
# 2ND MATE (F.G.) – MMD EXAMS SOLVED PAST QUESTION PAPERS

## Subject: - BRIDGE WATCHKEEPING & EMERGENCIES

## From - Jan-16 till Jan-22

*This book has been prepared to assist in preparation for Written Exams Only. It has been prepared by dedicating countless Hours in the form of references to Past Notes, Codes, Amendments & Online Contents.*

*All efforts have been made to ensure correctness of information before putting it down in this book.*

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# GYRO COMPASS

**Q) Explain the starting procedure of gyro compass** *(March-17)*

Ans:- Starting a Gyrocompass

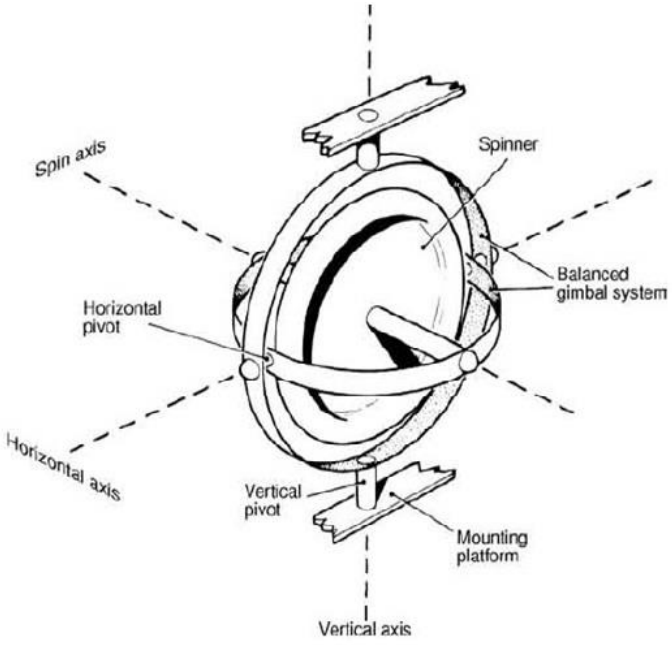
- A gyro needs time to settle on the meridian, the time taken will depend on the make, model & geographical location of the gyro.
- The settling time may be between one & several hours, manual provided by the manufacturer has to be consulted before switching on the gyro.
- If compass has been switched off, it will take longer time to bring compass into use.
- Following is the procedures for Sperry MK 37 digital.
- At power-up and prior entering the settling mode, system performs automatic procedure to determine if the equipment is operating within specified parameters.
- If gyro is stationary the system opts for cold start, if rotating a hot start if programmed.
- During a cold start, if no heading data is input to system when requested the gyro selects automatic. Once the power is switched on, two bleeps prompts for heading input, if the heading data is not entered within 5 minutes, the gyro switches to an auto level process. (In some older make, the slewing is done manually, a special key is provided for the same which is inserted into a slot).
- If heading data is fed the rotor is automatically slewed.
- The rotor is brought up to required speed within 14 minutes and the gyro will subsequently settle within an hour.
- If heading data is not fed, the gyro will settle within 5 hrs.

Some more points:-

- If entered heading is in error by more than 20 deg, gyro may take about 5 hours to settle.
- Once gyro is settled, synchronize the repeaters (radar & ECDIS also need synchronization.)
- If speed & latitude is fed manually, it should be done prior to starting the gyro.
- Once settled, compass error should be checked & compasses should be checked more frequently.

**Q) What is a free gyroscope? What are two properties of a gyroscope?** *(Aug-21, Dec-20, Jan-20, Sept-18, May-17)* **OR**
**With respect to a free gyroscope, with suitable figures, briefly explain the following terms: Gyroscopic inertia** *(Nov-20, May-19, July-17)* **OR**
**Q) With respect to a free gyroscope, with suitable figures, briefly explain the following terms: Precession** *(Oct-21, Jan-21, Dec-20, Nov-20, Jan-20, May-19, May-18, July-17, Jan-17)*

Ans:- Gyroscope having three degrees of freedom is called "FREE GYROSCOPE"




**A free Gyroscope**

Properties of Free Gyroscope:-

1) Gyroscopic inertia or rigidity in space.
2) Precession.

1) Gyroscopic Inertia:- A freely spinning gyroscope will maintain its axis of spin in the same direction with respect to space irrespective of how its supporting base is turned. It resists any attempt to change its direction of spin. Thus a free gyroscope has high directional stability. This property is called GYROSCOPIC INERTIA or RIGIDITY IN SPACE.

2) Precession:- Precession is the angular displacement of the spin axis of the gyroscope when a torque is applied to gyroscope. Hence, when a torque is applied to the spin axis the resulting movement will be in the direction at right angle to the applied torque. Earth is also a free gyroscope pointing north axis toward Polaris (rigidity in space). We all are also aware that earth also possesses force of gravity.

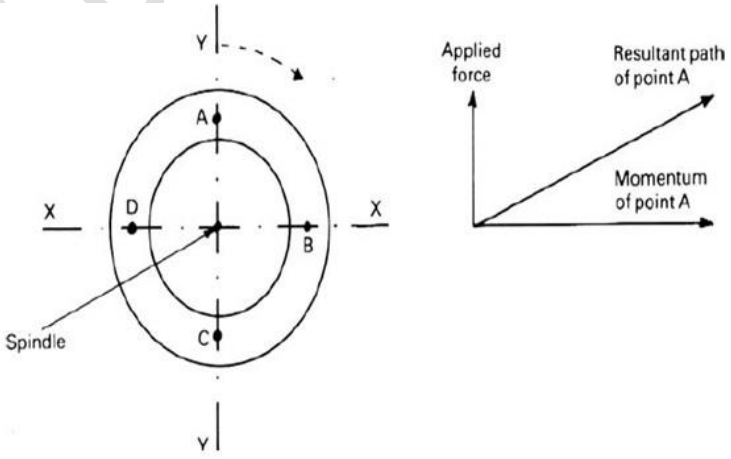



**FIG: Gyro Precession**

First property of free gyro scope is useful. However, due to the placing of this gyroscope on the surface of the earth it will be moved along the direction of rotation of the earth. As such the gyroscope will have an apparent motion. For example, at night if the gyroscope is made to point in the direction of a star, then the gyroscope will follow the star as the earth rotates and the star apparently moves in the sky.

W.R.T earth's surface the free gyro scope will not point in a fix direction but will be exhibiting tilt & drift.

**Q) With respect to a free gyroscope, with suitable figures, briefly explain the following terms: Drift and Tilt** *(Jan-22, Nov-21, Oct-21, Jan-21, Nov-20, Sept-19, May-19, Sept-18, July-18, May-18, July-17, Jan-17)*

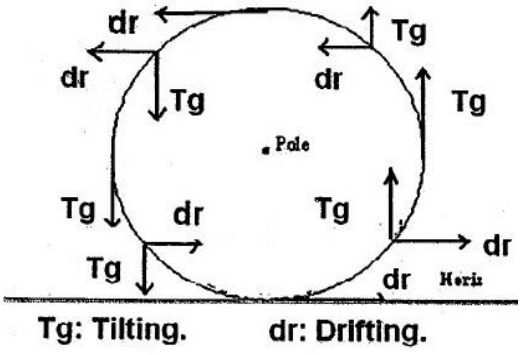
Ans:- W.R.T earth's surface the free gyro scope will not point in a fix direction but will be exhibiting tilt & drift.

**Tilt** is elevation or depression of the spin axis above or below the horizon.
**Drift** is the movement of the spin axis in the direction of azimuth.

**Rate of tilting** in degrees per hour = $15^O$ sine Azimuth * cosine Latitude
**Rate of Drift** in degrees per hour = $15^O$ sine Latitude

**Tilt**:-

- If a free gyroscope is situated on the equator and lies with its axis East West and horizontal, it can be assumed of as pointing to a star with zero declination and is about to rise.
- The East End of the gyroscope axis will follow the movement of this star and will tilt upwards as the star rises.
- After nearly six hours the axis will be vertical and after nearly twelve hours the gyroscope will have turned completely over with the axis again horizontal but now the original East end of the axis would be pointing to the star setting due West.
- After one sidereal day, the gyroscope would have tilted through $360^O$ and the star would again be rising.
- This rate of tilting of $360^O$ in a day is a rate of $15^O$ per hour.
- If the gyroscope had been situated on the equator with its axis lying in the North – South direction, then the North end would be pointing towards the Pole star and would then have no apparent movement relative to the Earth.
- The rate of tilting thus varies from zero when the axis is lying North – South to a maximum when it is lying East – West. That is the rate of tilting varies as the Sine of the Azimuth.
- A free gyroscope situated at a pole with its axis horizontal would have an apparent turntable motion due to the Earth's rotation.
- That is it would follow a fixed star around the horizon but it would not rise or set.
- The rate of tilting thus varies from a maximum when the latitude is $0^O$ to zero when the latitude is $90^O$. That is the rate of tilting varies as the Cosine of the Latitude.
- Rate of tilting in degrees per hour = $15^O$ sine Azimuth * cosine Latitude
- The direction of tilting is such that the end of the gyroscope axis, which lies to the East of the meridian, tilts upwards and the end of the axis, which lies to the West of the meridian tilts downward.




The gyroscope moves through 360° in one sidereal day.

**Drift**:-

- Drift is the apparent movement of a gyroscope in azimuth.
- A free gyroscope situated at the North Pole with its axis horizontal will have an apparent movement, which is entirely in the horizontal plane.
- Its axis will appear to move in a clockwise direction when viewed from above. This would be due to the real counter clockwise rotation of the earth beneath, this circular motion causes the gyroscope to drift through $360^{O}$ in one sidereal day, that is at a rate of $15^{O}$ per hour.
- A free gyroscope situated at the equator with its axis horizontal will not drift at all, irrespective of whether its axis is set in the North – South or East – West line.
- The rate of drift for a gyroscope with its axis horizontal thus varies from a maximum at the poles to zero at the equator.
- That is the rate of drift varies as the sine of the latitude. For a free gyroscope with its axis horizontal: Rate of Drift in degrees per hour = $15^{O}$ sin Latitude.
- The direction of drift depends upon hemisphere so that the North end of a horizontal gyroscopic axis drifts to the eastwards in the Northern hemisphere but to the Westwards in the southern hemisphere.

**Q) Differentiate between: Tilt and Drift** *(Jan-22)*

Ans:-

| Tilt | Drift |
|---|---|
| Caused by the Ship's roll | Caused by current or wind |
| Deviation from vertical | Deviation from the intended course |
| Measured by inclinometer | Measured by GPS or other navigational aids |
| Can be corrected by ballasting or shifting cargo | Can be corrected by adjusting course or using engines |
| Can affect the accuracy of gyrocompass and other navigational equipment | Can cause grounding or collision with other vessels or objects in the water. |

**Q) Differentiate between: Torque and Precision** *(Jan-22)*

Ans:-

| Torque | Precision |
|---|---|

| | |
|---|---|
| Torque is the twisting force applied to an object. | Precision is the degree of accuracy and exactness with which a measurement or calculation is made. |
| It is a measure of rotational force. | It is a measure of how closely individual measurements agree with each other. |
| It is measured in Newton-meters (Nm) or pound-feet (lb-ft). | It is measured in terms of the number of decimal places in a measurement or calculation. |
| It is important in determining the ability of a motor or engine to rotate a shaft or wheel. | It is important in determining the accuracy of measurements in various applications. |
| It can be affected by factors such as friction and the properties of the material being rotated. | It can be affected by factors such as the precision of instruments, the skill of the operator, and the environmental conditions. |

**Q) Explain following terms with respect to Operation of Gyro Compass: Three degree of Freedom.** *(Oct-21)*

Ans:- In the operation of a Gyro Compass, the term "Three degrees of freedom" refers to the ability of the compass to maintain its orientation in three dimensions, even when the ship is experiencing pitch, roll, and yaw.

The three degrees of freedom are:

1. Roll - the side-to-side motion of the ship
2. Pitch - the up-and-down motion of the ship
3. Yaw - the rotation of the ship around its vertical axis

The Gyro Compass compensates for these three degrees of freedom by using a series of gimbals to keep the compass card aligned with true north. The first gimbal allows the compass to remain upright and level, the second gimbal allows for pitch and roll compensation, and the third gimbal allows for yaw compensation.

This ability to maintain orientation in three dimensions is crucial for accurate navigation, as it ensures that the compass is always pointing towards true north, regardless of the ship's movements.

**Q) How is the Gyro Compass System made North Seeking?** *(Sept-17, July-16, Jan-16)*

Ans:- North Seeking Gyro:-

- In order to damp unwanted oscillation, we need to achieve damping in tilt.
- This is done by means of offset slightly to the east of vertical, resulting in component of the same force producing the required torque.
- The magnitude and direction of this force is pre-calculated to achieve the required damping oscillation.
- The amplitude of each oscillation is reduced to 1/3rd of previous oscillation.
- The spin axis reaches equilibrium and settles in a position at which drifting is counteracted by control precession & the damping precession counteracts tilting.
- Finally, the gyro settles in the meridian & becomes north seeking.

**Q) Explain the term latitude course & speed error with respect to the Gyro Compass.** *(Mar-21, March-20, March-19, Jan-18, Sept-17, July-16, Jan-16)* **OR**
**With regards to Gyro Compass, briefly explain: Procedure to determine the compass error** *(Jan-17)* **OR**
**Explain the course and speed correction of the Gyro and how will you apply?** *(May-16)* **OR**
**Explain w.r.t. Gyro Compass the terms 'settling error'.** *(May-18)*

Ans:- Course, Speed and Latitude Error (Speed Error):-

- The gyro compass settles in the N/S direction by sensing Earth's spinning motion. Same gyro compass when placed on a ship also senses the ship's motion. And therefore, the axis of gyro compass settles in a direction which is perpendicular to the resultant of the Earth's surface speed and the ship's velocity.
- The direction, in which the compass settles, is therefore, different to the direction of the True North and depends on ship's course, speed and latitude of the observer.
- This error also increases as the observer's latitude increases. The error is westward on all Northerly courses and vice-versa.
- In exactly E-W courses, the error is nil. In exactly N-S courses, the error is maximum.
- To compensate for speed error, a speed rider is provided, which in association with the latitude rider, shifts the lubber line equal to speed error in the appropriate direction.
- This error can be corrected automatically by a mechanism which moves the lubber line by an amount equal to the error, or it can be found from correction tables or from a portable correction calculator and then applied as necessary.

**Q) Explain importance of Taking & Recording Compass Error?** *(Nov-21)*

Ans:- Taking and recording compass error is important for several reasons:

1. Accurate navigation: Compass error is the difference between true north and magnetic north. By taking and recording the compass error, the navigator can make the necessary corrections to ensure accurate navigation.
2. Safety: Accurate navigation is crucial for safety at sea. A small error in compass reading can lead to a large error in course plotting, resulting in a potential collision or grounding.
3. Compliance: Taking and recording compass error is required by international regulations such as SOLAS and COLREGs. Failure to comply with these regulations can result in penalties and/or detention of the vessel.
4. Troubleshooting: Recording compass error over time can help identify and troubleshoot issues with the compass system. For example, if the error suddenly increases, it could indicate a problem with the compass or a change in the vessel's magnetic signature.

Overall, taking and recording compass error is a crucial aspect of safe and accurate navigation at sea.

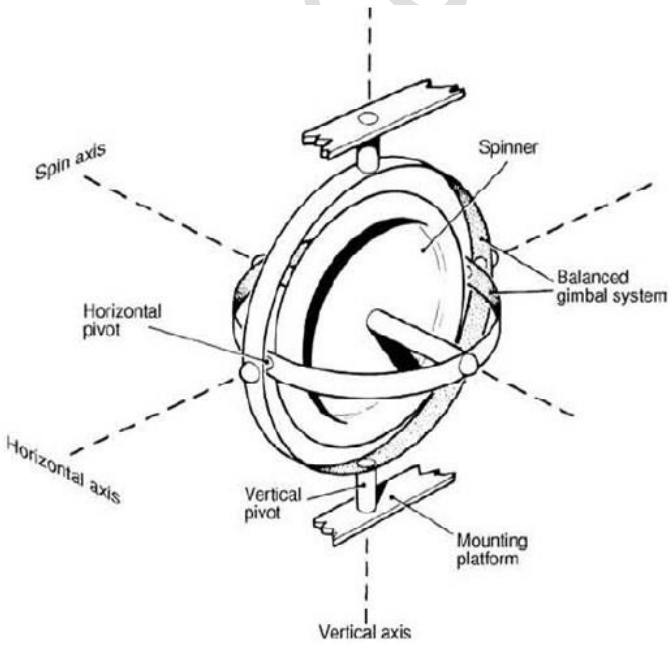
**Q) Explain w.r.t. Gyro Compass the terms 'tangent error'.** *(Jan-18)* **OR**
**Explain w.r.t. Gyro Compass the terms 'steaming error'.** *(Jan-19, May-18)*

Ans:- Tangent Error:-

- On a non-pendulous gyrocompass where damping is accomplished by offsetting the point of application of the force of mercury ballistic, the angle between the local meridian and the settling position or spin axis.
- Where the offset of the point of application of mercury ballistic is to the east of the vertical axis of the gyrocompass, the settling position is to the east of the meridian in north latitudes and to the west of the meridian in south latitudes.
- The error is so named because it is approximately proportional to the tangent of the latitude in which the gyrocompass is operating.
- The tangent latitude error varies from zero at the equator to a maximum at high northern and southern latitudes.

**Q) With respect to a free Gyroscope, briefly explain the following terms: Three Degrees of Freedom** *(Oct-21, Nov-20)*

Ans:- As a mechanical device a gyroscope may be defined as a system containing a heavy metal wheel or rotor, universally mounted so that it has three degrees of freedom: spinning freedom, about an axis perpendicular through its center; tilting freedom, about a horizontal axis at right angles to the spin axis; and veering freedom, about a vertical axis perpendicular to both the other axes. The three degrees of freedom are obtained by mounting the rotor in two concentrically pivoted rings, called inner and outer rings. The whole assembly is known as the gimbal system of a free or space gyroscope. The gimbal system is mounted in a frame, so that in its normal operating position, all the axes are mutually at right angles to one another and intersect at the centre of gravity of the rotor.




**A free Gyroscope**

## MAGNETIC COMPASS

**Q) Why the vessel is required to be swung once in a year to verify Magnetic Compass Deviation Card?** *(March-17, May-16)*

Ans:- Swinging the compass or swinging the ship:-

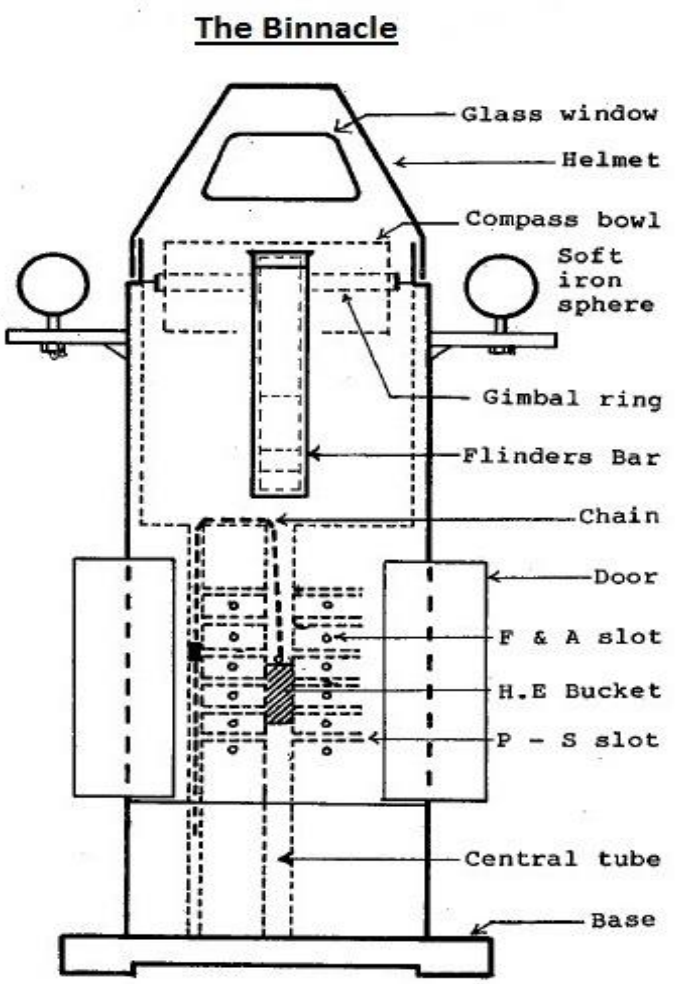
- Swinging the compass, or swinging the ship (as the operation is sometimes more

accurately called as the ship swings around the compass card which, ideally, remains pointing north), involves taking the vessel to a suitable location in open water with plenty of room for maneuvering. With the vessel steady on each of the eight primary compass points, existing compass headings or bearings are compared with what we know the actual magnetic headings or bearings should be, the difference being the deviation.

- During the process, any magnetic fields, created by the ship's structure, equipment, etc, which cause the compass to deviate are reduced or, if possible, eliminated, by creating equal but opposite magnetic fields using compensating correctors. These are placed inside the compass binnacle or adjacent to the compass:
  - Magnets are aligned fore and aft and athwartships to create horizontal magnetic fields to compensate for the permanent horizontal components of the ship's magnetism.
  - Soft iron correcting spheres or plates and the Flinders bar compensate for the induced magnetism caused by the effect the earth's magnetic field has on the ship's magnetism.
  - Heeling error magnets compensate for the vertical component of the ship's magnetism.
- The timing and logistics of this operation are often governed by the tide, the weather and other vessels in the vicinity. The time it takes to swing and adjust the compass is also influenced by the condition and accessibility of the compass and **correctors, the maneuverability of the vessel, the skill of the helmsman** and the complexity of, and reasons for, the deviating magnetic fields involved.
- On successful completion of compass swing, a table recording any remaining residual deviation and a statement as to the good working order of the compass will be issued. A current deviation card / certificate of adjustment is a legal requirement on all sea going commercial vessels.
- Deviation can be determined by a number of methods: the sun's azimuth or known bearings of distant objects, such as a mountain peak or lighthouse are considered most accurate. In certain circumstances, such as poor visibilty, calibration is carried out by making comparisons with other navigation instruments, such as a gyro or GPS compass.
- Using other navigation instruments to find deviation is only satisfactory if the absolute accuracy of these instruments has first been verified, or any known error is factored into the calculations. Most professionals prefer something tangible, such as a fixed landmark, with a known position and bearing to work with.

**Q) Draw a neat sketch of Magnetic Compass binnacle with all correctors.** *(Nov-21, July-21, Jan-20, Sept-19)*

Ans:- **The Binnacle**:- The binnacle is a cylindrical container made of teak wood and brass. No magnetic materials are used in its construction. Even the screws are of brass and the nails, copper. The compass bowl is slung inside the top portion of the binnacle. The middle potion is accessible by a door and contains an electric bulb. Light from this bulk passes upwards through a slot, through an orange coloured glass fitted over the slot, through the bottom of the compass bowl, to illuminate the compass card from below. The orange colour ensures that the night vision of the observer is not adversely affected.



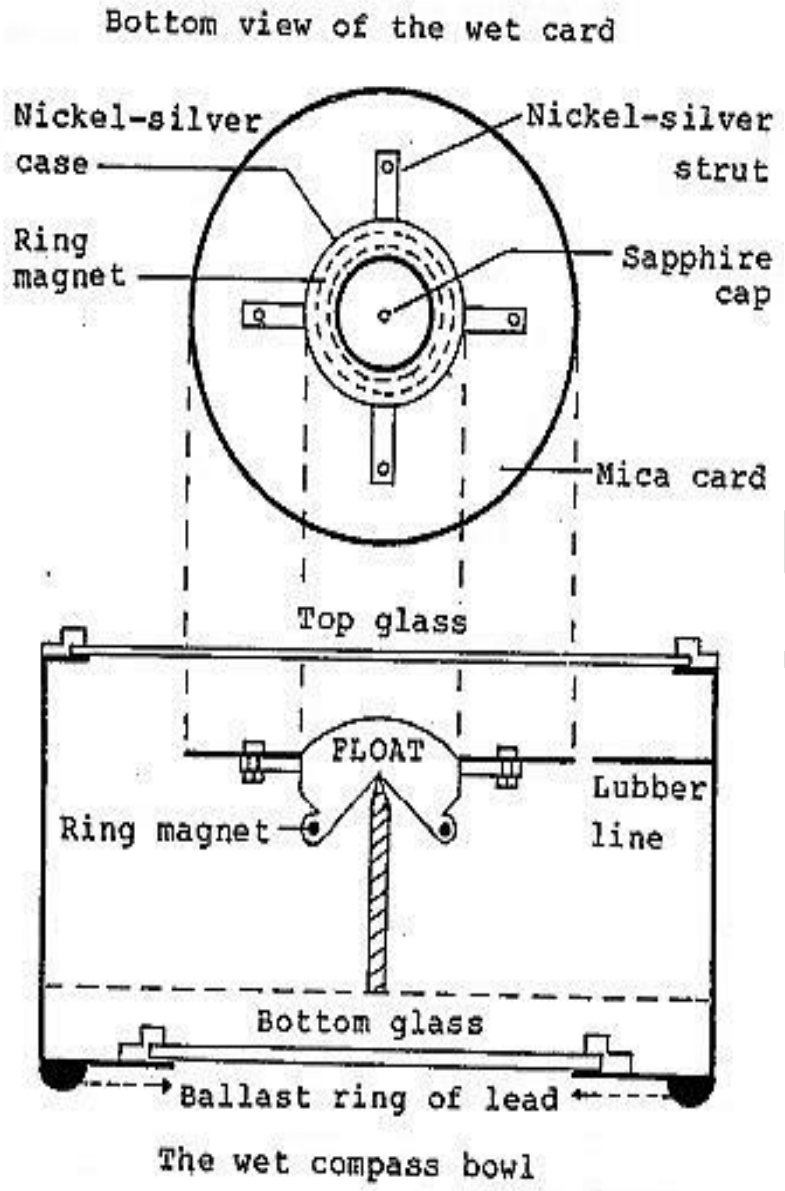

- **Corrector Magnets**:- (See Figure) In the centre of the lower half of the binnacle, there are a number of horizontal holes, both fore & aft and athwartships, for 'hard iron' or 'permanent' corrector magnets which are meant to offset undesirable, disturbing, magnetic effects caused by the ship's steel hull.

  The lower two-thirds of the binnacle has a vertical brass tube, at the centre, in which slides a 'bucket'. This bucket has some magnets in it called 'heeling error correctors'. The bucket is held in position by a brass chain.
- **Quadrantal Correctors**:- (See Figure) These are two 'soft iron' spheres which are fitted in brackets, one on either side of the binnacle. The brackets are slotted so that the distance between the spheres can be altered as desired during compass adjustment.
- **Flinders Bar**:- (See Figure) This is a soft iron corrector, (diameter about 7.5 to 10 cm) inserted in a 60 cm long brass case, fitted vertically on the forward or on the after part of the binnacle. If the ship has more superstructures abaft the compass, the Flinders bar is fitted on the forward part of the binnacle and vice versa.

