, its true altitude when on prime vertical east of the meridian was 42^{O}, find observer's latitude.

Q.3 a) State the conditions required for solar eclipse and lunar eclipse.

b) In latitude 65^{O}N, an observer obtains a lower meridian altitude of a celestial body as 20^{O} bearing north. Calculate the altitude and bearing of the same celestial body at upper meridian passage.

SECTION II – PRACTICAL NAVIGATION

QUESTION No. 4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 In DR position 30^{O} 15'N 026^{O} 40'W, an observation of sun gave a bearing of 110^{O}T intercept 6.5' towards. The ship then steamed 245^{O}T for 20 miles when latitude by meridian altitude of sun was found to be 30^{O}N. Find the ship's position at the time of second observation.

Q.5 On 17th January 1992, AM in DR 36^{O} 10'S 152^{O} 10'E, the sextant altitude of Sun's LL. East of the meridian was 52^{O}27'. I.E. 0.2' of the arc, H.E. 11m, GMT was 16th 23h 24m 18s. Find the P/L and observed longitude where it cuts the D.R. Latitude.

Q.6 On 1st May 1992 PM at ship in DR 30^{O} 10'S 010^{O} 30'E sext alt of star Sirius at GMT 01d 19h 10m 45s was 36^{O}49.2'. If IE was 2.1' on the arc and HE was 11 meters find the direction of position line and position to draw it by intercept method.

Q.7 a) On 2nd September 1992 moon set bearing 260^{O}(C) in DR 35^{O} 06'S 074^{O} 12'E. If variation was 12^{O}W, find the deviation.

b) On 1st September 1992 DR equator, 50^{O} 27'E, sextant meridian altitude of sun's UL was 82^{O} 10.4'. IE: 2.4' on the arc. HE= 17m. Find the observed latitude and the direction of PL.

Q.8 On 2nd May 1992 a ship was in DR position 57^{O} 55'N 094^{O} 35'W. Compute the sextant angle to set for star vega at the commencement of morning twilight, HE is 24m and IE is 2.2' on the arc.

**********X**********X**********

GOVERNMENT OF INDIA

AM PAPER **Date: - 3rd Sept-2024**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: **(30 MARKS EACH)**

Q.1 a) Define the following:

i) Geographical position ii) Azimuth iii) Obliquity of Ecliptic

b) If the latitude was $64^{O}27'S$ and declination of a star was $39^{O}4'S$, find out if the body is circumpolar. If so calculate the upper and lower meridian altitudes.

Q.2 a) Define with diagram, on the Rational Horizon.

i) True Altitude ii) Azimuth iii) Zenith Distance

b) Two ships on the Equator are 60 miles apart. Both steer $180^{O}T$ at equal speeds. How many miles will they have to proceed till they are 40 miles apart?

Q.3 Explain with suitable sketches:

a) Why starts rise 4 minutes earlier each day?

b) Venus is a morning or evening star.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 Due to engine failure while drifting to a SWly current @ 2 Kts, at 0800 hrs Sun sight using DR Lat 00^{O} 05'N gave Obs longitude $179^{O}55'W$ Azimuth 100^{O}True. Then again at 1300 hrs an Ex-meridian sight using longitude 179^{O} 55'W gave observed latitude $00^{O}05'N$, Azimuth 355^{O}True. Find ship's position at the time of second observation.

Q.5 On 20th July 1992 at ship in position at Equator obs. altitude of Moon UL West of meridian at GMT 20d 06h 12m 45s was 51°06.2'. If IE was 1.5' on the arc and HE was 12 meters find the direction of position line and position to draw the same.

Q.6 On 1st May 1992 PM at ship in DR 30° 10'S 30'E, sext alt of star Sirius at GMT 01d 19h 10m 45s was 36° 49.2'. If IE was 2.1' on the arc and HE was 11 meters find the direction of position line and position to draw it by intercept method.

Q.7 a) On 2nd September 1992 moon set bearing 260°(C) in DR 35°06'S 074° 12'E. If variation was 12°W, find the deviation.

b) On 1st September 1992 DR equator, 50° 27'E sextant meridian altitude of sun's UL was 82° 10.4'. IE: 2.4' on the arc, HE = 17m. Find the observed latitude and the direction of PL.

Q.8 On 2nd May 1992 a ship was in DR position 57° 55'N 094° 35'W. Compute the sextant angle to set for star vega at the commencement of morning twilight. HE is 24m and IE is 2.2' on the arc.

**********X**********X**********

GOVERNMENT OF INDIA

AM PAPER **Date: - 2nd July-2024**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: **(30 MARKS EACH)**

Q.1 a) Define Daylight Saving Time (DST). What is the purpose of DST?

b) Find the duration of Astronomical twilight for an observer in Lat 20^{O}00'S on the day summer solstice.

Q.2 a) Describe the conditions for a heavenly body to be circumpolar. Substantiate your answer with a suitable sketch.

b) If the sun's declination is 12^{O} 42'S, in what latitudes will there be:

i) Phenomenon of Midnight Sun

ii) Twilight All Night

iii) Continuous Night

Q.3 a) Write short notes on the following, with suitable sketches:

i) Sidereal Period of Moon

ii) Rational Horizon

iii) Elongation of an Inferior Planet

b) A stationery observer sees a star (declination 30^{O}S) pass through his Zenith at the time of its meridian passage. Calculate its amplitude when west of the meridian.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 Due to engine failure while drifting to a SWly current @ 2 Kts, at 0800 hrs Sun sight using DR Lat 00^{O} 05'N gave Obs longitude 179^{O}55'W Azimuth 100^{O}True. Then again at 1300 hrs an Ex-meridian sight using longitude 179^{O} 55'W gave observed latitude 00^{O}05'N, Azimuth 355^{O}True. Find ship's position at the time of second observation.

Q.5 On 20th July 1992 at ship in position at Equator obs. Altitude of Moon UL west of meridian at GMT 20d 06h 12m 45s was 51^{O}06.2'. If IE was 1.5' on the arc and HE was 12 meters find the direction of position line and position to draw the same.

Q.6 On 30th Nov 1992 at ship in DR 30^{O}N, 165^{O} 24'E sextant altitude of Sun UL at GMT 29d 22h 28m 42s was 29^{O} 03'. If IE was 0.5' on the arc and HE was 12 meters find the direction of position line and position to draw the same by intercept method.

Q.7 a) On 14th Oct 92 in DR longitude 048^{O}36'W observed altitude of Sun UL. North of observer was 78^{O} 09.4'. If HE was 15 meters find the direction of position line and latitude to draw it.
b) On 19th January 92, in DR 30^{O}N 060^{O} 30'E Compass bearing of Moon at GMT 23H 10M 00S was 269^{O}(C). If variation was 2.7^{O}W, find the direction.

Q.8 On 6th March '92 in DR 51^{O} 55'N, 171^{O} 10'E, the sextant altitude of the Sun's UL near the meridian was 32^{O}01.2' when the GPS showed 06d 01h 02m 30s GMT, IE 2' on the arc, HE 30m. Find the direction of the PL and the position through which it passes.

**********X**********X**********

GOVERNMENT OF INDIA

PM PAPER **Date: - 2nd May-2024**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 A) Show with the neat sketch, on the plane of Rational Horizon, observer located at Equator, the following:
i) Declination of Star A 20^O North and Star B 15^O South.
ii) The rising bearing of Stars A and B. (20 Marks)
b) Assuming the earth's radius to be 3960 NM and the moon's Horizontal Parallax to be 58.0'. Calculate the distance of the moon from the Earth. (10 Marks)

Q.2 a) State the conditions required for solar eclipse and lunar eclipse. (15 Marks)
b) In latitude 65^{O}N, an observer obtains a lower meridian altitude of a celestial body as 20^O bearing North. Calculate the altitude and bearing of the same celestial body at upper meridian passage. (15 Marks)

Q.3 a) If the earth's axis were perpendicular to the plane of its orbit, what would be the effect on seasons, if any? Give reason. (10 Marks)
b) To an observer the sun bore 090^{O}T with an altitude of 32^O 12' when it had a declination of 6^O 12'S and GHA of 44^{O}06.2'. Find the observer's position. (20 Marks)

SECTION II – PRACTICAL NAVIGATION

QUESTION No. 4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

Q.4 At 0440 hrs by ship's clock on a vessel in DR position 52^{O}21'N, 027^{O}50'W, an observation of star 'Deneb' on the meridian gave latitude 52^{O}26'N. A second sight, obtained at 0500 hrs of star 'Capella'. When worked using the original DR, gave azimuth 300^{O}T, intercept 3M towards respectively. The ship was steering 000^O(T), at 6 kts. Find by plotting the ship's position at 0500 hrs.

Q.5 On 17th Jan 1992 AM at ship in DR 31^{O}41'N 100^O 10'E. The sextant altitude of Venus was 19^O 48.6' GMT 16d 23h 39m 38s. If IE was 2.1' on the arc and HE was 12m, find the direction of Position Line. Calculate by Longitude by Chronometer.

Q.6 A ship observes the sextant altitude of Venus to be 28^O 40.1' in DR position 35^O 18.9'S 120^O 15.4'W. The sight was taken at GMT 01st December 03h 36m 19s. Index error of the sextant 0.8' off the arc and height of eye 16m. Calculate the intercept and the direction of position line.

Q.7 a) On 21st July 1992 in DR 30^O S 175^O E the rising Sun bore 085^O by compass. If variation was 15^{O}W, Find the deviation for the compass heading.
b) On 30th April 1992 in DR 075^O 15'E observed altitude of Sun's LL on the meridian was 75 05.9' north of the observer. If height of eye was 10 meters and index error 2.0' off the arc find the latitude and state the direction of position line.

Q.8 On 23rd Sept.'92 in DR 23^O 40'N, 161^O 56'E compute the sextant altitude of the Sun's LL on the meridian if IE 2.3' on the arc, HE 25m.

**********X**********X**********

GOVERNMENT OF INDIA

AM PAPER **Date: - 2nd May-2024**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Define Daylight Saving Time (DST). What is the purpose of DST?
b) Find the duration of Astronomical twilight for an observer in Lat 20^{O}00'S on the day summer solstice.

Q.2 a) How are Season's caused?
b) To an observer, star bore 065^{O}(T) when rising, its true altitude when on prime vertical east of the meridian was 42^{O}, find observer's latitude.

Q.3 a) What do you understand by circumpolar body? What are the conditions necessary for a heavenly body to be circumpolar? Substantiate your answer with a suitable sketch?
b) If the Sun's declination is 19^{O}30'N, in what latitude will there be:
- i) Phenomenon of Midnight Sun.
- ii) Twilight all Night.
- iii) Continuous Night.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.
(35 MARKS EACH)

Q.4 In DR position 30^{O}15'N 026^{O} 40'W, an observation of sun gave a bearing of 110^{O}T intercept 6.5' towards. The ship then steamed 245^{O}T for 20 miles when latitude by meridian altitude of sun was found to be 30^{O}N. Find the ship's position at the time of second observation.

Q.5 On 22nd Sept 1992 in DR 24^{O} 30'N sextant altitude of Moon UL East of meridian at GMT 22d 06h 17m 18s was 35^{O} 45.4'. If IE was 2.2' off the arc and HE was 15 mtrs. Find direction of position line and position to draw it.

Q.6 On 30th Nov 1992 at ship in DR 30^{O}N, 165^{O} 24'E sextant altitude of Sun UL at GMT 29d 22h 28m 42s was 29^{O} 03'. If IE was 0.5' on the arc and HE was 12 meters find the direction of position line and position to draw the same by intercept method.

Q.7 a) On 14th Oct 92 in DR longitude 048^{O}36'W observed altitude of Sun UL. North of observer was 78^{O} 09.4'. If HE was 15 meters find the direction of position line and latitude to draw it.
b) On 19th January 92, in DR 30^{O}N 060^{O} 30'E Compass bearing of Moon at GMT 23H 10M 00S was 269^{O}(C). If variation was 2.7^{O}W, find the direction.

Q.8 On 31st August 92 at ship in DR 179^{O}30'W Sextant Altitude of Pole star was 22^{O}30' at GMT 31d 17h 22m 26s. If IE: 1.6' on the arc and HE:12.5 meters find the direction of position line and latitude to draw it.

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GOVERNMENT OF INDIA

PM PAPER **Date: - 4th Mar-2024**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: **(30 MARKS EACH)**

Q.1 Explain the procedure for charge of seasons with suitable diagrams. How would it affect the seasons if the earth's axis was perpendicular to its orbit.

Q.2 a) Define with diagram on the Rational Horizon:
i) True Altitude ii) Azimuth iii) Zenith Distance
b) Two ships on the Equator are 60 miles apart. Both steer 180^{O}T at equal speeds. How many miles will they have to proceed till they are 40 miles per apart?

Q.3 a) What do you understand by circumpolar Body? What are the conditions necessary for a heavenly body to be circumpolar? Substantiate your answer with a suitable sketch?
b) If the Sun's declination is 19^{O}30'N, in what latitude will there be:
i) Phenomenon of Midnight Sun
ii) Twilight all Night
iii) Continuous Night

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

Q.4 Following simultaneous observations were calculated using the DR 25^{O}40'N, 140^{O}10'E.

Star X	Obs long 140^{O}15'E	Az 115^{O}T
Star Y	Intercept 2' Towards	Az 240^{O}T
Polaris	Obs lat 25^{O}38'N	Az 001^{O}T

Find vessel's position.

Q.5 On 1st Sept.'92 at GMT 31d 22h 11m 36s, a ship in DR position 32^{O}10'S 113^{O}25'E, the sextant altitude of Star Procyon was 30^{O}58', I.E. was Nil, HE was 8m, find the direction of the PL and the observed Long.

Q.6 On 16 January 1992, PM at ship in DR 35^{O}10'S, 127^{O}45'E at GMT 11h 19m 10s, the sextant altitude of Star SIRIUS was 43^{O}24.1'. If the I.E. is 0.4' on the arc and H.E. was 15m, find the direction of the PL and the point through which it passes using Intercept method.

Q.7 On 22nd Sept. 1992, in DR long 090^{O}06'E, observed altitude of star Rigel on the meridian was 73^{O}24.2'N of the observer. If dip was 15m find the latitude and direction of PL.

Q.8 On 10th Oct 1992, what sextant altitude should be set for observation of Polaris, at the beginning of PM Nautical twilight. Given that DR 30^{O}N, 150^{O}W, HE was 10m and IE 2.0' off the arc. Also, find the compass error if observed Az was 001^{O}(C).

**********X**********X**********

GOVERNMENT OF INDIA

AM PAPER **Date: - 4th Mar-2024**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) What is International Date Line? Why is it necessary and how is the date on a ship crossing the International Date Line on an Easterly course affected?
b) Calculate the duration of astronomical twilight in Lat 35^{O}N on the daily of spring equinox?

Q.2 a) With help of a diagram explain why stars culminate 4 min earlier each day?
b) A ship in position 40^{O}N 040^{O}W, declination of sun is 10^{O}N and LHA Sun 30^{O}. Calculate the Sun's G.P. also of a star whose declination is 20^{O}S and LHA 337^{O} 30'.

Q.3 An unknown star rose bearing 123^{O}T, when bearing East, it had a true altitude of 24^{O}30'. Find the observer's Lat and the star's declination.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.
(35 MARKS EACH)

Q.4 A vessel steaming on a course of 302^{O}(T) at 20 kts made following stellar observations,
i) at 1751, Star A, Az = 135^{O}(T), intercept 4.3′ towards,
ii) at 1812, Star B, Az = 056^{O}(T), intercept 1.5' away, 1800 DR was used for both sides which is 20^{O}15'S, 030^{O}36'W, Determine vessel's position at 1800 hrs.

Q.5 On 6th March 1992 in DR 00^{O} 09.7'S, 070^{O} 45'W, the sextant altitude of the Moon's LL was 17^{O}48' when GMT was 23h 10m 30s. If H.E. is 15m & I.E. is 0.4' off arc, determine the direction of the PL and the Longitude where it cuts the DR Latitude.

Q.6 On 31st August'92 in DR 60^{O}06'N, 066^{O}18'W the sextant altitude of Mars was 41^{O}32.4' at GMT 31d 08h 15m 02s. If H.E. 10m, I.E. 2.1' on the arc. Calculate the direction of the PL and the Longitude where it cuts the DR latitude.

Q.7 a) On 13th Dec LHA Aries 323^{O} 00.4', Sextant altitude of Pole star 41^{O}26', IE 2^{O} on the arc, HE 10m, find the direction of the PL and the position. Through which to draw it.
b) On 14th June 1992, in DR 20^{O}N 36^{O}W the Moon rose bearing 116^{O}C. If variation 3^{O}W, find the deviation on the ship's head.

Q.8 On 31st August 92 at ship in DR 179^{O}30'W Sextant Altitude of Pole star was 22^{O}30' at GMT 31d 17h 22m 26s. If IE: 1.6' on the arc and HE:12.5 meters find the direction of position line and latitude to draw it.

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GOVERNMENT OF INDIA

PM PAPER **Date: - 2nd Jan-2024**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Explain the different type of twilight.
b) Under what circumstances the Sun remains above the horizon in the higher Latitude for a 24 Hours period.

Q.2 Define with the help of a diagram: -
i) Geographical position of a celestial body.
ii) Amplitude
iii) Rational Horizon
iv) Dip
v) Equation of time

Q.3 True Altitude of the star on the meridian was $81^{O}04'$ and bearing 'South' and the true altitude on the meridian below the pole $16^{O}00'$ bearing 'South'. Find the latitude of observer and declination of star.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

Q.4 In DR $56^{O}11'$N $072^{O}23'$E an intercept of 6.3' (away) azimuth 130^{O}T was obtained by an astronomical observation. The vessel then streamed on a course of 243^{O}T for a distance of 43nm when another astronomical observation gave an intercept of 2.2' towards azimuth 210^{O}T. The DR used for the second observation was obtained directly by allowing the run to the first DR. Find the position of the ship at the second observation.

Q.5 On the 31st of August'92, PM at ship in position $10^{O}11'$S $000^{O}00'$ the sextant altitude of the suns lower limb was $39^{O}15'$, when the GMT was 15h 09m 50s. If index error was 2.5' on the arc and height of eye was 17m. Find direction of the P/L and position through which it will pass.

Q.6 At GMT 22h 45m 45s, on the 16th of June 1992 in DR position 36^{O} 10'N, 044^{O} 00'W the sextant altitude of Denobola was $58^{O}36'$, index error was 0.5' on the arc and H.E. was 9.0m. Calculate the intercept and direction of P/L.

Q.7 On 31st Aug 1992 at GMT 17H 22M 26S, in DR 18^{O} 00'N 178^{O} 11'E the sextant altitude of the Pole star was $18^{O}47.4'$ HE was 12.5m and IE was 1.6' on the arc. Find the direction of the P/L and position through which to draw it. If the azimuth was 001^{O}C and variation was 1.3^{O}E find the deviation.

Q.8 a) On the 01st of December'92 GMT 09H 08M 04S, in DR 36^{O} 27'N 144^{O} 44'E Venus bore 235^{O}C. If variation was 2.5^{O}E, find the deviation for the ships head.
b) On the 1st of December 1992 AM at the ship in DR $45^{O}20'$S $075^{O}00'$E, the sextant meridian altitude of the star Procyon was $39^{O}28.2'$. If IE was 1.5' off the arc and H.E. was 25m. Find the Lat and direction of P/L.

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GOVERNMENT OF INDIA

AM PAPER **Date: - 2nd Jan-2024**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Define:
i) Rational Horizon ii) Local Mean Time iii) First point of Libra
b) Explain sidereal day and compute the value of the sidereal day.

Q.2 a) What are the conditions for a body to be circumpolar?
b) A stationary observer sees a star (declination 25^{O}S) pass through his Zenith at the time of its meridian passage. Calculate its true bearing when rising and settling.

Q.3 For a stationary observer, amplitude of the rising Sun was E10 S. When it was on Prime Vertical, its true altitude was 10^{O} when bearing due East. Find the Latitude of observer, the Declination and LHA of the Sun at this point (on prime vertical).

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.
(35 MARKS EACH)

Q.4 In DR $30^{O}30'$S $110^{O}30'$E, and Ex-meridian sight gave an observed latitude of $30^{O}25'$S and a PL of 094^{O} – 274^{O}(T). After steaming 350^{O}(T) for 75M and 280^{O}(T) for 75M an intercept of 4.0 M towards Azimuth 75^{O}(T) was obtained working form the observed latitude. Find the position of the ship at the 2nd observation.

Q.5 On 22nd Sept 1992 in DR $64^{O}20'$N sextant altitude of Moon UL East of meridian at GMT 22D 06H 12M 12S was $24^{O}55.8'$. If IE was 2.0' off the arc and HE was 10m, find direction of position line and longitude.

Q.6 On 4th May 1992 at ship in DR 20^{O}S $170^{O}34.6'$ E Sextant altitude of star Sirius at GMT 04d 04h 18m 11s was $71^{O}52'$. If IE was 2.0' off the arc and HE was 10 meters find the direction of position line and the intercept.

Q.7 a) On 10th Oct in DR $030^{O}42'$E observed meridian altitude of sun's LL was $34^{O}20'$, bearing N, (HE: 12m), find the ship's latitude and the direction of PL.
b) on 19th Jan 1992 in DR $36^{O}26'$S $155^{O}30'$E, the azimuth of the sun was 035^{O}(C) at 0920 ship's time. If the ship's time was 09 hours ahead of GMT and the variation was 2.0'E, find the deviation for the ship's head.

Q.8 a) Explain the correction to be applied to the True Altitude of Pollaris to obtain the observed latitude.
b) In month of October when GHA Aries was 130^{O} 20.0', in Longitude $20^{O}32'$W, the sextant altitude of the POLE STAR was $30^{O}20'$, IE 2.0' off the arc and HE 15m. Find the latitude of the observer.

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GOVERNMENT OF INDIA

PM PAPER **Date: - 9th Nov-2023**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Show with the neat sketch, on the plane of Rational Horizon, observer located at Equator, the following:
i) Declination of star A 20^O North and Star B 15^O South
ii) The rising bearing of Stars A and B (20 Marks)
b) Assuming the earth's radius to be 3960 nm and the moon's Horizontal Parallax to be 58.0'. Calculate the distance of the moon from the Earth. (10 Marks)

Q.2 a) Draw a figure and show that
Sin Parallax in Altitude = (Sin Horizontal Parallax) x (Cos Apparent Altitude) (20 Marks)
b) What conditions are necessary for a celestial body to
i) reach the Prime Vertical? ii) be circumpolar? (10 Marks)

Q.3 a) The moon's altitude at the North Pole was 19^O 10'. In what North Latitude would the meridian altitude of the moon be double this?
b) Why does the times of Meridian Passage of the moon differ each day?

