ANNEX B OF CMO NO. 20, SERIES OF 2015
BACHELOR OF SCIENCE IN MARINE TRANSPORTATION
COURSE SPECIFICATIONS

Course Code	**:**	Nav 4
Course Descriptive Title	**:**	Celestial Navigation
Course Credits	**:**	3 units
Lecture Contact Hours per Week	**:**	2 hours
Laboratory Contact Hours per Week	**:**	3 hours
Prerequisite/s	**:**	Nav 3
Reference/s	**:**	1. Table A-II/1 of the 1978 STCW Code as amended Function: Navigation at the Operational Level 2. Table A-II/2 of the 1978 STCW Code as amended Function: Navigation at the Management Level 3. IMO Model Course 7.01 and 7.03 4. Annex A of CMO No. 20, Series of 2015 (Curriculum Mapping for BSMT)

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	TOPICS/ PERFORMANCE	APPROX HOURS
Plan and conduct a passage and	*Celestial Navigation*	1. Solar System − Describes the composition and dimensions of the	4

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	TOPICS/ PERFORMANCE	APPROX HOURS
determine position	Ability to use celestial bodies to determine the ship's position	solar system − Names inferior and superior planets − Describes the earth's elliptical orbit, and states approximate perihelion and aphelion distances and dates − Explains the eccentricity of the earth's orbit − Describes the inclination of the earth's axis to the plane of the orbit and the stability of the axis (ignoring precession) and its effect on the seasons − States the dates of the solstices and equinoxes − Explains the concept of the earth's axial rotation giving day and night − Explains the varying length of daylight through the year − Explains daylight and darkness conditions in various latitudes at the solstices and equinoxes − Describes the significance of the tropics of Cancer and Capricorn and of the Arctic and Antarctic Circles	
		2. Celestial sphere and equinoctial system of co-ordinates − Describes the celestial sphere − Explains the apparent annual motion of the sun and the concept of the ecliptic − Defines 'celestial poles', 'celestial meridians', 'equinoctial' and the 'obliquity of the ecliptic' − States that the equinoctial as a fixed reference plane and the direction of the First Point of Aries as a reference direction (ignoring the effect of precession) − Describes the equinoctial system of co-ordinates	4

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	TOPICS/ PERFORMANCE	APPROX HOURS
		and defines sidereal hour angle, declination and polar distance − Extracts information from the star diagrams in the Nautical Almanac or equivalent star finding device	
		3. Hour angle − Describes the concept of the earth's axial rotation causing change in the hour angle of bodies − Defines 'Greenwich Hour Angle (GHA)', 'Local Hour Angle (LHA)' and longitude, and explains their relationship − Describes the rate of change of GHA of the sun and Aries − Identifies the tabulation of SHA, GHA, and declination (and 'd' and 'v' corrections) in the Nautical Almanac for all celestial bodies − Determines the geographical position of a body for any given GMT	4
		4. Daily motion and horizontal system of co-ordinates − Defines 'rational horizon', 'zenith' and 'nadir' − Defines 'vertical circle' and 'prime vertical circle' − Defines 'elevated pole' and 'depressed pole' − Proves that the altitude of the elevated pole is equal to the observer's latitude − Defines the observer's upper and lower celestial meridian − Identifies the apparent daily path of all bodies − Defines 'true altitude', 'azimuth', and 'true zenith distance'	6

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	TOPICS/ PERFORMANCE	APPROX HOURS
		− Explains the relationship between azimuth, quadrantal bearings and 360º notation bearing − Recognizes rising and setting points and defines amplitude − Explains the meaning of the term circumpolar and describes the conditions necessary for a body to be circumpolar − Describes the condition necessary for a body to cross the prime vertical − Recognizes the parts of the PZX triangle − Draws figures on the plane of the rational horizon and of the observer's celestial meridian, using the equidistant projection to illustrate navigational problems and principles	
		5. Sextant and altitude corrections − Defines 'sextant altitude' − Describes the parts of a sextant − Demonstrate how to retrieve and return a sextant into the storage box − Demonstrates how to read a sextant − Shows how to correct a sextant into which has been introduced one or more of error of perpendicularity, side error or index error − Demonstrates how to find the index error of the sextant by the horizon − Describes how to find the index error of the sextant by the sun − Uses the sextant for taking vertical and horizontal angles − Describes the purpose of altitude correction	6