**Q) With a suitable sketch explain the construction of a Wet Card compass.** *(March-19, Nov-18, Aug-16)*

**Q) Draw a neat sketch of magnetic compass bowl and label different parts of it.** *(May-19)*

Ans:-



The wet compass bowl

- **Necessity**: - The dry card compass is too sensitive for steering purposes, especially in bad weather. Even small disturbances cause the dry card to oscillate. In the wet card compass oscillations are damped, without loss of accuracy, by immersing the card in a liquid. The card therefore has a 'dead beat' movement.
- **The card**: - The wet card is made of mica and is only about 15 cm in diameter. The card is attached to nickel- silver float chamber that has a sapphire cap. The cap rests on iridium tipped pivot. The sapphire has a polishing effect on the iridium tip. This arrangement is practically frictionless.
- **The directive element**: - In modern wet card compasses the directive element is a ring magnet fitted around the base of the float. The ring magnet offers less resistance to movement and causes less turbulence.
- **The bowl**: - The diameter of the bowl is about 23 cm in order to reduce disturbances caused by turbulence in the liquid during rotation of the card. The top of the bowl is of transparent glass. The bottom is of frosted glass.
- **Allowance for expansion**: - One method is to have a small accordion – like expansion chamber attached to the bowl. The chamber increases or decreases in volume, as necessary, as the liquid in the bowl expands or contracts due to changes in atmospheric temperature.
- **Suspension**: - The bowl of the wet card compass is suspended by gimbals. This bowl, being considerably heavier than that of the dry card compass, does not have

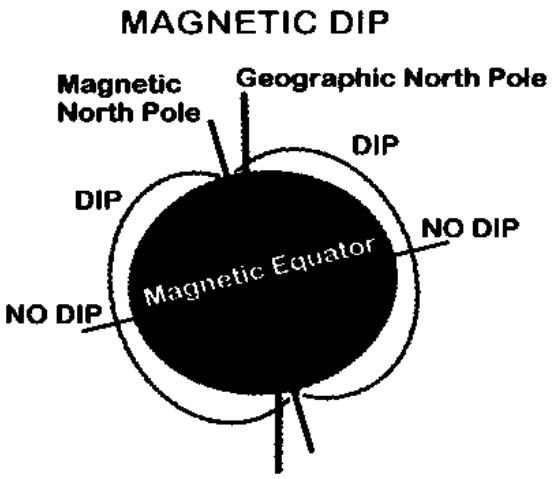
a glass hemisphere of alcohol and water attached to its underside. Instead, a ballast weight consisting of a ring of lead, enclosed in brass, is attached along with circumference of the underside of the bowl to bring its centre of gravity below the gimbals.

- **Care and Maintenance**: - The care and maintenance required for a wet card compass and its binnacle is the same as that for a dry card compass. The only changes / differences are: -
  - The wet compass card, if found defective owing to stickiness of movement, has to be renewed by the manufacturer or his authorized agent. Hence, no spare wet card is carried. Instead, an entire bowl is carried as a spare.
  - In rare cases, a bubble may develop in the wet compass bowl. This has to be removed at the earliest opportunity.

**Q) What is Dip? How compass is kept horizontal in varying latitudes?** *(Nov-16)*

Ans:- Magnetic dip Error:-

- Magnetic dip is the tendency of the compass needles to point down as well as to the magnetic pole.
- Dip is greatest near the poles and least near the Magnetic Equator.



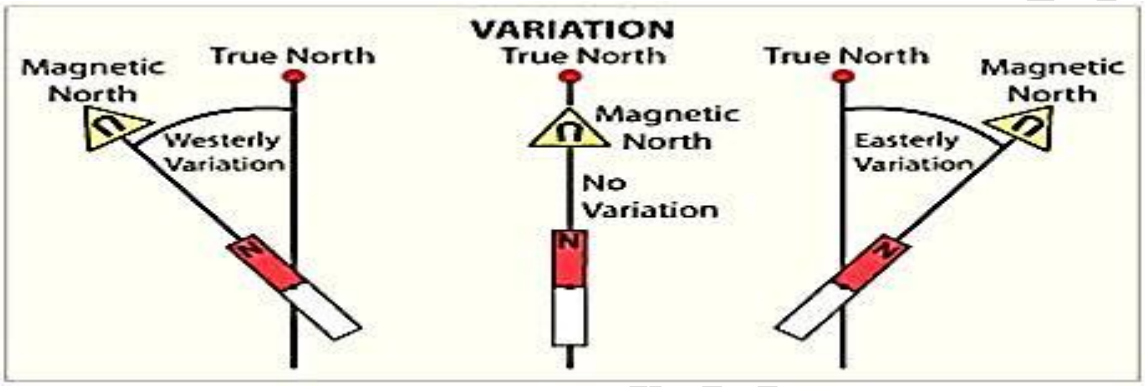

- The compass card is designed to operate in the **horizontal**, therefore, any movement from the horizontal plane introduces dip error.
- The needle of your magnetic compass will be parallel with Earth's surface at the Magnetic Equator, but will point increasing downward as it is moved closer to the Magnetic Pole.
- Northerly turning error is due to the mounting of the compass. Since the card is balanced in fluid, when the vessel turns, the card is also banked as a result of centrifugal force.
- While the card is banked, the vertical component of the Earth's magnetic field causes the north-seeking ends of the compass to dip to the low side of the turn. When making a turn from a northerly heading, the compass briefly gives an indication of a turn in the opposite direction.
- When making a turn from the south, it gives an indication of a turn in the correct direction but at a faster rate.

**Q) What is Magnetic variation, why it varies and where you fill find its value?** *(July-21, Jan-21, July-18)*

Ans:- **VARIATION**

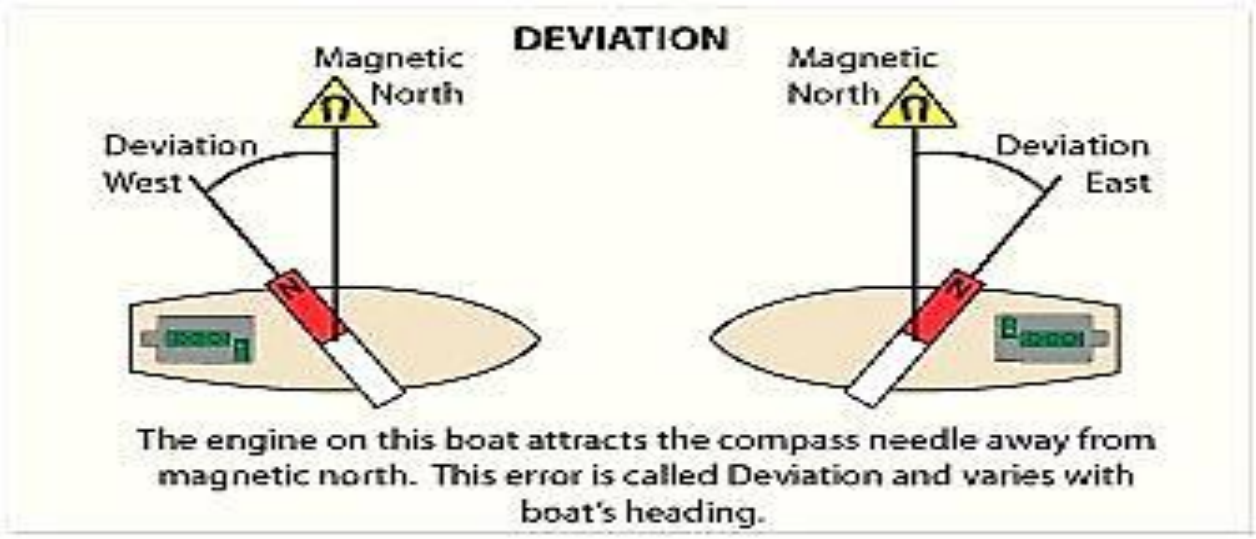
- The true North Pole and the magnetic north pole are not located at the same spot. This variation causes a magnetic compass needle to point more or less away from true north. The amount the needle is offset is called variation because the amount varies at different points on Earth's surface. Even in the same locality variation usually does not remain constant, but increases or decreases at a certain known rate annually.

The variation for any given locality, together with the amount of annual increase or decrease, is shown on the compass rose of the chart for that particular locality.




**DEVIATION**:-

- The amount a magnetic compass needle is deflected by magnetic material in the ship is called deviation. Although deviation remains a constant for any given compass heading, it is not the same on all headings. Deviation gradually increases, decreases, increases and decreases again as the ship goes through an entire 360° of swing.




- The magnetic steering compass is located in the pilothouse, where it is affected considerably by deviation. Usually the standard compass is topside, where the magnetic forces producing deviation are not as strong. Courses and bearings by these compasses must be carefully differentiated by the abbreviations PSC (per standard compass), PSTGC (per steering compass), and PGC (per gyrocompass). The standard compass provides a means for checking the steering compass and

the gyrocompass.

**Q) Write short notes on True North.** *(Oct-21)*
Ans:- True North refers to the direction of the geographic North Pole. It is the reference point for all navigational calculations and is represented on maps and charts as the vertical axis. True North does not vary with time or location and is considered a fixed point for navigation purposes.

**Q) Write short notes on Magnetic North.** *(Oct-21)*
Ans:- Magnetic North refers to the direction in which the Earth's magnetic field points. The magnetic field is not constant and changes over time and location. Therefore, the magnetic North Pole is not in the same location as the geographic North Pole. Magnetic North is used as a reference point for the magnetic compass, which is an important navigational instrument. The magnetic compass needle aligns with the Earth's magnetic field and points to Magnetic North.

**Q) What are the advantages of wet compass card over dry compass card? How will you remove an Air Bubble from the compass bowl?** *(Sept-21, Nov-17, Nov-16)*
Ans:- The dry card compass is generally used as a standard compass & the wet card compass as a steering compass. The dry card compass is very sensitive. Even a slight disturbance makes the dry card oscillate. In the wet card compass, the oscillation is damped in the liquid and hence more useful as a steering compass. In some ships, the wet compass is now used as a standard compass, mainly because of the availability of the gyro compass as the main direction indicating instrument.

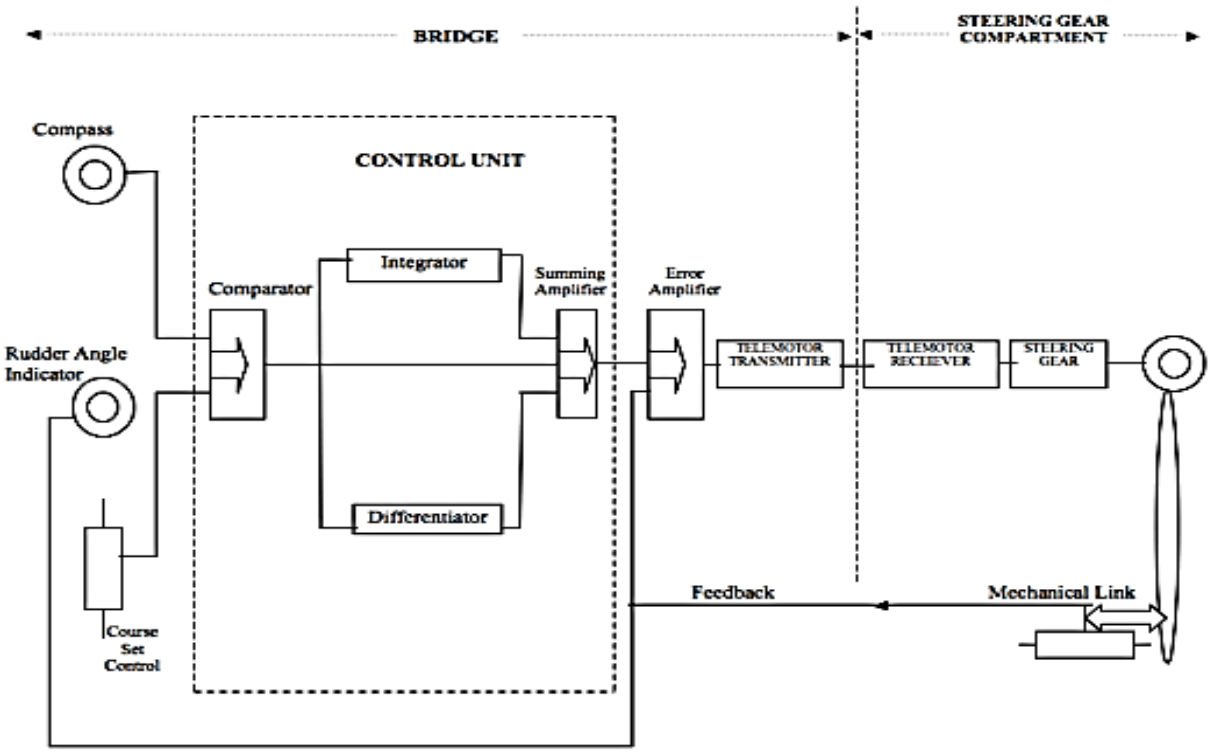
The following is a general procedure for removing air bubbles from a Magnetic Compass:
1. Ensure that the vessel is stable and not moving.
2. Open the compass bowl by releasing the locking mechanism.
3. Check the fluid level in the bowl and top it up if necessary with the correct type of compass oil as recommended by the manufacturer.
4. Using a magnet or compass corrector, rotate the compass card to check for any air bubbles that may be present in the fluid.
5. If air bubbles are present, gently tap the compass bowl with a soft object such as a rubber mallet or wooden block to dislodge the bubbles and allow them to rise to the surface.
6. Wait for the bubbles to rise to the surface, and then use a needle or other sharp object to puncture them, allowing the air to escape.
7. Repeat the tapping and puncturing process until all the air bubbles have been removed from the compass fluid.
8. Once all the air bubbles have been removed, close the compass bowl and lock it in place.

# AUTO PILOT

**Q) Explain with block diagram the working of an Auto Pilot.** *(Jan-23, Mar-21, Oct-20, March-18, Jan-18, March-17)*

Ans:- **AUTO PILOT**

- An autopilot is the ship's steering controller which automatically manipulates the rudder to decrease the error between the reference heading and actual heading.
- Autopilot relieves the helmsman to great extent but definitely autopilot is not a substitute for helmsman.
- Autopilot also reduces fuel consumption as the zig-zag course is avoided.




**Simplified Block Diagram of Auto pilot**

**Working of Auto Pilot**:-

- Course is selected by the course selector.
- Present heading is indicated by the compass.
- The output from the compass is fed to the comparator in the control unit. The signal from the course selector is also fed to the comparator.
- Difference between the two signals is causing the output error signal detected by the comparator.
- Integrator and differentiator also analyze the signal.
- The signals from the comparator, integrator and differentiator are fed to summing amplifier (control unit).
- The summing amplifier in turn, passes the signals to error amplifier which also receives feedback from the steering gear.
- The output of error amplifier is transmitted to steering gear via telemotor transmitter and telemotor receiver.
- A torque motor may be fitted instead of a telemotor.

**Q) Explain the various settings and controls on the Adaptive Auto pilot.**

*(Sept-21, Aug-21, March-21, March-20, July-19, May-19, Jan-19, May-18, May-17, March-16)*

Ans:- The Autopilot Control Unit – The PID Control Unit:- In order to maintain the ship's course accurately, the deviation signal has to be generated under the following conditions:

a) When the set course is changed (by the navigator)

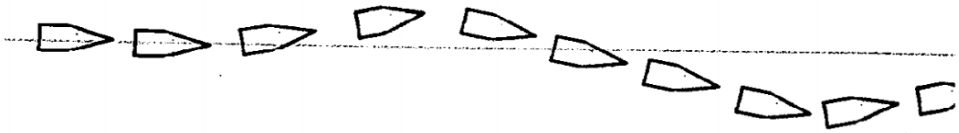
b) When the ship deviates from the set course (due to external factors)

For this purpose, the helm must be provided with data regarding the ship's movement relative to the course to steer line.

This is achieved by electronic circuits with the help of the following:

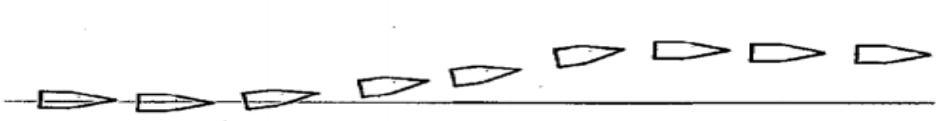
- **Proportional control**
- **Derivative control**
- **Integral control**

**Proportional Control**: -



- The effect on steering, when only the proportional control is applied, causes the rudder to move by an amount proportional to the off-course error from the course to steer.
- When the ship has gone off-course to port, an error occurs and helm, proportional to the deviation and hence error signal, is used to bring her back to the set course.
- As the ship starts to return to the set course, the helm is gradually eased and finally removed when the ship is back on the set course.
- The rudder will be amidships when the ship reaches its set course and then the heading overshoots resulting in the vessel to go more to starboard. Correcting helm is now applied causing the ship to return to port and back to the original course.
- The vessel thus keeps on oscillating to port and starboard of the course line.

**Derivative Control**: -



- In derivative control, the rudder is shifted by an amount proportional to the rate of change of the ship's deviation from the course. Any deviation of course to port will cause correcting rudder to be applied to starboard.
- As the rate of change of course decreases, the automatic rudder control decreases and at a point X, the rudder will return to midships before the vessel reaches its set course.
- The ship will now make good a course parallel to the required course.

**Integral Control**: -

- Certain errors due to the design of the ship (bow going to port due to transverse thrust, shape of the hull, current draft, etc.) have an impact on the steering capabilities of the ship and have to be corrected for effective overall steering performance.
- In order to achieve this, signals are produced by sensing the heading error over a period of time and applying an appropriate degree of permanent helm. The rudder used to correct the course will now be about this permanent helm. That is, the permanent helm will now act as midships.
- Additionally, there are various controls provided on the autopilot system along with a filter system for the action of the winds and waves which supply more data to the autopilot which optimizes the performance of integral control.
- The output of these three controls is combined and the net resultant thus obtained drives the rudder maintaining the ship on the set course. This type of auto pilot is referred to as PID auto pilot.

**Q) Explain the working of the following controls provided in an Auto Pilot System – Off Course Alarm** *(Sept-21, Sept-19)*

**Ans**:- **Off Course Alarm**:- Usually an Off Course Alarm is fitted on the Autopilot. This can be set for the required number of degrees. So that if at any time the difference between the actual course and the Autopilot set course is more than the preset degrees, an alarm will warn the officer.

There is however, one limitation which should be noted. In case, the gyrocompass itself begins to wander the Autopilot well steer so as to follow the wandering compass and the Off Course Alarm will not sound. It does not ring unless the difference between the course setting and gyro heading is more than the preset limit.

**Q) Describe the purpose of following settings in Autopilot: Rudder** *(Jan-19, May-18)*

Ans:- Rudder control:

- This control determines the amount of rudder to be used to correct the slightest amount deviation from the set course.
- The higher is setting the larger the rudder angle is used to correct a course deviation and this may result in over correcting.
- But if setting is less, the rudder angle is used to correct deviation may not be sufficient and will take longer time to return to set course.
- This is proportional controller which transmits a signal which is proportional to course error
    - Controller output = constant (Kp) x Deviation
- The ratio can be changed by settings (i.e. the ratio between instantaneous heading error and rudder command) also called rudder multiplier.
- Control Knob alters the ratio of output.
- Higher setting – Larger rudder angle (results in overcorrecting – overshooting)
- Lower setting – Less rudder angle (Long time to return to set Co-Sluggish).
- Therefore, optimum setting required.

**Q) Describe the purpose of following settings in Autopilot: Counter Rudder** *(Jan-19, May-18)*

Ans:- Counter rudder:

- This control determines the amount of counter action by the rudder to be used to steady the ship on the set course keeping the overshoot to minimum.
- Too low setting will allow the ship to overshoot and too high setting will bring the ship back in long time.
- This is Derivative control.
- Purpose is to apply a relatively greater amount of helm at the beginning of a course alteration to get the ship turning. Once the ship is turning, just enough helm is applied in order to keep her coming around. When new heading is approached, opposite helm is applied to stop the swing. As the ship settles on new heading and the yaw rate disappears, the helm is removed.
- Produces an output when course of vessel is changing.
- Depends on rate of change of course:
  - Controller output = constant ( KD ) x change of error / time
- Determines amount of counter rudder to steady the ship on set course.
- Keeps over shoot to minimum.
- Greater the ship's inertia, greater the setting required. If ship has good dynamic stability, relatively small settings of counter rudder will be sufficient. If the ship is unstable, higher settings will be required.
- Depends on ship's characteristics, loaded/ballast conditions and rate of turn.
- Too high setting will bring the ship to set Co slowly.
- Too low setting allows overshoot.
- As counter rudder settings increase, counter rudder increases.
- KD – Counter rudder time constant (Calibration done at sea trial to set KD).

**Q) Describe the purpose of following settings in Autopilot: Constant helm** *(Jan-19, March-18)*

Ans:- Constant / Permanent Helm:

- This is integral controller. (In NFU this control is out of action).
- When ship has known imbalance to one side, requiring a certain amount of bias helm (e.g. TT of propeller) manual setting of the approximate bias speed up the effect of the AUTOMATIC PERMANENT HELM calculator, because it started off nearer to its target.
- Whether the control setting is estimated correctly or left at zero has no effect on the final steering accuracy but only in the time it takes to reach this heading accuracy.
- If not used as described above, the permanent helm should be left at ZERO and the automatic permanent helm will function normally.
- Produces output as long a course error persists.
- Used when beam winds; couple formed causing ship to turn into wind.
- Rudder position required to counteract is permanent helm.
- Continuous control calibrated from 20 (P) to 20 (S).

**Q) Describe the purpose of following settings in Autopilot: Weather** *(Jan-19,*

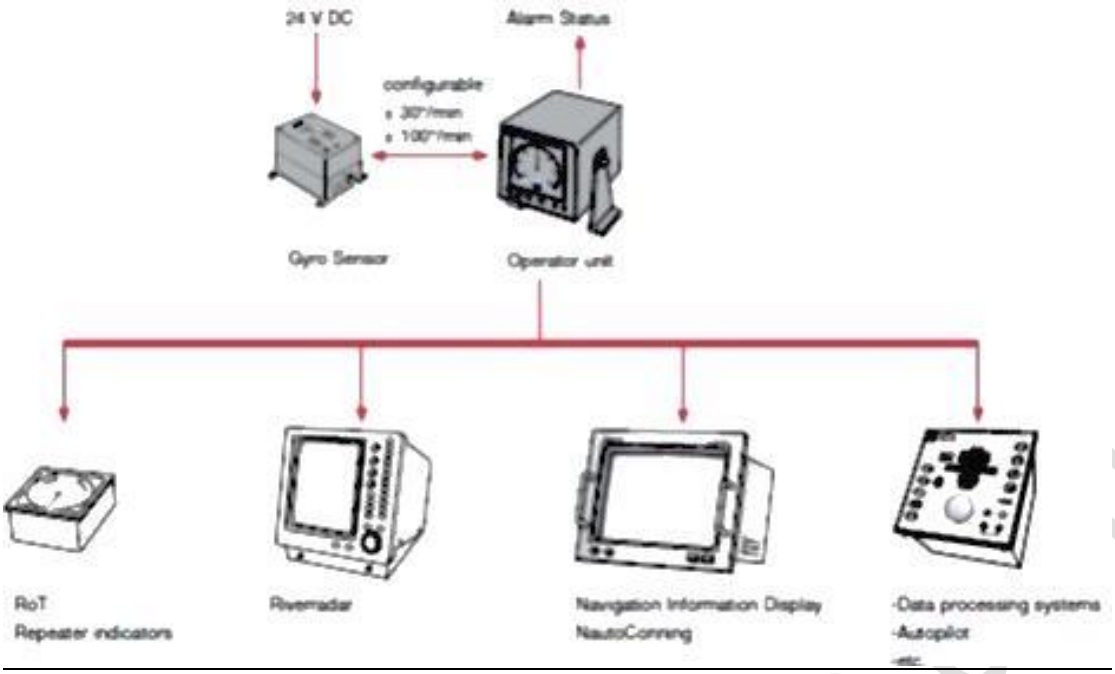
*May-18)*
Ans:- The setting of the yaw control depends upon the wind and weather condition and their effect on course keeping ability of the ship in bad weather this setting should be set high and calm weather this should be low.

**Q) Describe the purpose of following settings in Autopilot: Rudder limit** *(May-18)*
Ans:- Rudder limit: This control specifies the maximum amount of rudder to be used, when correcting the ship's head or altering the ship's course.

**Q) On what occasions, should an autopilot not to be used?** *(Oct-20)*
Ans:- Auto Pilot should not be used in the following conditions:-
- In narrow channels.
- At slow speeds.
- During maneuvering.
- During pilotage.
- During heavy weather conditions.
- During large alteration of course.
- Near or in area of restricted visibility.
- When passing close to vessels etc.

## ROTI

**Q) Explain the use of Rate of Turn Indicator.** *(May-18, March-16)*
Ans:- INTRODUCTION:
- IMO Recommendations on passage planning lay stress on controlled navigation. The passages in narrow channels or harbors are either along straight courses or along arcs of circles.
- As per SOLAS 2000 Amendment Chapter V Regulation 19.2.9, it is mandatory for ships over 50,000 GRT to have a rate of turn indicator. IMO recommends that large alteration of courses have to be planned along circular tracks with wheel over point marked.
- The Rate of Turn Indicator (ROTI) is a device which indicates the instantaneous rate at which the ship is turning. It is fitted on ship as an independent fitment integrated with the steering gear/auto pilot.




- When the wheel is turned over, the ship actually traverses along a curved track rather than performing a sharp turn about a point. It is very useful knowing the nature of this traversed path the ship takes which can help in planning:
  1. The desired turn with given radius
  2. Desired speed of the vessel to execute the planned turn.
  3. When to apply the turn (wheel over point)

**RATE OF TURN FORMULAE**:

ROT = v/R

Where,

v - Speed of the vessel .

R - Radius from a fixed point around which to turn the ship.

Note: ROT is directly proportional to the speed.

ROT is inversely proportional to radius.

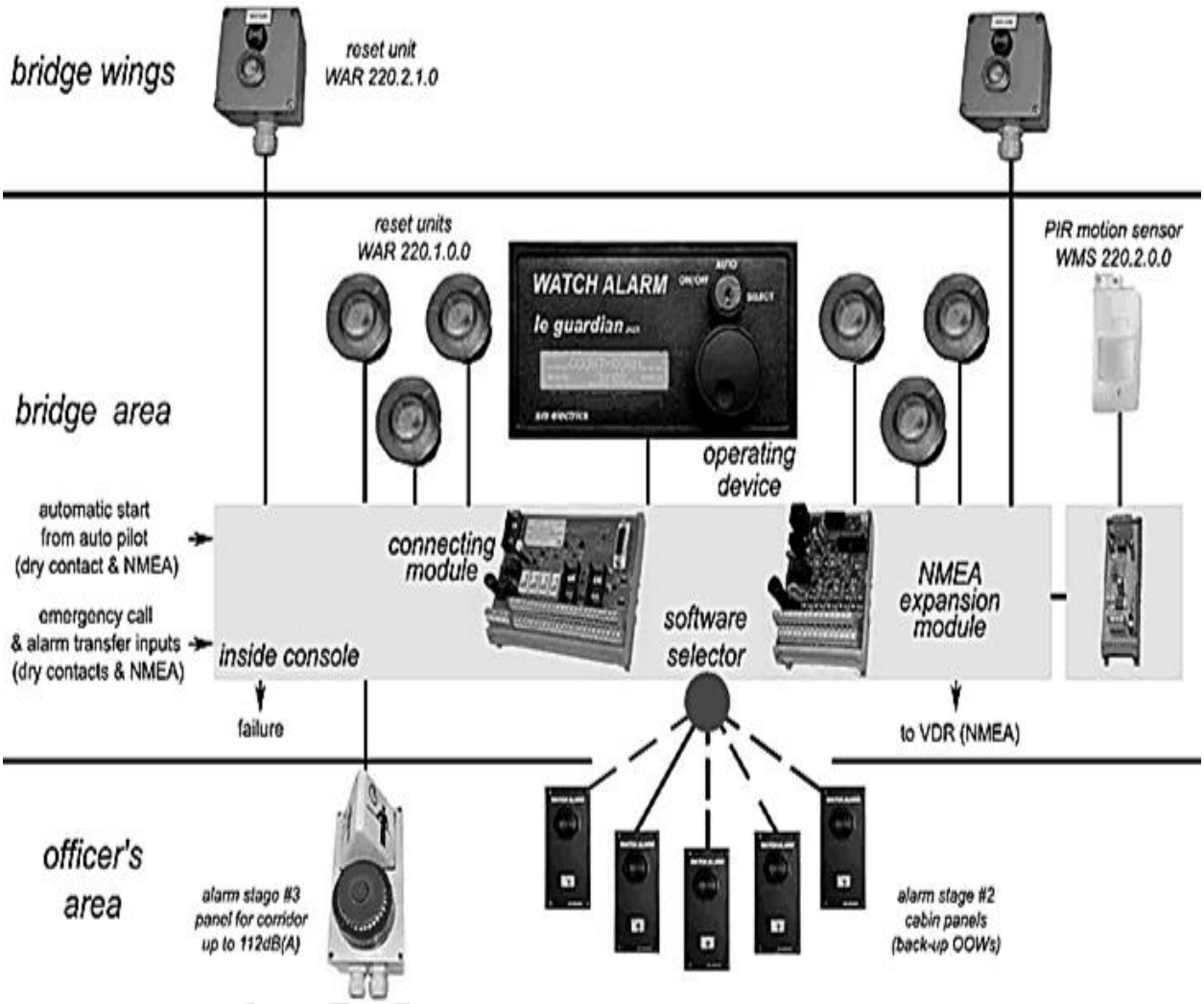
Use of ROTI (Rate Of Turn Indicator):-

1) The rate of turn indicator is equipment which indicates the instantaneous rate at which the ship is turning.
2) This indicator is fed 60 to 200 pulses per minute from the steering repeater and from this input it works out the instantaneous rate of turn.
3) The dial is marked usually $0^O$ to $60^O$ on either side. As per IMO performance standard the dial should be marked not less than $0^O$ to $30^O$ per minute on either side and graduated in intervals of $1^O$ per minute.
4) As we know that when ship turn she actually traverses some distance round the arc of a circle and cannot execute a sharp turns about a point.
5) When ship is making a turn it precise the ship track uncertain due to her characteristic, condition, weight and UKC.
6) Therefore navigator uses the touch of ship track during the turn that is uncertain of position until the ship is steadied on the new course.
7) IMO recommends for passage planning is not only monitor the position on straight course but also on curve section of passage. This can be achieved by the technique called radius turn by the help of roti and ship's log.