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

Q.4 In DR 33^{O}18'S 000^{O}12.6'W, a stellar Observation gave an intercept of 4.2' towards Az 241^O(T). After steaming 090^O(T) for 122nm another astronomical observation gave an Obs Long of 002^O 18.5'E bearing 140^O(T). The EP used for working the second observation was obtained through the first ITP. Find the position of the ship at the second observation. (35 Marks)

Q.5 On 17th Jan 1992 AM at ship in DR 31^O 41'N 100^O 10'E, the sextant altitude of Venus was 19^O 48.6' GMT 16d 23h 39m 38s. If IE was 2.1' on the arc and HE was 12m, find the direction of Position Line and the longitude through which to draw it. (35 Marks)

Q.6 On 30th April 1992, PM at ship in DR 34^O 18'S 40^O 20'W, the observed altitude of star Sirius was 57^{O}50.7' at GMT 30d 20h 51m 23s. If HE was 21m, find the direction of the PL and the Intercept. (35 Marks)

Q.7 On 2nd May 1992 in DR 15^O 36'S 080^O 11'W, the sextant altitude of the Sun's LL near the meridian was 58^O 25.6' at GMT 02d 17h 37m 48s. If IE was 1.6' on the arc and HE was 15m, find the direction of the PL and the latitude where it cuts the DR long. (35 Marks)

Q.8 a) On the morning of 1st Dec 1992, in DR 47^O 16'N 143^O 26'E the sextant altitude of Pole star was 46^O 50.7' at GMT 30d 20h 56m 26s. If IE was 2.1' off the arc and HE was 17m, find the direction of the PL and a position through which it passes. (20 Marks)
b) On 23rd Sept 1992, at GMT 05h 19m 00s, in DR Lat 36^O 08'S 078^O 50'W, Saturn bore 286^O (C). If Variation was 3^{O}W, find the deviation. (15 Marks)

**********X**********X**********

GOVERNMENT OF INDIA

AM PAPER **Date: - 9th Nov-2023**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Explain:
i) Conjunction ii) Ecliptic iii) LHA
b) If the Sun Rose at 0605 hrs LMT and set at 1743 hr LMT, find the value of equation of time.

Q.2 For an observer in position 00'N 022'W, the true altitude of a star is 59^{O} 24' and T. Az is 210^{O}, calculate the Geographical Position.

Q.3 a) With a suitable sketch, explain how seasons are caused?
b) An unknown star rose bearing 123^{O}(T) when bearing East it had a true altitude of $24^{O}30'$. Find the Latitude of the observer and the Star's declination.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.
(35 MARKS EACH)

Q.4 In DR 32^{O} 26'S 105^{O} 35'E, an Ex-meridian sight gave an Obs. Lat. of 32^{O} 30'S and a PL of 095^{O} – 275^{O} (T). After steaming 090^{O} (T) for 62 M and 180^{O} (T) for 126M an intercept of 5.4 M away from Azimuth 078^{O}(T) was obtained working from the earlier Obs. lat. Find the position of the ship at the 2nd observation.

Q.5 On 10th Oct 1992 in DR 34^{O} 20'N sextant altitude off Moon UL. East of meridian at GMT 10D 20H 20M 20S was 32^{O} 12.8'. If IE was 2' off the arc and HE was 18m, find the direction of position line and longitude.

Q.6 On 5th March 1992, AM at ship in DR position 38^{O} 02'S 150^{O} 10'E, the sextant altitude of Sun's LL was 36^{O} 13.4' when GMT time was 04d 23h 02m 40s. If HE was 28m and I.E. was 2.2' off the arc, find the intercept and direction of the P/L.

Q.7 a) On 1st September 1992 DR equator, 50^{O}27'E sextant meridian altitude of sun's UL was 82^{O}10.4' IE: 2.4' on the arc, HE = 17m. Find the observed latitude and the direction of PL.
b) On 19th Jan 1992 in DR 40^{O} 16'S 175^{O} 31'E, the azimuth of the sun was 262^{O} (C) at 1618 ship's time. If the ship's time difference was 11h 30m from GMT and the variation was 2.3^{O}E, find the deviation for the ship's head.

Q.8 On 1st May 1992 in DR Long 006^{O}02'W sextant altitude of Polaris at GMT 05H 17M 19S was 50^{O}22'. If IE was 2.0' on the arc and HE was 14 meters find the direction of position line and position to draw it.

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GOVERNMENT OF INDIA

Date: - 4th Sept-2023

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Define the following:
i) True Altitude ii) Vertical Circle iii) Elongation iv) Civil Twilight (15 Marks)

b) To an Observer the true altitude of a star when on the meridian above the Pole was 70^{O} 00' bearing South and below the Pole was 21^{O} 23' bearing North. Calculate the star's declination. (15 Marks)

Q.2 a) Why is "v" correction applied to the planets and moon? (10 Marks)
b) What are the conditions for a body to be circumpolar? (10 Marks)
c) When GHA Y was 212^{O} 14' the Easterly Hour Angle of the True Sun was 35^{O} to an observer in Longitude 35^{O}W. Find the RA of the True Sun. (10 Marks)

Q.3 Explain with suitable sketches:
a) Why stars rise 4 minutes earlier each day?
b) Venue is a morning or evening star?

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

Q.4 At 0830 SMT in DR position 48^{O} 30' N 24^{O} 20' W an observation of the sun gave an intercept of 4' towards azimuth 100^{O}T. Ship's Course and Speed was 250^{O}T, 14 Knots. Later at 1130 SMT a second observation of the sun on a bearing of 175^{O}T gave an intercept of 3' away, having run up from the DR position for the calculation. Determine the ship's position at the time of the second observation. (35 Marks)

Q.5 a) On 5th May 1992, in DR 50^{O} 10'S 064^{O} 15' W the observed Meridian altitude of Saturn North of the observer was 56^{O} 00.3'. If HE was 10M, find the latitude and the direction of position line. (20 Marks)
b) On 5th March 1992, in DR 32^{O} 12' N 178^{O} 16' E the rising sun bore 100^{O}C. If variation was 3^{O}E, find Deviation of the compass. (15 Marks)

Q.6 On 5th March 1992, in DR 38^{O} 16' S 151^{O} 14' E the sextant altitude of the sun's Lower Limb East of the Meridian was 36^{O} 01.2' at GMT 4th March 22h 55m 40s. If IE was 0.8' on the arc and HE 30M find the direction of position line and the observed longitude. (35 Marks)

Q.7 On 30th November 1992, PM at ship in DR Posn 35^{O} 20' S 120^{O} 15'W. Observed altitude of Venus was 28^{O} 39.6' GMT 1st December 03h 36m 16s HE 15m. Find the direction of position line and the intercept. (35 Marks)

Q.8 On the morning of 1st December 1992, in Longitude 065^{O} 34'E, the sextant altitude of Pole star was 23^{O} 01' at 01h 01m 34s GMT. IE 1.2' Off the arc, HE 17m. Find the direction of position line and the position through which it passes. (35 Marks)

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GOVERNMENT OF INDIA

Date: - 4th July-2023

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Define and explain:
(i) Sidereal hour Angle (ii) Sensible Horizon (iii) Equinoctial
b) What do you understand by "Precession of Equinoxes"? How it caused and what are its effects?

Q.2 a) The amplitude of a rising star was E 25^{O}N and its altitude when on the prime vertical was 42^{O}. Find the bet approximate true altitude of the pole star at its position. (15 Marks)
b) Explain why stars culminate about 4 minutes earlier each day? (15 Marks)

Q.3 a) State the conditions required for solar eclipse and lunar eclipse. (15 Marks)
b) In latitude 65^{O}N, an observer obtains a lower meridian altitude of a celestial body as 20^{O} bearing north. Calculate the altitude and bearing of the same celestial body at upper meridian passage. (15 Marks)

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 Marks Each)

Q.4 At 0440 hrs by ship's clock on a vessel in DR position 52^{O} 21'N, 027^{O} 50'W, an observation of star 'Denab' on the meridian gave latitude 52^{O} 26'N. A second sight, obtained at 0500 hrs of star 'Capella', when worked using the original DR, gave azimuth 300^{O}T, intercept 3M towards respectively. The ship was steering 000^{O}(T), at 6 kts. Find by plotting the ship's position at 0500 hrs.

Q.5 On 17th January 1992, AM in DR 36^{O}10'S 152^{O} 10'E, the sextant altitude of Sun's LL East of the meridian was 52^{O} 27'. I.E. 0.2' of the arc, H.E. 11m, GMT was 16th 23h 24m 18s. Find the P/L and observed Longitude where it cuts the D.R. Latitude.

Q.6 On 2nd March 1992 in DR 32^{O} 12'S 100^{O} 24'E, the sextant altitude of Venus east of the meridian was 18^{O} 05' when the GMT was 1st 22h 32m 58s. If the HE was 10m and IE 1.3' off the arc, find the direction of the PL and the position through which it passes using the Intercept Method?

Q.7 a) On 14th October 1992 in DR Long 105^{O} 20'W, the sextant alt of Mars on the meridian was 62^{O} 12.5' North of the observer. If HE was 12m and IE 3.0' on the arc. Find the observed latitude and position line.
b) On 14th June 1992, in D.R. lat 20^{O} N long 036^{O}W, the Moon rose bearing 116^{O}C. If the variation was 3^{O}W, find the deviation on the ship's head.

Q.8 On 4th March '92 in DR 27^{O} 28'N 168^{O} 10'W, the sextant altitude of the Sun's LL, near the meridian was 56^{O} 18.8' when the GPS showed 04d 23h 13m 43s GMT. H.E. was 11m and I.E. 2.6' on the arc, find the direction of PL and a position through which it passes.

**********X**********X**********

GOVERNMENT OF INDIA

Paper 1 **Date: - 2nd May-2023**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Define the following: (i) GHA (ii) Right Ascension (iii) Declination
(iv) Amplitude (v) Rational Horizon
b) In Latitude 65^{O}N, an observer attains a lower meridian altitude of a celestial body as 20^{O}bearing North. Calculate the altitude and bearing of the same celestial body at upper meridian passage.

Q.2 a) Describe how seasons are caused with the help of a diagram.
b) To an observer in a certain latitude the sun bore 076^{O}T as theoretical sun rise. Find the lat of the observer if the decl. of the sun was 12^{O} 14'N.

Q.3 An unknown star rose bearing 123^{O}T. When bearing East, it had a true altitude of 24^{O} 30'. Find the observer's lat and the star's declination.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 Marks Each)

Q.4 Following simultaneous observations were calculated using the

DR	25^{O} 40'N	140^{O} 10'E	
Star	X	Obs. long 140^{O} 15'E	Az 115^{O}T
Star	Y	Intercept 2' Towards	Az 240^{O}T
Polaris		Obs. lat 25^{O} 38'N	Az 001^{O}T

Find vessel's position

Q.5 On 1st Sept. '92 at GMT 31d 22h 11m 36s, a ship in DR position 32^{O} 10'S, 113^{O} 25'E, the sextant altitude of star Procyon was 30^{O} 58'. I.E was Nil, HE was 8m, find the direction of the PL and the observed Long.

Q.6 On 31st August '92 in DR 60^{O} 06'N, 066^{O} 18'W the sextant altitude of Mars was 41^{O} 32.4' at GMT 31D 08H 15M 02S. If H.E. 10m, I.E. 2.1' on the arc. Calculate the direction of the PL and the intercept.

Q.7 a) On 13th Dec LHA Aries 323^{O} 00.4', Sextant altitude of pole star 41^{O} 26', IE 2' on the arc, HE 10m, find the direction of the PL and the posn, through which to draw it.
b) On 14th June 1992, in DR 20^{O}N 36^{O}W the Moon rose bearing 116^{O}C. If Variation 3^{O}W, find the deviation on the ship's head.

Q.8 On 6th March '92 in DR 51^{O} 55'N, 171^{O} 10'E, the sextant altitude of the Sun's UL near the meridian was 32^{O} 01.2' when the GPS showed 06d 01h 02m 30s GMT, IE 2' on the arc, HE 30m. Find the direction of the PL and the position through which it passes.

**********X**********X**********

GOVERNMENT OF INDIA

Paper 2 **Date: - 2nd May-2023**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Define the following: i) Geographical position ii) Azimuth iii) Obliquity of ecliptic
b) If the latitude was 64^O 27'S and declination of a star was 39^O 47'S, find out if the body is circumpolar. If so calculate the upper and lower meridian altitudes.

Q.2 a) How are Season's caused?
b) To an observer, star bore 065(T) when rising, its true altitude when on prime vertical east of the meridian was 42^O, find observer's latitude.

Q.3 a) Parallax in Altitude = horizontal parallax X Cos app alt.
b) To an observer, star with decl 29^O 44.6'S, bore south when on the meridian. If its true altitude when at the maximum azimuth was 26^O 03', find observer's latitude.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 In DR position 30^O 15'N 026^O 40'W, an observation of sun gave a bearing of 110^O T intercept 6.5' towards. The ship then steamed 245^OT for 20 miles when latitude by meridian altitude of sun was found to be 30^ON. Find the ship's position at the time of second observation.

Q.5 On 22nd Sept 1992 in DR 24^O 30'N, sextant altitude of Moon UL East of meridian at GMT 22d 06h 17m 18s was 35^O 45.4'. If IE was 2.2' off the arc and HE was 15 mtrs. Find direction of position line and position to draw it.

Q.6 On 1st May 1992 PM at ship in DR 30^O 10'S, 010^O 30'E sext alt of star Sirius at GMT 01d 19h 10m 45s was 36^O 49.2'. If IE was 2.1' on the arc and HE was 11 meters find the direction of position line and position to draw it by intercept method.

Q.7 a) On 2nd September 1992 moon set bearing 260^O(C) in DR 35^O 06'S 074^O 12'E. If variation was 12^OW, find the deviation.
b) On 1st September 1992 Dr equator, 50^O 27'E sextant meridian altitude of sun's UL was 82^O 10.4'. IE: 2.4' on the arc, HE = 17m. Find the observed latitude and the direction of PL.

Q.8 On 2nd May 1992 a ship was in DR position 57^O 55'N 094^O 35'W. Compute the sextant angle to set for star vega at the commencement of morning twilight. HE is 24m and IE is 2.2' on the arc.

**********X**********X**********

GOVERNMENT OF INDIA

Paper 2 **Date: - 2nd Mar-2023**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Define the following: i) True Altitude ii) Vertical Circle iii) Elongation iv) Civil Twilight v) SHA (15 Marks)
b) To an Observer the true altitude of a star when on the meridian above the Pole was $70^{O}00'$ bearing South and below the Pole was 21^{O} 23' bearing North. Calculate the star's declination. (15 Marks)

Q.2 a) Why is V correction applied to the planets and moon? (10 Marks)
b) What are the conditions for a body to be circumpolar? (10 Marks)
c) When GHA Y was 212^{O} 14' the Easterly Hour Angle of the True Sun was 35^{O} to an observer in Longitude 35^{O}W. Find the RA of the True Sun. (10 Marks)

Q.3 a) With the aid of a diagram explain when a body may or may not cross the Prime Vertical. (10 Marks)
b) An observer in the south Pole finds the true altitude of a star to be 15^{O} 25'. In what Latitude will the observer find the meridian altitude of the same star double this. (20 Marks)

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

Q.4 At 0830 in position 48^{O} 30'N 24^{O} 20' W an observation of the sun gave an intercept of 4' towards azimuth 100^{O}T. Ship's Course and Speed was 250^{O}T, 14 Knots. Later at 1130 a second observation of the sun on a bearing of 175^{O}T gave an intercept of 3' away, having run up to the DR Position for the calculation. Required the ship's position at the time of the second observation. (35 Marks)

Q.5 a) On 5th May 1992, in DR 50^{O} 10'S 064^{O} 15'W the observed Meridian altitude of Saturn North of the observer was 56^{O} 00.3'. If HE was 10 M, find the Latitude and the direction of position line.
b) On 5th March 1992, in DR 32^{O} 12'N 178^{O} 16'E the rising sun bore 100^{O}C. If variation was 3^{O}E, find Deviation of the compass. (15 Marks)

Q.6 On 5th March 1992, in DR 38^{O} 16' S 151^{O} 14' E the sextant altitude of the sun's Lower Limb East of the Meridian was 36^{O} 01.2' at GMT 4th March 22h 55m 40s. If IE was 0.8'on the arc and HE 30 M find the direction of position line and the observed longitude. (35 Marks)

Q.7 On 30 November 1992, PM at ship in DR Posn 35^{O} 20' S 120^{O} 15' W Observed altitude of Venus was 28^{O} 39.6' GMT 1st December 03h 36m 16s HE 15 m. Find the direction of position line and the intercept. (35 Marks)

Q.8 On the morning of 1st December 1992, in Longitude 065^{O} 34'E, the sextant altitude of Pole Star was 23^{O} 01' at 01h 01m 34s GMT. IE 1.2' off the arc, HE 17m. Find the direction of position line and the position through which it passes. (35 Marks)

**********X**********X**********

GOVERNMENT OF INDIA

Paper 1 **Date: - 2nd Mar-2023**

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Explain why Venus is visible as a morning or evening star.
b) Explain with suitable sketches how are seasons caused giving appropriate dates and duration.

Q.2 a) Explain why duration of twilight varies with change of latitude.
b) Prove: Sin Amp. = Sin Decl x Sec Lat

Q.3 Find observer's position if True altitude of Sun 44^{O} 10' when bearing 090^{O}T and Decl11^{O} 3'N and GHA Sun 00^{O} 08.3'.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 Marks Each)

Q.4 An observation of a heavenly body gave an intercept 6.7' towards Az 053^{O}T. The DR used for working this sight was 35^{O}-45'S, 46^{O}44'E. After this sight the vessel steamed 129^{O}T for 45' when the second observation was made which gave intercept 3.7' towards Az 318^{O}T. Find the position of the vessel at the time of the second observation if the second sight was worked from ITP run up.

Q.5 On 17th Jan '92 PM in DR 11^{O} 05'N, 110^{O} 55'E the sextant altitude of the Sun's LL was 50^{O} 27' at GMT 17d 06h 19m 57s. HE 14.1 m, IE 2.5' on the arc. Find the direction of the PL and the long where it crosses the DR Lat.

Q.6 On 31st August '92 at ship in DR 33^{O} 43'S, 03^{O} 40'W, the sextant altitude of Spica was 49^{O} 18.5' when the GMT showed 31d 17h 28m 42s. It IE was 3.2' on the arc and HE 14.9m, find the direction of the PL and a position through which it passes using Intercept Method.

Q.7 a) On 2nd March 1992, in DR 22^{O} 22'N, 175^{O} 15'E the rising sun bore 102^{O}C. If Variation was 3^{O}E. Find the deviation of compass.
b) On 1st May '92 AM at ship in DR 40^{O} 26'N, 060^{O} 40'E Mars bore 096^{O}C at 30d 23h 05m 20s GMT. Variation 5^{O}W. Calculate deviation of Compass.

Q.8 On 23rd Sept. '92 in DR 23^{O} 40'N, 161^{O} 56'E compute the sextant altitude of the Sun's LL on the meridian if IE 2.3' on the arc, HE 25m.

**********X**********X**********

GOVERNMENT OF INDIA

Date: - 4th Jan-2023

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 Explain the procedure for change of seasons with suitable diagrams. How would it affect the seasons if the earth's axis was perpendicular to its orbit.

Q.2 a) Describe the conditions for a heavenly body to be circumpolar. Substantiate your answer with a suitable sketch.
b) If the sun's declination is 12^O 42'S, in what latitudes will there be:
i) Phenomenon of Midnight Sun
ii) Twilight all Night
iii) Continuous Night

Q.3 a) Write short notes on the following, with suitable sketches:
i) Sidereal period of moon.
ii) Rational Horizon
iii) Elongation of an Inferior Planet

b) A Stationary observer sees a star (declination 30^O S) pass through his Zenith at the time of its meridian passage. Calculate its amplitude when west of the meridian.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 Marks Each)

Q.4 A vessel steaming on a course of 302^O(T) at 20kts made following stellar observations
i) at 1751, Star A, Az = 135^O(T), intercept 4.3' towards
ii) at 1812, Star B, Az = 056^O(T), intercept 1.5' away.
1800 DR was used for both sides which is 20^O 15'S, 030^O 36'W; Determine vessel's position at 1800 hrs.

Q.5 On 06th March 1992 in DR 00^O 09.7'S, 070^O 45'W, the sextant altitude of the Moon's LL was 17^O 48' when GMT was 23h 10m 30s. If H.E. is 15m & I.E. is 0.4' off the arc, determine the direction of the PL and the longitude where it cuts the DR latitude.

Q.6 On 16th January 1992, PM at ship in DR 35^O 10'S, 127^O 45'E at GMT 11h 19m 10s, the sextant altitude of Star SIRIUS was 43^O 24.1'. If the I.E. is 0.4' on the arc and H.E. was 15m, find the direction of the PL and the point through which it passes using Intercept method.

Q.7 On 22nd Sept. 1992, in DR long 090^O 06'E, observed altitude of star Rigel on the meridian was 73^O 24.2' north of the observer. If dip was 15m find the latitude and direction of PL.

Q.8 On 10th Oct. 1992, what sextant altitude should be set for observation of Polaris, at the beginning of PM Nautical twilight. Given that DR 30^ON, 150^OW, HE was 10m and IE 2.0' off the arc. Also find the compass error if observed Az was 001^O(C).

**********X**********X**********

GOVERNMENT OF INDIA

Date: - 3rd Nov-2022

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) What is International Date Line? Why is it necessary and how is the date on a ship crossing the International Date Line on an Easterly Course Affected?
b) Calculate the duration of astronomical twilight in lat 35^{O}N on the day of spring equinox?

Q.2 a) What conditions are necessary for a heavenly body to:
i) Be circumpolar ii) Cross Prime Vertical iii) Rise bearing True east
b) Explain the factors which govern period of daylight for any observer.