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		− Defines 'visible', 'sensible' and 'rational' horizons − Defines 'observed altitude' and 'true altitude' − Defines 'dip', 'refraction', 'semi-diameter' and 'parallax', and explains their causes − Applies index error − Applies the corrections for the items listed in above objectives and explains the factors determining their magnitude − Illustrates the effect of terrestrial refraction on the dip and distance of the sea horizon − Demonstrates the use the altitude correction tables in the Nautical Almanac, including reference to critical tables, interpolation tables and low-altitude correction tables − Obtains the true zenith distance from the true altitude of the body	
		6. Amplitude − Determines the observed altitude of the sun when the true altitude is zero − Explains the effect of latitude on the accuracy of amplitude observations − Calculates the LAT and LMT of the theoretical and visible rising and setting of the sun − Extracts information from the tabulation of the rising and setting of the sun in the Nautical Almanac	2
		7. Time and equation of time − Defines describes the apparent solar day and states the relationship between LHA (sun) and LAT	2

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		− Defines 'sidereal day' and states that it is a fixed time interval − Explains the reasons for the sun's irregular rate of change of SHA and hence the necessity to adopt the astronomical mean sun for timekeeping purposes − Describes the equation of time (ET) and its components − Determines the ET from the Almanac and its sign of application − Defines GMT, LMT and longitude − Defines zone times and standard time − Explains how to alter the ship's time during a passage with increasing or decreasing longitude − Demonstrates the use of time signals − Determines the error of a chronometer or watch	
		8. Nautical Almanac − Describes the information contained in general in the Nautical Almanac (NA) and in detail in the daily pages − Uses the tables of corrections and incremental corrections in the Nautical Almanac − Finds the LHA of a body, given the date, GMT and longitude of the observer − Explains the importance of the First Point of Aries − Finds the LHA of Aries, given the date, GMT and longitude of the observer − Explains what is meant by the sidereal hour angle of a star and obtains it from the Nautical Almanac	6

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	TOPICS/ PERFORMANCE	APPROX HOURS
		− Derives the LHA of a star from the LHA of Aries and the SHA of the star − Demonstrates the uses the information in the Nautical Almanac to obtain the LMT of the meridian passage of a body to the nearest minute and interpolates for the observer's longitude when necessary	
		9. Latitude by meridian altitude − Applies the true zenith distance of a body when it is on the observer's meridian to the declination of the body, to obtain the observer's latitude − Applies these correctly when the declination and latitude have the same name − Applies these correctly when the declination and latitude have different names − Describes the relationship between the altitude of the elevated pole and the latitude of the observer − Explains what is meant by a circumpolar star, and the terms upper and lower transit − Finds the value of the polar distance of the body, using its declination − Applies the polar distance to the true altitude of a body at lower transit to find the altitude of the elevated pole and the latitude − Describes the direction of the position line through the observer when taking a meridian altitude	3
		10. Pole Star observations − Identifies certain major stellar constellations and navigational stars, describes their movement relative	3

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	TOPICS/ PERFORMANCE	APPROX HOURS
		to Polaris and the movement of Polaris with change of latitude − Identifies Polaris − Identifies some major constellations − Describes the motion of the stars about Polaris − Describes the relationship between the altitude of Polaris and the observer's latitude − Deduces from the above objective that the true altitude of Polaris can be used to find the latitude of the observer − Obtains the corrections, -1°, $+a_0$, $+a_1$, $+a_2$, from Pole Star tables in the 'Nautical Almanac' and applies them to the altitude of Polaris to find the latitude of the observer − Finds the true azimuth of Polaris from the tables and the direction of the position line	
		11. Position fixing − Combines the equinoctial and horizon system of co-ordinates to determine the centre and radius of a position circle and its direction in the vicinity of a selected position − Applies the principles of a method of enabling the navigator to draw a small part of the position circle in his vicinity to a practical problem − Explains the assumptions made when plotting celestial position lines and the circumstances in which they may become significant − Determines the direction of a position line through an observer and a position through which it passes	20

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		− Defines and evaluates the co-latitude, polar distance and zenith distance and uses them as the sides of the PZX triangle − Solves the PZX triangle to find the calculated zenith distance of the body when it is out of the meridian − Applies this calculated zeníth distance to the true zenith distance of the body to find the intercept and the intercept terminal point	
Determine position and the accuracy of resultant position fix by any means (ML)	Position determination in all conditions: .1 by celestial observations	1. Celestial Observations (MC 7.01) Determines parameters for position monitoring on ocean passages using celestial observations of the sun and stars uses appropriate techniques, frequency and is completed accurately Assess the accuracy of position monitoring using celestial techniques	10
		TOTAL	70