# BNWAS

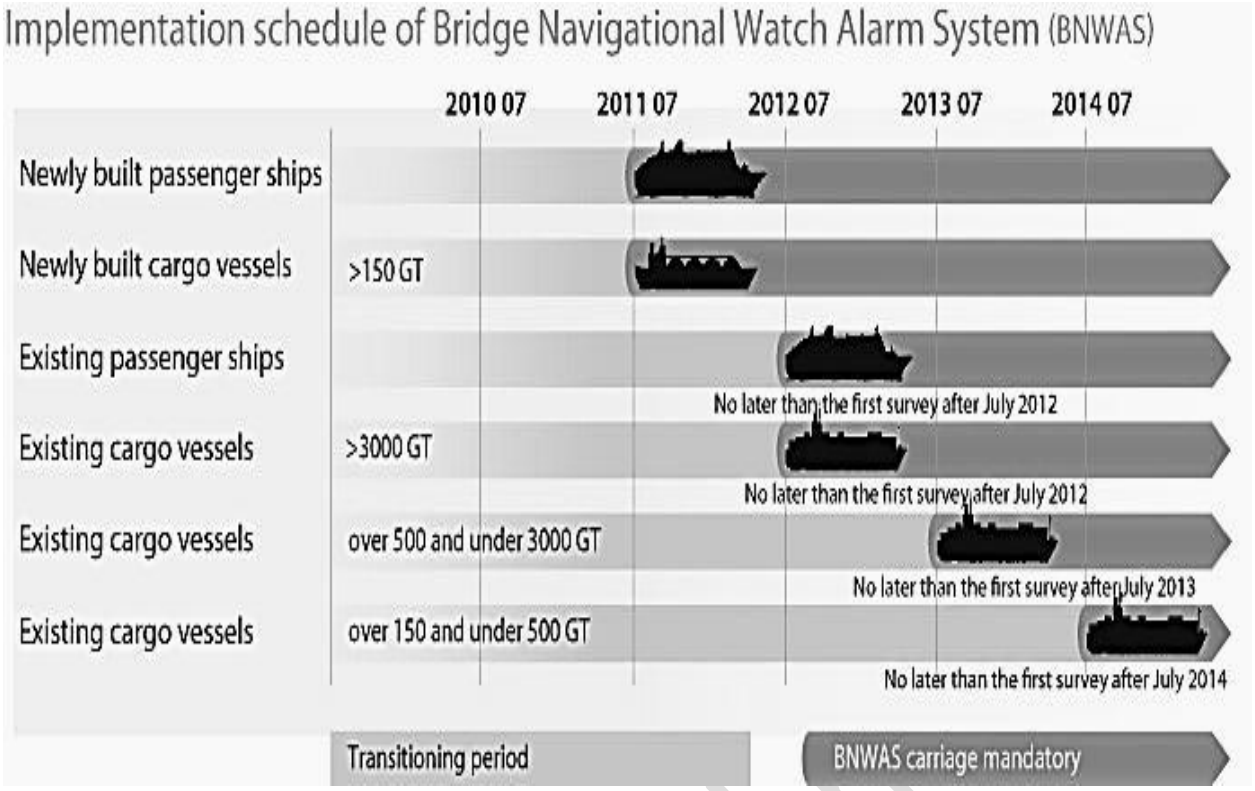
**Q) What is the purpose of 'BNWAS' and describe the sequence of warnings required to be generated by the BNWAS system.** *(Oct-21, Sept-19, Sept-18)*

Ans:- BRIDGE NAVIGATIONAL WATCH ALARM SYSTEM (BNWAS):-




Purpose:-

- The purpose of a bridge navigational watch alarm system is to monitor bridge activity and detect operator disability which could lead to marine accidents.
- The system monitors awareness of the Officer of the Watch (OOW) and automatically alerts the Master or another qualified person if, for any reason, the OOW becomes incapable of performing OOW duties.
- This purpose is achieved by series of indications and alarm to alert first the OOW and, if he is not responding, then to alert Master or another qualified person.
- Additionally, the BNWAS provides the OOW with means of calling for immediate assistance if required.




**OPERATIONAL MODES**: -
BNWAS should incorporate the following 3 operational modes:
1) Automatic
2) Manual 'ON'
3) Manual 'OFF'

1) Automatic: The BNWAS is automatically activated when the vessel is navigating by means of heading or track control system (autopilot / trackpilot) and inhibited when this system is deactivated.
2) Manual ON: The BNWAS is always in operation.
   a. Authorized person (Master) switches on system by single turning the key-switch to position "ON/OFF".
   b. Once dormant period (3 min, 9 min, 12 min) is set, the authorized person pulls out the key.
   c. Dormant period starts from the moment the system has been switched on.
3) Manual OFF: The BNWAS is turned off completely.

**ALERT SEQUENCE**:- If dormant period is over without the OOW resetting, the system activates all reset units by flash light.

**ALERT STAGE 1**:- If dormant period and flash light period (15 sec) are over and the OOW has not yet resetted the button, the system activates electronic buzzer on terminal board as well as additional buzzers located on the bridge and wing area.

**ALERT STAGE 2**:- If dormant period, flash light period (15 sec) and alert stage 1 (15 sec) are over without OOW's reset, system activates further alert via optic / acoustic alarm devices in officer's area (cabins or staircase) as well as for VDR link.

**ALERT STAGE 3**:- If dormant period, flash light period (15 sec), alert stage 1 (15 sec) and alert stage 2 (90 sec) are over without OOW's reset, the system activates

the General Alarm as well as for VDR link.

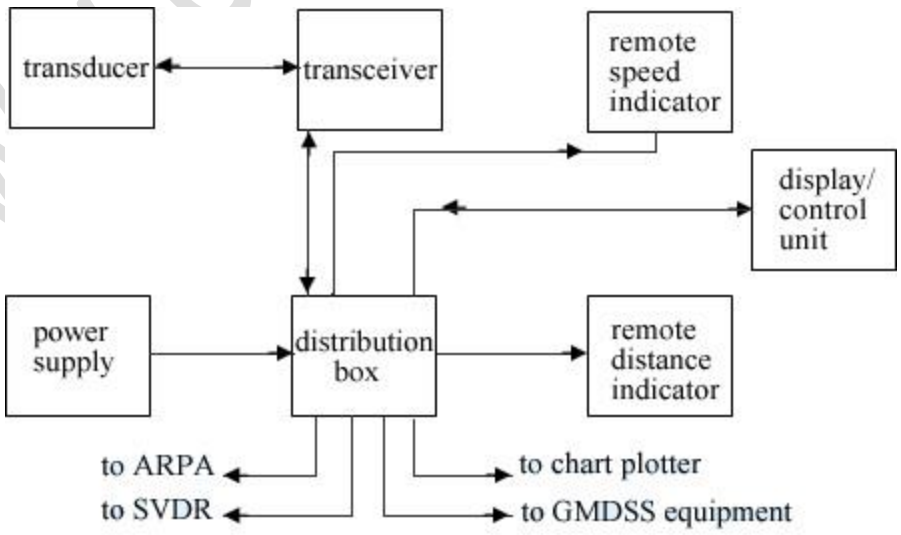
**EMERGENCY CALL**:-
- The OOW generates an emergency call by pushing any reset unit longer than 5 sec.
- That immediately activates alert stage 2 and subsequently alarm stage 3.
- After emergency call has been released, reset is possible by pushing a reset unit.

**REQUIREMENTS**:-
- The bridge navigational watch alarm system shall be in operation whenever the ship is underway at sea.
- System is powered by ships main power and MUST have a battery back up giving a minimum of 6 hours usage.

**CARRIAGE REQUIREMENTS**:-
1) Cargo ships of 150 grt and upwards and passenger ships irrespective of size constructed on or after 1 July 2011;
2) Passenger ships irrespective of size constructed before 1 July 2011, not later than the first survey after 1 July 2012;
3) Cargo ships of 3000 grt and upwards constructed before 1 July 2011, not later than the first survey after 1 July 2012;
4) Cargo ships of 500 grt and upwards but less than 3000 grt constructed before 1 July 2011, not later than the first survey after 1 July 2013; and
5) Cargo ships of 150 grt and upwards but less than 500 grt constructed before 1 July 2011, not later than the first survey after 1 July 2014.

## DOPPLER LOG

**Q) With the help of a block diagram explain how ship's speed is transmitted to remote displays.** *(Sept-17, Jan-16)*
Ans:-




*block diagram of a Doppler speed log*

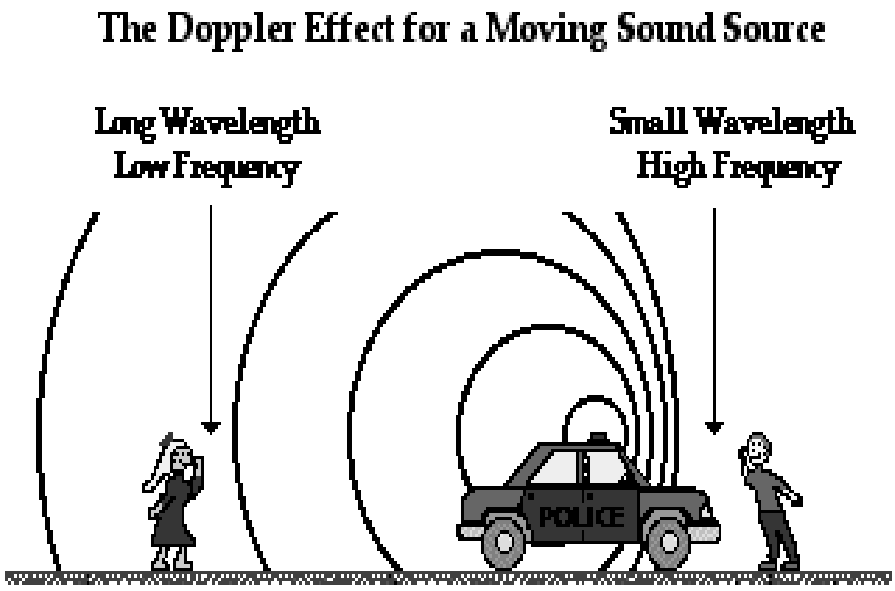
Explanation: -
- Distance recording is achieved by using a constant speed motor (10) which drives the distance counter (11), via friction gearing.

- The constant speed motor has been used in order that a distance indication may be produced that is independent of the non-linear characteristic of the system.
- The motor is started by contact (5) as previously described.
- The main shaft (7), whose angle of rotation is directly proportional to the speed of the ship, is fitted with a screw spindle (12).
- The rotation of the shaft causes a lateral displacement of the friction wheel (13). At zero speed, the friction wheel rests against the apex of the distance cone (14), whilst at maximum speed the wheel has been displaced along the cone to the rim.
- The distance indicator (11) is driven from the constant speed motor (10) via the cone.
- The nearer to the rim of the cone the friction wheel rides, the greater will be the distance indication.
- Revolutions of the distance shaft (15) are transmitted to the remote distance indicator via the servo transmission system (16 and 17).
- The speed unit provides the following outputs to drive both speed and distance counters:-
    - An analogue voltage, the gradient of which is 0.1 V/knot, to drive the potentiometer servo-type speed indicators.
    - A pulse frequency proportional to speed.
    - The frequency is 200/36 pulses/s/knot. Pulses are gated into the digital counter by a 1.8-s gate pulse.
    - A positive/negative voltage level to set the ahead/astern indication or the B track/W track indication.
    - 2000 pulses per nautical mile to drive the stepping motor in the digital distance indicator.

**Q) What is the principle of Doppler Speed Log?** *(March-20, July-19, May-19,March-19, Jan-18, Nov-18, Sept-18, May-18, Sept-17, July-17, May-17, Jan-17, Nov-16, May-16, Jan-16)* **OR**
**Q) Describe Janus Configuration.** *(Oct-21, Jan-20, July-18)* or
**Q) What is Doppler Effect?** *(Oct-20)*

Ans:- **Principle**:-

- Equipment to measure ship's speed.
- The Doppler log is based on measurement of the Doppler effect.
- The Doppler effect can be observed for any type of wave – water wave, sound wave, light wave, etc. we are most familiar with the Doppler effect because of our experiences with sound waves. For instance, a police car or emergency vehicle was travelling towards us on the highway. As the car approached with its siren blasting, the pitch of the siren sound (a measure of the siren's frequency) was high; and then suddenly after the car passed by, the pitch off the siren sound was low. That was the Doppler effect – an apparent shift in frequency for a sound wave produced by a moving source.




- The Doppler Effect is a frequency shift that results from relative motion between a frequency source and a listener.
- If both source and listener are not moving with respect to each other (although both may be moving at the same speed in the same direction), no Doppler shift will take place.
- If the source and listener are moving closer to each other, the listener will perceive a higher frequency – the faster the source or receiver is approaching the higher the Doppler shift.
- If the source and listener are getting further apart, the listener will perceive a lower frequency – the faster the source or receiver is moving away the lower the frequency.
- So, the Doppler shift is directly proportional to speed between source and listener, frequency of the source, and the speed the wave travels.

FORMULA:-

- Doppler effect can be further explained by following equations:
  - fr is the frequency received by observer.
  - ft is the transmitted frequency.
  - c is the speed of sound.
  - $v_O$ is Velocity of observer
  - $v_g$ is Velocity of source

  - If the source moves towards stationary observer,
    $fr = c\ ft / (c - v_g)$

  - If the source moves away stationary observer,
    $fr = c\ ft / (c + v_g)$

  - If the observer moves towards stationary source,
    $fr = ft\ (c + v_g) / c$

  - If the observer moves away from stationary observer,
    $fr = ft\ (c - v_g) / c$

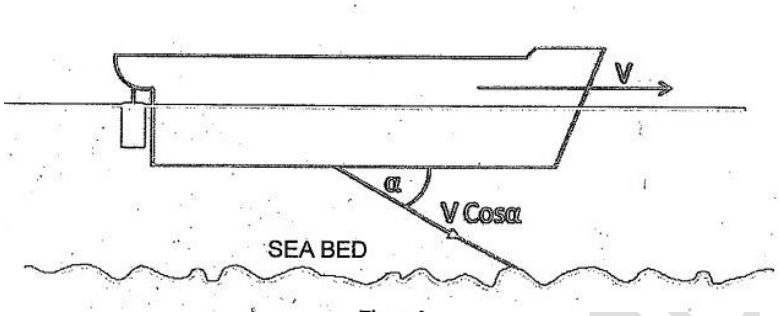
  - If the observer & source moves away from each other

$fr = ft\ (c - v_g) / (c + v_s)$

- If the observer & source moves toward each other
  $fr = ft\ (c + v_g) / (c - v_s)$

- Since, in the case of the Doppler log, the source & observer are the same. hence,
  $v_O$ *is equal to* $v_S$, *is equal to* $v$

  $fr = ft\ (c+ v) / (c - v)$

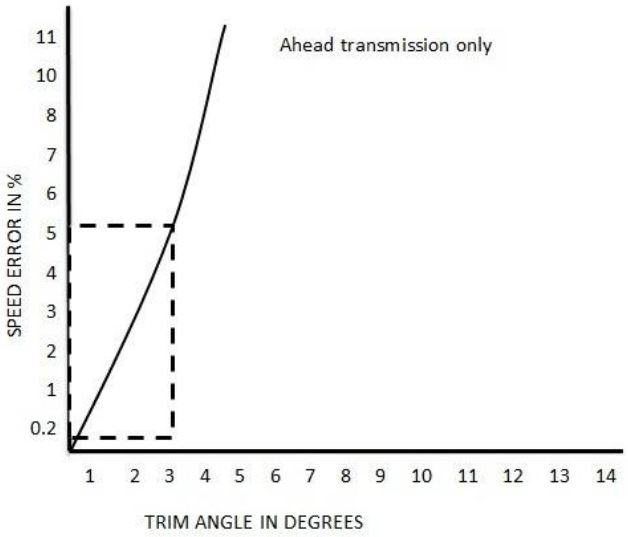



$fr = ft\ (c+ v \cos \alpha) / (c - v \cos \alpha)$

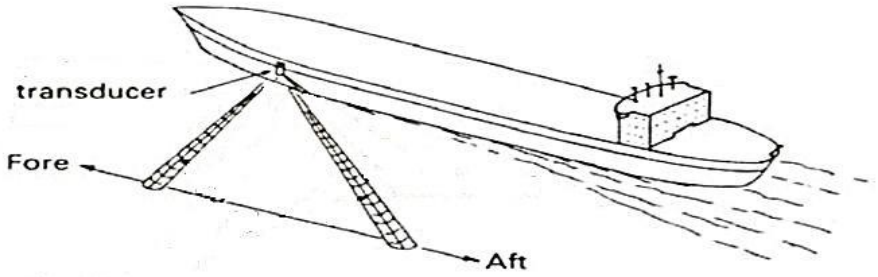
*After Further simplification*

$v = c\ (fr - ft) / 2\ ft \cos \alpha$

- Given a propagation angle of $60^O$, cos $\alpha$ = 0.5 (using single transducer facing forward)
- Graphs of speed error caused by variations of the vessel's trim:




- It follows that if the angle changes, the speed calculated will be in error because the angle of propagation has been applied to the speed calculation formula in this way. If the vessel is not in correct trim (or pitching in heavy weather) the longitudinal parameters will change and the speed indicated will be in error.
- To counteract this effect to some extent, two acoustic beams are transmitted, one ahead and one astern. The transducer assembly used for this type of transmission is called a **'Janus' configuration** after the Roman god who reputedly possessed two faces and was able to see into both the future and the past.

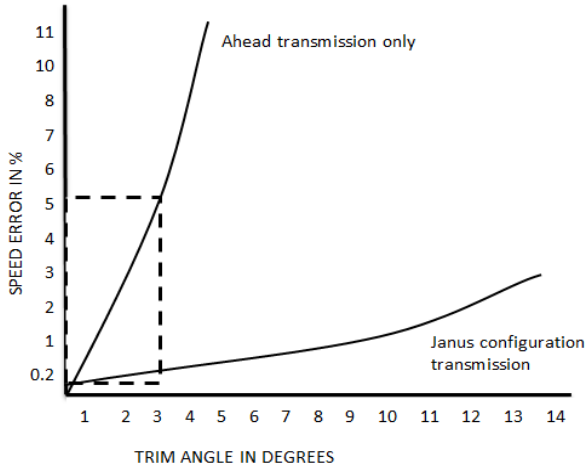



After installing transducer facing aft, the Doppler frequency shift formula now becomes: -

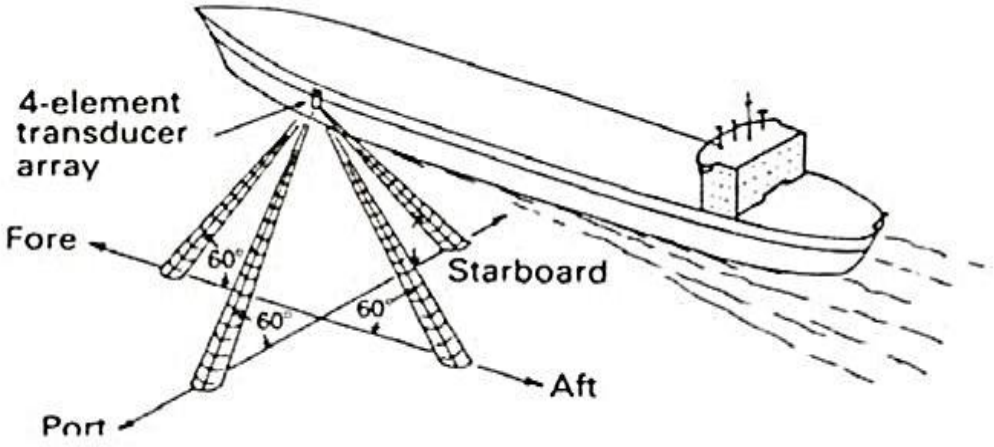
$$Fr_t - fr_a - 4\ vf_t \cos \alpha / c$$

Hence, $v = c\ (fr_t - fr_a) / 4\ ft \cos \alpha$

- Therefore, the transmission angle can effectively be ignored.
- The advantage of having a Janus configuration over a single transducer arrangement. It can be seen that a $3^O$ change of trim on a vessel in a forward pointing Doppler system will produce a 5 % velocity error. With a Janus configuration transducer system, the error is reduced to 0.2% but is not fully eliminated.




- The addition of a second transducer assembly set at right angles to the first one, enables dual axis speed (longitudinal speed and transverse speed) to be indicated.




**DOCKING OPERATION**:-

- The placing of the Janus configuration in a fore and aft direction is known as a single axis system and is used to calculate speed over ground in the forward and after direction. A dual axis system places a second grouping of Janus configured transducers in an athwart ships direction allowing for the calculation of a vessel's

speed when moving sideways through the water, as in docking. The beam width of the athwart ship installation is about 8 degrees to account for the possibility of a vessel's rolling.

- The Doppler system calculates speed to within an accuracy of about 0.5 percent of the distance traveled. It functions well for all speeds that modern vessels can attain and works from a minimum depth of about 1.5 feet to a maximum depth of about 600 feet. Frequencies employed are between 100 kHz and 600 kHz. There are primarily four errors to be aware of when using the Doppler system:
    - Transducer orientation error caused when the pitching or rolling of the vessel becomes excessive.
    - Vessel motion error caused by excessive vibration of the vessel as it moves through the water.
    - Velocity of sound errors due to changes in water temperature or den-sity due to salinity and particle content.
    - Signal loss errors caused by attenuation of the vibrations during tran-sit through the water or upon reflection from the bottom.
- The Doppler system normally measures speed over ground to about 600 feet. This depth signals may be returned by a dense, colder layer of water located throughout the oceans called the deep scattering layer (DSL). Signals received off the DSL are not as accurate as signals received from bottom reflections but can still be used to provide an indication of speed through the water instead of speed over ground when bottom tracking. Your unit may have a manual or automatic system which will switch from bottom tracking to water tracking at increased depth.
- The Doppler system can be connected with other electronic navigation systems providing generally accurate speed input. The navigator should be cautioned that precise speed should be determined not only by using the Doppler but also from careful calculations of distances be-tween accurate navigational fixes.

**Q) How Janus configuration of the Doppler Log minimizes various errors?** *(Sept-21)*

Ans:- The Janus configuration of the Doppler Log is designed to minimize various errors that can occur in traditional Doppler Log designs. The Janus configuration involves two transducers positioned at an angle to each other, with one transmitting and the other receiving. This configuration allows the system to measure the velocity of water passing through the transducers in two directions, which minimizes errors caused by the ship's motion.

Some of the errors that the Janus configuration helps to minimize include:

1. Error due to the ship's motion: The Janus configuration allows the system to measure water velocity in two directions, which helps to reduce errors caused by the motion of the ship through the water.
2. Error due to transducer misalignment: The use of two transducers at an angle to each other helps to minimize errors caused by misalignment of the transducers.
3. Error due to bottom interference: The use of two transducers also helps to minimize errors caused by bottom interference, as the system can measure water velocity in a direction that is less affected by the bottom.

**Q) Explain the advantages of 'Janus' Configuration of Doppler log.** *(Nov-21)*

Ans:- The Janus configuration of Doppler log offers several advantages over other configurations, including:

1. Accuracy: The Janus configuration measures the speed of the water flowing past the transducer from two different directions, which helps to eliminate errors caused by currents or turbulence in the water. This results in a more accurate measurement of the ship's speed through the water.
2. Redundancy: The use of two transducers in the Janus configuration provides redundancy, which means that if one transducer fails, the other can still provide accurate speed measurements.
3. Stability: The Janus configuration is more stable than other configurations because the two transducers are located on opposite sides of the hull, which helps to reduce the effects of rolling and pitching.
4. Flexibility: The Janus configuration can be used on a variety of vessel types and sizes, and can be easily installed on existing vessels without the need for major modifications.

**Q) Describe the errors associated with Doppler log.** *(Jan-21, Sept-19, Jan-19)*

Ans:- ERRORS OF DOPPLER LOG:- The Log speed indicated is subject to various errors, spanning installation, equipment, data processing, varying propagation conditions and sea conditions.

- Error in transducer orientation:- The transducers should make a perfect angle of 60° with respect to the keel or else the speed indicated will be inaccurate.
- Error in oscillator frequency:- The frequency generated by the oscillator must be accurate and constant. Any deviation in the frequency will result in the speed showing in error.
- Error in propagation:- The velocity of the acoustic wave at a temperature of 16°C and salinity of 3.2% is 1505 m/sec but taken as 1500 m/sec for calculation. This velocity changes with temperature, salinity and pressure. To compensate the error due to temperature change, a thermister is mounted near the transducer and change in velocity of the acoustic wave through the water from the standard value due to the change in sea water temperature is accounted for.
- Error in ships' motion:- During the period of transmission and reception, the ship may have a marginal roll or pitch and thereby the angle of transmission and reception can change and a two degree difference in the angle of transmission and reception can have a 0.10% error in the indicated speed, which is marginal and can be neglected.
- Error due to rolling/pitching:- The effect of pitching will cause an error in the forward speed and not the athwartship speed. Similarly, rolling will have an effect on the athwartship speed, not the forward speed.

**Actual speed = Indicated speed/Cosß**

- Error due to inaccuracy in measurement of frequency:- The difference in the frequencies received by the forward and aft transducers must be measured accurately. Any error in this will be directly reflected in the speed of the vessel.
- Error due to side lobe:- When the side lobe reception dominates over the main beam reception, there will be an error in the speed indicated. The error is more pronounced on a sloping bottom as the side lobe is reflected at a more favourable angle and will have path length less than the main beam. This error can be eliminated with the help of the Janus configuration and to reduce this error, the beam of the transmitted acoustic wave is reduced.