Q.3 A vessel in position 46^{O} 05.0'N 022^{O} 20'W observes the True altitude of a body to be 34^{O} 31' when it is on the prime vertical west of the meridian. Calculate the G.P. of the body.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 Marks Each)

Q.4 In DR 09^{O} 20'N 177^{O} 25'E a celestial observation gave intercept 5 miles away Azimuth 300^{O}T. Ship then steered 065^{O}T for 10 hrs at 15 kts with current ENE @ 2 kts throughout when second observation gave observed longitude 179^{O} 58'E, Azimuth 205^{O}. DR used for second observation was calculated from ITP of the first observation. Find ship's position at the time of second observation.

Q.5 On 05th Mar 1992 AM, in DR 30^{O} 11'S 147^{O} 10'E, the sextant altitude of the Sun's LL at GMT 04thd 22h 56m 04s was 35^{O} 59.1'. If the IE 0.3' off the arc HE was 30m. Find the direction of PL and the longitude where it crosses the DR Lat.

Q.6 On 01st May 1992, PM in DR 27^{O}54'S, 179^{O} 18'W, an intercept was worked using Jupiter. The sextant altitude of Jupiter was 46^{O} 25.5' at GMT 06h 20m 42s. If IE was 1.3'off the arc, HE was 19m. Find the direction of the PL and the position through which it passes.

Q.7 a) On 16th Jan 1992 in DR 011^{O} 20'W observed meridian altitude of Star Markab North of observer was 52^{O} 46.9'. If HE was 12.7 meters find direction of position line and latitude to draw it. Calculate GMT meridian passage of star to nearest second.
b) On 19th Jan 1992 in DR 30^{O} N 060^{O} 35' East 0310 hrs LMT Compass bearing of Moon at GMT 23h 10m 00s was 296^{O}C. If variation was 2.7^{O}W find the deviation of the compass heading.

Q.8 On 24th Aug 1992 at ship in DR 40^{O}S, 175^{O} 30'W Sextant altitude of Sun UL near the meridian at GMT 23h 27m 12s was 39^{O} 26'. If IE was 2.0' on the arc and HE was 17.5 meters, find the direction of position line and latitude to draw same.

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GOVERNMENT OF INDIA

Date: - 6th Oct-2022

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: **(30 MARKS EACH)**

Q.1 a) With the help of suitable diagram define the following:
i) First point of Aries ii) LHA iii) SHA

b) If the Sun Rose at 0605 hrs LMT and set at 1743 hrs LMT, find the value of equation of time.

Q.2 For an observer in position 00^{O}N 022^{O}W, the true altitude of a star is 59^{O} 24' and T. Az is 210^{O} calculate the Geographical position.

Q.3 Explain with suitable sketches:
a) Why stars rise 4 minutes earlier each day?
b) Venue is a morning or evening star.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 Marks Each)

Q.4 In DR 33^{O} 18'S 000^{O} 12.6'W, a stellar Observation gave an intercept of 4.2' away, bearing 241^{O}(T). After steaming 090^{O}(T) for 12.3 miles another astronomical observation gave an Observed Longitude of 002^{O} 20'E bearing 090^{O}(T). The position used for the second sight was obtained by allowing run from the first ITP. Find the position of the ship at second observation.

Q.5 On 25th Feb 1992, in DR 35^{O} 18'S 088^{O} 52.6'W, the sextant altitude of the moon's UL was 47^{O} 12.4' at GMT 25d 15h 11m 20s, HE 18m, IE 0.5' off the arc. Find the observed longitude and direction of PL.

Q.6 On 19th Jan 1992 in DR 00^{O}02'N, 170^{O} 50'E, the sextant altitude of the star BETELGUESE was 43^{O} 11.1' at 19d 07h 35m 02s, GMT. If HE was 18m, and IE 1.3' off the arc, find the intercept and the direction of the PL.

Q.7 a) On 21st Jan 1992 at 0320 ship's time, in DR 44^{O} 12'N 122^{O} 18'E, the star DENEB bore 031.5^{O}C. If the variation was 5^{O}E and the difference between ship's time and GMT is 7 hrs, find the deviation.

b) On 22nd Sep 1992, in DR 30^{O} 06'N 179^{O} 45'W the setting Sun bore 275^{O}(C). If the variation was 2^{O}W, find the deviation of the compass.

Q.8 Find the position line and position through which it passes in following case:
DR 28^{O} 25'N 027^{O} 25'W, the sextant altitude of the POLE STAR was 27^{O} 45, IE 1.0' off the arc and HE 16m, month March & GHA Aries 270^{O} 14.4'.

**********X**********X**********

GOVERNMENT OF INDIA

Date: - 7th Sept-2022

SECOND MATE OF A FOREIGN GOING SHIP

FUNCTION: NAVIGATION

PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:

1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) On the plane of Rational Horizon, for an Observer located on the Equator, show with a diagram.
i) Star A has Declination 20^O North, Star B has Declination 15^O South.
ii) What is the amplitude and raising bearing of Stars A and B as per the above diagram. (20 Marks)

b) Assuming the earth's radius to be 3960 miles and the moon's Horizontal Parallax to be 58.0'. Calculate the distance of the moon from the Earth. (10 Marks)

Q.2 a) Draw a figure and prove:
Sin Parallax in Altitude = Sin HP x Cos App Altitude. (20 Marks)
b) What conditions are necessary (with a neat sketch) (10 Marks)
i) for a body to cross the Prime Vertical?
ii) for a body to be circumpolar?

Q.3 a) The moon's altitude at the North Pole was 19^O 10'. In what Latitude the meridian altitude of the moon be double this? (20 Marks)
b) Why does the times of Meridian Passage of the moon differ each day? (10 Marks)

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

Q.4 In DR 33^O 18'S 000^O 12.6'W, a stellar Observation gave an intercept of 4.2' towards Az 241^O(T). After steaming 090^O(T) for 122 M another astronomical observation gave an Obs Long of 002^O 18.5'E bearing 140^O(T). The EP used for working the second observation was obtained through the first ITP. Find the Position of the ship at the second observation. (35 Marks)

Q.5 a) On 17th Jan 1992 AM at ship in DR 31^O 41' N 100^O 10' E. The sextant altitude of Venus was 19^O 48.6' GMT 16d 23h 39m 38s. If IE was 2.1' on the arc and HE was 12m, find the direction of Position Line and the position through which to draw it. Calculate by Longitude by Chronometer. (35 Marks)

Q.6 On 30th April 1992, PM at ship in DR 34^O 18' S 40^O 20' W, the observed altitude of star Sirius was 57^O 50.7' at GMT 30d 20h 51m 23s. If HE was 21m. Find the direction of the PL and the position through which it passes. Calculate by Intercept Method. (35 Marks)

Q.7 On 2nd May 1992, in DR 15^O 36'S 080^O 11' W, the sextant altitude of the Sun's LL near the meridian was 58^O 25.6' at GMT 02d 17h 37m 48s. If IE was 1.6' on the arc and HE was 15 m, find the direction of the PL and the Latitude where it cuts the DR Long. (35 Marks)

Q.8 a) On the morning of 1st Dec 1992, in DR 47^O 16' N 143^O 26' E the sextant altitude of Pole star was 46^O 50.7' at GMT 30d 20h 56m 26s. If IE was 2.1 off the arc and HE was 17m, find the direction of the PL and a position through which it passes. (20 Marks)
b) On 23rd Sept 1992, at GMT 23d 05h 19m 00s, in DR Lat 36^O 08' S 078^O 50' W, Saturn bore 286^O(C). If Variation was 3'W, find the Deviation. (15 Marks)

**********X**********X**********

GOVERNMENT OF INDIA

Date: - 4th Aug-2022

SECOND MATE OF A FOREIGN GOING SHIP

FUNCTION: NAVIGATION

PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:

1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Explain Synodic period and Sidereal period of the moon. (15 Marks)

b) In what Latitude will the ratio of day to night be 1:3 at the time of Winter Solstice in Northern Hemisphere. (15 Marks)

Q.2 a) Explain with a diagram why Venus is called morning or evening star? (20 Marks)

b) To a stationary observer, an unknown star bore 000^{O}T with True altitude 78^{O} 12'. After 12 hours, the same star bore 180^{O}T with True altitude 18^{O} 54'. Calculate the observer's Latitude and the declination of the star. (10 Marks)

Q.3 a) If the earth's axis were perpendicular the plane of its orbit, what would be the effect on seasons, if any? Give reasons. (10 Marks)

b) To an observer the sun bore 090^{O}T with an altitude of 32^{O} 12' when it had a declination of 6^{O} 12' S and GHA of 44^{O} 06.2'. Find the observer's position. (20 Marks)

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 In DR 56^{O} 11' N 72^{O} 23' E an intercept of 6.3' away from Az 130 T was obtained by astronomical observation. Ship then steamed 243^{O}T for 43 miles, when another astronomical observation gave intercept of 2.2' towards Az 210^{O}T. The DR used for second observation was obtained directly by allowing the run from the first DR. Find the position of the ship at second observation. (35 Marks)

Q.5 a) On 21st Jan 1992, in DR 24^{O} 36' S 110^{O} 20' W, the sextant altitude of the sun's LL on the meridian was 85^{O} 05.5'. If IE was 1.6' off the arc and HE was 10m find the latitude. (20 Marks)

b) On 5th March 1992, in DR 32^{O} 12' N 178^{O} 16' E, the rising sun bore 100^{O} C. If variation was 3^{O}E, find the deviation of the compass. (15 Marks)

Q.6 On 31st August 1992, PM at ship in DR 10^{O} 11' S 000^{O} 00', the sextant altitude of the Sun's LL was 39^{O} 15' when the GMT was 31d 15h 09m 50s. If IE was 2.5' on the arc and HE was 17m, find the direction of the PL and the position through which to draw it. Solve by Longitude by Chronometer. (35 Marks)

Q.7 On 19 Jan 1992, at about 1900 hrs at ship in DR 00^{O} 02' N 170^{O} 50' E, the sextant altitude of the star Betelgeuse was 43^{O} 11.1' at GMT 19d 07h 33m 44s. If HE was 18m and IE was 1.3' off the arc required the direction of position line and the position through which it passes. Solve by Intercept Method. (35 Marks)

Q.8 On 1st Sept 1992, in DR 23^{O} 18' N 165^{O} 02' E the sextant altitude of the sun's UL near the meridian was 75^{O} 01.7' at GMT 00h 49m 12s. If IE was 3.2' off the arc and HE was 20m, find the direction of position line and the position through which it passes. (35 Marks)

**********X**********X**********

GOVERNMENT OF INDIA

Date: - 6th July-2022

SECOND MATE OF A FOREIGN GOING SHIP

FUNCTION: NAVIGATION

PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:

1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Define the following:

i) Equation of time ii) Ecliptic iii) Rational Horizon iv) Sidereal Hour Angle (15 Marks)

b) Draw a figure reasonably to scale on the plane of rational horizon for an observer latitude 25^{O}S and mark the following on it:

A star having declination 20^{O}S and azimuth 090^{O}(T). (15 Marks)

Q.2 a) The amplitude of a rising star was E 25^{O}N and its altitude when on the prime vertical was 42^{O}. Find the best approximate true altitude of the pole star at its position. (15 Marks)

b) Explain why stars culminate about 4 minutes earlier each day? (15 Marks)

Q.3 a) State the conditions required for solar eclipse and lunar eclipse. (15 Marks)

b) In latitude 65^{O}N, an observer obtains a lower meridian altitude of a celestial body as 20^{O} bearing north. Calculate the altitude and bearing of the same celestial body at upper meridian passage. (15 Marks)

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 In Dr Position 20^{O} 30'N, 179^{O} 50'E an intercept of 5' away, AZ 000^{O}(T) was obtained by a stellar observation. The vessel the steered a course 180^{O}(T) for 20' and 090^{O}(T) for 40'. At the end of this steaming a star observation gave an AZ 045^{O}(T) x 2' away. Position used for calculation was initial DR position carried forward. Find the final position of the vessel.

Q.5 On 21st July 1992 in DR position 36^{O} 06'N 038^{O} 45'W, sextant altitude of Moon's UL was found to be 55^{O} 15.4' when GMT was 09h 20m 49s. IE: 3.5' on the arc HE 15m. Using "long by Chron" method. Find the direction of PL and the position through which it passes.

Q.6 On 29th November at GMT 11h 29m 20s in DR 25^{O} 36'S 107^{O} 20'W, the sextant altitude of star RIGEL was 35^{O} 07.8'. If HE was 12m IE 0.8' on the arc. Find the direction of the PL and the intercept.

Q.7 On 1st of May 1992 in DR 32^{O} 00'S, 81^{O} 00'E the sextant altitude of Sun's L.L. near the meridian was 42^{O} 30' at GMT 01d 06h 33m 40s. If IE was 1.6' on the arc and the HE was 17m. Find the direction of the P/L and the Latitude where it cuts the DR Longitude.

Q.8 a) On 23rd August 1992 in DR position 20^{O} 00'S 090^{O} 00'W, the sun rose bearing was 090^{O}(C). If variation was 3^{O}W. Find the deviation of the compass?

b) What altitude should be set on the sextant for the observation of polaries on 10th of October 1992 at the beginning of PM nautical twilight in DR position 30^{O} N 150^{O} W, If I.E. is 2.0' off the arc and H.E. 10m.

**********X**********X**********

GOVERNMENT OF INDIA

Date: - 3rd June-2022

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) What is international date line? Why is it necessary and how is the date on a ship crossing the International Date Line on an Easterly course affected?
b) Calculate the duration of astronomical twilight in lat 35 deg. N on the day of spiring (vernal) equinox?

Q.2 a) State and explain Kepler's law of Planetary motion.
b) Explain with suitable sketches how are seasons caused giving appropriate dates and duration.

Q.3 a) Prove Parallax in Altitude = Horizontal Parallax X Cos App alt.
b) To an observer, star with declination of 29 deg 44.6'S bore south when on the meridian. If its true altitude when at the maximum azimuth was 26 deg 03', find observer's latitude.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 An observation of a heavenly body an intercept 6.7' towards Az 053^{O}T. The DR used for working this sight was 35^{O} 45'S 46^{O} 44'E. After this sight the vessel steamed 129^{O}T for 45' when the second observation was made which gave intercept 3.7' towards Az 318^{O}T. Find the position of the vessel at the time of the second sight was worked from ITP run up.

Q.5 On 30th Nov 1992 PM, in DR 27^{O} 38'N 140^{O} 22'W, the sextant altitude of the Moon's UL at GMT 30d 23h 12m 18s was 30^{O} 51'. If the IE 1.2' on the arc and HE was 12m, find the direction of PL and the longitude where it crosses the DR Lat.

Q.6 On 1st May 1992, PM in DR 27^{O} 54'S 179^{O} 18'W, an intercept was worked using Jupiter. The sextant altitude of Jupiter was 46^{O} 25.5' at GMT 06h 20m 42s. If IE was 1.3' off the arc, HE was 19m. Find the direction of the PL and the position through which it passes.

Q.7 a) On 4th March 1992, in DR 45^{O} 14'N 120^{O} 30'W, compute the sextant meridian altitude of ANTARES, if IE was 3.2' off the arc and HE was 10m.
b) On 22nd SEP 1992, in DR 30^{O} 06'N 179^{O} 45'W the setting Sun bore 275^{O}(C). If the variation was 2^{O}W, find the deviation of the compass.

Q.8 On 04th Mar 1992, in DR 27^{O} 28'N 168^{O} 10'W, the sextant altitude of SUN's LL near the meridian was 56^{O} 18.8 at GMT 04d 23h 13m 43s. If IE 2.6' on the arc and HE 11m, find the direction of the PL and obs through which it passes.

**********X**********X**********

GOVERNMENT OF INDIA

Date: - 6th May-2022

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Define the following with neat sketches:
i) Azimuth ii) LHA iii) Rational Horizon iv) Right Ascension v) Amplitude
b) Sketch and show Rational Horizon diagram for a rising body whose Decl. is 10^{O}N and observer's Lat 20^{O}N.

Q.2 a) Explain why duration of twilight varies with change of latitude.
b) Prove: Sin Amp. = Sin Decl x Sec Lat

Q.3 a) What conditions are necessary for a heavenly body to i) be circumpolar ii) cross prime vertical.
b) If an observer is in Lat 45^{O}S and declination of a star is 50^{O}S, calculate upper and lower meridian altitude.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 In DR 53^{O} 47'S 178^{O} 37'W the SUN bore 076^{O}(T) intercept 11' away. The ship then steered 284^{O}(T) for 47 miles through a current setting 256^{O} (T) for 7 miles, when the SUN bore 284^{O} (T) intercept 5' towards. The position used for the second sight was obtained by allowing run from original DR. Find the position of the ship at the second observation.

Q.5 On 1st May '92, PM at ship in DR 19^{O} 54'S 179^{O} 58'W the sextant altitude of Jupiter was 52^{O} 38.5' at GMT 02d 06h 20m 42s. If IE was 0.2' off the arc and HE 17m. Find the direction of the PL and the position through which it passes. Using Long by Chronometer Method.

Q.6 On 1st May 1992, PM at the ship in DR 27^{O} 54'S, 179^{O} 18'W an intercept was worked using Jupiter. The sextant altitude of JUPITER was 46^{O} 25.5' at GMT 06h 20m 42s, if IE was 1.3' off the arc and HE 19m, find the direction of the PL and the intercept through which it pass.

Q.7 a) On 22nd Sept. '92 in DR 35^{O} 10'N, 030^{O} 30'W the sun rose bearing 095^{O}C. If variation was 1.8^{O}W, find Deviation.
b) A vessel in DR posn. 62^{O} 15'S 179^{O} 57.7'E observed the Azimuth of Spica 312.6^{O}G at GMT 30th April'92 13h 00m 05s. Find out the Gyro course if the vessel intends to steer 075^{O}T.

Q.8 On 31st Aug 92 at ship in DR 179^{O} 30' W Sextant Altitude of Pole Star at GMT 31D 17H 22M 26S was 22^{O} 40'. If IE: 1.6' on the arc and HE: 12.5 meters, find the direction of position line and latitude to draw it.

**********X**********X**********

GOVERNMENT OF INDIA

Date: - 11th April-2022

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) How are seasons caused? Explain with suitable diagram and giving appropriate date?
b) Compare the conditions necessary for Lunar and Solar eclipse.

Q.2 a) With help of a diagram explain why stars culminate 4 min earlier each day?
b) A ship in position 40^{O}N 040^{O}W, declination of sun is 10^{O}N and LHA sun 30^{O}. Calculate the sun's G.P., also of a star whose declination is 20^{O}S, and LHA 337^{O}30'.

Q.3 a) Explain the procedure for identifying a star without the use of a star finder?
b) A body bore 000^{O} and was at altitude of 10^{O} 12'. The altitude after about 12 hours of the same body was 66^{O} 14' on the bearing of 180^{O}. Find latitude of the observer and declination of the body.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 An observer steering 205^{O}(T) at 16 kts obtained following observation in DR 34^{O}27'N 076^{O}42'E. Find the observed position at 1803 hrs.

1820	-	Star 'X'	-	167^{O}	(T)	x	2.2'(T)
1824	-	Star 'Y'	-	081^{O}	(T)	x	4.5'(T)
1833	-	Star 'Z'	-	237^{O}	(T)	x	0.8'(A)

Q.5 In DR Lat 27^{O} 40'N, 140^{O} 23'W on 30th November 1992, PM, at ship, the sextant altitude of Moon's upper limb was found to be 30^{O} 51' at GMT 30d 23h 12m 13s. If H.E. was 12m, I.E. NIL, find the direction of position line and a position through which it passes. (use "long by chron" Method).

Q.6 20th July 1992 on ship in DR position 30^{O} 00' N, 120^{O} 00'W the sextant altitude of "JUPITER" was 23^{O}55' when the GMT time read on GPS showed 03 hr 30 min 30 sec. If the index error = 0.7' on the arc, HE = 21M. Find the intercept and direction of PL.

Q.7 a) On 1st May 1992 AM at ship in DR 40^{O} 26'N, 060^{O} 40'E, Mars bore 096^{O}(C) at 30d 23h 5m 20s GMT. Variation was 5^{O}W, calculate the deviation of the compass.
b) On 4th March 1992, in DR 45^{O} 14'N, 120^{O} 30'W, compute the sextant meridian altitude of ANTARES, if IE = 3.2' off the arc and HE 10m.

Q.8 On January 20th 1992 DR Long 052^{O} 30' W at LMT 1845 hrs an observation of the Pole star gave a Sextant Altitude of 40^{O} 15.5', IE 1.5' off the arc, HE 10 m. Find the direction of the P/L and the position through which it passes.

**********X**********X**********

GOVERNMENT OF INDIA

Date: - 4th March-2022

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:

1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) On a certain date, in longitude 030°W, LHA Sun was 250°, when GHA γ was 181°. Find SHA Sun. (20)
b) Why do Stars rise 4 minutes earlier each day? (10)

Q.2 a) How is the duration of daylight dependent upon:-
i) Observes Latitude ii) Sun's Declination. (15)
b) Define:
i) Observer's Zenith ii) Prime Vertical iii) Azimuth (15)

Q.3 a) Define i) Elongation ii) Superior Conjunction iii) Quadrant (15)
b) State the Laws of Planetary motion. (15)

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 Vessel steering a course of 334°(T) at 15 knots. At 0300 HRS, New Mangalore (12° 48'N 074° 54'E) bore 090°(T) 40 nm off. At 0600 hrs the following observations were made:

TIME	BODY	AZIMUTH	RESULT
0600	BETELGEUSE	080°(T)	Intercept 2nm (Towards)
0600	POLARIS	001°(T)	OBS LAT 13°40'

Find the observed position of the vessel at 0600 hrs.

Q.5 a) On 6th March 1992 in EP 52° 12'N 170° 40'E, the sextant altitude of the Sun UL near the meridian was 31° 59.8' when the GMT showed 06d 01h 27m 30s. If the IE was 2.3' on the arc and the HE was 40m, calculate the direction of the PL and a position which it passes. (32 marks)
b) Find the approximate ex-meridian limits for the observation of Sun, using the information provided in question 5 (a). (03 marks)

Q.6 On 29th Nov 1992, at ship in DR 25° 30'S 170° 20'W, the sextant altitude of star RIGEL was 51° 10.3' when the GMT showed 14h 29m 20s, if H.E. was 12m and I.E. 2.8' off the arc, find the direction of the PL and intercept.

Q.7 a) On 1st Sept 1992, sextant meridian altitude of Sun's UL was 70° 29.2'. North of the observer in DR longitude 116° 27'W, if I.E. was 3.2 off the arc and HE was 12m, find the observed latitude state the direction of the PL.
b) On 1st May 1992, in DR 30°06'N 179° 45'W, the setting Sun bore 285°(C). If variation was 3°W, find the deviation for the ship's head.