**Q) Describe the procedures for the calibration of Doppler log.** *(Jan-22)*

Ans:- The calibration of a Doppler log involves the following procedures:

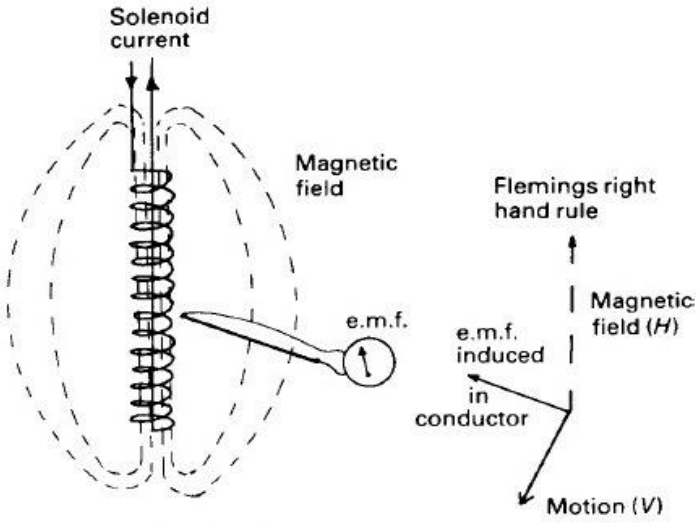
1. Stationary Calibration: The first step is to perform a stationary calibration where the log is placed in still water to determine the zero-speed offset. The offset is the difference between the measured speed and the actual speed of the water. The log is placed in a still water area, and the readings are compared to the actual speed of the water. If there is any difference, the offset value is calculated and entered into the log.
2. Dynamic Calibration: The next step is the dynamic calibration where the log is used to measure the speed of the vessel while underway. The log is turned on, and the speed is measured while the vessel is moving at a constant speed through the water. The log is compared to the GPS speed, and any differences are noted. The log is then adjusted to match the GPS speed, and the calibration is complete.
3. Bottom Tracking Calibration: The final step is the bottom tracking calibration. This is performed by lowering the transducer to the seabed and measuring the speed of the vessel as it moves over the seabed. The log is compared to the GPS speed, and any differences are noted. The log is then adjusted to match the GPS speed, and the calibration is complete.

## ELECTRO MAGNETIC LOG

**Q) Explain the principle and the errors of EM log.** *(March-19, July-18, March-18)*
**Q) What is the principle of Electromagnetic log? How is the principle used to find the speed of the vessel?** *(July-21, April-21, Nov-20)*

Ans:- Principles of Electromagnetic Speed Log:-

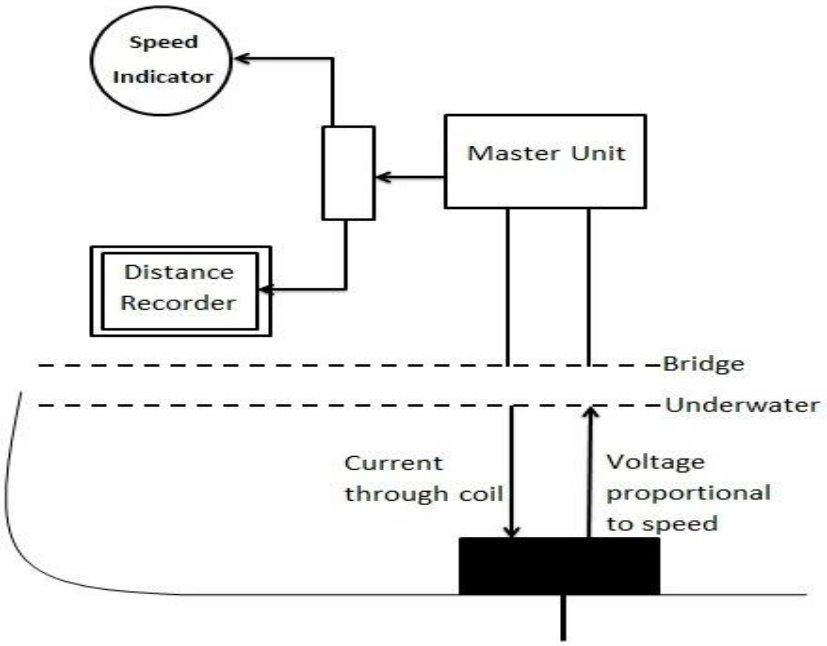
- The electromagnetic log is based is upon the induction law, which states that if a conductor moves across a magnetic field, an electro motive force (e.m.f.) is set up in the conductor.
- Alternatively, the e.m.f. will also be induced if the conductor remains stationary and the magnetic field is moved with respect to it.
- The induced e.m.f. is directly proportional to the velocity.
    - Velocity when integrated with time gives distance
    - The induced e.m.f. 'E' is given by the following:
        - E = F X L X V
    - Where F = magnetic field
    - L = the length of the conductor
    - V = the velocity of the conductor through the magnetic field.

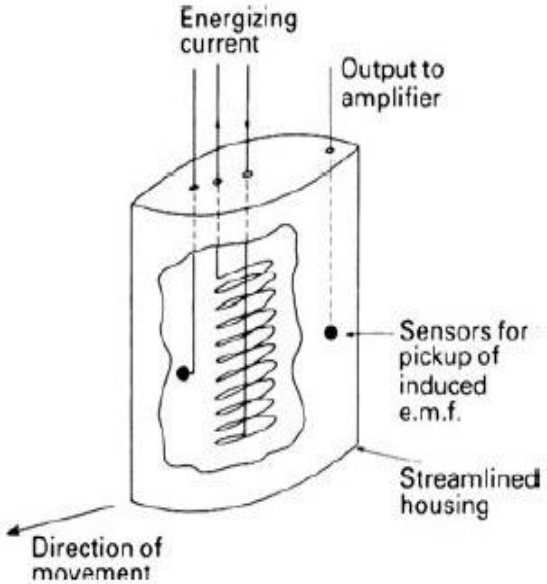



Effect of moving a conductor through a magnetic field.

Constructional Details of an electromagnetic log sensor:-
This type of log consists of:

1. Sensor
2. Amplifier
3. Indicator






Working of Electromagnetic Log:

- An Electromagnet consisting of a coil carrying alternative Current (A.C.) generates a vertical magnetic field in the water around the probe.
- The SW Conductor moving horizontally through this magnetic field has an electromotive force induced into it proportional to the seed of the vessel. In the EM log the 'F' and 'L' are maintained constant, therefore the induced e.m.f. is directly proportional to the velocity 'V', which is the velocity of the vessel through the water.
- The speed output from an EM log depends upon the water flow by way of the sensors.
- This type of log can give only speed through water and is greatly affected by the current flowing under the ship.
- The induced e.m.f. and hence the speed indication will vary with the conductivity of the water.
- This e.m.f. is picked up by 2 electrodes.
- This induced e.m.f. is very small hence the amplification is required.
- The amplified signal thus drives the mechanism which is connected to indicator.
- Hence, the induced e.m.f. which is directly proportional to the velocity is finally displayed on the indicator.

More information:-

- The Log Extends up to about 20 cm outside the hull.
- It should be retracted in case of reduced UKC & before proceeding to dry dock.
- Normally retracted from the engine room.
- If sensors are also fitted athwartship, the speed in athwartship direction also can be displayed.

Errors / Limitations:

- *Siting of the probe* is critical. This is so since if too close to the hull then due to the non-linearity of the hull form the speed of the water flow may give a wrong representation of the vessels speed. This is minimized by careful siting of the sensor as well as by calibrating the instrument while installation.
- *Pitching and Rolling* also give rise to errors however these are reduced by having an electrical time constant that is longer than a period of vessel motion. A well-adjusted log can have an accuracy of better than 0.1 percent of the speed range.
- *Sign of Speed*, it can show astern speed as well, but without sign if AC current is

used, if DC current is used to create the magnetic field it will show sign of speed range. This type of log can give only speed through water and is greatly affected by the current flowing under the ship.
- While navigating in area with greater current, one must exercise precautions.

**Q) Compare advantages and disadvantages of Electro-magnetic log with Doppler log.** *(March-18)* OR
**Q) Compare Doppler log and electromagnetic log.** *(Oct-20)*
Ans:- Advantages
- No moving parts
- Less affected by sea growth than Pit sword

Disadvantages
- Salinity and temperature of water affects calibration.
- Measurements affected by boundary layer, (water speed slowed down close to the hull by friction).
- Provides boat/ship speed relative to water not ground. Current affects accuracy.

**Q) Differentiate between water track speed and ground track speed.** *(July-21, March-20)*
Ans:- Water Track Speed:- In open seas, the sound pulse from the Doppler transducer may not reach the bottom, but get totally internally reflected from a layer of water in between. This is known as the echo from the 'Water Track".

When the sound is bounced off a water layer, called a water track, speed indicated is the 'Speed through Water". or from a layer of water and the echo is at a higher frequency.

The frequency of the echo from the water track will follow the same Doppler principles as the echo from the bottom track. However, the speed measured from the 'water Track' will not be 'Speed over the Ground', but it will be 'Speed through Water'.

Ground Track Speed: - Speed over ground is the speed of the ship with respect to the ground or any other fixed object such as fixed buoy or island.

Speed through water is the speed of the ship with respect to the water such as anything floating on water.

A ship with her engine stopped in water with 2 knots currents will have zero speed through water but will have 2 knots speed over ground.

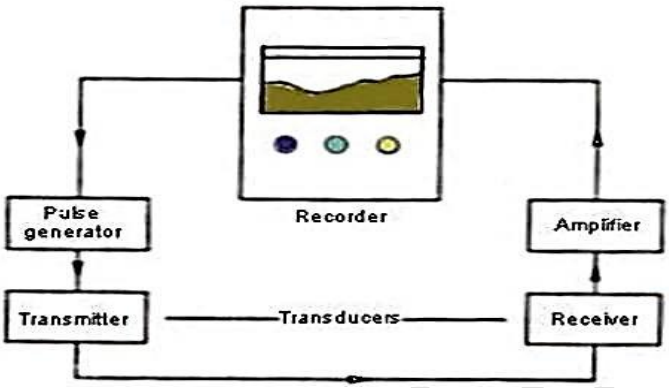
## ECHO SOUNDER

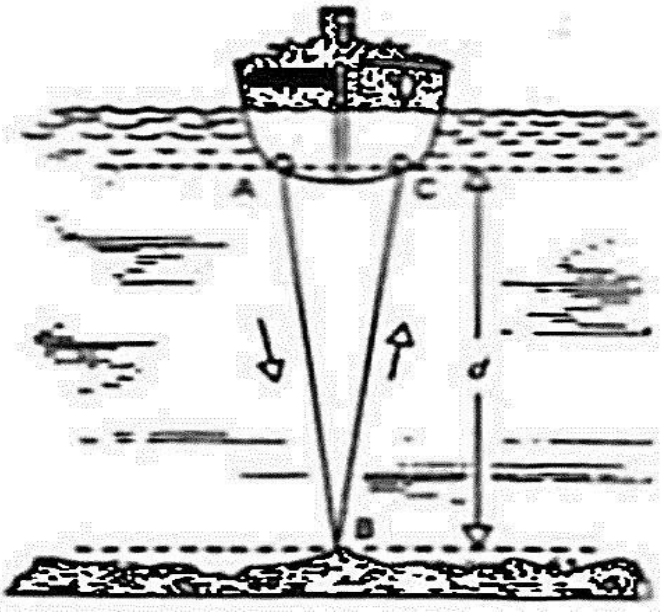
**Q) Explain the basic principle of an echo sounder with the help of a block diagram.** *(Dec-20, May-18, March-17, Aug-16, July-16, March-16)* **OR**
**Q) Describe the main components of an Echo-sounder with the help of a simple block diagram and state the function of each component?** *(July-19, July-17, March-16)* **OR**
**Q) Draw & explain the working of an Echo Sounder.** *(Jan-23, Jan-21, Jan-20, Sept-19, Jan-19)*

Ans:- **Basic Principle**:-

Short pulses of sound vibrations are transmitted from the bottom of the ship to the seabed. These sound waves are reflected back by the seabed and the time taken from transmission to reception of the reflected sound waves is measured. Since the speed of sound in water is about 1500 m/sec, the depth of the sea bed is calculated which will be half the distance travelled by the sound waves.

The received echoes are converted into electrical signal by the receiving transducer and after passing through to stylus which burns out the coating of the thin layer of aluminum powder and produces the black mark on the paper indicating the depth of seabed.




**COMPONENTS:-**

- Basically an echo sounder has following components:
- Transducer – to generate the sound vibrations and also receive the reflected sound vibration.
- Pulse generator – to produce electrical oscillations for the transmitting transducer.
- Amplifier – to amplify the weak electrical oscillations that has been generated by the receiving transducer on reception of the reflected sound vibration.
- Recorder - for measuring and indicating depth.

**CONTROLS**:-

- An echo sounder will normally have the following controls:
- Range Switch – to select the range between which the depth is be checked e.g. 0-50 m, 1 – 100 m, 100 – 200 m etc. Always check the lowest range first before shifting to a higher range.

- Unit selector switch – to select the unit feet, fathoms or meter as required.
- Gain switch – to be adjusted such that the clearest echo line is recorded on the paper.
- Paper speed control – to select the speed of the paper – usually two speeds available.
- Zero Adjustment or Draught setting control – the echo sounder will normally display the depth below the keel. This switch can be used to feed the ship's draught such that the echo sounder will display the total sea depth. This switch is also used to adjust the start of the transmission of the sound pulse to be in line with the zero of the scale in use.
- Fix or event marker - this button is used to draw a line on the paper as a mark to indicate certain time e.g. passing a navigational mark, when a position is plotted on the chart etc.
- Transducer changeover switch – in case vessel has more than one switch e.g. forward and aft transducer.
- Dimmer – to illuminate the display as required.

**Q) Explain in brief the working of Echo Sounder.** *(Mar-21, Dec-20, Nov-17, July-16)*

Ans:- **Working**:

- The acoustic pulses of very short duration are transmitted vertically at the rate of 5 to 600 pulses per minute having a beam width of 12 to 25°.
- These pulses strike the seabed and get reflected back towards the receiving transducer as echoes.
- These received echoes are converted into electrical signals by the receiving transducer and after passing through the different stages of the receiver, the current is supplied to the stylus which bums out the coating of the thin layer of aluminium powder and produces a black mark on the paper indicating the depth of the seabed.

***Principle used in the working of an Echo Sounder*:-**

There are two techniques:-

- Ranging
- Phasing

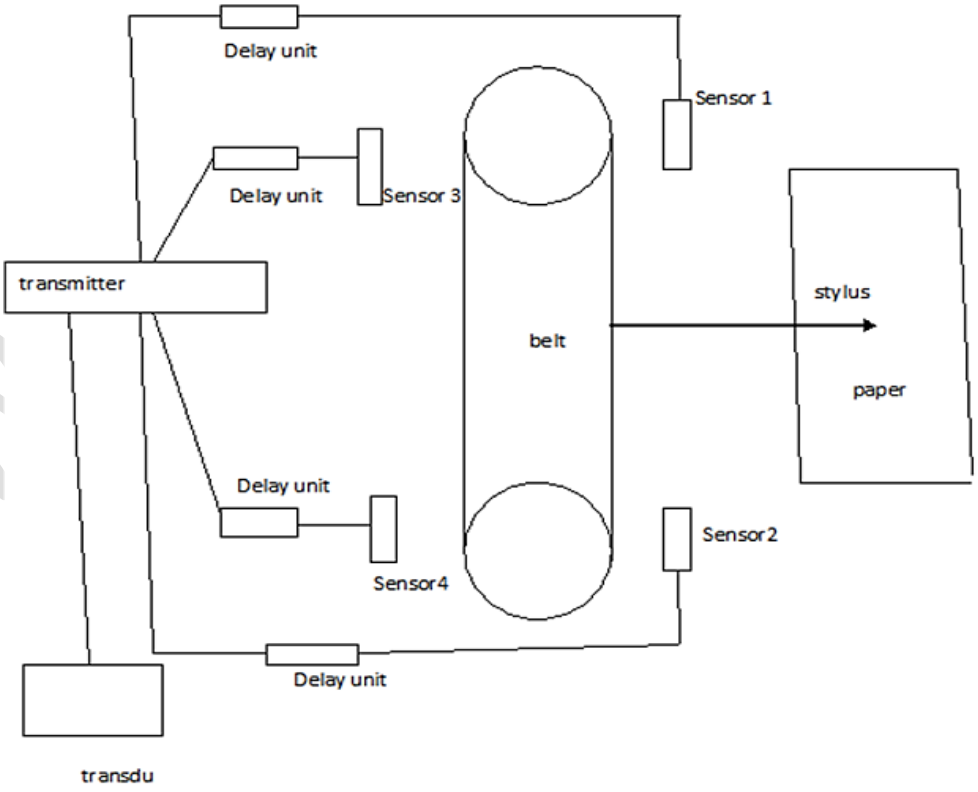
**Ranging**:-

- In echo sounder the stylus is mounted on circular belt driven by means of a stylus motor which moves at certain speed and transmission takes place when the stylus passes the zero marks.
- A magnet fixed on the stylus belt triggers the transmitter to transmit a pulse every rotation of belt when stylus is at zero mark on the paper scale, the transmission of the acoustic waves from the transducer is synchronized with the stylus at the zero mark.
- The acoustic waves are reflected from the seabed and echoes are received by the transducer and after passing through various stages eventually the current is supplied to stylus which burns out the coating of the thin layer of aluminum powder and produces the black mark on the paper indicating the depth of seabed.
- This cycle is repeated for every rotation so as the paper is pulled across the display, the profile of seabed is obtained.
- Suppose the lowest range scale is 0 to 50 M, the transmission will take place when stylus reaches at the zero mark.

- When the higher range is selected say 0 to 100 M, in order to cater for this range scale, the speed of the stylus motor is reduced, in this process the scale magnification is lost and as we switch over to higher ranges the scale becomes more & more congested.
- To overcome this problem some of echo sounding machines work on phasing technique.

**Phasing**:-

- In phasing the speed of the stylus motor remains constant.
- Instead of changing the speed of the stylus, the transmission point is advanced.
- If the first range is 0 to 50 M the second range will be 50 to 100 M (instead of 0 to 100 M).
- Various sensors are positioned around the stylus belt, the magnet generates the pulse when it passes the sensors which in turns activates the transmitter.
- In the below diagram, when we select the lowest range i.e. 0 to 50 M, the magnet mounted on the stylus belt will activate sensor no. 1, transmission takes place when the stylus exactly passes over the zero mark, when we switch over to higher range, say 50 to 100 M, the magnet mounted on the stylus belt will activate sensor no.2 and transmission will take place early, at the time of the transmission, the stylus will not be passing over 50 M mark on display unit, in other words there will be delay introduced by delay unit no.2 & the stylus will reach the 50 M on display unit after delay of 0.067 seconds. (50 x 2 / 1500, where 50 correspond to the range, multiplied by 2 because double of distance is covered by acoustic waves & the echoes and 1500 is the speed of acoustic waves).
- Likewise, when we switch over to higher range say, 100 to 150 M, magnet mounted on the stylus belt will activate sensor no. 3 & more delay will be introduced for the stylus to pass over the 100 M.




Caution when using phasing technique: - We must always start sounding at lowest range and check for echoes, adjust the gain control if required and then only switch

over to higher range.

**Q) Describe the various errors associated with an echo sounder.** *(Jan-23, Mar-21, Nov-18, May-18, Nov-17, March-17, Aug-16, March-16)*

Ans:- **ERRORS OF ECHO SOUNDER**:-

- Velocity of propagation in water:- The velocity changes with temperature salinity & pressure. The velocity of the acoustic wave assumed at the temperature of 16 degree C & Salinity of 3.4% is 1505 m/sec, but generally it is taken as 1500 m/sec for calculations. As velocity is varying hence depth recorded will be erroneous. Depth indicated in Fresh water can be about 3% higher than the actual depth. NP 139 can be referred in order to obtain the corrections. To compensate the error due to temperature variation, a component called "thermistor" may be mounted near the transducer & change in velocity of the acoustic wave through water from the standard value due to the change in sea water temperature is accounted for. Error due to pressure is not so significant.

- Stylus speed error:- The speed of the stylus is such that the time taken by the stylus to travel from top to bottom on chart is same as the time taken by sound waves to travel twice the range selected, but due to fluctuation in voltage supplied to stylus motor, will cause error in the recorded depth.

- Pythagoras error:- This error is found when two transducers are used, one for transmission and the other one for reception. This error is calculated using the Pythagoras principle. This error becomes prominent whenever distance between two transducer is more than 2 mtrs, manual should be referred in order to use the table for corrections.

- Multiple echoes:- The echo may be reflected no. of times from the bottom of the sea bed, hence providing the multiple depth marks on paper.

- The thermal and density layers:- The density of the water varies with temperature and salinity, which all tends to form different layers. The sound wave may be reflected from these layers.

- Zero line adjustment error:- If the zero is not adjusted properly, it will give error in reading.

- Cross noise:- If sensitivity of the amplifier is high, just after zero marking a narrow line along with the several irregular dots and dashes appear and this is called cross noise. The main reasons for the cross noise are aeration and picking up the transmitted pulse. If intensity of cross noise is high, it will completely mask the shallow water depths. This is controlled by swept gain control circuit.

- Aeration:- When the sound wave is reflected from the reflected from the air bubbles, it will appear as dots, this is known as aeration.
  - Aeration can be due to pockets of bubble due to heavy weather.
  - Rudder hard over causing drastic alteration of course.
  - Pitching in light condition.
  - Whilst astern propulsion. (Switch over to forward transducer if available.)

**Q) In a Marine Echo Sounder, describe: Pythagoras Error and how it is computed?** *(Mar-21)*

Ans:- Echo Sounder – Pythagoras Error:

This error occurs when two transducers are used, one for transmission and the other for reception. It is a function of the distance between the two transducers. The error can be found out by the formulae-

$$E = d - \sqrt{(d^2 - x^2\ 4)}$$

Where, d is the recorded depth and x is the distance between the transducers. The error is very prominent is shallow waters but not so significant in deep waters.

**Q) In a Marine Echo Sounder, describe: Cross Noise, Thermal Noise, Sea Noise** *(Mar-21)*

Ans:- Echo Sounder – Cross Noise:

If the sensitivity of the amplifier is high, several irregular dots appear near the zero line and this is called Cross Noise. This is caused as part of the transmitted energy is picked up by the transducer in addition to the aeration present. If cross noise is high, then shallow depths close to the zero line will not be seen.

To avoid this, amplification should be less after transmission and gradually increased so that weak echoes can be marked with clarity. This is done automatically by the swept gain control unit.

**Q) In a Marine Echo Sounder, describe: Multiple Echoes** *(Aug-21, Mar-21)*

Ans:- Echo Sounder – Multiple Echoes:

The echoes, in right conditions can be reflected number of times between the keel of the ship and seabed. On each return the echoes are picked up by the receiving transducer giving multiple depth marks on the recorder. Each depth mark will be at multiple of the actual distance, the lowest depth being the correct one.

This situation can also happen when a range scale is selected which is more than the depth of the seabed, e.g. range scale of 100-200 mtrs while the depth is actually only 60 mtrs. In this case, the depth will be marked at 120 mtrs and 180 mtrs. To avoid this, the equipment should be started at the minimum depth when Phasing facility is provided.

**Q) Describe 2nd Trace Echoes in Echo Sounder** *(Aug-21)*

Ans:- Second trace echoes occur when the sound waves emitted by the echo sounder bounce off a secondary object or feature in addition to the sea floor. For example, if the sound waves bounce off a wreck or a rock outcropping on the sea floor, the echo sounder may receive a second trace echo that appears as a faint echo, parallel to the main echo trace. This can make it difficult to accurately measure the depth of the sea floor, and may cause confusion or errors in navigation.

**Q) With respect to Echo sounder, explain the effect of density, temperature and the depth indicated.** *(Jan-18, May-17)*
Ans:- The thermal and density layers:- The density of the water varies with temperature and salinity, which all tends to form different layers. The sound wave may be reflected from these layers.

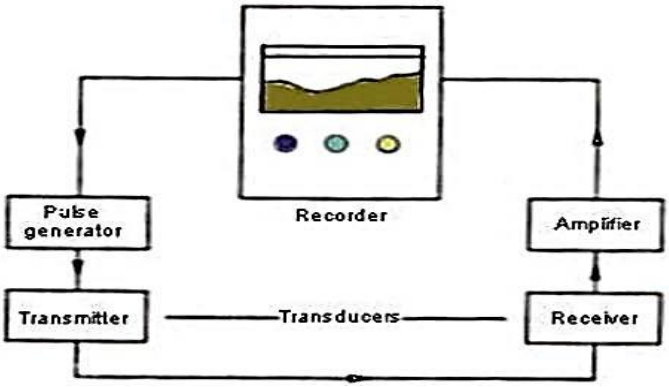
**Q) Describe the working of a piezo-electric transducer. What is the difference between a piezoelectric and electrostatic transducer?** *(Aug-21)*
Ans:- A piezoelectric transducer is a type of transducer that converts mechanical energy, such as pressure or vibration, into an electrical signal, or vice versa. It works based on the piezoelectric effect, which is the ability of certain materials, such as quartz or certain ceramics, to generate an electric charge when subjected to mechanical stress.

When a piezoelectric material is subjected to mechanical stress, such as pressure or vibration, the material generates a voltage across its surface, proportional to the amount of stress applied. This voltage can be measured and used as an electrical signal, or conversely, an electrical signal can be applied to the material, causing it to vibrate at a specific frequency, generating mechanical energy.

On the other hand, an electrostatic transducer works based on the principle of capacitance. It consists of two metal plates separated by a dielectric material. An electrical signal is applied to one of the plates, creating an electrostatic field between the two plates. When an acoustic signal is applied to the transducer, it causes the plates to vibrate, changing the capacitance between the two plates, which generates an electrical signal proportional to the acoustic signal.

The main difference between piezoelectric and electrostatic transducers is their principle of operation. Piezoelectric transducers work based on the piezoelectric effect, while electrostatic transducers work based on changes in capacitance. Piezoelectric transducers are generally more rugged and able to withstand high temperatures and pressures, making them suitable for use in harsh environments. Electrostatic transducers, on the other hand, are more sensitive to changes in capacitance, making them suitable for high-precision applications such as acoustic measurement and recording.

**Q) Describe the principle and functioning of the Electrostrictive type of transducer in the echo sounder.** *(Jan-22)*
Ans:-




Principle of electrostrictive transducer in the Echo Sounder:

- Electrostriction is the property of some materials to change their shape under the influence of an applied electric field.
- This property is used in the electrostrictive type of transducer used in echo sounders.
- The transducer is made of a polarized material such as quartz or barium titanate.
- When an electric field is applied to the material, it produces mechanical deformation in the crystal.
- The crystal vibrates at the same frequency as the electrical signal applied to it.
- These vibrations are transmitted into the water as sound waves and are reflected back to the transducer when they encounter an object.

Functioning of electrostrictive transducer in the Echo Sounder:

- The electrostrictive transducer is placed at the bottom of the vessel, in contact with the water.
- A high-frequency electrical signal is applied to the transducer, which causes the crystal to vibrate at the same frequency.
- These vibrations are transmitted into the water as sound waves, which travel through the water until they encounter an object.
- The sound waves are reflected back to the transducer, which converts the mechanical energy of the reflected waves back into electrical energy.
- The electrical energy is then amplified and processed to determine the distance to the object, which is displayed on the echo sounder screen.
- The distance to the object is calculated by measuring the time it takes for the sound wave to travel from the transducer to the object and back again.

**Q) What corrections are to be made to Echo Sounder before comparison with Chart?** *(Oct-21)*

Ans:- Before comparing an echo sounder reading to a chart, the following corrections should be made:

1. Draft Correction: The echo sounder should be corrected for the vessel's draft, which is the distance from the waterline to the deepest point of the vessel. The draft correction is necessary because the echo sounder measures the distance from the transducer to the seabed, which is not necessarily the same as the depth of the water beneath the vessel.
2. Speed Correction: The echo sounder reading should be corrected for the speed of the vessel through the water. This correction is necessary because the distance between the transducer and the seabed is affected by the speed of the vessel through the water.

3. Temperature Correction: The speed of sound in water varies with temperature, so the echo sounder reading should be corrected for the water temperature. This correction is necessary to ensure accurate depth measurements.
4. Salinity Correction: The speed of sound in water also varies with salinity, so the echo sounder reading should be corrected for the salinity of the water.

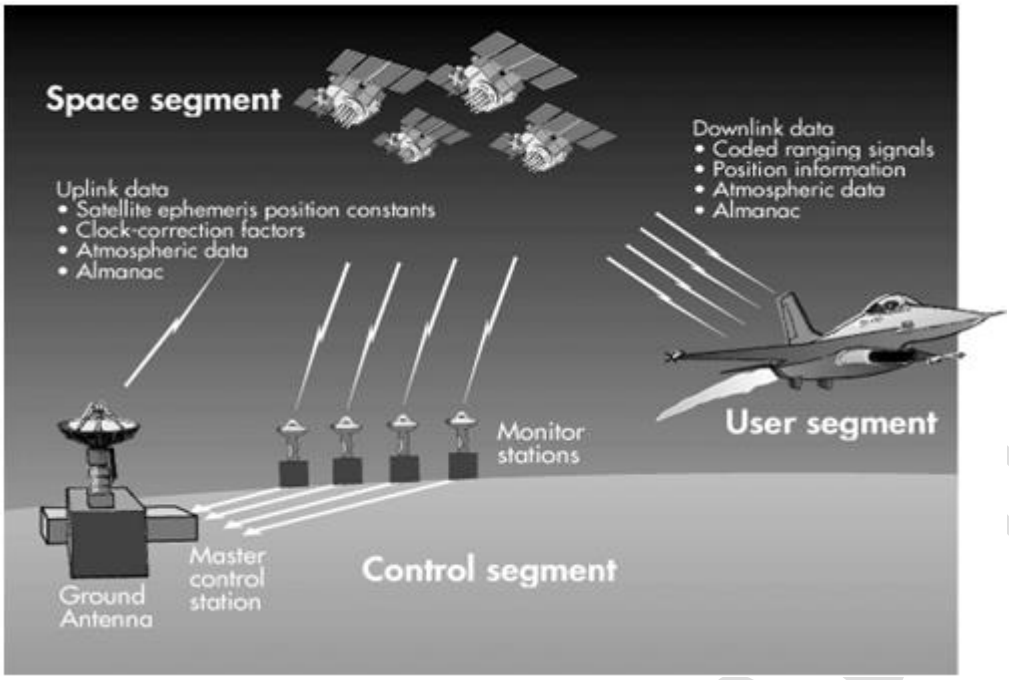
## ELECTRONIC POSITION FIXING SYSTEM

**Q) What is Clock-Bias Error?** *(Dec-20, July-18, May-16)*
Ans:- SATELLITE CLOCK BIAS ERROR:- Very small discrepancies in the accuracy within atomic clocks of the satellite can result in travel time measurement errors causing a degradation of about 1.5m in the final calculated position. For radio waves, time difference of 1μs (microsecond) equals 300m in terms of distance.

**Q) What are various segments of GPS?** *(Nov-21, Dec-20, Jan-19, Jan-18, Jan-17, Aug-16)*
**Q) Explain briefly: Why shipboard GPS receiver needs to track minimum of three satellites for position?** *(Jan-20, March-16)* **OR**
**Q) With respect to GPS write short notes on: Space segment & ground control segment.** *(April-21, Oct-20, July-18)*
**Q) Explain how the GPS is obtaining the position.** *(Nov-20, July-19, March-18)*
Ans:- **GPS or Global Positioning System** is a satellite navigation system that furnishes location and time information in all climate conditions to the user. GPS is used for navigation in planes, ships, cars and trucks also. The system gives critical abilities to military and civilian users around the globe. GPS provides continuous real time, 3-dimensional positioning, navigation and timing worldwide.

GPS System Working:-
The GPS system consists of three segments:
1) The space segment: the GPS satellites
2) The control system, operated by the U.S. military,
3) The user segment, which includes both military and civilian users and their GPS equipment.

**Space Segment**:
- The space segment is the number of satellites in the constellation. It comprises of 29 satellites circling the earth every 12 hours at 12,000 miles in altitude.
- The function of the space segment is utilized to route/navigation signals and to store and retransmit the route/navigation message sent by the control segment. These transmissions are controlled by highly stable atomic clocks on the satellites.
- The GPS Space Segment is formed by a satellite constellation with enough satellites to ensure that the users will have, at least, 4 simultaneous satellites in view from any point at the Earth surface at any time.



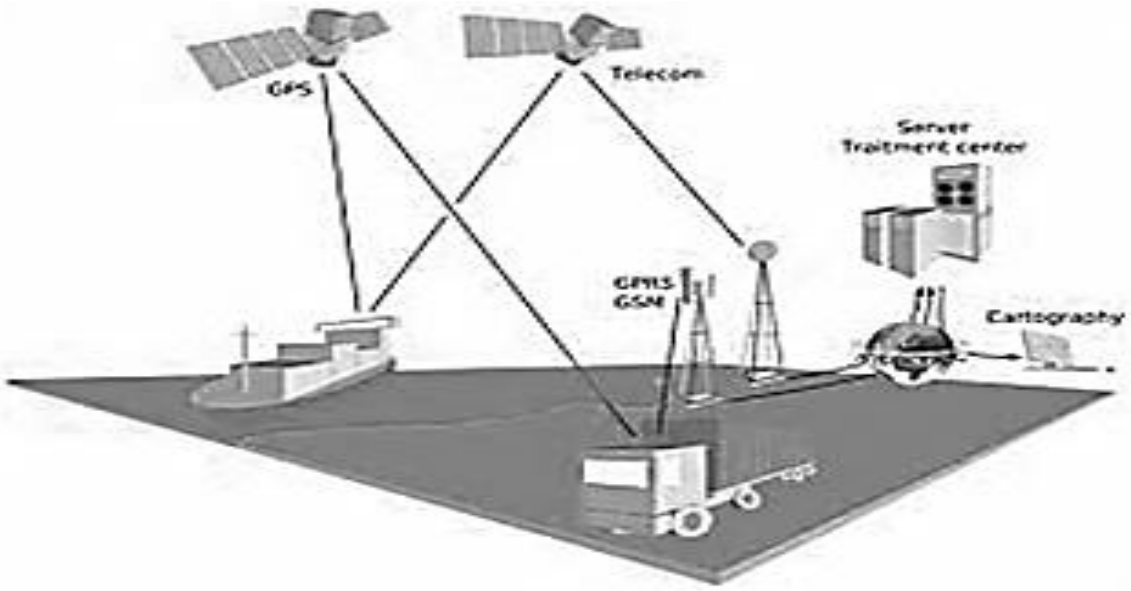

**GPS Control Segment**:

- The control segment comprises of a master control station and five monitor stations outfitted with atomic clocks that are spread around the globe.
- The five monitor stations monitor the GPS satellite signals and then send that qualified information to the master control station where abnormalities are revised and sent back to the GPS satellites through ground antennas. Control segment also referred as monitor station.

Control Segment

**User Segment**:

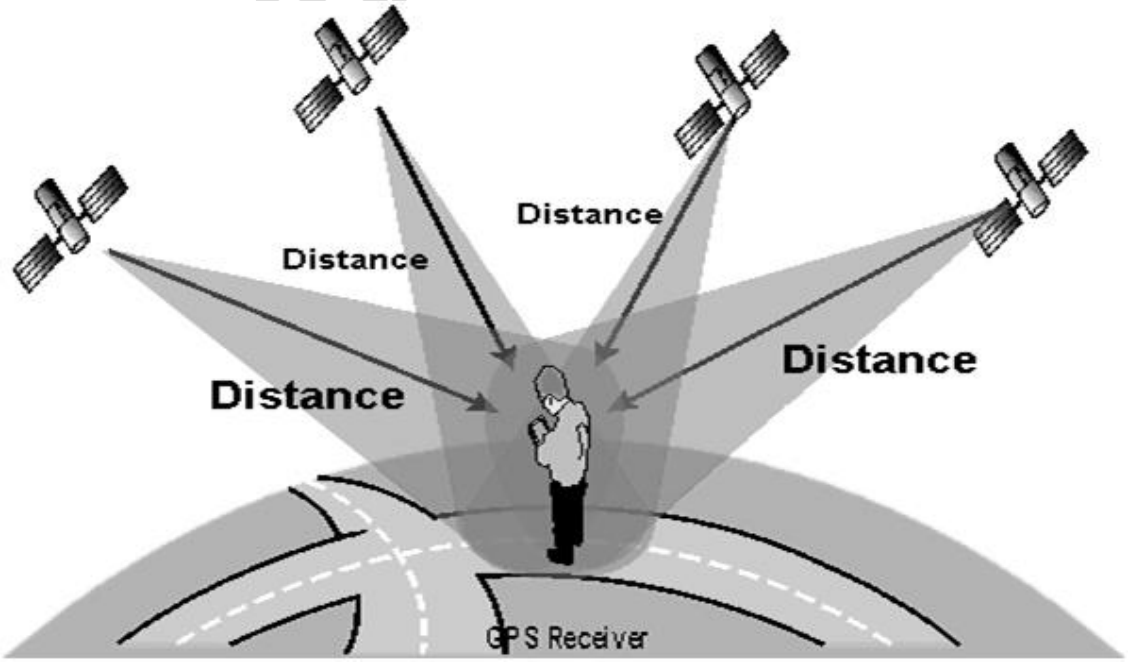
- The user segment comprises of the GPS receiver, which receives the signals from the GPS satellites and determine how far away it is from each satellite.
- Mainly this segment is used for the U.S military, missile guidance systems, civilian applications for GPS in almost every field.
- Most of the civilian uses this from survey to transportation to natural resources and from there to agriculture purpose and mapping too.




User segment

How GPS Determines a Position:

- The working/operation of Global positioning system is based on the 'trilateration' mathematical principle.
- The position is determined from the distance measurements to satellites. From the figure, the four satellites are used to determine the position of the receiver on the earth.
- The target location is confirmed by the 4th satellite. And three satellites are used to trace the location place.
- A fourth satellite is used to confirm the target location of each of those space vehicles. Global positioning system consists of satellite, control station and monitor station and receiver.
- The GPS receiver takes the information from the satellite and uses the method of triangulation to determine a user's exact position.




**GPS Circuit**:-

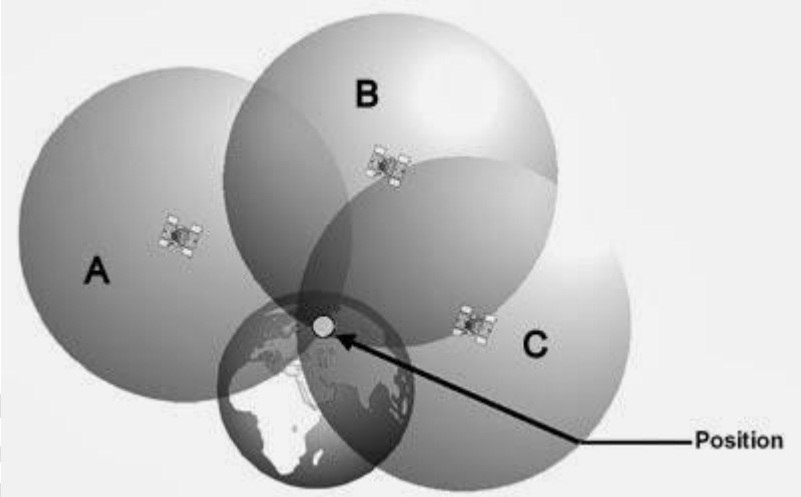
GPS is used on some incidents in several ways, such as:

- To determine position locations; for example, you need to radio a helicopter pilot the coordinates of your position location so the pilot can pick you up.
- To navigate from one location to another; for example, you need to travel from a lookout to the fire perimeter.
- To create digitized maps; for example, you are assigned to plot the fire perimeter and hot spots.
- To determine distance between two different points.

**Q) Explain how a GPS receiver determines the ship's position.** *(Jan-20, March-18, Jan-18, Nov-17, July-17, Aug-16)*

Ans:- **Position Fixing**:

- The receiver locks on to one satellite, and from this satellite it obtains the almanac of all the other satellites, and thereby selects the most suitable satellites for position fixing.
- The position obtained by the receiver is basically by determining the distances from the receiver to each of the selected satellites.
- The range measurement is achieved by measuring the propagation time from the selected satellite to the receiver.
- Not possible to precisely synchronize satellite and receiver clock hence the pseudo ranges are obtained.
- Hence an additional satellite is used to obtain the true ranges.




**Equation for position fixing**:-

- $R = C \times (t\text{-}t^2)$
- Range (R) of the satellite to the user.
- Where C is the velocity of the radio waves and
- $(t\text{-}t^2)$ = is the time difference (time taken for satellite signals to reach receiver.)

The satellite clock & the GPS clock may not be perfectly synchronized so this gives rise to an error in range measurement and the obtained is termed as pseudo range.

Hence, there are four unknowns i.e. latitudes, longitude, altitude (x, y, z co-ordinates) of the user as well as the user's clock error with respect to satellite clock.

- The position of the satellite S1 ($x_1$, $y_1$ , $z_1$) is known to the user by the 30 sec navigational message and from this satellite the following equation is obtained:-

$$PR_1 = (C \times \Delta t) = \sqrt{(x_1 - x)^2 + (y_1 - y)^2 + (z_1 - z)^2}$$

- Where $PR_1$ is the pseudo rage from satellite S1.
- (C x Δ*t*) is error in range measurement due to the error in the user's clock.
- Since there are four unknown, they can be resolved from four equations obtained from four different satellites, the other 3 equations will be following:

$$PR_2 - (C \times \Delta t) = \sqrt{(x_2 - x)^2 + (y_2 - y)^2 + (z_2 - z)^2}$$

$$PR_3 - (C \times \Delta t) = \sqrt{(x_3 - x)^2 + (y_3 - y)^2 + (z_3 - z)^2}$$

$$PR_4 - (C \times \Delta t) = \sqrt{(x_4 - x)^2 + (y_4 - y)^2 + (z_4 - z)^2}$$

With the help of these equations the 3D-fix can be obtained. In the case of a craft floating on water, a 2-D fix (i.e. Lat & long) is required and 3 equations from 3 satellites will be sufficient to fix position.

**Q) What do you understand by "Pseudo range" and "True Range?"** *(Mar-21)*
Ans:- True range is the major component of a range measurement, it is rivaled by the effects of the local receiver clock error. Clearly this enormous error must be carefully measured and eliminated. This is done by including the receiver clock error as an unknown that is estimated at the same time as the position of the receiver. This is what makes a GPS solution a 4-dimensional problem. This estimation is done at every timeline that a position is computed.

**Q) With respect to GPS briefly explain the following: Precise Positioning Service** *(Jan-19, May-17)*
Ans:- **Precise Positioning Service (PPS)**:-
- Authorised users have access to Precise Positioning Service.
- The L1 frequency, transmitted by all Navstar satellites, contains a course/acquisition (C/A) code ranging signal, with a navigation data message, that is available for peaceful civil, commercial, and scientific use; and a precision (P) code ranging signal with a navigation data message, that is reserved for authorized use.
- PPS predictably is 30 meters.

Q) **With respect to GPS briefly explain the following: Standard Positioning Service** *(Jan-19, May-17)*
Ans:- **Standard Positioning Service (SPS)**:-
- Civil Users worldwide use SPS.
- The L1 frequency, transmitted by all satellites, contains a coarse/ acquisition (C/A) code ranging signal, with a navigation data message, that is available for peaceful

civil, commercial, and scientific use.
- SPS predictability Accuracy: within 35 meters.
- It is subject to selective availability, intentional down gradation of accuracy.
- Now it has been announced by US Govt, that intentional down gradation will not be done.

**Q) What are the errors possible in GPS?** (Oct-20, July-19, *July-17, May-17, Nov-16, March-16)* **OR**
**Q) With respect to GPS. Explain the following: What factors affect the accuracy of GPS positions.** *(March-21, Jan-17)* **OR**
**Q) Explain: Pseudo Range** *(March-18, Nov-18)*

Ans:- **ERRORS OF GPS**:-

1) Atmospheric Error: Changing atmospheric conditions change the speed of the GPS signals as they pass through the Earth's atmosphere and this affects the time difference measurement and the fix will not be accurate.
   Each satellite transmits its message on two frequencies and hence a dual frequency receiver receives both the frequencies and correction is calculated and compensated within the receiver thus increasing the accuracy of the fix.
   a. Effect is minimized when the satellite is directly overhead.
   b. Becomes greater for satellites nearer the horizon. The receiver is designed to reject satellites with elevation less than 9.5 degrees.

2) User Clock Error: If the user clock is not perfectly synchronised with the satellite clock, the range measurement will not be accurate. The range measurement along with the clock error is called **pseudo range**. This error can be eliminated within the receiver by obtaining **pseudo range** from three satellites and is done automatically within the receiver.

3) Satellite Clock Error: This error is caused due to the error in the satellite's clock w.r.t. GPS time. This is monitored by the ground based segments and any error in the satellites clock forms part of the 30 seconds navigational message.

4) GDOP Error: The GDOP of a satellite determines the angle of cut which in turn governs the quality of the position obtained. Wider the angular separation between the satellites, better the accuracy of the fix. Or, conversely said, the lower the GDOP value, the greater the accuracy of the fix. The GDOP value is indicated on the display unit.

5) Multipath Error: This error is caused by the satellite signals arriving at the ship's antenna both directly from the satellite and those that get reflected by some objects. Thus two signals are received simultaneously which will cause the distortion of signal from which range measurement is obtained. Siting the antenna at a suitable place can minimize this error.

6) Orbital Error: The satellites are monitored and their paths are predicted by the ground based segment. However, between two consecutive monitoring of the same satellite, there may be minor drifts from their predicted paths resulting in small position inaccuracy.

GPS ERROR SOURCES

| ERROR SOURCE | TYPICAL RANGE ERROR | DGPS (CODE) RANGE ERROR <100 KM REF-REMOTE |
|---|---|---|
| SV CLOCK | 1 M | |
| SV EPHEMERIS | 1 M | |
| SELECTIVE AVAILABILITY | 10 M | |
| TROPOSPHERE | 1 M | |
| IONOSPHERE | 10 M | |
| PSEUDO-RANGE NOISE | 1 M | 1 M |
| RECEIVER NOISE | 1 M | 1 M |
| MULTIPATH | 0.5 M | 0.5 M |
| RMS ERROR | 15 M | 1.6 M |
| ERROR * PDOP=4 | 60 M | 6 M |

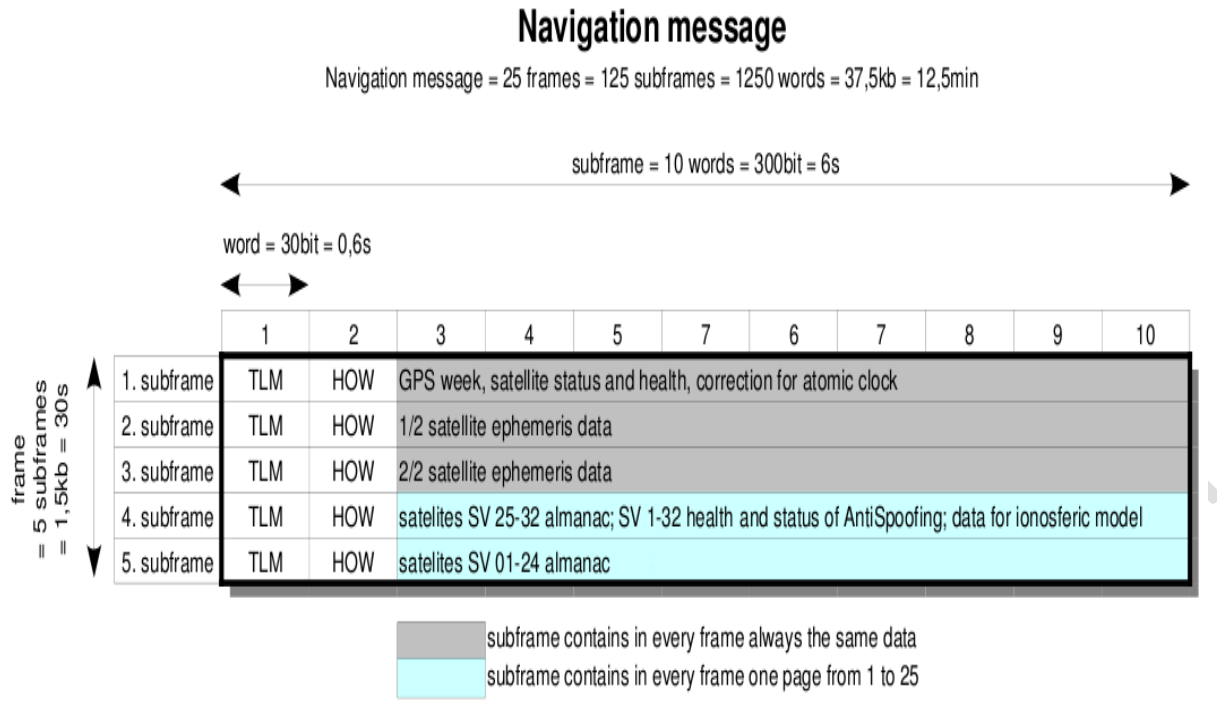
PDOP=Position Dilution of Precision (3-D) 4.0 is typical

**Q) With respect to GPS explain the following: Contents of navigation message** *(April-21, Sept-19, Sept-17, July-16, Jan-16)* **OR**
**Q) Describe the contents of navigation message and structure of the C/A Code transmitted by the GPS satellites.** *(Jan-22, May-19)* **OR**
**What message is contained in each sub-frame of the GPS Navigational Message** *(July-21, Jan-21, March-17)*

Ans:- Navigation Message: Essential purpose of the navigation message transmission by satellites is to determine its position by the GPS receiver. Each satellite transmits a navigational message of 30 seconds in the form of 50 bps data frame. This data, which is different for each satellite, is previously supplied to the satellites by master control station and is divided into 5 sub-frames.

Each sub-frame commences with telemetry word (TLM) containing satellite status followed by hand over word (HOW) data for acquiring P code from C/A code.

The sub-frames are:
**The 1st sub-frame** contains data relating to satellite clock correction.
**The 2nd and 3rd sub-frames** contain the satellite ephemeris defining the position of the satellite.
**The 4th sub-frame** passes the alpha-numeric data to the user and will only be used when upload station has a need to pass specific messages.
**The 5th sub-frame** gives the almanac of all the other satellites which includes the identity codes thus allowing the user the best choice of satellites for position fixing.




**Q) Describe the contents of navigational message of the GPS.** *(Jan-22, July-21, April-21)*

Ans: - The navigational message of the GPS (Global Positioning System) contains information about the satellite constellation and the GPS system clock that is necessary for determining a receiver's position. The navigational message is broadcast by each satellite in the GPS constellation and contains the following information:

1. Satellite health status: This indicates the current status of the satellite and whether it is functioning normally or not. This information is important for determining the accuracy of the GPS signal.
2. Ephemeris data: This includes the current position of the satellite in orbit, as well as its velocity and acceleration. This information is used by the receiver to calculate the satellite's position at the time of the GPS signal transmission.
3. Almanac data: This includes the approximate position of all satellites in the GPS constellation at a given time. This information is used by the receiver to predict the location of the satellites and improve the accuracy of the GPS signal.
4. Time and clock correction data: This includes the current GPS system time, as well as any clock correction factors that are necessary to adjust for differences in clock time between the receiver and the GPS system.
5. Status messages: These provide information about the operation of the GPS system and any known issues or anomalies that may be affecting the accuracy of the GPS signal.

**Q) With respect to GPS briefly explain the following: Geometric Dilution of precession** *(May-17)* **OR**
**Q) With respect to GPS explain the following: Various DOP's used** *(Sept-17, Jan-16)* **OR**
**Q) Explain Geometric Dilution of Precision (GDOP)** *(Aug-21, Jan-21, Sept-19, Nov-18, Sept-18)*

Ans:- Explanation:-

- Dilution of precision (DOP), or geometric dilution of precision (GDOP), is a term used in satellite navigation and geomatics engineering to specify the additional multiplicative effect of navigation satellite geometry on positional measurement precision.

- DOP can be expressed as a number of separate measurements:
  - HDOP – horizontal dilution of precision
  - VDOP – vertical dilution of precision
  - PDOP – position (3D) dilution of precision
  - TDOP – time dilution of precision

- These values follow mathematically from the positions of the usable satellites. Signal receivers allow the display of these positions (skyplot) as well as the DOP values.

- The term can also be applied to other location systems that employ several geographical spaced sites. It can occur in electronic-counter-counter-measures (electronic warfare) when computing the location of enemy emitters (radar jammers and radio communications devices). Using such an interferometry technique can provide certain geometric layout where there are degrees of freedom that cannot be accounted for due to inadequate configurations.

- The effect of geometry of the satellites on position error is called geometric dilution of precision and it is roughly interpreted as ratio of position error to the range error. Imagine that a square pyramid is formed by lines joining four satellites with the receiver at the tip of the pyramid. The larger the volume of the pyramid, the better (lower) the value of GDOP; the smaller its volume, the worse (higher) the value of GDOP will be. Similarly, the greater the number of satellites, the better the value of GDOP.

**Q) With respect to GPS, write in brief about: HDOP** *(March-19)*

Ans:- HDOP: Acronym for horizontal dilution of precision. A measure of the geometric quality of a GPS satellite configuration in the sky. HDOP is a factor in determining the relative accuracy of a horizontal position. The smaller the DOP number, the better the geometry.

**Q) Describe how a GPS receiver determines the speed of the ship.** *(Sept-21, Sept-18, Nov-16)*

Ans:- SPEED DETERMINATION

- The carrier frequency is also used to determine the speed of the user by the measurement of Doppler shift, i.e. change in the frequency of radio waves received when the distance between the satellite and user is changing due to the relative motion between the two.
- The position and velocity of the satellite as well as the position of the user are known to the user's receiver.
- The velocity vector of the satellite can be resolved in two ways:
  - In the direction towards the user
  - In the direction perpendicular to (i).

- The 2nd component is not considered as speed in this direction will not cause Doppler shift.
- The receiver calculates the velocity vector of the satellite in the direction towards the user.
- If the relative approach speed between the satellite and the user's speed (based on the Doppler shift measurement) is not equal to the satellite speed vector towards the user; the difference can only arise due to user's speed towards or away from the satellite.
- Similarly with the help of the other two satellites, the receiver can calculate two additional speed vectors and these speed vectors will be towards or away from their respective satellites.
- These velocity vectors are resolved into three other vectors, i.e. x, y and z co-ordinates and with these three vectors the course and speed of the user is calculated.

**Q) With respect to GPS explain the following: System configuration and frequencies used** (Sept-17, Jan-16)
**With respect to GPS, explain the following: P & C/A code** *(Jan-21, Sept-19, Sept-18, July-16)*
Ans:- **Codes**:- Each satellite transmits two codes:-

- **P Code (Precession Code)** that is only available to US military and its allies.
- **C/A Code (Coarse Acquisition Code)** available for use to all civilian users.

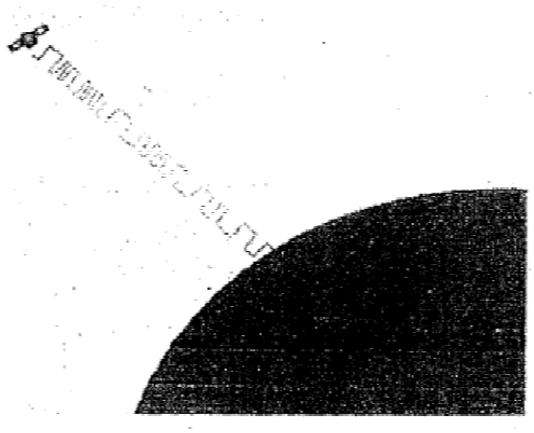
Frequencies: - 1575.42 MHz (L1 signal) and 1227.6 MHz (L2 signal).