Q.8 On 02nd May 1992, on the ship in DR 15°40'S 079° 58'W, the sextant altitude of Sun's LL near the meridian was 58° 16.5' at GMT 17h 38m 05s. If IE was 1.0' on the arc, HE was 25m, calculate the position and direction of PL.

**********X***X**********

GOVERNMENT OF INDIA

Date: - 3rd February-2022

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:

1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Explain why Venus is visible in mornings or evenings. (15 Marks)

b) What should the position of Sun's LL when taking amplitude & why? (15 Marks)

Q.2 a) Define: i) Elongation ii) Opposition iii) Inferior Conjunction. (15 Marks)

b) Find observer's position if Altitude of Sun is 44^{O} 10' when bearing 090^{O} True and its declination at that instant is 11^{O} 13'N and GHA Sun is 0^{O} 06.3'. (15 Marks)

Q.3 a) What are different types of Solar Eclipses? Explain the conditions which are required for Annular Solar Eclipse to occur. (15 Marks)

b) If Latitude of Observer is 45^{O}S & Declination of a heavenly body is 50^{O}S. Find if the body is circumpolar. If yes, then calculate Upper & Lower Meridian Altitude. (15 Marks)

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 In DR position 33^{O} 18'S 018^{O} 12.6'W, a Stellar observation was taken which gave an Intercept of 4.2' Towards an Azimuth of 241^{O}(T). After steaming an easterly course for 122M, another astronomical observation gave an observed longitude of 015^{O} 41.5'W azimuth 140^{O}(T). The EP used for working the Second observation was obtained by running the first ITP. Find the position of the ship at the second observation.

Q.5 On 30th April 1992 PM, in DR 12^{O} 37'N 179^{O} 12'W, the sextant altitude of sun's UL was 31^{O}18'. GMT 03h 59m 24s on 1st May, I.E. 3.2' on the arc and HE was 18.7m. Find the direction of PL and the longitude where it crosses the DR lat.

Q.6 On 1st May 1992, PM at the ship in DR 27^{O} 54'S, 179^{O} 18'W an intercept was worked using Jupiter. The sextant altitude of JUPITER was 46^{O} 25.5' at GMT 06h 20m 42s on 2nd May. If IE was 1.3' off the arc and HE 19m, find the direction of the PL and the intercept.

Q.7 a) On 21st Jan 1992, at 0320 ship's time, in DR 44^{O} 12'N, 122^{O} 18'E, the star DENEB bore 031.5^{O}(C). If the variation was 5^{O}E, and the difference between ship's time and GMT is 7 hrs, find the deviation

b) On 25th Feb 1992, in DR 10^{O} 05'N, 103^{O} 16'E, the sextant meridian altitude of the Moon's UL was 56^{O} 14.9'. If IE was 1.6' on the arc and HE was 12m, find the latitude and the PL.

Q.8 On 1st Dec 1992 AM in DR 59^{O} 15'N, 133^{O} 37'E, find the sextant altitude of Pole Star at GMT 30th Nov 18h 40m 20s (error 05m 11s slow). IE was 1.1' off the arc and HE was 15m.

**********X***X**********

GOVERNMENT OF INDIA

Date: - 7th January-2022

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Define the following with neat sketches:
i) Azimuth ii) LHA iii) Rational Horizon iv) Right Ascension v) Amplitude

Q.2 a) Explain why duration of twilight varies with change of latitude.
b) Prove: Sin Amp. = Sin Decl x Sec Lat

Q.3 a) Prove Parallax in Altitude = horizontal parallax X Cos app alt.
b) To an observer, star with declination of 29^{O} 44.6'S bore south when on the meridian. If its true altitude when at the maximum azimuth was 26^{O} 03', find observer's latitude.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 An observation of a heavenly body gave an intercept 6.7' towards Az 053^{O}T. The DR used for working this sight was 35^{O} 45'S 46^{O} 44'E. After this sight the vessel steamed 129^{O}T for 45' when the second observation was made which gave intercept 3.7' towards Az 318^{O}T. Find the position of the vessel at the time of the second observation if the second sight was worked from ITP run up.

Q.5 On 05th Mar 1992 AM, in DR 38^{O} 11'S 151^{O} 10'E, the sextant altitude of the Sun's LL at GMT 04th d 22h 55m 40s was 35^{O}59.1'. If the IE 1.3' off the arc and HE was 30m. Find the direction of PL and the longitude where it crosses the DR Lat.

Q.6 On 31st August '92 at ship in DR 33^{O} 43'S 03^{O} 40'W, the sextant altitude of Spica was 49^{O} 18.5' when the GMT showed 31d 17h 28m 42s. It IE was 3.2' on the arc and HE 14.9m, find the direction of a PL and a position through which it passes using intercept Method.

Q.7 a) On 21st July 1992 in DR 30^{O} S 175^{O} E the rising Sun bore 085^{O} compass. If variation was 8^{O}W find the deviation for the compass heading.
b) On 13th Oct 92 in DR longitude 048^{O} 36'W observed altitude of Sun UL. North of observer was 78^{O} 09.4'. If HE was 15 meters find the direction of position line and latitude to draw it.

Q.8 On 23rd Sept. '92 in DR 23^{O} 40'N, 161^{O} 56'E compute the sextant altitude of the Sun's LL on the meridian if IE 2.3' on the arc, HE 25m.

**********X***X**********

GOVERNMENT OF INDIA

Date: - 9th December-2021

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) State Kepler's laws of planetary motion.
b) Why is longitude correction applied to obtain moon rise, moonset & moon meridian passage times whereas there is no such correction for Sun?

Q.2 a) Find the ratio of the period of darkness to the period of daylight in latitude 52^{O} 15'N when the Sun's declination was 21^{O} 25'S.
b) Calculate the LHA of a star whose RA is 67^{O} 30' for an observer in longitude 49^{O} 51'E, when GHA Aries is 192^{O} 35'?

Q.3 a) On 02nd March 1992, in DR 15^{O} 30'N, 070^{O} 35'W, calculate exact LMT of meridian passage of star Deneb?
b) An observer in Latitude 61^{O} 51'S sights a star whose declination is 34^{O} 43'S. Find out if this star will be circumpolar and if so calculate the upper & lower meridian altitudes.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 At 0440 hrs in DR position 52^{O} 21'N 027^{O} 50'W, a meridian observation of Deneb gave an obs. Lat 52^{O} 26'N. At 0500 hrs using DR Capella gave Azimuth 300^{O}T, Intercept 3' Towards. Ship's course 000^{O}(T), speed 6 Kts. Find ship's at 0440 hrs & 0500 hrs by plotting.

Q.5 On 02nd Sept 1992 at ship in DR 40^{O}19.0'S 000^{O}20'W, the sextant altitude of Sun's UL west of the meridian was 10^{O}02.0' at GMT 16h 43m 12s. If HE was 25m and IE 2.4' off the arc, find the direction of the PL and that longitude where it cuts the DR latitude.

Q.6 A ship observes the sextant altitude of Venus to be 28^{O}40.1' in DR position 35^{O} 18.9'S 120^{O} 15.4'W. The sight was taken at GMT 01st December 03h 36m 19s. Index error of the sextant 0.8' off the arc and height of eye 16m. Calculate the Intercept and the direction of position line.

Q.7 a) On 21st January 1992, a vessel in DR position 24^{O} 36'S, 110^{O} 20'W observes the sextant altitude of Sun LL on the Meridian to be 85^{O} 05.5'. If IE is 1.6' off the arc and HE 10m. Calculate the latitude required for plotting the PL. Also find the GMT of meridian passage to the exact second using equation of time.
b) In DR longitude 116^{O} 27'W, on the 14th of September 1992, the sextant meridian altitude of Sun's upper limb was found to be 70^{O} 27.8' north of the observer. Find the latitude and direction of the position line if the index error was 1.9' on the arc and height of eye 20m.

Q.8 On the morning of 1st December 1992, in DR 47^{O} 16'N, 143^{O} 26'E, the sextant altitude of the pole star was 46^{O} 50.7 at 20h 51m 15s GMT. If IE was 2.1' off the arc and HE was 17m, find the direction of PL and the position through which it passes.

**********X***X**********

GOVERNMENT OF INDIA

Date: - 3rd November-2021

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) State Kepler's laws of planetary motion. (15 marks)

b) Sketch and show Rational Horizon diagram for a rising body whose Decl. is 10'N and observer's Lat 20'N. (15 marks)

Q.2 a) Find the ratio of the period of darkness to the period of daylight in latitude 52^{O} 15'N when the Sun's declination was 21^{O} 25'S.

b) Calculate the LHA of a star whose RA is 67^{O} 30' for an observer in longitude 49^{O} 51'E, when GHA Aries is 192^{O} 35'?

Q.3 a) On 02nd March 1992, in DR 15^{O} 30'N, 070^{O} 35'W, calculate exact LMT of meridian passage of star Deneb?

b) An observer in Latitude 61^{O} 51'S sights a star whose declination is 34^{O} 43'S. Find out if this star will be circumpolar and if so calculate the upper & lower meridian altitudes.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 An observation of a heavenly body gave an intercept of 6.7' towards azimuth 053^{O}(T). The DR used for working the sight was 35^{O} 45' S, 46^{O} 44'E. After this sight the vessel steamed 129^{O}(T) for 45 miles when a second observation was taken which gave Intercept of 3.7' towards azimuth 318^{O}(T). Find the position of the vessel at the time of second observation if the second sight was worked from I.T.P. run up.

Q.5 A vessel in DR 27^{O} 39.5' N, 140^{O} 25.5' W, observes the sextant altitude of Moon's upper limb to be 30^{O} 49.2' at GMT 30th November 1992, 23h 12m 15s. The height of eye of the observer was 20 m and the Index error of the sextant Nil. Find the position from where the PL passes and the direction of the PL using longitude by chronometer method.

Q.6 A ship observes the sextant altitude of Venus to be 28^{O} 40.1' in DR position 35^{O} 18.9' S, 120^{O} 15.4' W. The sight was taken at GMT 01st December 03h 36m 19s. Index error of the sextant 0.8' off the arc and height of eye 16m. Calculate the Intercept and the direction of position line.

Q.7 a) A vessel in DR position 62^{O} 15'S, 179^{O} 57.7' E observed the Azimuth of Star Spica to be 312.6^{O} (G) at GMT 30th April 13h 00m 05s. Find out the Gyro course to set if the vessel intends to steer 075^{O}(T).

b) In DR Longitude 116^{O} 27' W, on the 14th of September 1992, the sextant meridian altitude of Sun's upper limb was found to be 70^{O} 27.8' north of the observer. Find the latitude and direction of the position line if the index error was 1.9' on the arc and height of eye 20m.

Q.8 On 1st December 1992 in longitude 065^{O} 33.7' E the sextant altitude of the Pole star was 23^{O} 18' at GMT 01d 01h 01m 48s. If index error was 0.3' off the arc & height of eye 23m, find the direction of the position line and the position through which it passes.

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GOVERNMENT OF INDIA

Date: - 5th October-2021

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: **(30 MARKS EACH)**

Q.1 a) What is international date line? Why is it necessary and how is the date on a ship crossing the International Date Line on an Easterly course affected?
b) Calculate the duration of astronomical twilight in lat 35deg N on the day of spring (vernal) equinox?

Q.2 Explain how season's are caused?

Q.3 a) Prove Parallax in Altitude = horizontal parallax X Cos app alt.
b) To an observer, star with declination of 29deg 44.6'S bore south when on the meridian. If its true altitude when at the maximum azimuth was 26 deg 03', find observer's latitude.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 In DR 53^{O} 47'S 178^{O} 37'W the SUN bore 076^{O}(T) intercept 11' away. The ship then steered 284^{O}(T) for 47 miles through a current setting 256^{O}(T) for 7 miles, when the SUN bore 284^{O}(T) intercept 5' towards. The position used for the second sight was obtained by allowing run from original DR. Find the position of the ship at the second observation.

Q.5 On 30th Nov 1992 PM, in DR 27^{O} 38'N 140^{O}22'W, the sextant altitude of the Moon's UL at GMT 30d 23h 12m 18s was 30^{O}51'. If the IE 1.2' on the arc and HE was 12m, find the direction of PL and the longitude where it crosses the DR Lat.

Q.6 On 01st May 1992, PM in DR 27^{O}54'S 179^{O}18'W, an intercept was worked using Jupiter. The sextant altitude of Jupiter was 46^{O}25.5' at GMT 06h20m42s. If IE was 1.3' off the arc, HE was 19m. Find the direction of the PL and the position through which it passes.

Q.7 a) On 4th March 1992, in DR 45^{O}14'N 120^{O}30'W, compute the sextant meridian altitude of ANTARES, if IE was 3.2' off the arc and HE was 10m.
b) On 22nd SEP 1992, in DR 30^{O}06'N 179^{O}45'W the setting Sun bore 275^{O}(C). If the variation was 2^{O}W, find the deviation of the compass.

Q.8 Find the position line and position through which it passes in following case:
DR 28^{O} 25'N 027^{O}25'W, the sextant altitude of the POLE STAR was 27^{O} 45', IE 1.0' off the arc and HE 16m, month March & GHA Aries 276^{O}14.4'.

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GOVERNMENT OF INDIA

Date: - 3rd September-2021

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use **NAUTICAL ALMANAC** for 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: **(30 MARKS EACH)**

Q.1 a) Define and illustrate by figures:
i) Celestial Sphere ii) Ecliptic iii) Vertical Circle iv) SHA (15)
b) Calculate LHA of a star whose RA is 70^{O}, for an observer in longitude 47^{O}E, when GHA ɣ is 210^{O}. (15)

Q.2 a) Define (i) Elongation (ii) Opposition (iii) Inferior conjunction (15)
b) Why is Venus referred to as a morning or an evening star? (15)

Q.3 a) A vessel sails on a RHUMB LINE course of 144^{O}(T) from latitude 15^{O}40'N and makes a d'long of 47^{O}50'. Find the distance covered and the latitude reached?
b) Define (i) Age of Moon (ii) Lunar Month (iii) Sidereal Period of Moon (15)

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR.

(35 MARKS EACH)

Q.4 At 0600 hrs in DR 00^{O} 10'S 135^{O} 12'W a stellar observation bearing 125^{O}T gave longitude of 135^{O}00'W. Ship steered course 290^{O}T at 15 Kts through a current setting SW at 3 knots throughout. At 1130 hrs an ex-meridian sight of Sun gave observed latitude 00^{O} 03'S, Azimuth 185^{O}T. Find the ship's position at the time of Second observation.

Q.5 On 20th July 1992 a ship in position at equator observed the altitude of Moon UL West of meridian 51^{O} 06.2' at GMT 20d 06h 12m 45s. If IE was 1.5' on the arc and HE was 12 meters find the direction of position line and position to draw the same.

Q.6 On 30th Nov 1992 in DR position 24^{O} 56' N, 165^{O} 20'E sextant altitude of Sun LL at GMT 29D 22H 28M 42S was 33^{O} 00.5'. If IE was 0.5' on the arc and HE was 12 meters find direction of PL and position to draw position line by intercept method.

Q.7 a) On 21st July 1992 in DR 30^{O} S 175^{O}E the rising Sun bore 085^{O} compass. If variation was 8^{O}W find the deviation for the compass heading.
b) On 13th Oct 92, in DR longitude 048^{O} 36'W observed altitude of Sun UL North of observer was 78^{O} 09.4'. If HE was 15 meters find the direction of position line and latitude to draw it.

Q.8 On 31st Aug'92 at ship in DR 179^{O} 30'W Sextant Altitude of Pole Star at GMT 31D 17H 22M 26S was 22^{O}40'. If IE: 1.6' on the arc and HE:12.5 Meters, find the direction of position line and latitude to draw it.

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GOVERNMENT OF INDIA

Date: - 4th August-2021

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use Nautical Almanac 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Define the following with neat sketches:

i) Azimuth ii) LHA iii) Rational Horizon iv) Right Ascension v) Amplitude

b) Sketch and show Rational Horizon diagram for a rising body whose Decl. is 10′N and observer's Lat. 20′N.

Q.2 a) State and explain Kepler's Law of Planetary motion.

b) Explain with suitable sketches how are seasons caused giving appropriate dates and duration.

Q.3 a) What conditions are necessary for a heavenly body to:

i) be circumpolar ii) cross prime vertical

b) If an observer is in Lat 45^{O}S and declination of a star is 50^{O}S, calculate upper and lower meridian altitude.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR.

(35 MARKS EACH)

Q.4 At 1530 hrs ship's time on a vessel in DR 15^{O} 20'S, 179^{O} 50'W an observation of Sun's bearing 260^{O}(T) gave Observed long 179^{O} 55'W. The vessel then sailed on a course of 265^{O}(T) at 15 knots. At 1900 hrs an observation of Venus gave an intercept of 4' away and Azimuth 165^{O}(T). If observation of Venus was calculated using DR obtained by allowing run to the DR latitude and observed Long at 1530 hrs, find the ship's position at 1900 hrs.

Q.5 On 1st May'92 PM at ship in DR 19^{O}54'S 179^{O}58'W, the sextant altitude of Jupiter was 52^{O}38.5' at GMT 02d 06h 20m 42s. If IE was 0.2' off the arc and HE 17m. Find the direction of the PL and the position through which it passes. Using Long by Chronometer Method.

Q.6 On 1st May'92 PM at the ship in DR 35^{O}10'S, 016^{O} 00'W the sextant altitude of the star Sirius at GMT 01d 19h 10m 45s was 57^{O}28.5'. If IE was 2.1' on the arc and HE 11m, find the direction of the PL and the position through which to draw it using Intercept method.

Q.7 a) On 22nd Sept. '92 in DR 35^{O}10'N, 030^{O} 30'W the sun rose bearing 095^{O}C. If variation was 1.8^{O}W, find Deviation.

b) A vessel in DR posn. 62^{O}15'S 179^{O}57.7'E observed the Azimuth of Spica 312.6^{O}G at GMT 30th April'92 13h 00m 05s.Find out the Gyro course if the vessel intends to steer 075^{O}T.

Q.8 On 1st Sept'92 at ship in Long 178^{O}E, the sextant altitude of the Pole star was 18^{O}57.4' at 17h 23m 25s GMT, if IE was 1.5' on the arc and HE 13.5m. Find the direction of the PL and the position through which it passes. If Azimuth was 005^{O}(C), and variation 2.3^{O}E, find the deviation.

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GOVERNMENT OF INDIA

Date: - 14th July-2021

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use Nautical Almanac 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Define Twilight, Define Civil, Nautical and Astronomical twilight. Explain cause of the Twilight, reason why it lasts longer in higher latitudes.

b) To an observer, star bore 065(T) when rising, its true altitude when on prime vertical cast of the meridian was 42 deg, find observer's latitude.

Q.2 a) State and explain Kepler's Law.

b) In what latitude would the longest day be 5 hours more than the shortest day?

Q.3 a) Prove that Sin Amp = Sin Decl. Sec Lat.

b) To an observer in a certain latitude, the sun declination 12 deg 14'N bore 076 (T) at theoretical sunrise, find observer's latitude.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR.

(35 MARKS EACH)

Q.4 At 1530 hrs ship's time on a vessel in DR 15^{O} 20'S 179^{O} 50'W an observation of Sun bearing 260^{O}(T) gave an observed long 179^{O} 55'W. The vessel then sailed on a course of 265^{O}(T) at 15 knots. At 1900 hrs an observation of Venus gave an intercept of 4' away and azimuth 165^{O}(T). If the observation of Venus was calculated using DR obtained by allowing run on DR latitude and observed longitude at 1530 hrs, find the position of the ship at 1900 hrs.

Q.5 On 05th Mar 1992 AM, in DR 38^{O}11'S 151^{O}10'E, the sextant altitude of the Sun's LL at GMT 04th d 22h 55m 40s was 35^{O}59.1'. If the IE 1.3' off the arc and HE was 30m. Find the direction of PL and the longitude where it crosses the DR Lat.

Q.6 On 1st May 1992, PM at the ship in DR 27^{O}54'S, 179^{O} 18'W an intercept was worked using Jupiter. The sextant altitude of JUPITER was 46^{O} 25.5' at GMT 06h 20m 42s, if IE was 1.3' off the arc and HE 19m, find the direction of PL and the intercept through which it pass.

Q.7 a) On 01st May 1992, AM at ship in DR 40^{O} 26'N, 060^{O} 40'E, MARS bore 096^{O}C at 30d 23h 55m 20s GMT. If the variation was 5^{O}W, find the deviation of the compass.

b) On 04th Mar 1992, in DR 45^{O} 14'N 120^{O} 30'W, compute the sextant meridian altitude of ANTARES if IE was 3.2' off the arc and HE was 10m.

Q.8 On 23rd Sept 1992, in DR 23^{O}40'N, 161^{O} 56'E, compute the sextant altitude of Sun's LL in the meridian if IE 2.3' on the arc, HE 25m.

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GOVERNMENT OF INDIA

Date: - 9th April-2021

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use Nautical Almanac 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: **(30 MARKS EACH)**

Q.1 a) Explain why Venus is visible as a morning or evening star.
b) Explain with suitable sketches how are seasons caused giving appropriate dates and duration.

Q.2 a) Explain why duration of twilight varies with change of latitude.
b) Prove: Sin Amp. = Sin Decl. x Sec Lat

Q.3 Find observer's position if True altitude of Sun $44^{O}10'$ when bearing 090^{O}T and Decl. 11^{O} 13'N and GHA Sun 00^{O} 08.3'.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR.

(35 MARKS EACH)

Q.4 An observation of a heavenly body gave an intercept 6.7' towards Az 053^{O}T. The DR used for working this sight was 35^{O} 45'S 46^{O} 44'E. After this sight the vessel steamed 129^{O}T for 45' when the second observation was made which gave intercept 3.7' towards Az 318^{O}T. Find the position of the vessel at the time of the second observation if the second sight was worked from ITP run up.

Q.5 On 17th Jan '92 PM in DR 11^{O} 05'N 110^{O} 55'E, the sextant altitude of the Sun's LL was 50^{O} 27' at GMT 17d 06h 19m 57s. HE 14.1m, IE 2.5' on the arc. Find the direction off the PL and the longitude where it crosses the DR Lat.

Q.6 On 31st August '92 at ship in DR 33^{O} 43'S 03^{O} 40'W, the sextant altitude of Spica was 49^{O} 18.5' when the GMT showed 31d 17h 28m 42s. It IE was 3.2' on the arc and HE 14.9m, find the direction of the PL and a position through which it passes using Intercept Method.