- The **L1** carrier consists of **both the C/A and P codes**, while the **L2 carrier** consists the **P code only**.
- Each satellite transmits pseudo random noise signals on these two different frequencies.

Function of these codes is as follows:

- For satellite identification since each satellite has a unique code.
- For measurement of the propagation time from the satellite to user.

**The C/A code**:-



- The C/A code is different for every satellite.
- The C/A code is made up of sequences called chips.
- Sequence repeats itself every millisecond.
- The C/A code is for the civilians.

**P code**:-

- The full code length is of 267 days.
- The extremely long code length makes it difficult to lock on to the P code.
- P code is available only for US & allies.
- P code is different for every satellite.

**Q) Explain briefly: Alarms of GPS** *(March-16)*

Ans:- Alarms of GPS:- There are seven alarm conditions which generate both audible and visual alarms. When an alarm setting is violated, the buzzer sounds and the name of the offending alarm appears on the display. The alarm icon also appears on the Plotter 1, Plotter 2 and Highway displays.

1) Arrival Alarm, Anchor Watch Alarm:-
   a. Arrival alarm:- The arrival alarm informs you that own ship is approaching a destination waypoint. The area that defines an arrival zone is that of a circle which you approach from the outside of the circle.
   b. Anchor watch alarm:- The anchor watch alarm sounds to warn you that own ship is moving when it should be at rest.

2) Cross Track Error (XTE) Alarm :- The XTE alarm warns you when own ship is off its intended course.

3) Ship's Speed Alarm:- The ship's speed alarm sounds when ship's speed is lower or higher (or within) the alarm range set.

4) Trip Alarm:- The trip alarm sounds when the distance run is greater than the trip alarm setting.

5) Water Temperature Alarm:- The water temperature alarm sounds when the water temperature is higher or lower (or within) the preset temperature. This alarm requires temperature signal from external equipment.

6) Depth Alarm:- The depth temperature alarm sounds when the depth is higher or lower (or within) the preset depth. This alarm requires video sounder connection.

7) WAAS/DGPS Alarm:- The WAAS/DGPS alarm sounds when the WAAS/DGPS signal is lost. This alarm may be enabled or disabled as below.

**Q) Explain the functioning of DGPS** *(July-21, March-19, July-17)* **OR**
**Explain the working principle of DGPS and its limitations.** *(July-16)* **OR**
**Explain briefly: Working principle of DGPS** *(March-16)* **OR**
**Q) Explain the errors of the GPS system.** *(May-19)*

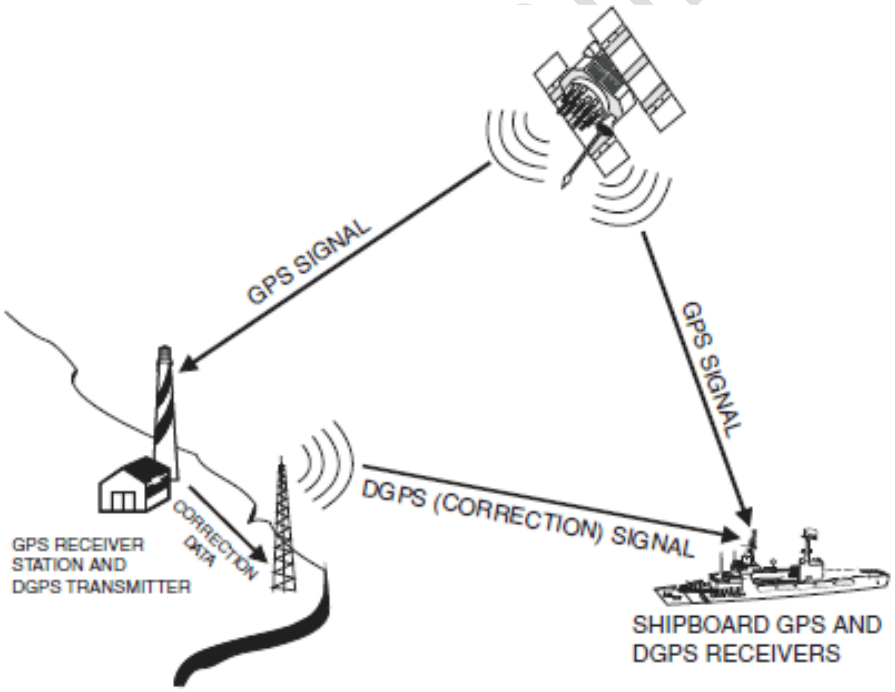
Ans:- Differential GPS (DGPS) is a system in which differences between observed and computed co-ordinates ranges (known as differential corrections) at a particular known point are transmitted to users (GPS receivers at other points) to upgrade the accuracy of the users receivers position.

Differential Correction:- Differential correction is a technique that greatly increases

the accuracy of the collected DGPS data. It involves using a receiver at a known location - the "base station" and comparing that data with DGPS positions collected from unknown locations with "roving receivers."

Limitation & Errors of DGPS:-
a) International Limitation of Accuracy
b) Receiver Independent Exchange Format
c) Reference System Co-ordinates

Methods used to Transmit Corrections:-
- Computing & transmitting – a position correction in terms of Lat, Long & altitude i.e. x, y, z co-ordinates.
- Computation of pseudo range correction to each satellite which is then broadcasted to the user and applied to the user's pseudo range measurement before the position is calculated by the onboard receiver resulting in a higher accuracy of position fix.
- DGPS removes common-mode errors, those errors common to both the reference and remove receivers (not multipath or receiver noise). Errors are more often common when receivers are close together (less than 100 km). Differential position accuracies of 1-10 meters are possible with DGPS based on C/A code SPS Signal.




**Q) How the DGPS calculate even more accurate position than the GPS?** *(Nov-20, Nov-21, Nov-17)*
**Q) Explain how DGPS enhances the accuracy of a GPS receiver.** *(Sept-18, March-18)*
Ans:- Explanation:-
- Differential Global Positioning System (DGPS) is an enhancement to Global Positioning System that provides improved location accuracy, from the 15-meter nominal GPS accuracy to about 10 cm in case of the best implementations.
- DGPS uses a network of fixed ground-based reference stations to broadcast the difference between the positions indicated by the GPS satellite systems and the

known fixed positions.

- These stations broadcast the difference between the measured satellite pseudo ranges and actual (internally computed) pseudo ranges, and receiver stations may correct their pseudo ranges by the same amount.
- The digital correction signal is typically broadcast locally over ground-based transmitters of shorter range.

**Q) What do you understand by the term 'chart datum'? Which default datum is used in GPS? Can a fix obtained from the GPS receiver be plotted directly onto a navigational chart?** *(March-20)*

Ans:- Chart Datums:- Chart Datum (CD) is defined simply in the Glossary as the level below which soundings are given on Admiralty charts. CDs used for earlier surveys were based on arbitrary low water levels of various kinds.

Modern Admiralty surveys use as CD a level as close as possible to Lowest Astronomical Tide (LAT), which is the lowest predictable tide under average meteorological conditions. This is to conform to an IHO Technical Resolution which states that CD should be set at a level so low that the tide will not frequently fall below it.

The actual levels of LAT for Standard Ports are listed in Admiralty Tide Tables. On larger scale charts, abbreviated details showing the connection between chart datum and local land levelling datum are given in the tidal panel for the use of surveyors and engineers, where those connections are known.

Datums in use on charts:-

Large scale modern charts contain a panel giving the heights of MHWS, MHWN, MLWS and MLWN above CD, or MHHW, MLHW, MHLW and MLLW, whichever is appropriate, depending on the tidal regime in the area concerned. The definitions of all these terms are given in the Glossary. If the value of MLWS from this panel is shown as 0·0 m, CD is the same as MLWS and is not therefore based on LAT. In this case tidal levels could fall appreciably below CD on several days in a year, which happens when a CD is not based on LAT.

Other charts for which the UKHO is the charting authority are being converted to new CDs based on LAT as they are redrawn. The new datum is usually adopted in Admiralty Tide Tables about one year in advance to ensure agreement when the new charts are published. When the datum of Admiralty Tide Tables thus differs from that of a chart, a caution is inserted by Notice to Mariners on the chart affected drawing attention to the new datum.

Where foreign surveys are used for Admiralty charts, the chart datums adopted by the hydrographic authority of the country concerned are always used for Admiralty charts. This enables foreign tide tables to be used readily with Admiralty charts. In tidal waters these CDs may vary from Mean Low Water (MLW) to lowest possible low water. In non–tidal waters, such as the Baltic, CD is usually Mean Sea Level (MSL). Caution. Many CDs are above the lowest levels to which the tide can fall, even under average weather conditions. Charts therefore do not always show minimum depths. For further details, see the relevant Admiralty Tidal Handbook.

## AIS

**Q) Briefly explain the working principle of AIS?** *(Jan-21, Dec-20, Mar-19, Jan-*

*17, May-17, July-16, May-16)*

**OR**

**Explain the principle of AIS and the frequencies used.** *(Aug-16)*

**OR**

**How data is transmitted by the Automatic Identification System?** *(Jan-20, Sept-17)*

**OR**

**Write short notes on: AIS** *(Jan-23, Oct-21, May-19, Nov-18, Sept-18, May-18, Jan-18, July-17, Nov-16)*

Ans:- Automatic Identification System:-

- Very simply, the Automatic Identification System is a broadcast transponder system, operating in the VHF maritime mobile band.

- It is capable of sending information such as identification, position, course, speed and more, to other ships and to shore. AIS operates principally on two dedicated VHF frequencies or channels:

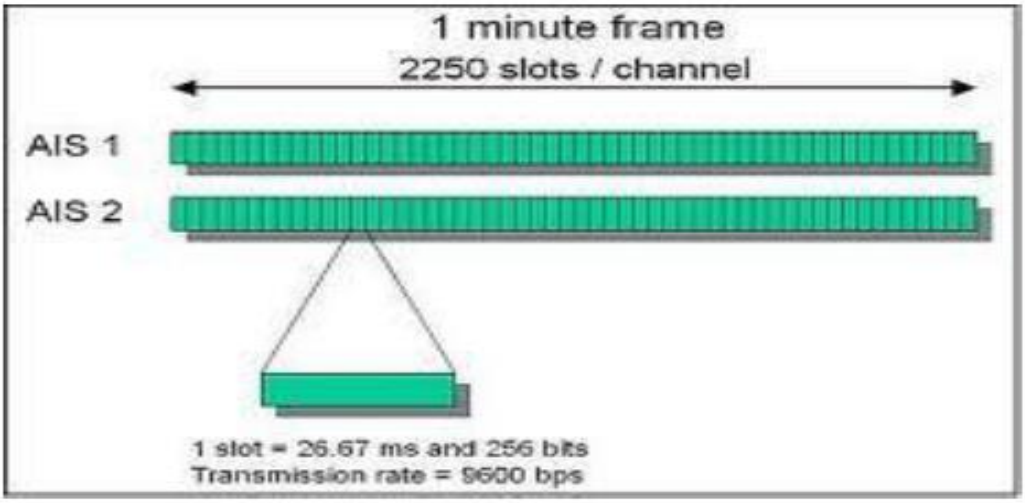
  **AIS 1 – 161.975 MHz – channel 87B (Simplex, for ship to ship) and**
  **AIS 2 – 162.025 MHz – channel 88B (Duplex for ship to shore).**

- AIS uses Self-Organizing Time Division Multiple Access (SOTDMA) technology to meet this high broadcast rate and ensure reliable ship-to-ship operation. It normally works in an autonomous and continuous mode, regardless of whether it is operating in the open seas, coastal or inland areas.

- Although only one radio channel is necessary, each station transmits and receives over two radio channels to avoid interference problems and to allow channels to be shifted without communications loss from other ships.

- Each station determines its own transmission schedule (slot), based upon data link traffic history and knowledge of future actions by other stations.

- A position report from one AIS station fits into one of 2250 time slots established every 60 seconds.




- AIS stations continuously synchronize themselves to each other, to avoid overlap of slot transmissions.

- Slot selection by an AIS station is randomized within a defined interval. When a station changes its slot assignment, it pre-announces both the new location and

the timeout for that location.

- In this way, new stations including those stations which suddenly come within radio range close to other vessels will always be received by those vessels.

- *Each AIS consists of* on VHF transmitter, two VHF TDMA receivers, one VHF DSC receiver, and a standard marine electronic communications link to shipboard display and sensor systems.

- *Working of AIS*:-
  - AIS is fitted with two receivers, one transmitter VHF DSC receiver Standard marine electronic communication link providing the various input data.
  - The AIS transmission uses 9.6 kb GMSK FM over 25 or 12.5kHz channel using HDLC Packet control.
  - Each AIS transmits and receives over two radio channel to avoid interference problems.
  - Each station determines its own transmission slot based on the data link traffic history and knowledge of future actions by other stations.
  - Range of AIS is about 20 NM.

**Q) What are the objectives of AIS?** *(Mar-21)*

Ans:- Objectives of AIS:

- AIS is intended to enhance, safety of life at sea, the safety and efficiency of navigation and the protection of the marine environment.
- As per SOLAS regulation V/19 requires that AIS exchange data ship-to ship and with shore-based facilities.
- Therefore, the purpose of AIS is to help identify vessel, assist in target tracking, simplify information exchange (e.g. reduce verbal mandatory ship reporting) and provide additional information to assist situation awareness.
- In general, data received via AIS will improve the quality of the information available to the OOW, whether at a shore surveillance station or on board a ship.
- AIS should become a useful source of supplementary information to that derived from navigational systems (including radar) and therefore an important 'tool' in enhancing situation awareness of traffic confronting users.

**Q) What are the advantages of AIS?** *(Oct-20, Jan-17)*

**OR**

**Write in short purpose of AIS.** *(Jan-19)*

Ans:- Advantages of AIS:-

- AIS helps in collision avoidance with respect to situational awareness, AIS can calculate the CPA & TCPA which can be compared with ARPA.
- Information regarding navigation status cane be beneficial.
- By virtue of AIS vessels can be positively identified.
- AIS reduced the work load associated with verbal reporting system required by the VTS.
- AIS contributes to Maritime security, authorities can monitor the movement of the vessels, multiple AIS coast stations can be linked together to get the extended surveillance.
- AIS can pick up targets even during heavy weather & restricted visibility especially

due to rain etc.
- AIS can pick up targets beyond small islands & bends.
- Problem on target swap (for ARPA) will not be experienced in case of AIS.
- No problem of range discrimination or bearing discrimination.
- Pseudo AIS can be used to generate virtual buoys to indicate dangers.
- AIS can also be installed on light houses, beacons for positive identification of these marks.
- Pseudo AIS can also be used to generate target in case of SAR operations.
- AIS can be used for meteorological & navigational information.
- AIS can be interfaced with VDR, ECDIS & radar.

**Q) What are the added advantages of AIS over ARPA w.r.t. collision avoidance?** *(Mar-21)*

Ans:- AIS is not yet recommended as such to be collision avoidance aid. It may be used in conjunction with other recognised collision avoidance aids such as Radar and ARPA, etc. but is not meant as a replacement for the same.

**Q) Explain the limitations of AIS and the precautions during the use of same for collision avoidance?** *(Jan-23, July-21, Oct-20, March-17, Jan-16)*

Ans:- Limitation of AIS:-
- Small crafts may not be fitted with AIS
- AIS might have switched off on other ship
- Erroneous data might have entered
- Accuracy of data received depend on the accuracy of data transmitted
- Error in sensor's input data,
- Failure of sensors to provide data
- Cell of vessel may be full

Precautions while using AIS in collision avoidance:-
- Do not rely on AIS as the sole information system, making use of all safety-relevant information available.
- AIS is an additional source of navigational information. It does not replace other nav aids.
- Watches must be kept as per STCW.
- It does not have any impact on the composition of watch arrangement.
- Swapping of targets.

**Q) Explain the use of AIS in collision avoidance and SAR operations.** *(Mar-21, July-19)*

Ans:- Use of AIS in Collision avoidance: AIS has potential to significantly contribute to safety of navigation. It provides positive identification of targets fitted with AIS along with their static and dynamic information.

This enhances the navigational effectiveness and it can greatly improve situational awareness and decision making abilities. AIS also assists OOW in tracking and monitoring targets, as it also provides information on CPA and TCPA.

Use of AIS in SAR operations:

- SAR operations can be used for receiving messages from an AIS-SAR transmitter (SART), which have built in GPS receivers to derive accurate positioning information, on survival craft.
- In combined aerial and surface searches AIS may allow the direct presentation of the position on other displays, such as radar, electronic chart systems and ECDIS.
- AIS-SART facilitates the task of SAR craft in rescuing distressed seafarers.
- For ships in distress without AIS, the on scene co-ordinator could create an AIS target.

**Q) Describe the contents and indicate the broadcast intervals for each message type for a class A AIS.** *(March-20)*

Ans:- Type of AIS on class A:

- A Class A AIS unit broadcasts the following information every 2 to 10 seconds while underway and every 3 minutes while at anchor at a power level of 12.5 watts.
- The information broadcast includes:
  - MMSI number - unique reference able identification
  - Navigation status - not only are "at anchor" and "underway using engine" currently defined, but "not under command" is also currently defined.
- Rate of turn - right or left, 0 to 720 degrees per minute.
- Speed over ground - 1/10 knot resolution from 0 to 102 knots.
- Position accuracy - differential GPS or other and an indication if RAIM processing is being used Longitude - to 1/10000 minute and Latitude - to 1/10000 minute.
- Course over ground - relative to true north to $1/10^{th}$ degree.
- True Heading - 0 to 359 degrees derived from gyro input.
- Time stamp - The universal time to nearest second that this information was generated.
- In addition, the Class A AIS unit broadcasts the following
- information every 6 minutes:
  - MMSI number - same unique identification used above, links the data above to described vessel.
  - IMO number - unique reference able identification (related to ship's construction).
  - Radio call sign - international call sign assigned to vessel, often used on voice radio.
- Name - Name of ship, 20 characters are provided.
- Type of ship/cargo - there is a table of possibilities that are available.
- Dimensions of ship - to nearest meter.
- Location on ship where reference point for position reports is located.
- Type of position fixing device - various options from differential GPS to undefined.
- Draught of ship - 1/10 meter to 25.5 meters [note "air-draught" is not provided].
- Destination - 20 characters are provided.
- Estimated time of Arrival at destination - month, day, hour, and minute in UTC.

**Q) Explain briefly with respect to AIS: Types of messages.** *(Jan-23)*

**OR**

**Q) With Respect to AIS explain the followings: Dynamic Message** *(July-21, Oct-20)*

Ans:- AIS message data falls under the below categories:-

a) Static data
b) Dynamic data
c) Voyage data
d) Safety related data

a) Static Data: The static data are sent every six minutes unless changed.
- IMO Number
- Call sign and name
- Length and beam
- Type of ship
- Location of position fixing antenna.

b) Dynamic Data:
- Course over ground
- Speed over ground
- Ship's position
- Time
- Heading
- Navigation status
- Rate of turn
- The dynamic data are sent as per the ship's navigational status and speed and are as follows:
  - When at anchor every three minutes.
  - 0-14 kts-every 12 seconds
  - 14-23 kts-every 6 seconds
  - 14-23 kts and changing course every 2 seconds
  - 23+ kts every 2 seconds

c) Voyage related data:
- These information are entered manually
- Ship's draft
- Destination and ETA
- Type of cargo
- No. of crew etc.

d) Safety related data:
- The safety messages are normally sent in the text form and may be directed to one stations or various stations.
- These messages are sent only when required.

**Q) With respect to AIS, what is the information contained in "Dynamic messages"?** *(July-21)*

Ans:- In AIS (Automatic Identification System), the "Dynamic messages" contain information about the vessel's dynamic characteristics, such as its position, course, speed, and navigational status. The Dynamic messages are transmitted by the vessel periodically, typically every 2-10 seconds depending on the vessel's speed, and include the following information:

1. Position: The vessel's current position, expressed in latitude and longitude.
2. Course over ground (COG): The vessel's current course, expressed in degrees relative to true north.
3. Speed over ground (SOG): The vessel's current speed, expressed in knots.

4. Heading: The vessel's current heading, expressed in degrees relative to true north.
5. Rate of turn (ROT): The vessel's current rate of turn, expressed in degrees per minute.
6. Navigational status: The vessel's current navigational status, such as "under way using engine", "at anchor", "not under command", or "restricted maneuverability".
7. Voyage-related data: This includes the vessel's destination, ETA (estimated time of arrival), and other voyage-related information.

**Q) Why should AIS not be used as the sole anti-collision aid? What is meant by Pseudo-AIS or Virtual-AIS and where could these be used?** *(Aug-21)*

Ans:- AIS (Automatic Identification System) should not be used as the sole anti-collision aid because it has several limitations and can provide incomplete or misleading information in certain situations. Some of the limitations of AIS include:

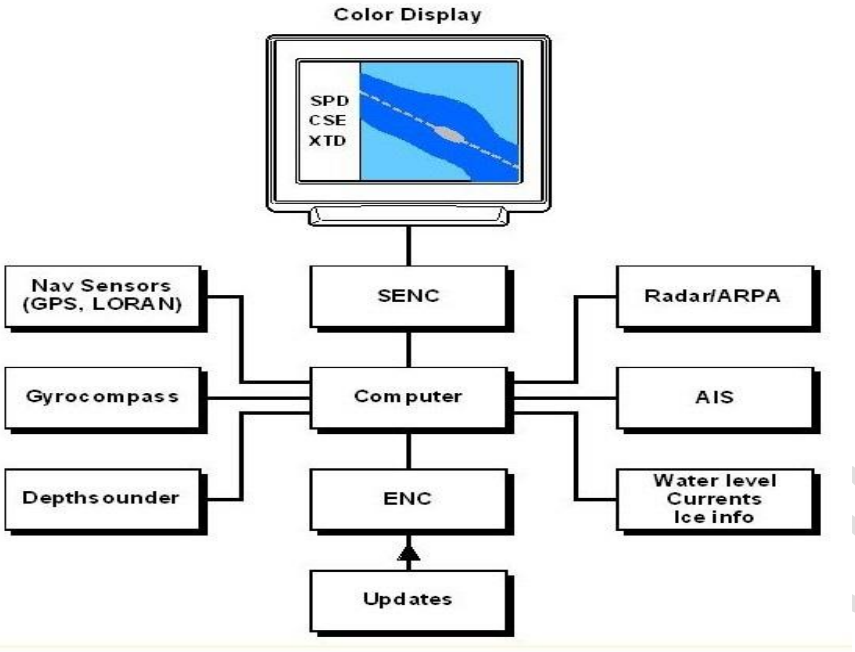
- Limited range: AIS has a limited range and may not detect vessels beyond a certain distance.
- Limited reliability: AIS messages can be lost, garbled, or delayed, leading to incomplete or inaccurate information.
- Limited information: AIS provides limited information about a vessel's intentions, such as whether it is turning or altering course.
- Vulnerability to tampering: AIS signals can be deliberately or accidentally jammed, leading to a loss of information.

Pseudo-AIS or Virtual-AIS is a term used to describe a system that simulates an AIS signal without the use of an actual AIS transceiver. This can be achieved using a satellite or other communication link to transmit the simulated AIS data to other vessels or shore-based authorities. Pseudo-AIS or Virtual-AIS can be used in areas where AIS coverage is limited or non-existent, or where additional information is needed to supplement AIS data. However, it is important to note that Pseudo-AIS or Virtual-AIS should not be used as a substitute for an actual AIS transceiver, as it may not provide accurate or reliable information in all situations.

## ECDIS

**Q) Write short notes on ECDIS** *(Oct-21)*

**Ans:-** Electronic Chart Display and Information System (ECDIS) is an electronic navigational chart system that integrates GPS and other navigational sensors to provide a real-time display of the vessel's position and surrounding navigational information.




Components of ECDIS

Here are some key points on ECDIS:

- Purpose: The primary purpose of ECDIS is to enhance navigational safety by providing accurate and up-to-date navigational information to the bridge team. It eliminates the need for paper charts and reduces the risk of errors in manual chart plotting.
- Components: An ECDIS system comprises a display unit, a computer, and navigational sensors such as GPS, gyrocompass, and speed log. It also includes electronic charts, which are regularly updated to ensure accuracy.
- Working: ECDIS receives navigational data from various sensors and displays it in real-time on an electronic chart. The system allows the bridge team to plan and monitor the vessel's route, set alarms for potential hazards, and obtain information on other vessels in the vicinity. It also provides information on navigational hazards, such as shallow waters, rocks, and wrecks.
- Features: ECDIS has various features that enhance navigational safety, including route planning and monitoring, automatic identification system (AIS) integration, radar overlay, and the ability to display real-time weather and tidal information. It also allows the bridge team to record and review the vessel's track history for future reference.
- Training and Certification: As per the STCW Convention, all navigational officers operating ECDIS must receive specific training and be certified for its use. This training covers the principles of ECDIS, its components and operation, chart information, and route planning and monitoring.

**Q) Define following as applicable to ECDIS: ENC** *(Jan-21, Jan-20)*

Ans:- Electronic Navigational Chart (ENC) means the database, standardized as to content, structure and format, issued for use with ECDIS on the authority of government authorized hydrographic offices. The ENC contains all the chart information necessary for safe navigation and may contain supplementary information in addition to that contained in the paper chart (e.g. sailing directions) which may be considered necessary for safe navigation. Vector charts are an

example.

**Q) Define following as applicable to ECDIS: SENC** *(Jan-20)*
Ans:- System Electronic Navigational Chart (SENC) means a database resulting from the transformation of the ENC (a vector chart) by ECDIS for appropriate use, updates to the ENC by appropriate means and other data added by the mariner. It is the database that is actually accessed by ECDIS for the display generation and other navigational functions and is the equivalent to an up-to-date paper chart. The SENC may also contain information from other sources.

**Q) Define following as applicable to ECDIS: Standard Display** *(Jan-20)*
Ans:- Standard Display means the SENC information that should be shown when a chart is first displayed on ECDIS. Depending upon the needs of the mariner, the level of the information it provides for route planning or route monitoring may be modified by the mariner.

**Q) Define following as applicable to ECDIS: Display Base** *(Jan-20)*
Ans:- **Display Base** means the level of SENC information which cannot be removed from the display, consisting of information which is required at all times in all geographic areas and all circumstances. It is not intended to be sufficient for safe navigation.

**Q) Define following as applicable to ECDIS: Vector Chart** *(Jan-20)*
Ans:- A vector chart is a digital database of all the objects (points, lines, areas, etc.) represented on a chart. Vector charts store information, such as isolated dangers, depths, depth contours, coastline features, cables and pipelines etc in separate layers which can be displayed as per the user's requirements. Vector charts are also referred to as intelligent charts as they can be interrogated for information not displayed but stored in it's memory.

**Q) Define following as applicable to ECDIS: Raster Chart** *(Jan-20)*
Ans:- Raster Chart data is created by scanning the information on a paper chart and storing this information in the form of pixels. Many thousands of pixels together make a flat digital image. Each pixel contains all the data for a particular point: colour, brightness etc. They are also geographically referenced which makes the raster chart identical in every way to the paper chart on which it is based. Raster charts cannot be manipulated or queried. Also referred to as the Raster Chart Display System (RCDS), the information is contained in one single layer only. Information can only be added to this type of chart.

**Q) What are the advantages and disadvantages of ECDIS over paper charts?**

*(Aug-21)*
Ans:- ECDIS (Electronic Chart Display and Information System) and paper charts both have advantages and disadvantages, as described below:

Advantages of ECDIS:
- Greater accuracy and precision: ECDIS provides accurate and precise navigational data, allowing for safer and more efficient navigation.
- Improved situational awareness: ECDIS displays real-time navigational data, allowing for better decision-making and situational awareness.
- User-friendly interface: ECDIS is typically more user-friendly than paper charts, with easier search and display functions.
- Easy updating: ECDIS allows for easy updating of navigational data, eliminating the need for manual updates.
- Integration with other systems: ECDIS can be integrated with other systems such as radar and AIS, allowing for better integration of navigational data.

Disadvantages of ECDIS:
- Dependence on technology: ECDIS relies on technology, which can be subject to malfunctions, power failures, or cyber attacks.
- Complexity: ECDIS is more complex than paper charts, requiring proper training and knowledge to operate and interpret the data.
- Cost: ECDIS systems can be expensive, particularly for smaller vessels.
- Reliance on data sources: ECDIS relies on accurate and up-to-date navigational data, which may not always be available or reliable.

## LRIT

**Q) With respect to LRIT: Provide what information is transmitted & explain when a contracting government can have a right to get these information.** *(March-19)*
**Q) Write short notes on: LRIT** *(Oct-21, May-19, Sept-18, May-18, Nov-17, July-17, Nov-16)*
**OR**
**What is the purpose of LRIT & How Data is transmitted** *(April-21, Jan-21, March-19, Jan-19, Sept-17, March-17, Aug-16, July-16, Jan-16)*
**OR**
**Q) Long range and identification system.** *(Nov-18)*
Ans:- **LONG RANGE IDENTIFICATION AND TRACKING (LRIT)**:-
**PURPOSE OF LRIT:-**
- The Long Range Identification and Tracking (LRIT) system is a designated International Maritime Organization (IMO) system designed to collect and disseminate vessel position information received from IMO member States ships.
- The main purpose of the LRIT ship position reports is to enable a Contracting Government to obtain ship identity and location information in sufficient time to evaluate the security risk posed by a ship off its coast and to respond, if necessary, to reduce any risks.
- The SOLAS regulation on LRIT establishes a multilateral agreement for sharing LRIT information between SOLAS **contracting governments** for security and search and rescue purposes. It maintains the right of flag states to protect information about the ships entitled to fly their flag, where appropriate, while

allowing coastal states access to information about ships navigating off their coasts.

- LRIT has also become an essential component of SAR operations and marine environment protection.
- It is a satellite-based, real-time reporting mechanism providing almost worldwide coverage (Inmarsat Coverage) that allows unique visibility to position reports of vessels that would otherwise be invisible and potentially a threat.

**CARRIAGE REQUIREMENT**:- Ships in international voyages

- Passenger ships
- Cargo ships over 300 t
- Mobile platforms

*Ships fitted with AIS and sailing in sea A1 areas do not need to transmit LRIT data.*

**INFORMATION TRANSMITTED**:-

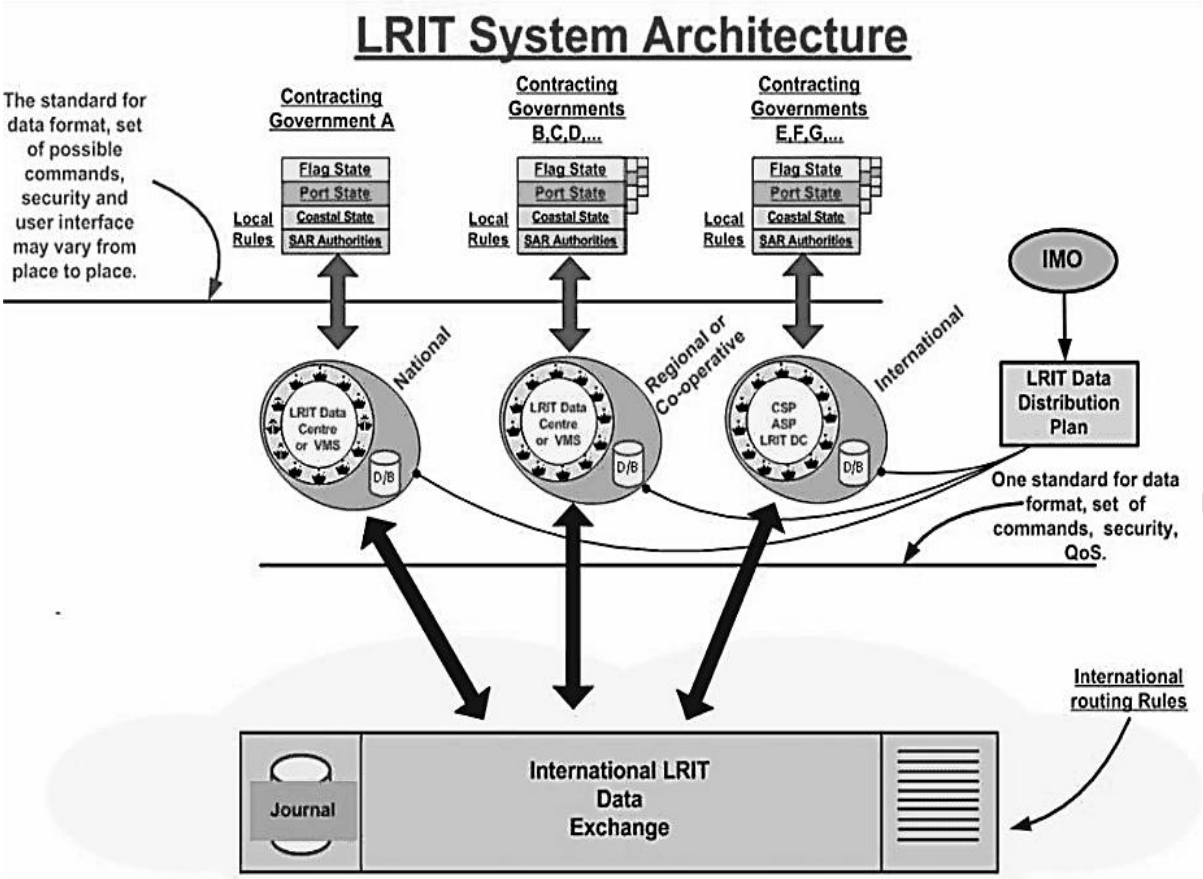
- Identity (Ship's LRIT Identifier)
- Position (Lat/Long)
- Date and time (UTC)

**UPDATE INTERVAL**:-

- Default value 6 hourly
- Update interval remotely selectable
- Minimum interval 15 min
- May be switched off by the Master under certain conditions

**THE LRIT SYSTEM CONSISTS OF**:

1. The ship borne LRIT information transmitting equipment
2. Communications Service Providers (CSPs)
3. Application Service Providers (ASPs)
4. LRIT Data Centres (DC), including any related Vessel Monitoring System(s) (VMSs)
5. The LRIT Data Distribution Plan (DDP)
6. The International LRIT Data Exchange (IDE), and,
7. LRIT Co-Ordinator




**Q) Explain the following: LRIT Data Centres** *(Aug-21, April-21, March-17)*

Ans:- LRIT Data Centres:-

- The primary purposes of an LRIT Data Centre (DC) are to collect, store and make available to **authorised entities the LRIT information transmitted** by ships instructed by their administrations to utilise the services of that DC. In carrying out these core functions, the DC is required to ensure that LRIT data users are only provided with the LRIT information they are entitled to receive under the terms of SOLAS Regulation V/19.1.
- In addition, the LRIT DC acts as a "clearing house" by receiving requests for LRIT information lodged in other DCs from its associated Administration(s) and obtaining the data requested. Generally LRIT reports so requested will be exchanged through the International Data Exchange.
- LRIT Data Centers are required to archive their data so that the reports can be recovered, if required, at a later date and the activities of the DC can be audited by the LRIT Coordinator.
- LRIT DCs may make a charge for LRIT data they provide to other DCs.
- DCs may be either National (established to provide service to only one Contracting Government); Cooperative (established to provide services to a number of Contracting Governments) or Regional (established to provide services to a number of Contracting Governments acting through a regional entity of some kind). The IMO Performance Standard envisages also an International Data Centre (IDC), to provide LRIT services on an international basis to many countries that do not wish to establish their own DCs, but the IMO Maritime Safety Committee (MSC) has not yet decided to establish such an IDC.
- Authorized receivers may request LRIT information for safety and security purposes, such as monitoring a vessel's movements in areas of heightened security risk, or in response to a distress or emergency situation.

**Q) List the authorized users of LRIT information and state the conditions under which LRIT information from ships can be released to the authorized users.** *(Sept-21)*

Ans:- The Long Range Identification and Tracking (LRIT) system is a global monitoring system that allows the identification and tracking of ships. The authorized users of LRIT information include:

1. Flag State Administrations
2. Search and Rescue (SAR) authorities
3. Rescue Coordination Centers (RCCs)
4. Coast Guard and law enforcement authorities
5. Port State Control (PSC) authorities
6. Maritime Safety Information (MSI) providers

The release of LRIT information from ships to the authorized users is subject to the following conditions:

1. LRIT information can only be released to the authorized users for the purpose of maritime safety and security, including search and rescue, prevention of illegal activities, and the protection of the marine environment.
2. LRIT information can only be released to the authorized users who have a legitimate need to know the information.
3. LRIT information must be protected from unauthorized access or disclosure.
4. The release of LRIT information must comply with the relevant national and international regulations, including the International Maritime Organization's (IMO) guidelines on the use of LRIT.
5. Ships must ensure that they have the necessary approvals and agreements in place with the relevant authorities before transmitting LRIT information.
6. The use of LRIT information must be consistent with the principles of international law and human rights.

**Q) What is the Function of DDP?** *(Aug-21)*

Ans:- DDP stands for "Dynamic Positioning System". The function of the DDP is to automatically maintain a vessel's position and heading using a combination of thrusters, sensors, and computers. DDP is commonly used on offshore drilling rigs, construction vessels, and other types of vessels that require precise positioning without the use of anchors or mooring lines.

The DDP continuously monitors the vessel's position and heading using GPS, sonar, and other sensors, and calculates the required thruster inputs to maintain the desired position and heading. The system can automatically compensate for changes in wind, waves, and currents, and can also be manually controlled by the operator. The DDP is an important safety feature on vessels that require precise positioning in challenging offshore environments.

**Q) Explain the following: Functions of LRIT National Data Centre** *(March-17)*

Ans:- International LRIT Data Exchange:-

- The International LRIT Data Exchange (IDE) exists to route LRIT information

between LRIT DCs using the information provided in the LRIT Data Distribution Plan. It is therefore connected via the internet to all LRIT DCs and the LRIT Data Distribution Plan server.

- The IDE cannot access and does not archive the LRIT data itself, but it does maintain a journal of message header information – which can be understood as the "envelope" containing the LRIT information. This journal is used for invoicing functions and for audit purposes.
- The performance of the IDE is audited by the LRIT Coordinator.

**Q) How does LRIT differ from AIS?** *(Jan-16)*

Ans:- Explanation:-

- AIS is a broadcast system and data is available to all receiver in the receiving range whereas LRIT is available only to the authorized person.
- AIS works on the very high frequency, whereas LRIT is based on the satellite system.
- AIS range is limited to the VHF range but LRIT range is worldwide.
- AIS DATA is not stored by any organization whereas LRIT data is stored and available on demand.
- There is display for AIS ON BOARD but there is no display for LRIT on board the ship.

**Q) Compare the AIS & LRIT** *(Jan-22, Nov-21, Dec-20, Nov-20, Sept-19, Jan-19, July-18, March-18, Sept-17, March-16)*

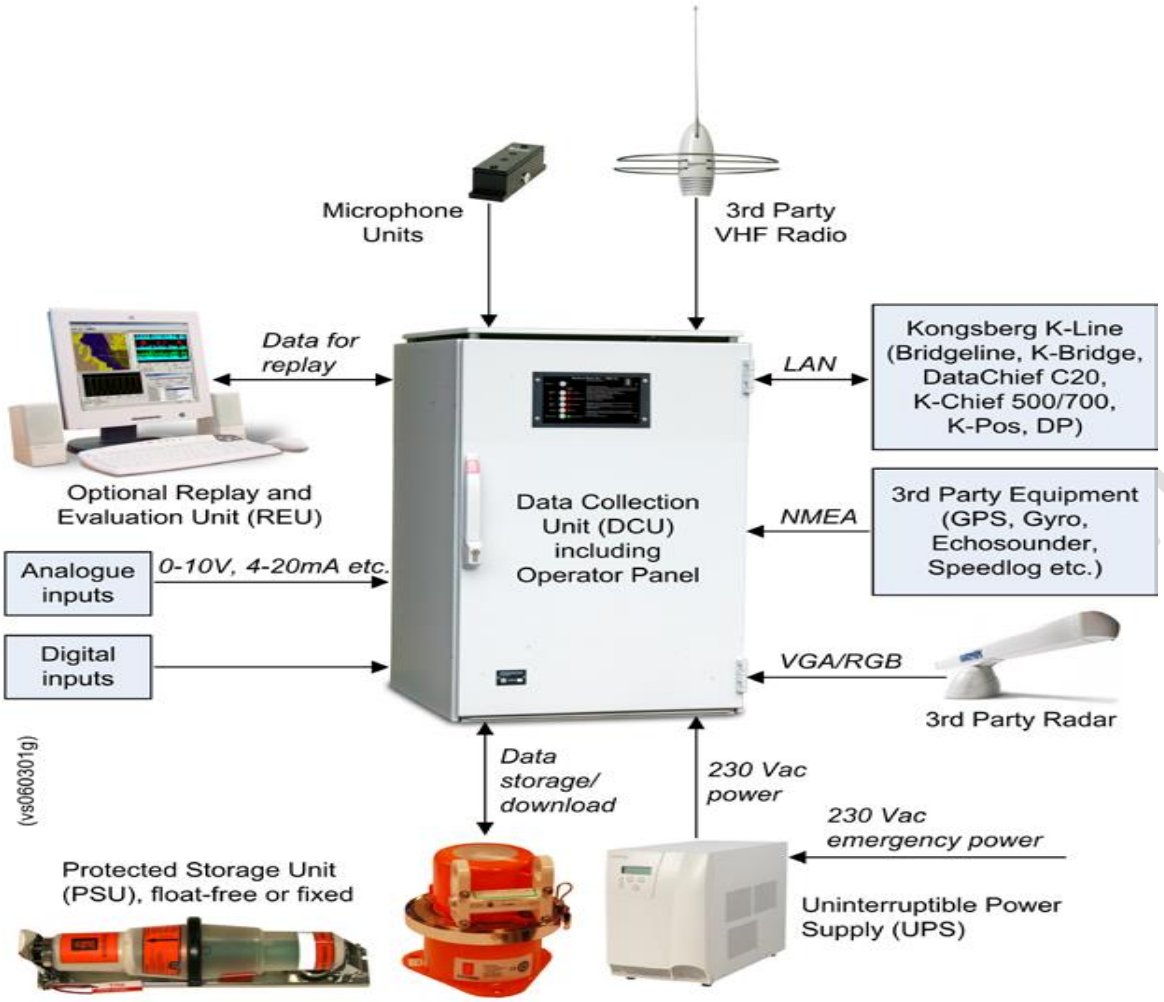
Ans:-

| AIS | LRIT |
|---|---|
| Satellite | VHF |
| Global | Only where AIS coverage is provided |
| Secure Data | Public Data |
| Position, IMO Number, Date Time | Position, IMO Number, Date Time, Vessel Type, Speed, Course |
| Unlimited range | Line of sight, up to 40NM |
| Flag State Owns Data | Anyone can see data |
| Maritime Security and Awareness | Navigation and Anti-collision Tool |

## VOYAGE DATA RECORDER

**Q) Write a short note on VDR.** *(Jan-23, Oct-21, April-21, Jan-18, Nov-18, Nov-17, July-17, Jan-17, Nov-16)*

Ans:- VOYAGE DATA RECORDER (VDR) :-




Explanation:-

- A VDR or voyage data recorder is an instrument installed on a ship to continuously record vital information related to the operation of a vessel.
- It contains a voice recording system for a period of at least last 12 hours.
- This recording is recovered and made use of for investigation in events of accidents.
- The data records covering the last 12 hours are continuously overwritten by the latest data.
- A VDR is capable of withstanding heavy weather, collisions, fires and pressure conditions even when a ship is at a depth of several meters in water.

Working:-

- There are various sensors placed on bridge of the ship and on prominent location from which the required data is continuously collected.
- This data which comprises of voices, various parameters, ships location etc. are then fed to a storage unit where the whole input is recorded and saved for at least 12 hours.
- There is also a record button provided in the bridge unit so that after pushing button (say during starting of any incident like collision or grounding), the recorder will start recording new set of information from that period of time.
- The data collected by VDR is digitalised, compressed, and is stored in a protective storage unit which is mounted in a safe place.
- This tamper proof storage unit can be a retrievable fixed or floating unit connected with EPIRB for early location in the event of accident.

Main Components: -

- *Data Management Unit*: It acquires data from various sources using interfaces, processes and stores the data in a specified format.
- *Audio Module*:
  - It consists of an audio mixer for recording audio from microphones placed in the wheelhouse, bridge wings, ECR and various other locations.
  - VHF audio signals can also be interfaced with this unit.
- *Final Recording Unit*:
  - This is a fire resistant, pressure tight storage medium to store recorded data.
  - The capsule is resistant against shock, penetration, fire, deep sea pressure and immersion. Housed in a highly visible protective capsule which can withstand high temperatures (1100$^{O}$C) and deep sea pressure of 6000 m.
- *Remote Alarm Module*: This is a small panel connected to the Data Management Unit that will sound an alarm should any error or fault develop in the equipment.
- *Replay Station*:
  - This is an optional module for downloading and replaying the recorded data.
  - The data when played back can help in casualty investigations as well as for self analysis.
- *Information Recorded*:-
  - *Date & Time* from GPS every 1s
  - *Position & Datum* – Lat/Long and datum from GPS, Loran-C etc. The source of data is identified on playback.
  - *Speed* (water / ground) recorded every 1s to 0.1k resolution
  - *Heading* (gyro or magnetic) is recorded at intervals of 1s to a resolution of 0.1 deg
  - *Depth* under keel from echo sounder to a resolution of 0.1m.
  - *Auto pilot* settings for speed, latitude, rudder limit, off-course alarms etc.
  - *Bridge audio* in real time, both internal & external (150-6000Hz). The mic test beeps every 12 hrs & this is recorded.
  - *Radar image* recorded every 15s includes range rings, EBLs, VRMs, radar maps, parts of SENC & other essential navigational indications.
  - *Wind speed/direction* from the Anemometer is recorded & stored individually with time stamps.
  - *VHF communication from* 2 VHFs are recorded for both transmitted and received audio signals. Audio is compressed and labeled VHF 1 & VHF 2.
  - *Hull openings & watertight doors* status is received every 1s and stored with time stamps
  - *Hull stresses* are received and stored with time stamps.
  - *Thruster status* (bow/stern) can be recorded for their order and response
  - *Rudder order and response angle* is recorded to a resolution of 1 deg
  - *Engine order and response* from the telegraph or direct engine control with shaft revolution and ahead and astern indicators are recorded to a resolution of 1 rpm
  - *AIS target data* is recorded as a source of information regarding other ships.
  - *Alarms* are recorded with time stamps. All IMO mandatory alarms as well as other audible alarms are stored individually by the bridge audio microphones.

**Q) Explain the purpose of VDR, list the data recorded on VDR/ S-VDR and data retrieving procedure in case of a collision.** *(Sept-21, April-21, Jan-21, Nov-*

*20, March-20, July-19, May-19, Sept-18, March-18, May-17, March-16)*
Ans:- **Purpose of VDR**:-

- The main purpose of VDR is to record and store ship's critical parameters to facilitate reconstruction of the incident for the purpose of analysis
- Additionally navigator can use this for self-analysis, as lessons-learning tool and thus improvement of procedures in the future.
- VDR can be used to identify cause of an accident and thus make major contribution to maritime safety.
    - The benefits are:
    - Promotion of safe practices
    - Accident investigation and enquiry
    - Response assessment and study
    - Training aid and support
    - Reduction in insurance costs
    - Statistics generation

**VOYAGE DATA RECORDER - DATA ITEMS TO BE RECORDED**: - IMO Performance Standard (Res. A.861(20)) and IEC Information format (IEC 61996).

| DATA ITEM | SOURCE |
|---|---|
| Date & Time | Preferably external to ship (e.g.GNSS) |
| Ship's position | Electronic Positioning system |
| Speed (through water or over ground) | Ship's SDME |
| Heading | Ship's compass |
| Bridge Audio | 1 or more bridge microphones |
| Comms. Audio | VHF |
| Radar data- post display selection | Master radar display |
| Water depth | Echo Sounder |
| Main alarms | All mandatory alarms on bridge |
| Rudder order & response | Steering gear & autopilot |
| Engine order & response | Telegraphs, controls and thrusters |
| Hull openings status | All mandatory status information displayed on bridge |
| Watertight & fire door status | All mandatory status information displayed on bridge |
| Acceleration & hull stresses | Hull stress and response monitoring equipment where fitted |
| Wind speed & direction | Anemometer when fitted |

**SIMPLIFIED VOYAGE DATA RECORDER (S- VDR) - DATA ITEMS TO BE RECORDED**:- IMO Performance Standard (Res. MSC.163 (78)) and IEC Information format (IEC 61996).

| DATA ITEM | SOURCE |
|---|---|
| Date and time | Preferably external to ship (e.g. GNSS) |
| Ship's Position | Electronic Positioning System |
| Speed (Through the water or over the ground) | Ship's SDME |
| Heading | Ship's compass |
| Bridge Audio | 1 or more bridge microphones |

| | |
|---|---|
| Communications audio | VHF communications |
| Radar data: post-display selection | Master radar display |
| AIS Data | AIS to be recorded if it is impossible to record radar data.<br>If radar is recorded AIS may be recorded as an additional source of information. |
| Other items | Additional items required for VDR (Res.A.861(20)) when interfacing available. |

**Recovery of VDR**: Recovery of the VDR is conditional on the accessibility of the VDR or the data contained therein.

a) In the case of a non-catastrophic accident, recovery of the memory should be straightforward. For example, in some VDRs it can be accomplished by removal of a hard disc from the VDR unit. This action will have to be taken soon after the accident to best preserve the relevant evidence for use by both the investigator and the ship owner. As the investigator is very unlikely to be in a position to instigate this action soon enough after the accident, the owner must be responsible, through its on-board standing orders, for ensuring the timely preservation of this evidence in this circumstance.

b) In the case of abandonment of a vessel during an emergency, masters should, where time and other responsibilities permit, recover the memory and remove it to a place of safety and preserve it until it can be passed to the investigator.

c) In the case of a catastrophic accident, where the VDR is inaccessible and the data has not been retrieved prior to abandonment, a decision will need to be taken by the Flag State in co-operation with any other substantially interested States on the viability and cost of recovering the VDR balanced against the potential use of the information. If it is decided to recover the VDR the investigator should be responsible for coordinating its recovery. The possibility of the capsule having sustained damage must be considered and specialist expertise will be required to ensure the best chance of recovering and preserving the evidence. In addition, the assistance and co-operation of the owners, insurers and the manufacturers of the VDR and those of the protective capsule may be required.

**Q) Write short notes with comparison on the following: VDR (Voyage Data Recorder) vs S-VDR.** *(Nov-21)*

Ans:- VDR (Voyage Data Recorder) and S-VDR (Simplified Voyage Data Recorder) are both devices used for recording crucial data related to the voyage of a ship. Here are some short notes comparing the two:

VDR:

- Mandatory for all vessels over 3,000 gross tonnage
- Records data from various ship systems, such as radar, AIS, gyro compass, and voice communication
- Records for a minimum of 12 hours and stores data for up to 30 days
- Includes both fixed and floating data capsules for recovery in the event of an incident
- Used for accident investigation and safety analysis

S-VDR:
- Mandatory for all vessels over 3,000 gross tonnage that were constructed after July 1, 2002 and that do not already have a VDR installed
- Records a limited set of data, including vessel position, speed, heading, and audio from the bridge
- Records for a minimum of 12 hours and stores data for up to 30 days
- Includes a fixed data capsule for recovery in the event of an incident
- Used for accident investigation and safety analysis

## SEXTANT

**Q) What are the various errors of sextant and how will you correct them?** *(Jan-23)*

Ans:- Errors of sextant:
a) Adjustable errors
b) Non-adjustable errors

Adjustable errors:
a) The error of perpendicularity: The error of perpendicularity in a sextant is caused by the index glass not being perpendicular to the plane of the instrument. To check for this error, clamp the index bar and hold the sextant horizontally with the arc away from you. Look obliquely into the index mirror and check if the images are in alignment. If not, adjust the first screw at the back of the index glass until the images align.
b) Side Error: The side error of a sextant is caused by the horizon glass not being perpendicular to the plane of the instrument. To check for this error, clamp the index bar at zero and observe the horizon through the telescope while holding the sextant horizontally. If the true horizon and its reflection in the mirror appear in alignment, side error is not present. If not, adjust the second screw until the true and reflected horizons align.
c) Index Error: The index error of a sextant is caused by the index glass and the horizon glass not being parallel to each other when the index bar is at zero. To find the index error, hold the sextant vertically and view the horizon through the telescope while clamping the index bar at zero. Adjust the micrometer drum until the true horizon and its reflection appear in the same line, and then adjust the third screw until they are in alignment to eliminate the index error.
d) The error of collimation is due to the axis of the telescope not being parallel to the plane of the instrument.

Non-Adjustable errors:
a) Graduation error: Due to inaccurate graduation of the scale on the arc or of the micrometer/vernier.
b) Shade error: Due to the 2 surfaces of the coloured shades not being exactly parallel to each other.
c) Centering error: Pivot of the index bar not coincident with the centre of the circle of which the arc is a part.
d) Optical Error: May be caused by the prismatic errors of the mirror or aberrations in the telescope lenses.
e) Back-lash: Wear on the rack and worm, which forms the micrometer movement

would cause a back-lash, leading to inconsistent errors. When the index bar is set at zero, the plane of the index mirror.

Error Corrections:

a) To correct the error of perpendicularity, turn the first adjustment screw at the back of the index glass until the images of the index bar appear in alignment when the sextant is held horizontally with the arc away from you.
b) To correct the side error, adjust the second screw until the true and reflected horizons are aligned when the index bar is clamped at zero and the sextant is held horizontally.
c) To correct the index error, adjust the third screw until the true horizon and its reflection are in alignment when the index bar is clamped at zero and the sextant is held vertically. Then, adjust the micrometer drum until the micrometer reading is zero.
d) To correct the error of collimation, adjust the collimation screws on the frame of the instrument until the reflected image of the index arm in the horizon glass is superimposed on the image of the index arm seen through the telescope.

**Q) How will you find the Index error of a sextant?** *(May-16)*

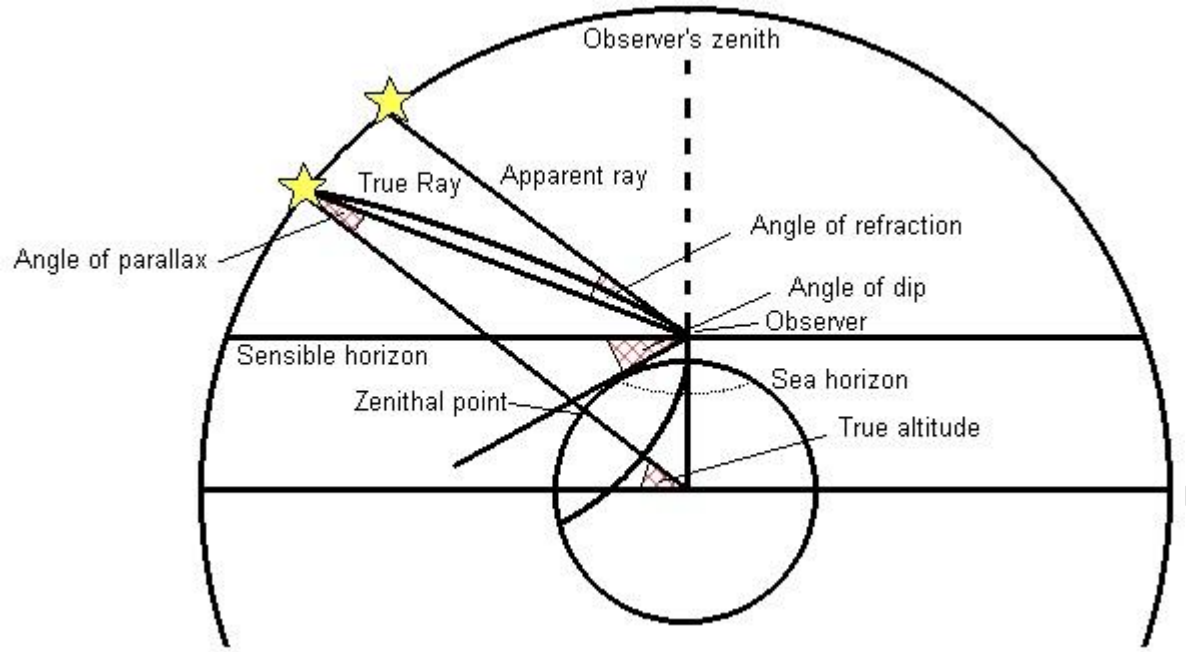
Ans:- Index error:- When the index bar is set at zero, the plane of the index mirror and horizon glass are NOT parallel to each other.