Q.7 a. On 2nd March 1992, in DR 22^{O} 22'N 175^{O} 15'E the rising sun bore 102^{O}C. If Variation was 3^{O}E. Find the deviation of compass.
b. On 1st May '92 AM at ship in DR 40^{O} 26'N, 060^{O} 40'E Mars bore 096^{O}C at 30d 23h 05m 20s GMT. Variation 5^{O}W. Calculate deviation of Compass.

Q.8 On 23rd Sept. '92 in DR 23^{O} 40'N, 161^{O} 56'E compute the sextant altitude of the Sun's LL on the meridian if IE 2.3' on the arc, HE 25m.

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GOVERNMENT OF INDIA

Date: - 4th March-2021

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Define Daylight Saving Time (DST). What is the purpose of DST?
b) Find the duration of Astronomical twilight for an observer in Lat $20^{O}00'S$ on the day of summer solstice.

Q.2 a) Define with diagram on the Rational Horizon:
i) True Altitude ii) Azimuth iii) Zenith Distance
b) Two ships on the Equator are 60 miles apart. Both steer $180^{O}T$ at equal speeds. How many miles will they have to proceed till they are 40 miles apart?

Q.3 a) What do you understand by circumpolar Body? What are the conditions necessary for a heavenly body to be circumpolar? Substantiate your answer with a suitable sketch?
b) If the Sun's declination is 19^{O} 30'N, in what latitude will there be:
i) Phenomenon of Midnight Sun.
ii) Twilight all Night.
iii) Continuous Night.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR.

(35 MARKS EACH)

Q.4 Due to engine failure while drifting to a SWly current @ 2 Kts, at 0800 hrs Sun sight using DR Lat 00^{O} 05'N gave Obs longitude 179^{O} 55'W Azimuth 100^{O}true. Then again at 1300 hrs an Ex-meridian sight using longitude 179^{O} 55'W gave observed latitude 00^{O} 05'N, azimuth 355^{O} true. Find Ship's position at the time of second observation.

Q.5 On 20th July 1992 at ship in position at Equator Sext. Altitude of Moon UL West of meridian at GMT 20d 06h 12m 45s was 51^{O} 06.2'. If IE was 1.5' on the arc and HE was 12 meters find the direction of position line and position to draw the same.

Q.6 On 30th Nov 1992 at ship in DR 30^{O} N, 165^{O} 24' E sextant altitude of Sun UL at GMT 29d 22h 28m 42s was 29^{O} 03'. If IE was 0.5' on the arc and HE was 12 meters find the direction of position line and position to draw the same by intercept method.

Q.7 a) On 14th Oct 92 in DR longitude 048^{O} 36'W observed altitude of Sun UL North of observer was 78^{O} 09.4'. If HE was 15 meters find the direction of position line and latitude to draw it.
b) On 19th January 92 in DR Lat 30^{O}N 060^{O}30'E. Compass bearing of Moon at GMT 23H 10M 00S was 269^{O}(C). If variation was 2.7^{O}W, find the deviation.

Q.8 On 31st August 92 at ship in DR 179^{O} 30'W, Sextant Altitude of Pole Star was 22^{O} 30' at GMT 31D 17H 22M 26S. If IE: 1.6' on the arc and HE: 12.5 meters find the direction of position line and latitude to draw it.

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GOVERNMENT OF INDIA

Date: - 13th January-2021

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Explain the 'v' and 'd' correction given in Nautical Almanac. Why is 'v' correction applied for only certain celestial bodies?
b) Define 'twilight'. Explain clearly the cause of the phenomena and the reason why it lasts longer in high latitudes.

Q.2 a) Define: i) Horizontal Parallax ii) Parallax in Altitude
b) Draw a sketch & show the relationship between the two.

Q.3 a) Write short notes on the followings, with suitable sketched:
i) Rational Horizon ii) Elongation
b) Find the duration of astronomical Twilight for an observer in Lat $20^{O}00'S$ on the day of summer solstices?

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR.
(35 MARKS EACH)

Q.4 In DR 30^{O} 15' N 26^{O} 40' W at 0945 hrs an observation of the Sun gave a bearing 110^{O}T intercept 6.5' towards. The vessel then steamed a course 245^{O}T for 2 hrs at 10kts when the latitude obtained by meridian altitude of Sun was 30^{O} 00.0'N. Find the vessel's position at the second observation.

Q.5 On 5th March 1992 AM, in DR $38^{O}11'S$ $151^{O}10'E$, the sextant altitude of the Sun's LL at GMT 04th d 22h 55m 40s was $35^{O}59.1'$. If the IE 1.3' off the arc and HE was 30m. Find the direction of PL and the longitude where it crosses the DR Lat.

Q.6 On 31st August '92 at ship in DR 33^{O} 43'S 03^{O} 40'W, the sextant altitude of Spica was 49^{O} 18.5' when the GMT showed 31d 17h 28m 42s. It IE was 3.2' on the arc and HE 14.9m, find the direction of the PL and a position through which it passes using intercept method.

Q.7 a) On 2nd May '92 in DR 15^{O} 40'S 079^{O} 58'W the sextant alt of Sun LL near the meridian was $58^{O}16.5'$ at GMT 17h 38m 05s. If IE was 1.0' on the arc and the HE was 25m. Find the direction of the PL and the lat where it cuts the DR Long.
b) On 20th January '92 in DR 54^{O} 20'S 46^{O} 27'W the sun set bearing 236^{O}C. If Variation was 3^{O}W, find Deviation.

Q.8 On 1st Dec '92 in long 65^{O} 33.7'E the sextant altitude of the Pole star was 23^{O} 18' at GMT 01d 01h 01m 48s. If IE was 0.3' off the arc and HE 23m, find the direction of the PL and the position through which to pass it.

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GOVERNMENT OF INDIA

Date: - 4th December-2020

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Explain with aid of suitable sketches what is lunar eclipse & why lunar eclipse may not take place on every full moon day?

b) Explain with diagrams the correction to be applied to the altitude of celestial body.

i) Refraction ii) Parallax iii) Dip

Q.2 a) Explain why Venus is visible in mornings or evenings.

b) Explain why stars culminate about 4 minutes earlier each day?

Q.3 a) Explain with suitable sketch, PZX triangle.

b) A Star when on the meridian above the pole, bore North with a true altitude of $70^{O}04'$, and when on the meridian, below the pole bore North with true altitude $22^{O}05'$. Find the observer's latitude and star's declination?

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR.

(35 MARKS EACH)

Q.4 In DR $33^{O}18'$S 000^{O} 12.6'W a stellar observation gave an intercept of 4.2' towards Az 241^{O}(T). After steaming 090^{O}(T). After steaming 090^{O}(T) for 122M, another astronomical observation gave an Obs long of 002^{O} 18.5'E bearing 140^{O}(T). The EP used for working the second observation was obtained through the first ITP. Find the position of the ship at the 2nd observation.

Q.5 On 21st July 92 at ship in DR 40^{O} 42'N sextant altitude of Moon UL, East of meridian at GMT 21D 15H 35M 45 S was 45^{O} 15'. If IE was 1.0' on the arc and HE was 13.3 meters, find the direction of Position Line and longitude to draw it.

Q.6 On 1st May 1992 PM at ship in DR 30^{O} 10'S 010^{O} 30' E Sext alt of star Sirius at GMT 01d 19h 10m 45s was 36^{O} 49.2'. If IE was 2.1' on the arc and HE was 11 meters. Find the direction of position line and position to draw it by intercept method.

Q.7 a) On 1st May 1992 in DR longitude $179^{O}58'$E the observed altitude of the sun's LL on the meridian was $64^{O}35.9'$ south of the observer. If the HE was 15m, find the latitude and the PL.

b) In DR 55^{O} 15'W on 30th April 1992 observed altitude of Sun's LL on the meridian was 70^{O} 05.9' North of the observer. If height of eye was 10 meters and index error 2.0' off the arc. Find the latitude and state the direction of position line.

Q.8 What altitude should be set on the sextant for the observer of Polaris on 30th Nov 1992 at the end of civil twilight DR 45^{O} 50' N 166^{O} 30' W. IE 2.5 off the arc and HE 12 meters.

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GOVERNMENT OF INDIA

Date: - 12th November-2020

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) With the help of suitable diagrams explain solar eclipse.
b) Two ships A and B, on the same meridian observe the sun simultaneously at Noon and both get the same MZD 40^O, the Declination of the Sun is 10^ON. The sun bears due North from A and due south from B. Find the latitudes of 'A' and 'B'.

Q.2 a) With the help of figure: i) Prove that the altitude of Pole is equal to the Latitude of the observer,
ii) Measure approximately the altitudes of a body having Declination 56^ON , at its Lower & Upper meridian passages for an observer at Latitude 50^ON.
b) In the southern hemisphere a vessel sailed on a course of 042^O(T) making a Departure of 200 nm and a D.M.P of 240. Find the Latitude left.

Q.3 a) On 23rd August 1992 in DR position 20^O 00'S 090^O 00'W, the sun rose bearing was 090^O (C). If variation was 3^OW. Find the deviation of the compass.
b) Explain various phases of Moon.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR.
(35 MARKS EACH)

Q.4 In DR 20^O 30'N 179^O 50' E an intercept of 5' away, AZ 000^O(T) was obtained by a stellar observation. The vessel then steered a course 180^O(T) for 20' and 090^O(T) for 40'. At the end of this steaming a star observation gave an AZ 045^O(T) X 2' away. Position used for calculation was initial DR position carried forward. Find the final position of the vessel.

Q.5 On 1st December, 1992 at ship in DR 26^O 08'N, 129^O 57'W. The sextant altitude of the Sun LL was 27^O 42.3' when GMT was 01d 17h 46m 25s. If HE was 12.0 meter and IE was 2.2' ON the arc. Calculate the direction of the PL and a position through which it passes using Long by Chron method.

Q.6 On 1st of May'92 in DR 32^O 00'S 81^O00'E the sextant altitude of Sun's L.L. near the meridian was 42^O30' at GMT 01d 06h 33m 40s. If IE was 1.6' on the arc and the HE was 17m. Find the direction of the P/L and the Latitude where it cuts the DR Longitude.

Q.7 a) While a ship steering 040^O(C), on 29th November 1992, in DR 28^O 24'N 110^O 24'W, the Sun rose bearing 110^O(C). If the variation was 6.5^OE, determine the Deviation of the Compass.
b) On 21st Jan 1992 on a ship in DR 24^O36'S, 110^O20'W, the sextant altitude of the Sun's LL on the meridian was 85^O05.5'. If IE was 1.6' off the arc & HE was 10m. Find the observer's latitude, state the direction of PL.

Q.8 On 31st August 1992 in DR position 60^O 06'N 66^O 18'W, the sextant altitude of Mars was 41^O 32.4', when GMT was 08h 15m 02s. If HE was 10m and IE was 2.1' on the arc, calculate the direction of the PL and a position through which it passes by intercept method.

**********X***X**********

GOVERNMENT OF INDIA

Date: - 7th October-2020

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Define the following with suitable diagrams:
i) Declination ii) SHA iii) Rational Horizon
b) If the equation of time was +07m 53s, and Sun's declination was 10^{O} 15' N and decreasing, calculate the SHAMS, assuming the obliquity of the ecliptic to be 23^{O} 26.7'.

Q.2 Explain with the help of figures, the following:
i) Precession of equinoxes.
ii) Geographical position of a celestial body.
iii) Synodic period of moon's revolution.

Q.3 a) During the same night, a star bore south with true altitude of 25^{O} 35' and again with a true altitude 70^{O} 45'. Calculate the star's declination and the latitude of the observer.
b) Explain the refraction correction to be applied for the altitude of a celestial body.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR.
(35 MARKS EACH)

Q.4 In DR 11^{O} 15.4'S 156^{O} 34' W, a stellar observation gave an intercept of 4.2' away azimuth 241^{O}(T). After steaming 114^{O}(T) for 85 miles, another astronomical observation gave an observed longitude of 155^{O} 04.3' W. The EP used for 2nd observation was obtained by running up the first ITP. Find the position of the ship at the 2nd observation.

Q.5 On 25th February 1992, AM in DR 34^{O} 55'S 086^{O} 56'E, the sextant altitude of Moon's UL was 46^{O} 32' at GMT 03h 10m 11s. IE 1.2' off the arc. HE: 12m. Find the direction of the PL and observed longitude through which to draw it.

Q.6 On 31st August 1992, AM at ship in DR 40^{O} 30'N 064^{O} 56'E, the sextant altitude of the star DIPHDA was 21^{O} 23.4' at GMT 31d 00h 20m 24s. If HE was 9m and IE 0.9' off the arc, find the direction of the PL and the position through which it passes by Marc ST. Hillare's method.

Q.7 On 5th May 1992, in DR 50^{O} 10'S, 064^{O} 15'W, the observed meridian altitude of Saturn was 56^{O} 00.3', if HE was 10m, find the latitude of the observer and the direction of the PL. Also find, to the nearest second, the GMT of the meridian passage of Saturn.

Q.8 On 6th March 1992 in DR 51^{O} 55'N, 171^{O} 10'E, the sextant altitude of the Sun's U.L., near the meridian was 32^{O} 01.2', when GPS showed 06d 01h 02m 30s GMT. I.E. = 2' on the arc, HE: 30 m. Find the direction of the PL and a position through which it passes.

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GOVERNMENT OF INDIA

Date: - 3rd March-2020

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE:

(30 MARKS EACH)

Q.1 a) What is 'V' & 'D' Correction?
b) Define: i) LHA ii) RA iii) SHA iv) Declination

Q.2 a) What are the conditions for a body to be on the prime vertical?
b) Vessel in position $46^{O}05'N$ $22^{O}20'W$ observes the true altitude of a body to be $34^{O}31'$ when it is on the prime vertical west of the meridian. Calculate the GP of the body.

Q.3 a) Why does twilight last for a longer duration in high latitudes?
b) Prove: Sin Amp. = Sin Decl. x Sec Lat.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR.

(35 MARKS EACH)

Q.4 A vessel using the D/R position $10^{O}S$ $50^{O}W$ obtained the following observations:
1840 Hrs: Star 'A' – Azimuth 145^{O} x 5' Towards
1910 Hrs: Star 'B' – Azimuth 190^{O} x 3' Away
If the course Steered by the vessel during this time was 210^{O}(T) and speed was 12 knots, calculate the vessel's position at 1900 hrs.

Q.5 On 30th April 1992, AM at ship in D/R position $00^{O}21'N$ $060^{O}12'W$ the sextant altitude of Sun's UL was 44^{O} 17.7' at 13h 00m 52s GMT. If IE was 1.2' on the arc and HE was 20m, find the direction of PL and the longitude where it crosses the DR latitude?

Q.6 On 19th Jan 1992, during the evening twilight at ship, in D/R position $00^{O}02'N$ 170^{O} 50'E, the sextant altitude of a star Betelgeuse was found to be $43^{O}11.1'$ at 07h 33m 44s GMT. If HE was 18m, IE 1.3' off the arc, find the intercept and the direction of the PL.

Q.7 a) On 23rd September 1992, PM at ship in DR 26^{O} 37'N $150^{O}42'E$, ship steering $095^{O}G$, (093^{O} C) Venus bore $253^{O}G$ when GMT time in GPS was 08h 12m 12s. Find the Gyro Error and the deviation of the ship's head if variation was $3^{O}E$. **(15 Marks)**
b) On 29th November 1992, a ship in DR $14^{O}00'N$, 081^{O} 20'E, bound for Kolkata from Chennai and keeping IST, found the observed meridian altitude of the Sun to be 54^{O} 19'. HE: 15m. Find the ship's latitude.
(20 Marks)

Q.8 a) On January 20th DR long 52^{O} 30'W at LMT 1845 hrs an observation of the Pole Star gave a sextant altitude of 40^{O} 15.5', IE 1.5' off the arc, HE 10m. Find the direction of the P/L and the position which it passes. **(20 Marks)**
b) Find the approximate ex-meridian limits for the observation of the Sun, when the latitude of the observer is $20^{O}N$ and declination of the Sun is $5^{O}S$? **(15 Marks)**

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GOVERNMENT OF INDIA

Date: - 7th Jan-2020

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: **(30 MARKS EACH)**

Q.1 a) Explain why Venus is visible as a morning or evening star.
b) Explain the difference between theoretical Sun rise and Visible Sun rise.

Q.2 a) What are the conditions for a body to be circumpolar?
b) Calculate the duration of astronomical twilight in Lat 35^{O}N on the day of spring equinox.

Q.3 With the aid of drawing define:
a) SHA b) GHA c) EHA d) True altitude e) Amplitude.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR.
(35 MARKS EACH)

Q.4 In DR position 05^{O} 10.0'N 179^{O} 45.0'E a stellar obs gave intercept 4.5 miles away, azimuth 225^{O}T. Ship then steered course of 135^{O}T for 18 miles against N x Wly current and 3 miles drift, when a light house in position 05^{O}05'N, 179^{O} 54'W bore 030^{O}T. Find the ship's position at the time of 2nd observation.

Q.5 On 5th March '92 in DR 30^{O}S Obs altitude of Sun's LL East of meridian at GMT 04D 22H 56M 04S was 35^{O} 59.1'. If IE: 3.5' off the arc and HE was 30 meters, find the direction of Position Line and position to draw it arc.

Q.6 On 29th November '92 in DR 25^{O} 54'S 149^{O} 19'W Sext Alt of Saturn at GMT 06H 20M 42S was 35^{O} 16.7'. If IE was 1.3' off the arc and HE was 18 meters, find the direction of PL and position to draw the same using Marc Saint Hillaire method.

Q.7 a) On 24th February 1992 on Equator 065^{O} 30'W the moon rose bearing 123^{O}(C). If the variation was 2.5^{O}W, find the deviation.
b) On 23rd Sept '92 in DR 23^{O} 30' N 161^{O} 56'E the sextant meridian altitude of Sun LL was 66^{O}10.0'. If IE was 2.5' on the arc and HE was 10 meters find the latitude and position line.

Q.8 On 15th June 1992, in DR 20^{O}56'S 080^{O}00'E, the sextant altitude of the SUN's LL near the meridian was 45^{O}40.2' when GPS showed 15d 06h 35m 44s GMT. If IE was 1.6' on the arc and HE 17m, find the direction of the PL and latitude where it will cut the DR Longitude.

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GOVERNMENT OF INDIA

Date: - 5th Nov-2019

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) With suitable sketch, explain how Seasons are caused?
b) When observing the Sun for amplitude, what should be the observed altitude of the sun's lower limb. Explain with a suitable sketch.

Q.2 a) What do you understand by a Circumpolar Body? What are the conditions necessary for a Heavenly body to be circumpolar? Substantiate your answer with a suitable sketch?
b) If the sun's declination is $12^{O}42'S$, in what latitudes will there be:
- i) Phenomenon of Midnight Sun
- ii) Twilight all night
- iii) Continuous Night

Q.3 a) Write short notes on the following, with suitable sketches:
- i) Rational Horizon
- ii) Elongation of an Inferior Planet.

b) A stationary observer sees a star (declination $30^{O}S$) pass through his Zenith at the time of its meridian passage. Calculate its amplitude when west of the meridian.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR.

(35 MARKS EACH)

Q.4 In DR 24^{O} 30'N 033^{O} 18'E, an observation of a heavenly body gave an intercept of 1.8'(T) on an azimuth of 119^{O}(T). At the same time another observation of a heavenly body gave an intercept of 2.3'(A) on an azimuth of 238^{O}(T). Find the position of the vessel at the time of observation.

Q.5 On 21st July 1992 at Ship in DR latitude $40^{O}42'N$, sextant altitude of Moon UL, East off meridian at GMT 21D 15H 35M 45S was $45^{O}15'$. If IE was 1.0' on the arc and HE was 13.3 meters. Find the direction of position line and longitude to draw it.

Q.6 On 30th Nov 1992 PM at a ship in DR position 35^{O} 20S, 120^{O} 15'W observed altitude of Venus was 28^{O} 39.6'at GMT 01d 03h 36m 16s. If HE is 15m, find the direction of the PL and the point through which it passes using intercept method.

Q.7 a) On 29th Nov 1992, AM at ship in DR 26^{O} 27'N 130^{O} 27'W, the azimuth of the sun was 130^{O}(C) at GMT 17h 47m 49s. If the variation was $3^{O}E$, find the deviation of the compass.
b) In DR $55^{O}15'W$ on 30th April 1992 observed altitude of the sun's LL on the meridian was $70^{O}05.9'$ North of the observer. If height of eye was 10 meters and index error 2.0' off the arc find the latitude and state the direction off the position line.

Q.8 a) On 13th Dec, LHA Aries 323^{O} 00.4, Sextant Altitude of Pole star was $41^{O}26'$ IE 2' on the arc, HE 10m. Find the direction of P/L and position through which to draw it.
b) On 5th March 1992 in DR 32^{O} 12'N 178^{O} 16'E, the rising sun bore 100^{O}(C). If variation was $3^{O}E$, find the deviation of compass.

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GOVERNMENT OF INDIA

Date: - 9th Sept-2019

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Explain the Horizon System of defining position of a heavenly body on the celestial sphere.
b) Calculate the duration of astronomical twilight in lat. 35^{O}N on the day of spring equinox?

Q.2 a) With the aid of suitable sketches, explain the following:
i. Sidereal Day.
ii. Daily retardation of Moon.

b) Explain with neat sketch Conditions for a body to be Circumpolar.

Q.3 For a stationary observer, amplitude of the setting Sun was W20^{O}S. When it was on Prime Vertical, its true altitude was 9^{O}. Find the Latitude of observer & Declination of Sun.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR.
(35 MARKS EACH)

Q.4 In DR 49^{O}30'S 069^{O} 14'E an observation of a heavenly body gave an intercept of 9.5'(T) on an azimuth of 056^{O}(T). Vessel then steamed on a course of 144^{O}(T) for 35 miles when the 2nd observation of a heavenly body gave an intercept of 8.2'(T) on an azimuth of 324^{O}(T). Find the position of the vessel at the time of 2nd observation. The second sight was worked from I.T.P. run up.

Q.5 In DR 00^{O} 00' 160^{O} 00' W, the sextant altitude of the Moon's UL was 42^{O} 32' at 12h 40m 20s GMT on 10th October 1992. If H.E. is 14.2m, I.E. is 0.8' ON the arc, determine the direction of the PL and the longitude where it cuts the DR latitude.

Q.6 On 16th January 1992, PM at ship in DR 35^{O}10'S 127^{O} 45'E at GMT 11h 19m 10s, the sextant altitude of Star SIRIUS was 43^{O}24.1'. If the I.E. is 0.4' ON the arc and H.E. was 15m, find the direction of the PL and the point through which it passes using Intercept method.

Q.7 a) While a ship steering 040^{O}(C), on 29th November 1992, in DR 28^{O} 24'N 110^{O} 24'W, the Sun rose bearing 110^{O} (C). If the variation was 6.5^{O}E, determine the Deviation of the Compass.
b) On 21st Jan 1992 on a ship in DR 24^{O}36'S, 110^{O}20'W, the sextant altitude of the Sun's LL on the meridian was 85^{O}05.5'. If IE was 1.6' off the arc & HE was 10m, find the observer's latitude, state the direction of PL.

Q.8 On 1st Sept 1992 at ship in Long 178^{O}E, the sextant altitude of the Pole Star was 18^{O} 57.4' at 17h 23m 25s GMT, if IE was 1.5' on the arc and HE was 13.5m, find the direction of the PL and the position through which it passes. If Azimuth was 005^{O}(C), and variation 2.3^{O}E. Find the deviation.

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GOVERNMENT OF INDIA

Date: - 5th July-2019

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Explain with suitable diagram why duration of twilight varies with Latitude, if Declination of sun remains constant.
b) To an observer in a certain Latitude, the Sun's declination $12^{O}24'$N, bore 076^{O}(T) at theoretical sun rise. Find observer's Lat.

Q.2 a) Prove the expression: Sin amplitude = Sin declination X Sec latitude.
b) In Lat 45^{O} N, the theoretical sunrise took place at GMT 00h 30m 00s, on 16th June'92. Find observer's Longitude.

Q.3 a) If the Sun's declination is 18^{O} 00'N, between which latitudes will there be
a) daylight throughout b) twilight all night.
b) Define: i) Rational Horizon ii) Right ascension iii) Dip iv) Horizontal Parallax v) 'd' correction.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR.
(35 MARKS EACH)

Q.4 At 1200 hrs Latitude by Meridian Altitude of sun was found to be $20^{O}30'$S. Vessel sailed on a course 210^{O}(T) X distance 30 n.m. On completion of steaming an intercept of sun was observed AZ 330^{O}(T) X 4'(A) using a DR position Lat:- 21^{O} 00' S Long:- 30^{O} 30'W. Find vessel's initial and final position.

Q.5 On 21st July 1992 in DR position 36^{O} 06' S, 038^{O} 45' W, sextant altitude of Moon's UL was found to be 39^{O} 30' when GMT was 09h 20m 49s. IE 3.5' on the arc, HE 15m. Using Long by Chron method. Find the direction of P/L and position through which it passes.

Q.6 On March 5th 1992, AM at ship in DR position 37^{O} 59'S 151^{O} 10'E, the sextant altitude of Sun's LL was 36^{O} 09.1' when GMT time was 04d 22h 55m 40s. If HE was 30m and I.E. was 1' off the arc, find the intercept and direction of the P/L.

Q.7 On 12th Sept 1992 in DR position 43^{O} 06S', 072^{O} 19'E the sextant meridian altitude of the star Aldebaran was 30^{O} 40.7'. If IE was nil and HE was 18m find
a. The latitude and the PL.
b. The exact meridian passage time of the star to the nearest second.

Q.8 a) On 1st Sept 1992 in DR position 17^{O} 54' N, 178^{O} 11'E compute the sextant altitude of Polaries on 31st Aug at 17h 22m 26s GMT, I.E.:- 1.6' off the arc, H.E.:- 12.5 m.
b) On 2nd Sept 1992, in DR position 40^{O} 28' N, 064^{O} 20' E, the rising Sun bore 090^{O}(C), if Variation was 5^{O} W, find the deviation of the compass at this particular comp course.

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GOVERNMENT OF INDIA

Date: - 06th May-2019

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Define Twilight, Define Civil, Nautical and Astronomical twilight. Explain cause of the Twilight, reason why it lasts longer in higher latitudes.
b) Calculate the duration of astronomical twilight in lat 35deg N on the day of spring equinox?

Q.2 a) State and explain Kepler's law.
b) In what latitude would the longest day be 5 hours more than the shortest day?

Q.3 a) Prove that Sin Amp = Sin Decl. Sec Lat.
b) To an observer in a certain latitude, the sun declination 12 deg 14'N bore 076(T) at theoretical sunrise, find observer's latitude.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR.
(35 MARKS EACH)

Q.4 At 1600 Hrs Sun sight calculated using DR 24^{O}S 000^{O} 15'E gave intercept 5 miles away azimuth 296^{O}T. At 1930 hrs a star gave azimuth 198^{O} True intercept 4 miles towards. DR position used for 2nd sight was calculated using original DR. If ship steered course 310^{O} at 13 knots during the sight and WSW'ly current was setting @ 2 kts, find ship's position at the time of 2nd observation.

Q.5 On 30th April 92 at Equator the observed altitude of Sun Upper Limb East of meridian at GMT 30D 08H 12M 16S was 33^{O} 17.9'. If HE was 20 meters and IE was 1.5' off the arc find the direction of position line and longitude to draw it.

Q.6 On 27th Feb 1992 in DR 30^{O} S, 014^{O} 10'W Sextant altitude of star. Antares at GMT 05H 00M 26S was 63^{O} 35.4'. If IE was 1.2' off the arc and HE was 12 meters find the direction of Position line and position to draw it by Intercept method.

Q.7 a) On 2nd Sept 92 in DR 45^{O} 30'S , 145^{O} 30'E the moonset bearing was 265^{O}(C). If variation was 12^{O}W, find the deviation.
b) On 14th October 1992 at ship in DR longitude 48^{O} 36'W the observed altitude of Sun UL on the meridian North of observer was 78^{O} 09.4'. If IE was 2.5' on the arc and HE was 15 Meters, find the latitude and state the direction of position line. From Equation of time find GMT meridian passage to nearest second.

Q.8 On 9th October 92 in DR Long 003^{O} 10'W sextant altitude of Polaris at GMT 18H 17M 19S on 9th October was 55^{O} 12'. If IE was 2.0' on the arc and HE was 14 meters find the direction of position line and position to draw it.

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GOVERNMENT OF INDIA

Date: - 12th March-2019

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) With a suitable sketch, explain how seasons are caused?
b) If the earth's axis was perpendicular to its orbit, what effect would it have on the seasons?

Q.2 a) Explain – Venus as Morning and Evening Star.
b) Briefly explain: (i) Conjunction (ii) Opposition (iii) Quadrature

Q.3 a) Write short notes on the following with suitable sketches:
(i) Synodic period moon, (ii) Rational Horizon (iii) Elongation of a inferior planet
b) To an observer in a certain latitude, the sun (Declination $12^{O}14'N$), bore $076^{O}(T)$ at theoretical rising. Find the observer's latitude?

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR.
(35 MARKS EACH)

Q.4 In DR $36^{O}48'S$ $110^{O}37'E$, an Ex-meridian sight gave an Obs. Lat. of $37^{O}00'S$ and a PL of 100^{O}-$280^{O}(T)$. After steaming $000^{O}(T)$ for 87 M and $270^{O}(T)$ for 101M an intercept of 7.2M away from Az $086^{O}(T)$ was obtained working from the earlier Obs. lat. Find the position of the ship at the 2nd observation.

Q.5 On 22nd Sept 1992 in DR $24^{O}30'N$ sextant altitude off Moon UL East of meridian at GMT 22D 06H 17M 18S was $35^{O}45.4'$. If IE was 2.2' off the arc and HE was 15 mtrs, find direction of position line and position to draw it.

Q.6 On 1st May 1992 PM at ship in DR 30^{O} 10' S 010^{O} 30' E Sext alt of star Sirius at GMT 01d 19h 10m 45s was 36^{O} 49.2'. If IE was 2.1' on the arc and HE was 11 meters find the direction of position line and position to draw it by intercept method.

Q.7 a) On the 28th April in DR $17^{O}30'S$ $070^{O}43'E$ find the expected ships time of meridian passage. If observed meridian altitude of sun's LL was $58^{O}16'$ (HE: 14m), find the ship's latitude and the details about PL.
b) On 19th Jan 1992 in DR $40^{O}16'S$ $175^{O}31'E$, the azimuth of the sun was $267^{O}(C)$ at 1618 ship's time. If the ship's time difference was 11h 30m from GMT and the variation was $2.3^{O}E$, find the deviation for the ship's head.

Q.8 On 24th Aug 92 at ship in DR 40^{O} S, 175^{O} 30' W Sextant altitude of Sun UL near the meridian at GMT 23H 27M 12S was 39^{O} 26'. If IE was 2.0' on the arc and HE was 17.5 meters, find the direction of position line and latitude to draw same.

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GOVERNMENT OF INDIA

Date: - 09th Jan-2019

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:

1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted, however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) With the help of suitable diagram explain solar eclipse.

b) Two ships A and B, on the same meridian observe the sun simultaneously at Noon and both get the same MZD 40^O, the Declination of the sun is 10^ON. The sun bears due North from A and due south from B. Find the latitudes of 'A' and 'B'.

Q.2 a) Explain Kepler's law of planetary motion?

b) In the southern hemisphere a vessel sailed on a course of 042^O(T) making a Departure of 200nm and a D.M.P. of 240. Find the Latitude left.

Q.3 a) An unknown star rose bearing 123^O(T) when bearing East it had a true altitude of $24^O30'$. Find the Lat of the observer and the Star's declination.

b) Explain various phases of Moon.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR.

(35 MARKS EACH)

Q.4 At 0500 hrs by ship's clock on a vessel in DR position $52^O21'$N, 027^O 50'W, an observation of star 'Deneb' on the meridian gave latitude $52^O26'$N. A second sight, obtained at 0520 hrs of star 'Capella', when worked using the original DR, gave azimuth 300^OT, intercept 3 M towards respectively. The ship was steering 000^O(T) at 6 kts. Find by plotting the ship's position at 0520 hrs.

Q.5 On 1st Sept 1992 AM at GMT 31d 22h 11m 36s., a ship in DR position $32^O10'$S 113^O 25'E, the sextant altitude of star Procyon was $30^O58'$ I.E was nil and H.E. was 8m, find the direction of PL and observed Longitude.

Q.6 On 31st August 1992 in DR position 60^O 06'N 66^O 18'W, the sextant altitude of Mars was 41^O 32.4', when GMT was 08h 15m 02s. If HE was 10m and IE was 2.1' on the arc. Calculate the direction of the PL and a position through which it passes by intercept method.

Q.7 a) On 14th October 1992 in DR Long 105^O 20'W, the sextant all of Mars on the meridian was 62^O 12.5' North of the observer. If HE was 12m and IE 3.0' on the arc. Find the observed latitude and position line.

b) On 14th June 1992, in D.R. lat 20^ON long. 0.36^OW, the Moon rose bearing, 116^OC. If the variation was 3^OW, find the deviation on the ship's head.

Q.8 On 6th March 1992 in DR $51^O55'$N, 171^O 10'E, the sextant altitude of the Sun's U.L. near the meridian was 32^O 01.2', when GPS showed 06d 01h 02m 30s GMT. I.E. = 2' on the arc. HE:30m. Find the direction of the PL and a position through which it passes.

**********X***X**********

GOVERNMENT OF INDIA

Date: - 09th Nov-2018

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:

1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted, however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a. Explain with a suitable sketch that when observing the Sun for an amplitude, what should be the observed altitude of the Sun's lower limb, Explain with a suitable sketch?

b. Define parallax in altitude and Horizontal Parallax. With the aid of a figure, show why this correction is always positive.

Q.2 a. Explain any two types of Lunar Eclipses with sketches.

b. An observer in position $22^{O}05.0N$ $034^{O}12.5'W$ found the true altitude of a star with declination $10^{O}15'N$ to be $60^{O}40'$ west of the meridian. If GHA aries at that instant was $223^{O}12'$, find the star's SHA.

Q.3 a. Prove the expression SIN Amp = Sin Decl. x Sec Lat.

b. The true altitude of a star when bearing north was $70^{O}04'$, Later the same star gave a true altitude of $30^{O}24'$ when bearing south. Find the star's declination and latitude of the observer.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR.

(35 MARKS EACH)

Q.4 At 1800 hrs on a certain day DR 22^{O} 37'N 028^{O} 47'W,
At 1750 hrs Star A gave an intercept 5.1' Towards Az 129^{O}T
At 1813 hrs Star B gave an intercept 2.1' Away Az 048^{O}T.
Both sights were worked using the 1800 DR. Find the position of the vessel 1800hrs if the vessel was steaming on a course of 293^{O}T at a speed of 22 Kts.

Q.5 On 30th April'92, PM at ship in DR 12^{O} 37'N 179^{O} 12'W, the sextant altitude of the Sun UL $31^{O}18'$ at GMT 03h 59m 24s on 1st May, IE 3.2' on the arc, HE 18.7m. Find the direction of the PL and the long, where it crosses the DR Lat.

Q.6 On 30th April'92, PM at ship in DR 34^{O} 18'S 040^{O} 20'W the observed altitude of star Sirius was 57^{O} 50.7' at GMT 20h 51m 21s. If HE was 21m, find the direction of the PL and the position through which to draw it using Intercept method.

Q.7 a. On 21st Jan 1992, at 0320 ships time, in DR $44^{O}12'N$ $122^{O}18'E$, the star DENEB bore $031.5^{O}C$. If the variation was $5^{O}E$ and the difference between ships time and GMT is 7 hrs, find the deviation.

b. On 1st May'92 in DR 30^{O} 06'N 179^{O} 45'W the setting sun bore $285^{O}C$. If variation was $2^{O}E$, find the deviation.

Q.8 In June 1992 during morning twilight in DR 15^{O} 43.6'N 110^{O} 07.3'W when GHA Aries was 76^{O} 39.2' the true altitude of Polaris was 16^{O} 11.3'. Find the direction of the PL and the position through which to pass it.

***************************X***X***************************

GOVERNMENT OF INDIA

Date: - 10th Sept-2018

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:

1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted, however, each step should clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 (a) Define:

i) Geographical position

ii) Azimuth

iii) Obliquity of ecliptic

b) If the latitude was 64^{O} 27'S and declination of a star was 39^{O} 47'S, find out if the body is circumpolar. If so calculate the upper and lower meridian altitudes.

Q.2 For a stationary observer, the amplitude of the setting sun was W 20^{O} S, when it was on prime vertical, its true altitude was 9^{O}, Find:

a) The latitude of observer

b) Declination of sun.

Q.3 Observer in latitude 30^{O} N, finds a star rising on Azimuth of 068^{O}. If the star rose at 1900 LT, then what time will it set?

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS OUT OF REMAINING FOUR.

(35 MARKS EACH)

Q.4 In DR Position 30^{O} 15'N 026^{O} 40'W, an observation of Sun gave a bearing of 110^{O}T intercept 6.5' towards. The ship then steamed 245^{O}T for 20 miles when latitude by meridian altitude of Sun was found to be 30^{O}N. Find the ship's position at the time of second observation.

Q.5 On 21st July 1992 in DR position 36^{O} 06'N 038^{O} 45'W, sextant altitude of Moon's UL was found to be 55^{O} 15.4' when GMT was 09h 20m 49s. IE: 3.5' on the arc 'HE 15m. Using "long by Chron method" find the direction of PL and the position through which it passes.

Q.6 On 29th November at GMT 11h 29m 20s in DR 25^{O} 36'S 107^{O} 20'W the sextant altitude of star RIGEL was 35^{O} 07.8'. If HE was 12m IE 0.8' on the arc. Find the direction of the PL and the intercept.

Q.7 a) On 2nd September 1992 moon set bearing 260^{O}(C) in DR 35^{O} 06'S 074^{O} 12'E. If variation was 12^{O}W, find the deviation.

b) On 1st September 1992 DR equator, 50^{O} 27'E sextant meridian altitude of sun's UL was 82^{O} 10.4'. IE:2.4' on the arc, HE=17m. Find the observed latitude and the direction of PL.

Q.8 On 2nd May 1992 a ship was in DR position 57^{O} 55'N 094^{O} 35'W. Compute the sextant angle to set for star vega at the commencement of morning twilight. HE is 24m and IE is 2.2' on the arc.

****************************X***X******************************

GOVERNMENT OF INDIA

Date: - 9TH July-2018

SECOND MATE OF A FOREIGN GOING SHIP

FUNCTION: NAVIGATION

PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:

1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted, however, each step should clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 (a) Define:

1. Equation of time 2. Ecliptic 3. Rational Horizon 4. Sidereal Hour Angle (15 Marks)

(b) Draw a figure reasonably to scale on the plane of rational horizon for an observer latitude 25^{O}S and mark the following on it:

A star having declination 20^{O}S and azimuth 090^{O}(T) (15 Marks)

Q.2 a) The amplitude of a rising star was E 25^{O}N and its altitude when on the prime vertical was 42^{O}. Find the best approximate true altitude of the pole star at its position. (15 Marks)

b) Explain why stars culminate about 4 minutes earlier each day? (15 Marks)

Q.3 (a) State the conditions required for solar eclipse and lunar eclipse. (15 Marks)

(b) In latitude 65^{O}N, an observer obtains a lower meridian altitude of a celestial body as 20^{O} bearing North. Calculate the altitude and bearing of the same celestial body at upper meridian passage. (15 Marks)

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR.

(35 MARKS EACH)

Q.4 In DR Position 20^{O} 30'N 179^{O} 50'E an intercept of 5' away, AZ 000^{O}(T) was obtained by a stellar observation. The vessel then steered a course 180^{O}(T) for 20' and 090^{O}(T) for 40'. At the end of this steaming a star observation gave an AZ 045^{O}(T) X 2' Away. Position used for calculation was initial DR position carried forward. Find the final position of them vessel.

Q.5 On 17th January 1992, AM in DR 36^{O}10'S, 152^{O} 10'E, the sextant altitude of Sun's LL East of the meridian was 52^{O}27' I.E. 0.2' of the arc, H.E. 11m, GMT was 16th 23h 24m 18s. Find the P/L and observed Longitude where it cuts the D.R. Latitude.

Q.6 On 2nd March 1992 in DR 32^{O} 12'S 100^{O} 24'E, the sextant altitude of Venus east of the meridian was 18^{O}05' when the GMT was 1st 22h 32m 58s. If the HE was 10m and IE 1.3' off the arc, find the direction of the PL and the position through which it passes using the Intercept Method?

Q.7 On 1st of May'92 in DR 32^{O} 00'S 81^{O}00'E the sextant altitude of Sun's L.L. near the meridian was 42^{O}30' at GMT 01d 06h 33m 40s. If IE was 1.6' on the arc and the HE was 17m. Find the direction of the P/L and the Latitude where it cuts the DR Longitude.

Q.8 a) On 23rd August 1992 in DR position 20^{O} 00'S 090^{O} 00'W, the sun rose bearing was 090^{O}(C). If variation was 3^{O}W. Find the deviation of the compass?

b) What altitude should be set on the sextant for the observation of polaries on 10th of October 1992 at the beginning of PM nautical twilight in DR position 30^{O}N 150^{O}W. If I.E. is 2.0' off the arc and H.E. 10m.

****************************X***X******************************

GOVERNMENT OF INDIA

Date: - 9TH May-2018

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:

1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted, however, each step should clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 (a) What is International Date Line? Why is it necessary and how is the date on a ship crossing the International Date Line on an Easterly course affected?
(b) Calculate the duration of astronomical twilight in lat 35deg N on the day of spring equinox?

Q.2 (a) How are Season's caused?
(b) To an observer, star bore 065(T) when rising, its true altitude when on prime vertical east of the meridian was 42deg, find observer's latitude.

Q.3 (a) **Parallax in Altitude = horizontal parallax X Cos app alt.**
(b) To an observer, star with decl. 29deg 44.6'S bore south when on the meridian. If its true altitude when at the maximum azimuth was 26 deg 03', find observer's latitude.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR.

(35 MARKS EACH)

Q.4 In DR 09^{O}20' N 177^{O} 25' E a celestial observation gve intercept 5 miles away Azimuth 300^{O}T. Ship then steered 065^{O} T. Ship then steered 065^{O} T for 10 hrs at 15 Kts with current ENE @ 2 kts throughout when second observation gave observed longitude 179^{O} 58' E, Azimuth 205^{O}. DR used for second observation was calculated from ITP of the first observation.
Find ship's position at the time of second observation.

Q.5 On 22nd Sept 1992 in DR 24^{O} 30' N sextant altitude of Moon UL East of meridian at GMT 22D 06H 17M 18S was 35^{O} 45.4'. If IE was 2.2' off the arc and HE was 15 mtrs, find the direction of position line and position to draw it by intercept method.

Q.6 On 1st May 1992 PM at ship in DR 30^{O} 10' S 010^{O} 30' E sext alt of star Sirius at GMT 01d 19h 10m 45s was 36^{O} 49.2'. If IE was 2.1' on the arc and HE was 11 meters find the direction of position line and position to draw it by intercept method.

Q.7 a) On 16th Jan 1992 in DR 011^{O}20'W observed meridian altitude of Star Markab North of observer was 52^{O} 46.9'> if HE was 12.7 meters find direction of position line and latitude to draw it. Calculate GMT meridian passage of star to nearest second.

b) On 19th Jan 92 in DR 30^{O} N 060^{O} 35'E 0310 hrs LMT. Compass bearing of Moon at GMT 23H 10M 00S was 269^{O}C. If variation was 2.7^{O}W find deviation of the compass heading.

Q.8 On 24th Aug 92 at ship in DR 40^{O} S, 175^{O} 30' W Sextant altitude of Sun UL near the meridian at GMT 23H 27M 12S was 39^{O} 26'. If IE was 2.0' on the arc and HE was 17.5 meters, find the direction of position line and latitude to draw same.

****************************X***X******************************

GOVERNMENT OF INDIA

Date: - 12TH March-2018

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted, however, each step should clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) Define and explain:
i) Sidereal hour Angle ii) Sensible Horizon iii) Equinoctial
b) What do you understand by "Precession of Equinoxes"? How it caused and what are its effects?

Q.2 For an observer in position 00^{O}N 022^{O}W, the True altitude of a star is 59^{O} 24' and T'Az, is 210^{O}, calculate the Geographical position.

Q.3 Explain with suitable sketchers:
a) Why stars rise 4 minutes earlier each day?
b) Venue is a morning of evening star.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR.

(35 MARKS EACH)

Q.4 At 0440 hrs by ship's clock on a vessel in DR position 52^{O} 21'N, 027^{O} 50'W, an observation of star 'Deneb' on the meridian gave latitude 52^{O}26'N, A second sight, obtained at 0500 hrs of star 'Capella', when worked using the original Dr, gave azimuth 300^{O}T, intercept 3 M towards respectively. The ship was steering 000^{O} (T), at 6 kts. Find by plotting the ship's position at 0500 hrs.

Q.5 On 25th Feb 1992, in Dr 35^{O} 18'S 088^{O} 52.6'W, the sextant altitude of the moon's UL was 47^{O} 12.4' at GMT 25d 15h 11m 20s, HE 18m, IE 0.5' off the arc. Find the observed longitude and direction of PL.

Q.6 On 19TH Jan 1992, in DR 00^{O} 02'N 170^{O} 50'E, the sextant altitude of the star BETELGUESE was 43^{O} 11.1' at 19d 07h 35m 02s, GMT. If He was 18m, and I.E 1.3' off the arc, find the intercept and the direction of the PL.

Q.7 a) On 14TH October 1992 in DR Long 105^{O} 20'W, the sextant alt of Mars on the meridian was 62^{O} 12.5' North of the observer. If HE was 12m and IE 3.0' on the arc. Find the observed latitude and position line.
b) On 14th June 1992, in D.R. lat 20^{O} N long. 36^{O}W, the Moon rose bearing, 116^{O}C. If the variation was 3^{O}W, find the deviation on the ship's head.

Q.8 On 4th March 1992, in DR. 27^{O} 28'N 168^{O} 10'W, the sextant altitude of the Sun's L.L. near the meridian was 56^{O} 18.8' when the GPS showed 04d 23h 13m 43s GMT. H.E. was 11m and I.E. 2.6' on the arc, find the direction of PL and position through which it passes.

**********X***X**********

GOVERNMENT OF INDIA

Date: - 9TH January-2018

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 140** **MAX. MARKS: 200**

Notes:
1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted, however, each step should clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE: (30 MARKS EACH)

Q.1 a) With the help of suitable diagram define the following:
i) First point of Aries ii) LHA
b) If the Sun Rose at 0605 hrs LMT and set at 1743 hrs LMT, find the value of equation of time.

Q.2 a) What conditions are necessary for a heavenly body to
i) Be circumpolar ii) Cross Prime Vertical iii) Rise bearing True east

b) Explain the factors which govern period of daylight for any observer.

Q.3 A vessel in position 46^{O} 05.0'N 022^{O} 20'W observes the True Altitude of a body to be 34^{O} 31' when it is on the prime vertical west of the meridian. Calculate the G.P. of the body.

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY, ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR.

(35 MARKS EACH)

Q.4 In DR 33^{O} 18'S 000^{O} 12.6'W a stellar observation gave an intercept of 4.2' away, bearing 241^{O} (T). After steaming 090^{O} (T) for 123 miles another astronomical observation gave an observed longitude of 002^{O} 20'E bearing 090^{O} (T). The position used for the second sight was obtained by allowing run from the first ITP. Find the position of the ship at the second observation.

Q.5 On 05th March 1992 AM, in DR 30^{O}11'S 147^{O} 10'E, a sextant altitude of the Sun's LL at GMT 04th d 22h 56m 04s was 35^{O}59.1'. If the IE 0.3' off the arc and HE was 30m. Find the direction of PI and the longitude where it crosses the DR Lat.

Q.6 On 01st May 1992, PM, in DR 27^{O}54'S 179^{O}18'W, an intercept was worked using Jupiter. The sextant altitude of Jupiter was 46^{O}25.5' at GMT 06h20m42s. If IE was 1.3' off the arc, HE was 19m. Find the direction of the PI and the position through which it passes.

Q.7 a) On 21st Jan 1992, at 0320 ship's time, in DR 44^{O}12'N 122^{O} 18'E, the star DENEB bore 031.5^{O}C. If the variation was 5^{O}E and the difference between ship's time and GMT is 7hrs, find the deviation.

b) On 22nd SEP 1992, in DR 30^{O}06'N 179^{O} 45'W the setting Sun bore 275^{O}(C). If the variation was 2^{O}W, find the deviation of the compass.

Q.8 Find the position line and position through which it passes in the following case:
DR 28^{O}25'N 027^{O}25'W, the sextant altitude of the POLE STAR was 27^{O}45', IE 1.0' off the arc and HE 16m, month March & GHA Aries 276^{O} 14.4'.

**********X***X**********

GOVERNMENT OF INDIA
SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 HOURS | PASS MARKS: 140 | MAX MARKS: 200

Notes:
1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted, however, each step should be clearly shown

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE **(30 MARKS EACH)**

Q.1. a. How is the duration of daylight dependent upon :-
i. Observers Latitude ii Sun's Declination. (15)
b. Define :- (15)
i. Observer's Zenith ii. Prime Vertical iii Azimuth.

Q.2 a. Define i) Elongation ii) Superior Conjunction iii) Quadrature. (15)
b. State the Laws of Planetary motion (15)

Q.3 a. On a certain date, in longitude 030°W, LHA Sun was 250°, when GHA ♈ was 181° Find SHA Sun. (20)
b. Why do Stars rise 4 minutes earlier each day? (10)

SECTION II-PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY. ATTEMPT ANY THREE QUESTION FROM THE REMAINING FOUR. **(35 MARKS EACH)**

Q.4 Vessel steering a course of 334° (T) at 15 knots .At 0300HRS,, New Mangalore (12° 48'N 074° 54' E) bore 090° (T) 40nm off. At 0600 hrs the following observations were made:

TIME	BODY	AZIMUTH	RESULT
0600	BETELGEUSE	080°(T)	Intercept 2nm(Towards)
0600	POLARIS	001°(T)	OBS LAT 13° 40

Find the observed position of the vessel at 0600 hrs.

Q.5 On 02nd Sept 1992 at ship in DR 40°19.0'S 000° 20'W , the sextant altitude of Sun's UL , west of the meridian was 10°02.0' at GMT 16h 43m 12s . If HE as 25m and IE 2.4, off the arc , find the direction of the PL and the longitude where it cuts the DR latitude.

Q.6 On 29th Nov 1992 , at ship in DR 25° 30' S170° 20' W, the sextant altitude of star RIGEL was 51° 10.3' when the GMT showed 14 h 29m 20s . if H.E was 12 m and I.E 2.8' off the arc , find the direction of the PL and Intercept.

Q.7 a) On 01st Sept 1992, sextant meridian altitude of Suns UL was 70° 29.2, North of the observer in DR longitude 116° 27' W If I.E was 3.2 off the arc and HE was 12m , find the Observed latitude state the direction of the PL .

b) On 1st May 1992, in DR 30° 06' N 179° 45'W , the setting Sun bore 285°(C) . If variation was 30°W, find the deviation for the ship's head.

Q.8 On 02nd May 1992, on the ship in DR 15° 40'S 079° 58'W, the sextant altitude of Sun's LL near the meridian was 58° 16.5' at GMT 17h 38m 05s . If IE was 1.0' on the arc , HE was25m , calculate the position and direction of PL.

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GOVERNMENT OF INDIA
SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

Code 95A

TIME: 3 HOURS | PASS MARKS: 140 | MAX MARKS: 200

Notes:

1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted, however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE **(30 MARKS EACH)**

Q1 (a) Define Twilight. Define Civil, Nautical and Astronomical twilight. Explain cause of the Twilight, reason why it lasts longer in higher latitudes.
(b) Calculate the duration of astronomical twilight in lat 35deg N on the day of spring equinox?

Q2 (a) State and explain Kepler's law.
(b) To an observer, star bore 065(T) when rising, its true altitude when on prime vertical east of the meridian was 42deg, find observer's latitude.

Q3 (a) Prove that Sin Amp = Sin Decl. Sec Lat
(b) To an observer, star with decl 29deg 44.6'S bore south when on the meridian. If its true altitude when at the maximum azimuth was 26 deg 03', find observer's latitude.

SECTION II-PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY. ATTEMPT ANY THREE QUESTION FROM THE REMAINING FOUR.

(35 MARKS EACH)

Q.4 In DR 30° 15' (N) 26°40'(W) at 0945 hrs, an observation of the sun gave a bearing of 110°(T) intercept 6.5' towards.
The vessel then steamed with a course of 245°(T) for 2 hrs at 10 kts when the latitude obtain by lat by meridian altitude of sun was 30°00' N. Find Posith of Vessel at the time of 2nd Observation.

Q.5 On 17th Jan 1992, PM, in DR 11°05' (N) 110°55' (E), the sextant altitude of Sun's LL was 50°27.0' at GMT 17d 06h 19m 57s. HE 14.1m, IE 2.5' ON the arc.
Find the direction of PL and position through which to draw it using Long by Chron method.

Q.6 On 31st August, 1992, at ship in DR 33°43' S, 03°40'W, the sextant altitude of Spica was 49°18.5' when the GMT showed 31d 17h 28m 42s.
If IE was 3.2' ON the arc and HE was 14.9m, find the direction of the PL and a position through which it passes using Intercept method.

Q.7 a) On 21st July, 1992, in DR 37° 22' N, 96° 36' W, the sextant meridian altitude sun's UL was 73° 26.3' . If IE was 1.4' OFF the arc & HE was 17.4m, find the latitude and PL.
b) On 2nd March, 1992, in DR 22° 22'(N), 175° 15' (E). The rising sun bore 102°(C).
If variation was 3°(E), find the deviation of the compass.

Q. 8 On 10th October, 1992, PM in DR 43° 10' (N), 24° 54' (E), the Sextant altitude of Polaris was 43° 16.2' and bearing 004° at GMT time 10d 18h 15m 32s.
HE was 11.2m and IE 3.2' OFF the arc. Find the direction of the PL and latitude where it cuts the DR longitude. Also find the deviation of compass if variation was 4° W.

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GOVERNMENT OF INDIA
SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

Code 88A

TIME: 3 HOURS **PASS MARKS: 140** **MAX MARKS: 200**

Notes:
1. Use nautical almanac 1992
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown

SECTION I – PTINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE **(30 MARKS EACH)**

Q.1 a) How are seasons caused? Explain with suitable diagram and giving appropriate date?
b) Compare the conditions necessary for Lunar and Solar eclipse

Q.2 a) Explain the procedure for identifying a star without the use of a star finder
b) A body bore 000° and was at altitude of 10° 12', The altitude after about 12 hours of the same body was 66°14' on the bearing of 180°. Find latitude of the observer and declination of the body

Q.3 a) With help of a diagram explain why stars culminate 4 min earlier each day?
b) A ship in position 40°N 040°W, declination of sun is 10°N and LHA sun 30°. Calculate the sun's G.P., also of a star whose declination is 20°S, and LHA 337° 30'

SECTION II - PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY. ATTEMPT ANY THREE OUT OF REMAINING FOUR
(35 MARKS EACH)

Q.4 An observer steering 205° (T) at 16 kts obtained following observations in DR 34°27'N 076°42'E. Find the observed position at ~~1803~~ 1833 hrs.

1820	- Star'X' -	167°	(T)	x 2.2' (T)
1824	- Star'Y' -	081°	(T)	x 4.5' (T)
1833	- Star'Z' -	237°	(T)	x 0.8' (A)

Q.5 20th July 1992 on ship in DR position 30° 00'N, 120° 00W the sextant altitude of "JUPITER" was 23° 55' when the GMT time read on GPS showed 03 hr 30 min 30 sec. If the index error=0.7' on the arc, HE=21M. Find the intercept and direction of PL

Q.6 In DR Lat 27° 40'N, 140° 23'W on 30th November 1992, PM, at ship, the sextant altitude of Moon's upper limb was found to be 30° 51' at GMT 30d 23h 12m 13s. If H.E was 12m, I.E NIL, find the direction of position line and a position through which it passes. (use "long by chron" Method)

Q.7 a) On 1st May 1992 AM at ship in DR 40°26' N 060° 40'E Mars bore 096° (C) at 30d 23h 5m 20s GMT. Variation was 5° W; calculate the deviation of the compass.
b) On 4th March 1992, in DR 45° 14' N 120° 30' W, compute the sextant meridian altitude of ANTARES if IE =3.2' off the arc and HE 10m

Q.8 On January 20th 1992 DR Long 052° 30' W at LMT 1845 hrs an observation of the Pole star gave a Sextant Altitude of 40° 15.5', IE 1.5' off the arc , HE 10 m . Find the direction of the P/L and the position through which it passes

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JULY -2012

GOVERNMENT OF INDIA

Date: - 11th May-2017 (Batch-2)

SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

TIME: 3 Hours **PASS MARKS: 120** **MAX. MARKS: 200**

Notes:
1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted, however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVITATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE (30 MARKS EACH)

Q.1 Explain and show in case of Polaris
Latitude = True Altitude + - small correction.
b) Explain in details three main systems of defining a position on the celestial sphere.

Q.2 a) Find the latitude within which star Dubhe on 10th Oct. 1992
i. Will cross observer's prime vertical
ii. Will be circumpolar
iii. Will Never Rise
b) Describe how the axial tilt of the earth, cause different seasons in North hemisphere.

Q.3 Find observer position if True Altitude of sun is 44^O 10', when bearing 090^O True and Declination at that instant is 11^O13' N and GHA sun is 00^O 08.3'

SECTION II – PRACTICAL NAVIGATION

QUESTION 4. IS COMPULSORY, ATTEMPT ANY THREE OUT OF REMAINING FOUR. (30 MARKS EACH)

Q.4 In DR 49^O30' S 69^O14' E, an observation of a heavenly body gave an intercept of 9.5' (T) on an azimuth of 056^O (T). Vessel then steamed on a course of 144^O(T) for 35 miles when the 2nd observation of a heavenly body gave an intercept of 8.2'(T) on an azimuth of 324^O(T). Find the position of the vessel at the time of 2nd observation. The second sight was worked from I.T.P. run up.

Q.5 In DR 35^O 03'S, 087^O 11'E, on 25th Feb 1992, AM, the sextant altitude of Moon's UL was found to be 46^O 29.5' at 03h 11m 20s GMT. If HE was 22m and IE was 1.5' on the arc. Find the longitude where PL cuts the DR latitude and the direction of position line.

Q.6 On 31st Aug 1992, on a ship in DR 60^O 06'N 066^O 18'W, the sextant altitude of Mars was 41^O 32.4' when GMT was 08h 15m 02s. If IE was 2.1' on the arc, HE was 10m, calculate the intercept and direction of PL.

Q.7 a) On 21st January 1992, a vessel in DR position 24^O 36'S 110^O 20'W observes the sextant altitude of Sun LL on the meridian to be 85^O05.5'. If IE is 1.6' off the arc and HE 10M.
Calculate the latitude required for plotting the PL. Also, find the GMT of meridian passage to the exact second using equation of time. (20 Marks)
b) For a vessel in DR position 27^O40'N 003^O26'E, compute the sextant altitude of pole star on 24th February 1992 at GMT 17h 34m 00s (IE is 2.6' off the arc and HE 21m). (15 Marks)

Q.8 a) On 6th March 1992 in EP 52^O 12'N 170^O 40'E, the sextant altitude of the Sun UL near the meridian was 31^O59.8' when the GMT showed 06d 01h 27m 30s. If the IE was 2.3' on the arc and the HE was 40m, calculate the direction of the PL and a position through which it passes. (32 marks)
b) Find the approximate ex-meridian limits for the observation of Sun, using the information provided in question 8(a). (03 marks)

**********X***X**********

GOVERNMENT OF INDIA
SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

Code 85A

TIME: 3 HOURS **PASS MARKS: 140** **MAX MARKS: 200**

Notes:
1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted, however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE **(30 MARKS EACH)**

Q.1 a) State Kepler's laws of planetary motion.
b) Why is longitude correction applied to obtain moonrise, moonset & moon meridian passage times whereas there is no such correction for Sun?

Q.2 a) Find the ratio of the period of darkness to the period of daylight in latitude 52° 15' N when the Sun's declination was 21° 25' S.
b) Calculate the LHA of a star whose RA is 67° 30' for an observer in longitude 49° 51' E, when GHA Aries is 192° 35'?

Q.3 a) On 02nd March 1992, in DR 15° 30' N 070° 35' W, calculate exact LMT of meridian passage of star Deneb?
b) An observer in Latitude 61° 51' S sights a star whose declination is 34° 43' S. Find out if this star will be circumpolar and if so calculate the upper & lower meridian altitudes.

SECTION II-PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY. ATTEMPT ANY THREE OUT REMAINING FOUR.
(35 MARKS EACH)

Q.4 At 0440hrs in DR position 52° 21'N 027° 50'W, a meridian observation of Deneb gave an obs. lat 52° 26'N. At 0500hrs using DR Capella gave Azimuth 300°T, Intercept 3' Towards. Ship's course 000° (T), speed 6 Kts.
Find ship's position at 0440hrs & 0500hrs by plotting.

Q.5 On 02nd Sept 1992at ship in DR 40°19.0'S 000°20'W, the sextant altitude of Sun's UL, west of the meridian was 10° 02.0' at GMT 16h 43m 12s. If HE was 25m and IE 2.4' off the arc, find the direction of the PL and the longitude where it cuts the DR latitude.

Q.6 A ship observes the sextant altitude of Venus to be 28° 40.1' in DR position 35° 18.9' S 120° 15.4' W. The sight was taken at GMT 01st December 03h 36m 19s. Index error of the sextant 0.8' off the arc and height of eye 16 m. Calculate the Intercept and the direction of position line.

Q.7 a) A vessel in DR position 62° 15' S 179° 57.7' E observed the Azimuth of Star Spica to be 312.6° (G) at GMT 30th April 13h 00m 05s. Find out the Gyro course to set if the vessel intends to steer 075° (T).

b) In DR Longitude 116° 27' W, on the 14th of September 1992, the sextant meridian altitude of Sun's upper limb was found to be 70° 27.8' north of the observer. Find the latitude and direction of the position line if the index error was 1.9' on the arc and height of eye 20 m.

Q.8 On the morning of 1st Dec 1992,in DR 47°16'N 143° 26'E, the sextant altitude of the pole star was 46°50.7 at 20h 51m 15s GMT, if IE was 2.1' off the arc and HE was 17m, find the direction of the PL and the position through which it passes.

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GOVERNMENT OF INDIA
SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

Code 84A

TIME: 3 HOURS | PASS MARKS: 140 | MAX MARKS: 200

Notes:
1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted, however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE **(30 MARKS EACH)**

Q.1 a) Define the following:
i) Declination ii) GHA iii) Rational Horizon
b) If the equation of time was +07m 53s and sun's declination was 10° 15'N and decreasing, calculate the SHAMS, assuming the Obliquity of the Ecliptic to be 23° 26.7'.

Q.2 a) Explain the three types of Lunar Eclipses with sketches.
b) Prove the expression
Sin Amp = Sin Decl x Sec Lat

Q.3 a) Define:
i) Parallax in altitude
ii) Horizontal Parallax

b) The true altitude of a star when bearing north was 70° 04'. Later the same star gave a true altitude of 30° 24' when bearing south. Find the star's declination and latitude of the observer.

SECTION II-PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY. ATTEMPT ANY THREE OUT REMAINING FOUR. **(35 MARKS EACH)**

Q.4 A vessel steering 140°(T) sights an island (15°02'S 167°15'E) 20° on her starboard bow. She then steams 20M when a celestial observation of a body worked using a DR Position 15°16'S 167°37'E, gave a bearing 140°(T) & intercept 9.2' away. Find the ships position at the time of the celestial observation.

Q.5 On 25th February 1992 AM on ship, in DR 20°04'S 090°04'W, the sextant altitude of the Moon's UL was 52°28.4' at GMT 25d 14h 52m 16s. If IE was 1.0'on the arc and HE was 19m, calculate the direction of the PL and the longitude where it crosses the DR latitude.

Q.6 On 29th Nov 1992, at ship in DR 25° 30'S 170° 20'W, the sextant altitude of star RIGEL was 51° 10.3' when the GMT showed 14h 29m 20s. If H.E. was 12m and I.E. 2.8' off the arc, find the direction of the PL and Intercept.

Q.7 On 12th Sept 1992 in DR 43° 06'S 72° 19' E the sextant meridian altitude of star Aldebaran was 30° 40.7'. If IE was nil & HE 18 m Find
a) The latitude & the PL.
b) The exact meridian passage time of the star to the nearest second.

Q.8 In DR 52° 11' N 170° 39' E the sextant altitude of the Sun's UL near the meridian was 31° 59.3' at GMT 06th March 1992, 01h 27m 30s. If IE was 2.3' on & HE was 40m, find the position line.

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GOVERNMENT OF INDIA
SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

Code 83A

TIME: 3 HOURS **PASS MARKS: 140** **MAX MARKS: 200**

Notes:
1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted, however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE **(30 MARKS EACH)**

Q.1 a) What are the three different types of lunar eclipses? With suitable figures explain how they are caused
b) Explain Synodic period & sidereal period of the moon.

Q.2 a) What are circumpolar bodies? Describe the conditions for a body to be circumpolar.
(b) Find two latitudes in which a star having declination of 67° 43' N will bear north with a true altitude of 17° 14'.

Q.3 a) Define parallax in altitude & horizontal parallax. With the aid of a figure show why this correction is always positive.
(b) To an observer in certain latitude the Sun bore 073° (T) at theoretical rising. Find the latitude of the observer if the declination of Sun was 13° 17' N.

SECTION II-PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY. ATTEMPT ANY THREE OUT REMAINING FOUR.
(35 MARKS EACH)

Q.4 In D/R 33°18'S 000°12.6'W a stellar observation gave an intercept of 4.2' away azimuth 241°(T). After steaming 090° (T) for 123 Miles another astronomical observation gave an observed longitude of 002° 20.0' E bearing 090° (T) .The position used for the second sight was obtained by allowing the run from the first ITP. Find the position of the ship at the second observation.

Q.5 On 25th Feb 1992, AM, in DR position 35° 03' S, 087° 11'E sextant altitude of Moon's U.L was 46° 30.6' at 03h 11m 15s GMT. If IE was 1.6' on the arc and height of the eye was 18m, find the direction of PL and a position through which it passes? Calculate using long by chron method.

Q.6 On 31st August 1992 in DR 60°06'N 066°18'W, the sextant altitude of the planet Mars was 41°32.4' at GMT 08h 15m 02s. If the IE was 2.1'on the arc and the HE was 10m, calculate the direction of PL and the position through which it passes using Marc St. Hilaire's (Intercept) Method.

Q.7 a) On 21st Jan 1992 on a ship in DR 24° 36'S, 110° 20'W, the sextant altitude of the Sun's LL on the meridian was 85°05.5'. If IE was 1.6' off the arc & HE was 10m, find the observer's latitude, state the direction of PL.
b) on 29th Nov 1992, AM at ship in DR 26° 27'N 130° 27'W, the azimuth of the Sun was 130°(C) at GMT 17h 47m 49s. If the variation was 3°E, find the deviation of the compass.

Q.8 On 02nd May 1992, on a ship in DR 15° 40' S 079° 58'W, the sextant altitude of Sun's LL near the meridian was 58° 16.5' at GMT 17h 38m 05s. If IE was 1.0' on the arc, HE was 25m, calculate the position and direction of PL.

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GOVERNMENT OF INDIA
SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

Code 91A

TIME: 3 HOURS **PASS MARKS: 140** **MAX MARKS: 200**

Notes:
1. Use nautical almanac 1992
2. Use of non-programmable scientific calculator is permitted; however, each step should be clearly shown

SECTION I – PTINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE **(30 MARKS EACH)**

Q.1 a) Define the following with sketch:
i) Sea mile ii) Geographical position iii) parallax
b) From Latitude 50°S a vessel steers 140°(T) until she changes her longitude by 15°. In what latitude will she arrive and what distance she has made good?

Q.2 a) Explain why the correction "augmentation of moon's semi diameter is applied to the semi diameter of the moon tabulated in the Nautical almanac. Why is the sun's semi diameter not augmented by similar correction?
b) By how much is Venus brighter than Jupiter on 6th March 1992?

Q.3 a) What is 'V' Correction? Why it must be applied for planets and Moon?
b) For an observer in longitude 085° 30' W, a star with an SHA of 268° 20' had an LHA of 100° 40'. If RAMS then was 11h 17mm 10s, calculate the GMT at that instant

SECTION II – PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY. ATTEMPT ANY THREE OUT OF REMAINING FOUR **(35 MARKS EACH)**

Q.4 At 1530hrs ship's time on vessel in DR position 15°20'S 179° 50'W an observation of Sun bearing 260° T, gave observed longitude 179° 55'W. The vessel then sailed on a course of 265°T at 15 knots .At 1900 hrs an observation of Venus gave an intercept of 4' away and azimuth of 165° T. If observation of Venus was calculated using DR obtained by allowing run on DR latitude and observed longitude at 1530hrs. Find the ship's position at 1900hrs

Q.5 In DR position 14° 20' N 086° 12' E sextant altitude of Sun's LL was 47° 10', (IE ~~105~~ 1.5' on the arc, HE :15m) at GMT 28th February 04h 02m 12s . Calculate the observed longitude in order to have a position through which to plot PL. Also calculate the direction of PL

Q.6 On 22nd Sept 1992 PM at ship in DR 62° 10' N 092° 27' E the sextant altitude of star 'Arcturus' was 25° 01' when GPS showed 22d 12h 51m 32s as GMT . If IE was 0.2' on the arc and HE was 17m, find the direction of P/L and the position through which it passes by intercept method

Q.7 a) June 1992 during morning twilight in DR 15° 43.6' N 110° 07.3'W when the GHA ♈ was 76° 39.2' the true altitude of Polaris was 16° 11.3'. Find the direction of the PL and position through which to draw it (20 Marks)
b) On 20th January 1992, in DR 54° 20' S 046° 27' W, the Sun sets bearing 236° C. If the variation was 3°W, find the deviation of compass (15 Marks)

Q.8 a) On 21st July 1992 noon, DR 25° 05'S 040° 20' W compute the sextant Meridian Altitude of SUN's LL , if IE is 2.7' OFF the arc and HE is 11.2m (20Marks)
b) Determine the Time limits within which an Ex- Meridian sight of Sun can be taken on that day (15Marks)

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GOVERNMENT OF INDIA
SECOND MATE OF A FOREIGN GOING SHIP
FUNCTION: NAVIGATION
PAPER: CELESTIAL NAVIGATION

Code 87A

TIME: 3 HOURS **PASS MARKS: 140** **MAX MARKS: 200**

Notes:
1. Use nautical almanac 1992.
2. Use of non-programmable scientific calculator is permitted, however, each step should be clearly shown.

SECTION I – PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE **(30 MARKS EACH)**

Q.1 a) Define Amplitude. Explain the difference between theoretical and visible Sun rise and Sun Set.
b) If the latitude was 64°27'S and declination of a star was 39°47'S.Find out if the body is circumpolar; if so calculate the upper and lower meridian altitude.

Q.2) Explain with the help of diagram where ever applicable:
a) Solar and lunar eclipse.
b) 'V' corrections and 'd' correction.

Q.3) Find the observer's position if altitude of the Sun is 44°10' when bearing 090° (T) and its declination at this instant is 11°13'N and GHA sun 0° 06.3'?

SECTION II - PRACTICAL NAVIGATION

QUESTION.4. IS COMPULSORY. ATTEMPT ANY THREE OUT REMAINING FOUR.
(35 MARKS EACH)

Q.4 Using DR 20°N, 40°W following sights were obtained
1740 Hrs Star vega Az 135°T intercept 5 miles away
1810 hrs Star altair Az 198° T intercept 4 miles towards
Vessel was steering 210° T at 15 Kts during the observation and SWly current was setting at 5 kts.
Find Ship's position at 1800 Hrs.

Q.5 On 20th July 1992 equator S Altitude of Moon UL at GMT 20D 05H 12M 45S was 67° 49'. If IE was 1.5' on the arc and HE was 20 meters find the direction of position line and longitude to draw it.

Q.6 ON 30th Nov 1992 in DR position 24° 56' N 165° 20' E Sextant altitude of Sun LL at GMT 29D 22H 28M 42S was 33° 00.5'. If IE was 0.5' on the arc and HE was 12 meters, find the direction of position line and position to draw it by intercept method.

Q.7 a) On 21st Jan 1992 on a ship in DR 24° 36'S, 110° 20'W, the sextant altitude of the Sun's LL on the meridian was 85°05.5'. If IE was 1.6' off the arc & HE was 10m, find the observer's latitude, state the direction of PL.
b) On 29th Nov 1992, AM at ship in DR 26° 27'N 130° 27'W, the azimuth of the Sun was 130°(C) at GMT 17h 47m 49s. If the variation was 3°E, find the deviation of the compass.

Q.8 On 1st Sept 1992 at ship in Long 178°E, the sextant altitude of the Pole Star was 18° 57.4' at 17h 23m 25s GMT, if IE was 1.5' on the arc and HE was 13.5m, find the direction of the PL and the position through which it passes. If Azimuth was 005(C), and variation 2.3E, find the deviation.

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Note: Que No 9(b) will be replaced by new question.

15/9/16

GOVERNMENT OF INDIA

15/09/2016

SECOND MATE OF A FOREIGN GOING SHIP
OFFICER IN-CHARGE OF A NAVIGATIONAL WATCH

FUNCTION: NAVIGATION

PAPER: CELESTIAL NAVIGATION

TIME: 3 HOURS **PASS MARKS: 140** **MAX. MARKS: 200.**

NOTES:

1. **Use nautical almanac 1992**
2. **Use of non-programmable scientific calculator is permitted, however, each step should be clearly shown.**

SECTION – I PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE (30 MARKS EACH)

Q.1 a) Define Amplitude. Explain the difference between theoretical and visible Sun rise and Sun Set.

b) If the latitude was 64°27'S and declination of a star was 39°47'S. Find out if the body is circumpolar ;if so calculate the upper and lower meridian altitude

Q. 2 a) What conditions are necessary for a heavenly body to,
I) Be circumpolar II) Cross Prime Vertical III) Rise bearing True east

b) Explain the factors which govern period of daylight for any observer.

Q.3 a) What are different types of Solar Eclipses? Explain the conditions which are required for Annular Solar Eclipse to occur.

~~b) If Latitude of Observer is 45°S & Declination of a heavenly body is 50°S, Find if the body is circumpolar. -If yes, then calculate Upper & Lower Meridian Altitude.~~

Find the two latitude in which a star having declination 68°51'S will have true altitude 11°50', when brg 180°T.

Contd...2...

SECTION II PRACTICAL NAVIGATION

QUESTION NO.4 IS COMPULSORY. ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR **(35 MARKS EACH)**

Q.4 A Sun sight in DR 20° N 178° 06′ E gave intercept 4 miles towards, Az 130° T. Ship then steered a course of 120° T for 120 miles when a stellar observation gave longitude 179° 58′ W. Find ship's position at the time of second observation if the ship experienced NxWly current and drift of 15 miles. DR used for second observation was calculated using ITP of first observation.

Q.5 On 30th April 1992 PM, in DR 12° 37'N 179° 12'W, the sextant altitude of sun's UL was 31° 18', GMT 03h 59m 24s on 1st May, I.E. 3.2' on the arc and HE was 18.7m. Find the direction of PL and the longitude where it crosses the DR lat.

Q.6 On 1st May 1992 PM at ship in DR 35° 10′ S 018° 00′ W sext alt of star Sirius at GMT 01d 19h 10m 45s was 57 28.5′. If IE was 2.1′ on the arc and HE was 11 meters find the direction of position line and position to draw it by intercept method.

Q.7 On 21st Jan 1992,In D/R 24°36'S 110°20'W the sextant altitude of the Sun's LL on the meridian was 85°05.5' If IE was 1.6'off the arc and HE was 10m,find the latitude and state the direction of the PL.

Q.8 On 1st December 1992 in longitude 065° 33.7′ E the sextant altitude of the Pole star was 23° 18′ at GMT 01d 01h 01m 48s. If index error was 0.3′ off the arc & height of eye 23 m, find the direction of the position line and the position through which it passes.

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12.07.2016

GOVERNMENT OF INDIA

SECOND MATE OF A FOREIGN GOING SHIP
OFFICER IN-CHARGE OF A NAVIGATIONAL WATCH

FUNCTION: NAVIGATION

PAPER: CELESTIAL NAVIGATION

TIME: 3 HOURS **PASS MARKS: 140** **MAX. MARKS: 200**

NOTES:

1. **Use nautical almanac 1992**
2. **Use of non-programmable scientific calculator is permitted, however, each step should be clearly shown.**

SECTION – I PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE (30 MARKS EACH)

Q. 1a) Explain why Venus is visible in mornings or evenings.

b) What should be the position of Sun's LL when taking amplitude & why?

Q. 2 a) What are circumpolar bodies? Describe the conditions for a body to be circumpolar.

b) Find two latitudes in which a star having declination of 67° 43' N will bear north with a true altitude of 17° 14'.

Q.3 a) Explain under what conditions, an observer on earth surface, will experience:

i) Solar Eclipse
ii) Annular eclipse
iii) Partial lunar eclipse.

b) Find the two latitudes in which a star having declination 68° 51' S will have true altitude 11° 50' when bearing 180°(T).

(b) To an observer in certain latitude the Sun bore 073°(T) at theortical rising. Find the latitude of the observer if the declination of sun was 13° 17' N.

38° 11.9' N

Contd...2...

SECTION – II PRACTICAL NAVIGATION

QUESTION NO. 4 IS COMPULSORY. ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR (35 MARKS EACH)

Q.4 An observation of a heavenly body gave an intercept of 6.7′ towards azimuth 053° (T). The DR used for working the sight was 35° 45' S 46° 44' E. After this sight the vessel steamed 129 ° (T) for 45 miles when a second observation was taken which gave Intercept of 3.7' towards azimuth 318° (T). Find the position of the vessel at the time of second observation if the second sight was worked from I.T.P. run up.

Q.5 In DR 35° 03'S, 087°11'E, on 25th Feb 1992, AM, the sextant altitude of Moon's UL was found to be 46° 29.5′ at 03h 11m 20s GMT. If HE was 22m and IE was 1.5′ on the arc. Find the longitude where PL cuts the DR latitude and the direction of position line.

Q.6 On 31st Aug1992, AM at ship in D/R position 40°30'N 064°56'E,the sextant altitude of star DIPHDA′ was 21°23.4′at 00h 20m 26s GMT.IF HE was 9m,IE 0.9′ off the arc, find the direction of PL and a position through which it passes by Marc st. Hillarie's (Intercept) Method.

Q.7 On 12th Sept 1992 In DR 43° 06'S 72° 19' E the sextant meridian altitude of star Aldebaran was 30° 40.7'. If IE was nil & HE 18 m Find
a. The latitude & the PL.
b. The exact meridian passage time of the star to the nearest second.

Q.8 On 1st Sept 1992 at ship in Long 178°E, the sextant altitude of the Pole Star was 18° 57.4′ at 17h 23m 26s GMT, if IE was 1.5' on the arc and HE was 13.5m, find the direction of the PL and the position through which it passes. If Azimuth was 005(C), and variation 2.3E, find the deviation.

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9/5/16

GOVERNMENT OF INDIA

SECOND MATE OF A FOREIGN GOING SHIP
OFFICER IN-CHARGE OF A NAVIGATIONAL WATCH

FUNCTION: NAVIGATION

PAPER: CELESTIAL NAVIGATION

TIME: 3 HOURS **PASS MARKS: 140** **MAX. MARKS: 200**

NOTES:

1. Use nautical almanac 1992
2. Use of non-programmable scientific calculator is permitted, however, each step should be clearly shown.

SECTION – I PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE (30 MARKS EACH)

Q. 1 a) Describe the retrograde and direct motion of Venus.
b) Explain the factors which governs period of daylight for any observer.

Q. 2 a) Explain different types of twilights.
b) An observer on the North Pole finds the true altitude of a star to be 15^0 25′. In what latitudes will an observer find the meridian altitude of the same star to be double this value?

Q. 3 a) Define Amplitude. Explain the difference between theoretical and visible sunrise and sunset.
b) A star of declination 60^0 05′N is on the meridian of an observer, below the pole, having True Alt. $09^0$42′. Calculate its bearing at maximum azimuth and the time period after which it will occur.

Contd...2....

09/05

SECTION II – PRACTICAL NAVIGATION

Q.4 is compulsory. Attempt any three Questions from the remaining four. (35 marks each).

Q. 4 At 0400 hrs a light house in position 15° 02'S 167° 15'E bore 160°(T). Vessel steams 140°(T) x 10kts for 2 hours. When an observation of the Moon worked using DR 15° 16'S 167° 35'E gave bearing 140°(T) and intercept 7.4' away. Find the ship's position at second observation.

Q. 5 On 22nd sept 1992, AM at ship in DR 10° 02'S 076° 50'E, the sextant altitude of the Moon's LL was 44° 31.7' at 00h 24m 49s. If IE was 0.6' on the arc and HE was 14m, find the direction of the PL and the longitude where it cuts the DR latitude. GMT

Q. 6 On 31st Aug 1992, AM at ship in DR 40° 30'N 064° 56'E, the sextant altitude of star 'DIPHDA' was 21° 23.4' at 00h 20m 26s GMT. If HE was 9m, IE 0.9' off the arc, find the direction of PL and a position through which it passes by Marc St. Hillarie's (Intercept) method.

Q. 7 a) On 1st May 1992, in DR 30° 06'N 179° 45'W, the setting sun bore 285°(C) . If variation was 2°E, find the deviation for the ship's head.
b) On 21st Jan 1992, in DR 24° 36'S 110° 20'W the sextant altitude of the Sun's LL on the meridian was 85° 05.5'. If IE was 1.6' off the arc and HE was 10m, find the latitude and state the direction of the PL.

Q. 8 On 21st July' 92, in DR 31°40'N 031°30'E, compute the sextant altitude of Polaris at GMT 17h 34m. If I.E. 1.7' on the arc & H.E. 16m. If the compass bearing of the pole star was 349°(C) and variation was 12°E, find the deviation.

09/05/16

$\frac{\text{d.long} \times \text{long}}{360}$

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GOVERNMENT OF INDIA

SECOND MATE OF A FOREIGN GOING SHIP
OFFICER IN-CHARGE OF A NAVIGATIONAL WATCH

FUNCTION: NAVIGATION

PAPER: CELESTIAL NAVIGATION

TIME: 3 HOURS **PASS MARKS: 140** **MAX. MARKS: 200**

NOTES:

1. **Use nautical almanac 1992**
2. **Use of non-programmable scientific calculator is permitted, however, each step should be clearly shown.**

SECTION – I PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE (30 MARKS EACH)

Q. 1 a) State and explain in short Kepler's law of planetary motion. (15 Marks)

b) Find the duration of 'Nautical Twilight' for an observer in Latitude 35° N, when the declination of sun is 20° 30'N. (15 Marks)

Q. 2 a) What is 'International Date Line'? Why is it necessary? How is the date on ship altered on crossing this line? (15 Marks)

b) Sketch and show Rational Horizon Diagram for a rising body whose Declination is 10° N and observer's latitude is 20°N. Also show the angle which is measured at Amplitude. (15 Marks)

Q. 3 a) Explain with figures which eclipse (solar eclipse or lunar eclipse) is seen by more number of people from the surface of the earth and why? (15 Marks)

b) Draw celestial sphere in the plane of the RH of observer in lat 30° N. The declination of body is 15° N & is to the west of observer. Altitude at the time of observation is 54°. Calculate LHA of the body. (15 Marks)

SECTION – II PRACTICAL NAVIGATION

QUESTION NO. **4** IS COMPULSORY. ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR **(35 MARKS EACH)**

Q. 4 A vessel using the D/R position 20°N 40°E obtained the following observations:
1840 Hrs: Star 'A' – Azimuth 145° x 5' Towards
1910 Hrs: Star 'B' – Azimuth 190° x 3' Away
If the course steered by the vessel during this time was 210° (T) and speed was 12 knots, calculate the vessel's position at 1900 Hrs.

Contd...2...

Q. 5 On 30th April 1992, AM at ship, in D/R position 00° 20'N 060° 12'W the sextant altitude of sun's UL was 44° 17.7' at 13h 00m 52s GMT. If IE was 1.2' on the arc and HE was 20 m, find the direction of PL and the longitude where it crosses DR Latitude?

Q. 6 On 19th Jan 1992, during the evening twilight at ship, in D/R position 00° 02'N 170° 50'E, the sextant altitude of a Star BETELGEUSE was found to be 43° 11.1' at 07h 33m 44s GMT. If HE was 18 m, IE 1.3' off the arc, find the Intercept and direction of PL?

Q. 7 a) On 23rd September 1992 DR 23° 40' N 161° 56'E compute the sextant Meridian altitude of Sun's LL if IE was 2.3' on the arc and HE was 10.5m. (20)

b) Compass bearing of Sun was S 72° E at 05d 04h 00m GMT on 5th March 92. Ship's DR then was 18° 45' N 068° 40'E. Find compass error. (15)

Q. 8 On 15th June' 92 in DR 20° 56'S 080° 00'E the sextant altitude of Sun L.L. near the meridian was 45° 40.2' when GPS showed 15d 06h 35m 44s GMT. If IE was 1.6' on the arc and the HE was 17m. Find the direction of the PL and the latitude where it cuts the DR Longitude.

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80 a

Jan'2016

GOVERNMENT OF INDIA

SECOND MATE OF A FOREIGN GOING SHIP
OFFICER IN-CHARGE OF A NAVIGATIONAL WATCH

FUNCTION: NAVIGATION

PAPER: CELESTIAL NAVIGATION

TIME: 3 HOURS **PASS MARKS: 140** **MAX. MARKS: 200**

NOTES:

1. **Use nautical almanac 1992**
2. **Use of non-programmable scientific calculator is permitted, however, each step should be clearly shown.**

SECTION – I PRINCIPLES OF NAVIGATION

ATTEMPT ANY TWO QUESTIONS OUT OF THREE (30 MARKS EACH)

Q. 1 Explain/define with diagram:
a) Geographical position of a celestial body
b) Amplitude
c) Rational horizon
d) Dip
e) Equation of time

Q. 2 a) What do you understand by a Circumpolar Body? What are the conditions necessary for a heavenly body to be circumpolar? Substantiate your answer with a suitable sketch?
b) If the sun's declination is 12°42'S, in what latitudes will there be:
i. Phenomenon of Midnight Sun;
ii. Twilight All Night

Q. 3 a) Define:
i) Parallax in altitude
ii) Horizontal parallax

b) The true altitude of a star when bearing north was $70^0 04'$. Later the same star gave a true altitude of $30^0 24'$ when bearing south. Find the star's declination and latitude of the observer.

SECTION – II PRACTICAL NAVIGATION

QUESTION NO. 4 IS COMPULSORY. ATTEMPT ANY THREE QUESTIONS FROM THE REMAINING FOUR (35 MARKS EACH)

Q. 4 In DR 49^0 30'S 069^0 14'E, an observation of a heavenly body gave an intercept of 9.5'(T) on an azimuth of 056^0(T). Vessel then steamed on a course of 144^0(T) for 35 miles when the 2nd observation of a heavenly body gave an intercept of 8.2'(T) on an azimuth of 324^0(T). find the position of the vessel at the time of 2nd observation. The second sight was worked from I.T.P run up.

Contd...2...

Q. 5 On 02nd Sept 1992at ship in DR40°19.0'S 000°20'W, the sextant altitude of Sun's UL, west of the meridian was 10°02.0' at GMT 16h 43m 12s. If HE was 25m and IE 2.4' off the arc, find the direction of the PL and the longitude where it cuts the DR latitude.

Q. 6 On 31st Aug 1992, on a ship in DR 60°06'N 066° 18'W, the sextant altitude of Mars was 41°32.4' when GMT was 08h15m02s. If IE was 2.1' on the arc, HE was 10 m, Calculate the Intercept and direction of PL.

Q. 7 a) On 01st Sept 1992, sextant meridian altitude of Sun's UL was 70°29.8' North of the observer in DR longitude 116°27'W. if I.E was 3.2' off the arc and HE was 12m, find the observed latitude and state the direction of the PL.

b) On 01st May 1992, in DR 30°06' N 179°45'W, the setting Sun bore 285°(C). If variation was 3°W , Find the deviation for the ship's head.

Q. 8 On 02nd May 1992, on a ship in DR 15°40' S 079°58'W, the sextant altitude of Sun's LL near the meridian was 58°16.5' at GMT 17h38m05s. If IE was 1.0' on the arc, HE was 25m, calculate the position and direction of PL.

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