How to determine:

- During day time, clamp the index bar at zero and holding the sextant vertically, view the horizon through the telescope.
- If the true horizon and its reflection appear in the same line, Index error is not present.
- If they appear displaced vertically, turn the micrometer drum till they are in the same line.
- The micrometer reading then is the index error, which is
- on the arc if the micrometer reading is more than zero,
- off the arc if it is less than zero.

**Q) With the help of sketches show and explain the following with respect to a marine sextant: i) Dip ii) Refraction iii) True altitude and iv) Sensible horizon** *(Jan-22)*

Ans:-




1) Dip: Dip is the correction that needs to be applied to the sextant altitude when taking a measurement from a moving platform, such as a ship, due to the height of the observer's eye above sea level.
2) Refraction: Refraction is the bending of light as it passes through the Earth's atmosphere. This can cause an error in the sextant altitude measurement, as the observed position of a celestial body may appear higher than its true position.
3) True altitude: True altitude is the altitude of a celestial body above the observer's true horizon. It is calculated by correcting the sextant altitude for dip and refraction.
4) Sensible horizon: The sensible horizon is the visible horizon from the observer's position, and it can be affected by factors such as the height of the observer's eye above sea level, atmospheric conditions, and the curvature of the Earth.

These corrections and calculations are important for accurately determining the position of a ship using celestial navigation.

## BRIDGE PROCEDURES

**Q) Write short notes on the contents of Bridge Procedure Guide?** *(Dec-20, May-19, July-18, Nov-16, March-16, May-16, Jan-16)*

**OR**

**What are the contents of the Bridge Procedure Guide. Briefly describe each section of the guide.** *(Jan-22, Jan-20, Jan-19, Jan-17)*

Ans:- Bridge Procedure Guide:- The Bridge Procedures Guide (BPG) is an International Chamber of Shipping (ICS) publication that aims to reflect Best Practice aboard Merchant Ships embracing standards and recommendations promoted by the IMO. This includes the concept of 'continuous improvement' as described in the ISM Code and the watchkeeping requirements of STCW Chapter VIII. Questions on the content of the bridge procedures guide make a regular appearance in both SQA and oral examinations.

**Contents**:-

## PART A: GUIDANCE FOR MASTERS AND WATCH KEEPING OFFICERS

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1.3 Safety System – Maintenance And Training.

2. Passage Planning
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3. Duties Of The Officer On Watch
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3.5 Periodic Checks Of Navigational Equipment.
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3.9 Calling The Master.
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3.11 Watchkeeping Personnel.
3.12 Search And Rescue.
3.13 Helicopter Operations.
3.14 Log Books.
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3.16 Ship At Anchor.
3.17 Ships Draft And Manoeuvering Information.
3.18 Bridge Located Systems / Systems Controls / Monitoring And Operations.

4. Operation And Maintenance Of Navigational Equipment
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4.3 Steering Gear And Autopilot.
4.4 Gyro And Magnetic Compasses.
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4.8 Electronic Position Fixing Aids.
4.9 Direction Finders.
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ANNEX OF BRIDGE PROCEDURE GUIDE
ANNEX I: Pilot Card.
ANNEX II: Wheelhouse Poster.
ANNEX III: Guidance On Steering Gear Test Routines.
ANNEX IV: Notice On The Correct Use Of Vhf Channels.

ANNEX V: Required Boarding Arrangements For Pilots.

**PART B: BRIDGE CHECKLISTS**

1) Familiarisation With Bridge Equipment.
2) Daily Tests and Checks.
3) Preparation For Sea.
4) Embarkation / Disembarkation of Pilot.
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6) Navigation, Deep-Sea.
7) Navigation, Coastal Waters / Traffic Separation Schemes.
8) Changing Over the Watch.
9) Preparation For Arrival in Port.
10) Anchoring And Anchor Watch.
11) Restricted Visibility.
12) Navigating In Heavy Weather Or In Tropical Storm Areas.
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**PART C: EMERGENCY CHECKLISTS**

1) Main Engine Failure.
2) Steering Failure.
3) Gyro Failure / Compass Failure.
4) Bridge Control / Telegraph Failure.
5) Imminent Collision / Collision.
6) Stranding
7) Fire
8) Flooding
9) Boat / Liferaft Stations
10) Man Over Board.
11) Search and Rescue.

**Q) As per bridge procedure guide, what are the duties of the officer of the watch?** *(Jan-20, Sept-19)*

Ans:- The Officer of the Watch (OOW) is the Master's representative and is responsible at all times for the safe navigation of the ship, in full compliance with the Convention on time International Regulations for the Prevention of Collisions at Sea (COLREGS).

The presence of the Master on the bridge does not relieve the OOW of responsibility for the watch. A decision by the Master to assume responsibility for the watch should be unambiguously advised to the OOW and other members of the Bridge Team.

The OOW should comply with the requirements of the SMS and the Master's standing and daily orders. Compliance ensures that agreed and robust procedures which promote safety and mitigate risks are followed by Bridge Teams to execute and monitor the passage plan.

The primary duty of the OOW is to maintain a safe navigational watch at sea or at anchor, which will require ensuring:

- Compliance with the Company's navigational policies and requirements;

- Effective watch handovers;
- Management of the Bridge Team;
- Keeping a proper look-out;
- Familiarity with the bridge layout and equipment;
- Familiarity with bridge procedures;
- Maintaining situational awareness;
- Surveillance of the ship;
- Execution of the passage plan;
- Navigation and control of the vessel;
- Collision avoidance in compliance with the COLREGS;
- GMDSS watchkeeping;
- Compliance with environmental requirements;
- Monitoring the performance of navigational equipment;
- Recording bridge activities;
- Management of emergency situations; and
- Security awareness.

**Q) What does "Bridge Procedure Guide" say about Bridge Familiarisation?** *(Jan-22)*

Ans:- The "Bridge Procedure Guide" outlines the importance of bridge familiarisation as a key aspect of safe navigation. It provides guidance on the following aspects related to bridge familiarisation:

1. Master's responsibility: The Master has the ultimate responsibility for ensuring that all personnel involved in navigation are familiar with the bridge procedures and equipment.
2. Familiarisation programme: The guide recommends that a structured familiarisation programme be established for all new bridge team members, which should include familiarisation with the vessel's navigation equipment, communication systems, emergency procedures, and bridge-specific roles and responsibilities.
3. On-board training: The guide highlights the importance of on-board training to reinforce the bridge familiarisation programme and ensure that all bridge team members are proficient in the use of the vessel's navigation equipment and procedures.
4. Ongoing familiarisation: The guide also emphasises the need for ongoing familiarisation, as personnel and equipment may change over time. It recommends regular training and drills to ensure that all bridge team members are competent and confident in their roles.

**Q) What does "Bridge Procedure Guide" say about Standing Orders by Master?** *(Jan-22)*

Ans:- The "Bridge Procedure Guide" provides guidance on establishing standing orders by the Master, which are the rules and procedures to be followed by the Bridge Team during normal operations. The following are some of the key points regarding standing orders:

- The Master is responsible for establishing standing orders and ensuring that they are understood and followed by the Bridge Team.
- The standing orders should be in writing and clearly communicated to all relevant personnel.

- The standing orders should cover all aspects of bridge operations, including watchkeeping procedures, communications, navigation, and emergency procedures.
- The standing orders should be reviewed regularly and updated as necessary to reflect changes in operating conditions or procedures.
- The standing orders should be posted in a prominent location on the bridge where they can be easily referenced by the Bridge Team.
- The standing orders should be enforced by the Master and reinforced through training and drills.

**Q) What is the purpose of the log book? Your vessel is arriving in port, list the entries you will make in the log book from the time pilot on board until vessel secured alongside the berth.** *(May-19)*

Ans:- Deck log book:- The Deck log book is an important document and serves as necessary evidence in case of any Accidents and Casualties. It must contain Factual Entries with Time in each entry. It is essential that clear and accurate record of the activities of the ship are kept, as the Log book will form a main part of the collection of evidence in case of any incidents. Vessel's official language is mentioned on very first page of the log book.

Record of Pilotage events during watch:

- Pilot on board.
- Passing abeam to break water.
- Passing under the bridge.
- Passing few navigation marks/ signal stations.
- Change of pilot(s).
- Any emergency during pilotage.
- Position and name of tugs made fast, first line ashore.
- All fast fwd n aft (configuration of rope example:- 4+2+2 F&A).
- Alongside on which side.
- Name of wharf etc.
- Tugs cast off.
- M/E blown through, finished with engines, bunkers, LO & FW ROB.
- Gangway down/Pilot away, arrival drafts etc.

**Q) Prepare a check list prior to entry into a space that has been closed for an extensive period of time.** *(May-19)*

Ans:- Enclosed Space Entry Permit:- This permit relates to entry into any enclosed space and should be completed by the master or responsible person and by any persons entering the space, e.g. competent person and attendant.

GENERAL

Location/name of enclosed space

Reason for entry .....

This permit is valid from:_____hrs Date.....
to:_____hrs Date.....
(See Note 1)

SECTION 1 – PRE-ENTRY PREPARATION
(To be checked by the master or nominated responsible person)

| | Yes | No |
|---|---|---|
| • Has the space been thoroughly ventilated by mechanical means? | ..... | ..... |
| • Has the space been segregated by blanking off or isolating all connecting pipelines or valves and electrical power/equipment? | ..... | ..... |
| • Has the space been cleaned where necessary? | ..... | ..... |
| • Has the space been tested and found safe for entry? (See note 2) | ..... | ..... |
| • Pre-entry atmosphere test readings: | | |
| - oxygen .....% vol (21%)* By: | | |
| - hydrocarbon .....% LFL (less than 1%) | | |
| - toxic gases ..... ppm (less than 50% OEL of the specific gas) Time: (See note 3) | | |
| • Have arrangements been made for frequent atmosphere checks to be made while the space is occupied and after work breaks? | ..... | ..... |
| • Have arrangements been made for the space to be continuously ventilated throughout the period of occupation and during work breaks? | ..... | ..... |
| • Are access and illumination adequate? | ..... | ..... |

| | Yes | No |
|---|---|---|
| • Is rescue and resuscitation equipment available for immediate use by the entrance to the space? | " | " |
| • Has an attendant been designated to be in constant attendance at the entrance to the space? | " | " |
| • Has the officer of the watch (bridge, engine-room, cargo control room) been advised of the planned entry? | " | " |
| • Has a system of communication between all parties been tested and emergency signals agreed? | " | " |
| • Are emergency and evacuation procedures established and understood by all personnel involved with the enclosed space entry? | " | " |
| • Is all equipment used in good working condition and inspected prior to entry? | " | " |
| • Are personnel properly clothed and equipped? | " | " |

**SECTION 2 – PRE-ENTRY CHECKS**
(To be checked by each person entering the space)

| | Yes | No |
|---|---|---|
| • I have received instructions or permission from the master or nominated responsible person to enter the enclosed space | " | " |
| • Section 1 of this permit has been satisfactorily completed by the master or nominated responsible person | " | " |
| • I have agreed and understand the communication procedures | " | " |
| • I have agreed upon a reporting interval of ..... minutes | " | " |
| • Emergency and evacuation procedures have been agreed and are understood | " | " |
| • I am aware that the space must be vacated immediately in the event of ventilation failure or if atmosphere tests show a change from agreed safe criteria | " | " |

**SECTION 3 – BREATHING APPARATUS AND OTHER EQUIPMENT**
(To be checked jointly by the master or nominated responsible person and the person who is to enter the space)

| | Yes | No |
|---|---|---|
| • Those entering the space are familiar with any breathing apparatus to be used | ..... | ..... |
| • The breathing apparatus has been tested as follows: | | |
| - gauge and capacity of air supply | ..... | ..... |
| - low pressure audible alarm if fitted | ..... | ..... |
| - face mask – under positive pressure and not leaking | ..... | ..... |
| • The means of communication has been tested and emergency signals agreed | ..... | ..... |
| • All personnel entering the space have been provided with rescue harnesses and, where practicable, lifelines | ..... | ..... |

Signed upon completion of sections 1, 2 and 3 by:

Master or nominated responsible person ..... Date ..... Time

Attendant ..... Date ..... Time

*Person entering the space*..... Date ..... Time

**SECTION 4 – PERSONNEL ENTRY**
(To be completed by the responsible person supervising entry)

Names .....

Time in ..... Time out .....

**SECTION 5 – COMPLETION OF JOB**
(To be completed by the responsible person supervising entry)

| | | |
|---|---|---|
| • Job completed | Date | Time ..... |
| • Space secured against entry | Date | Time ..... |
| • The officer of the watch has been duly informed | Date | Time..... |

Signed upon completion of sections 4 and 5 by:

Responsible person supervising entry ..... Date ..... Time .....

THIS PERMIT IS RENDERED INVALID SHOULD VENTILATION OF THE SPACE STOP OR IF ANY OF THE CONDITIONS NOTED IN THE CHECKLIST CHANGE

**Q) What are the precautions to be taken prior, during and after entering enclosed space?** *(Jan-22, Dec-20)*

Ans:- The steps below provides an overview of entry procedures:

| | |
|---|---|
| **Before Entry** | **All parties to discuss the job to be done in the space:**<br>➢ What are the hazards of the space and how can they be controlled? |

| | |
|---|---|
| | ➢ What are the hazards of the job and how can they be controlled?<br><br>**Risk assessment:**<br>5. Document the hazards and necessary safety measures and controls<br><br>**Secure the space:**<br>6. Empty the space if necessary and take steps to prevent the space filling up:<br>• Lock out valves and pumps; and<br>• Place notices forbidding their operation.<br>• Is the space adjacent to other tanks, holds, or pipelines which if not secure could present a danger?<br><br>**Ventilate:**<br>➢ Allow sufficient time for the space to be thoroughly ventilated naturally or mechanically.<br>➢ Guard any openings against accidental and unauthorized entry.<br><br>**Test:**<br>➢ Test the atmosphere in the space for oxygen content and the presence of flammable and toxic gases or vapours.<br>➢ Do not enter until the atmosphere has been determined to be safe.<br><br>**Permit** – complete an enclosed space entry permit to work, confirming that:<br>➢ The hazards of the job and of the space have been dealt with.<br>➢ The atmosphere in the space is safe and ventilated.<br>➢ The space will be adequately illuminated.<br>➢ An attendant at the entrance has been appointed.<br>➢ Communications have been established between bridge and entry point, and entry.<br>➢ Emergency rescue equipment is available at the entrance and there are sufficient personnel on board to form a rescue party.<br>➢ All personnel involved are aware of the task and the hazards, and are competent in their role. |
| **During Entry** | ➢ Ensure the space is suitably illuminated.<br>➢ Wear the right PPE.<br>➢ Continue to ventilate the space.<br>➢ Test the atmosphere at regular intervals.<br>➢ Communicate regularly.<br>➢ Be alert, and leave the space when requested or if you feel ill. |
| **After Entry** | ➢ Ensure all equipment and personnel are removed from the space.<br>➢ Close the access of the space to prevent unauthorized entry.<br>➢ Close the entry permit.<br>➢ Reinstate any systems as appropriate. |

**Q) List all the checks/ tests and communication with VTS /pilots prior to**

**arrival at port.** *(May-19)*

Ans:- Checklist prior to arrival at Port:-

| Vessel Name | Date | Print name of person completing checklist |
|---|---|---|
| | | |

**Notify port at least 72 hours before arrival (some require 96 hours) to ensure vessel may be received.**

**Navigation & Communications**

| | |
|---|---|
| ☐ | Communicate with port authorities for any local information |
| ☐ | Plan checkpoints so position can be checked with radar, echo sounder or sight / bearing. |
| ☐ | Note congested areas, restricted areas and underlying obstructions |
| ☐ | Document local traffic reporting regulations, checkpoints and radio frequencies for traffic coordination |
| ☐ | If necessary, report security status, number of persons aboard, fuel, water, oil, cargo, passengers, tonnage, destination, owners info, agent info, date of departure of last port call, official numbers and call sign. |
| ☐ | Discuss potential security issues with crew in pre-arrival meeting |
| ☐ | Review all publications and charts for the port |
| ☐ | ISPS compliant ports, vessel security status and previous ten port calls will be required. |
| ☐ | Check bridge electronics, including echo sounder |
| ☐ | Test inter-ship communications, make contact with engine room |
| ☐ | Check running lights and day shapes |
| ☐ | Hoist appropriate flags |
| ☐ | Use radar/ AIS system to calculate safe distances from other vessels using anchorages |
| ☐ | Have a plan for potential wind, current changes |
| ☐ | Verify communications with deck |
| ☐ | Maintain radio watch on port/ safety frequencies |

**Documentation**

| | | | |
|---|---|---|---|
| ☐ | All documents for port call to be stamped with ship's official stamp and signed by the Master | | |
| ☐ | List of personal items to be signed by the individuals | | |
| ☐ | Additional documents typically required by the port: | | |
| | ☐ Crew list | ☐Medical Inventory | ☐ Unmanifested cargo |
| | ☐ Ship's particulars | ☐Declaration of Security | ☐ Cargo Nil list |
| | ☐ Ship stores | ☐ Previous 10 port calls list | ☐Vaccination list |

| | | |
|---|---|---|
| | ☐Previous Port Clearance Papers | ☐ Personal items list for each person aboard |

## Steering and Propulsion

| | |
|---|---|
| ☐ | Test steering gear **(SOLAS ChV Reg 26 Pt 1-2)** |
| ☐ | Anchor gear in good working order |
| ☐ | Turn on steering system and test rudders and rudder angle indicator |
| ☐ | Once bow thruster is started, rotate the head and test the clutch/ throttle |

## Safety

| | |
|---|---|
| ☐ | Check vessel perimeter to ensure mooring lines, cables, straps in position and secured |
| ☐ | Survey gear properly stowed |
| ☐ | Main engine gear boxes working properly |
| ☐ | Secure loose objects on bridge |

## Personnel

| | |
|---|---|
| ☐ | Brief crew so all understand their duties during mooring operations |
| ☐ | Personnel station at positions and in proper PPE |
| ☐ | Advise personnel what to look for and who to notify in case of suspicious activity |

## PILOT

| | |
|---|---|
| ☐ | Complete JSA for vessel to vessel transfer |
| ☐ | Contact approaching pilot and negotiate boarding procedures |
| ☐ | Have vessel crew stand by to assist |
| ☐ | Crewman to escort pilot to bridge |
| ☐ | Ask pilot about any recommended precautions to be taken ashore, security issued in port, local ordinances or curfews |
| ☐ | Crewman to escort pilot off bridge to disembark |

## Secured alongside

| | |
|---|---|
| ☐ | Secure bow thruster and steering |
| ☐ | Notify engineering when ready to secure engines |
| ☐ | Switch radar to stand by |
| ☐ | Secure running lights |
| ☐ | Turn radios to proper channel to monitor communications with port authorities |
| ☐ | Deploy gangway securely with safety net in place |

| | |
|---|---|
| ☐ | Post gangway watch with sign in log |
| ☐ | Post additional security as needed |

**Q) Describe the procedure for testing of controls prior departure from port.** *(Jan-19, May-17)*

Ans:- Testing the controls prior to departure from port is an essential procedure to ensure the safety of the vessel and its crew. The following steps can be followed for testing the controls:

1. Check the steering gear and ensure that it is working properly. Test the steering gear using the local control, remote control, and emergency control, and make sure that the rudder is moving in the correct direction.
2. Test the engine controls, including the telegraph, throttle, and clutch. Ensure that the engine is responding to the controls and that the RPM and direction of rotation are correct.
3. Test the navigation equipment, including the GPS, radar, and compass. Check that the equipment is functioning properly and that the information displayed is accurate.
4. Test the communication equipment, including the VHF radio and intercom system. Check that the equipment is functioning properly and that the communication channels are clear.
5. Test the bilge and fire alarms, and ensure that they are functioning properly.
6. Test the emergency equipment, including the life rafts, life jackets, and distress signals. Ensure that the equipment is in good condition and that the crew knows how to use it.
7. Test the deck equipment, including the windlass and winches. Ensure that the equipment is functioning properly and that the crew knows how to use it.
8. Finally, conduct a safety briefing with the crew and ensure that they understand their roles and responsibilities in the event of an emergency.

**Q) Enumerate steering gear tests & checks.** *(Nov-21)*

Ans:- Steering Gear – Testing and Drills: Within twelve hours before departure of the ship from port, following systems to be checked and tested:

- Main steering gear and system
- Auxiliary steering gear and system
- The remote control systems of steering gear
- The steering position indicator on the navigation bridge
- The emergency power supply to one of the steering unit
- The rudder angle indicators showing actual position of the rudder
- Power failure alarms for the remote steering gear control system
- Power unit failure alarms for the steering gear unit
- Automatic isolating arrangements and other automatic equipment

Following listed procedure must be included along with the check and tests described above:

1. The full movement of the rudder as per the required capabilities of the steering gear system present onboard

2. A visual inspection of all the linkages and connection in the steering gear
3. The means of communication between the steering gear room and navigational bridge must always be operational

Other Important requirements related to steering gear are:

- A block diagram displaying the steering system, the changeover procedure from remote to local steering and steering gear power unit indicating the emergency supply unit must be clearly mentioned.
- This diagram must be pasted in Navigation Bridge and steering gear compartment
- All officers and crew concerned with the operation and maintenance of steering gear system must be familiar with changeover procedure from one to other system
- Emergency steering drills to be carried out inn not more than three months period.
- Date and time for the tests, checks and drills carried out in steering gear system must be recorded.

## BRIDGE WATCHKEEPING

**Q) State the STCW guidelines in ensuring a safe and efficient bridge watch.** *(Nov-20, July-16)*

Ans:- Watchkeeping arrangements and principles to be observed:-

1) Masters, Chief Engineer Officers and all watchkeeping personnel on board their ships shall comply with the requirements, principles, principles and guidance set out in section A-VIII/2 of the STCW Code. The requirements shall be observed to ensure that safe continuous watches appropriate to the prevailing circumstances and conditions are maintained in all sea going ships at all times.
2) The Master of every ship shall ensure that watchkeeping arrangements are adequate for maintaining safe watches, taking into account the prevailing circumstances and conditions and that, under the Master's general direction-
   a) Officers in charge of the navigational watch are responsible for navigating the ship safely during their periods of duty, when they shall be physically present on the navigating bridge or in a directly associated location such as the chartroom or bridge control room at all times;
   b) Radio operators are responsible for maintaining a continuous radio watch on appropriate frequencies during their periods of duty;
   c) Officer in charge of an engineering watch under the direction of the Chief Engineer Officer, shall be immediately available and on call to attend the machinery spaces and, when required, shall be physically present in the machinery space during their periods of responsibility; and
   d) An appropriate and effective watch or watches are maintained for the purpose of safety at all times, while the ship is at anchor or moored and, if the ship is carrying hazardous cargo, the organisation of such watches takes full account of the nature, quantity, packing and stowage of the hazardous cargo and of any special conditions prevailing on board, afloat or ashore.

**Q) State the circumstances under which you will call the Master.** *(Oct-21, Oct-20, July-19, Jan-19, Jan-18, Nov-17, May-17, May-16)*

Ans:- Calling the Master:- Master to be called for the following reasons

1) When visibility has dropped or is suspected to drop to limit stated in Master's

standing orders.
2) Failure to sight a navigation mark.
3) When any navigation mark is found unexpectedly.
4) Failure of navigation / radio equipment.
5) Failure of main engine / reduction in RPM.
6) Failure of aux engines / steering.
7) When atmospheric pressure dropped 3 hpa below normal. (or as directed by the Master in the standing orders.)
8) If the position of own vessel is doubtful.
9) On receipt of any urgent message received from company, owners, charterers, agent etc.
10) In case of any emergency.
11) When any vessel / person in distress.
12) When traffic is causing concern, other vessel not complying with COLREGS, or if own vessel needs to deport from COLREGS necessary to avoid immediate danger.
13) Failure to make land fall or in case of unexpected landfall.
14) When soundings are not obtained as expected or when sounding is found unexpectedly.
15) When CPA/ TCPA cannot be achieved as per standing orders.
16) When wind force increased to limit stated in Master's standing orders.
17) When difficulty is experienced to maintain the course.
18) When vessel is pounding or pitching heavily.
19) When shipping season foc'sle deck.
20) During heavy weather when there is any doubt regarding possibility of heavy weather damage.
21) Whenever unsafe practices are being carried on board.
22) If the relieving watch keeper(s) is/ are unfit for the watch.
23) If any nav. warning, met warning or piracy report is received is concerning own vessel.
24) If any suspicious craft/ object is sighted.
25) When any oil spillage sighted.
26) When vessel's speed dropped, unexpectedly without reduction in RPM.
27) If any danger message to be sent as per SOLAS ch V.
28) If unusual change in list or trim is observed.
29) Whenever vessel is suspected to go into no go area.
30) When vessel is suspected to contravene company's UKC policy.
31) If any important instructions received from VTS, port control etc.
32) Whenever the vessel reached the point marked on the chart / ECDIS by Master himself. (Master will write:- "Call Me").
33) When at anchorage, should you have reasons to believe that own vessel is dragging anchor or other vessel in vicinity is dragging anchor.
34) When at anchor, if other vessel is going to drop anchor or dropped the anchor very close distance to own vessel (Master must mention the distance in his standing orders).
35) Should you have reasons to believe that the own vessel had near miss situation with another vessel (collision).
36) If deck cargo is suspected to be washed overboard.
37) If the gyro error or compass deviation is greater than the limit mentioned by Master.
38) Any other instructions as per Master's standing orders or the company's standing orders or SMS procedures or night order / bridge order book.
39) If presence of master is required for any reasons not stated anywhere (Master's or company's standing orders may not be exhaustive).

40) Call the Master whenever in any kind of doubt, (an early call is better rather than calling at last moment, adjustment of night vision should be taken into consideration, till master reaches the bridge appropriate action to be taken).

**Q) Explain what are the information / instructions available in Master's standing order and explain why it is important to OOW.** *(July-19)*

Ans:- Master's Standing Orders:

- The standing orders are a set of guidelines to ensure safe ship navigation and operations whether at sea or at port. These set of guidelines by the Master encompass a very wide array of aspects of navigation and rules of conduct for the officers. Standing orders are to be followed at all times by the officer on duty and is duly signed by every officer on board, making them liable to adhere to the orders. That is to say that the standing orders are in-force and applicable at all times the ship is at sea, at port or at anchor.
- The Master exercises due experience and knowledge every time he takes over command. He assesses every situation keeping in mind the extent of the capabilities of his bridge team, the ECR team, the crew and the technical facilities at his disposal. This makes the standing as well as the night orders an extension of his personal judgment on matters of ship safety and security.
- All seafarer's are familiar with the term "The Master's word is final". Well, let us just say that this is why these orders are put down in writing; to make their striking importance crystal clear. Keeping such high importance in mind, the orders should be executed with the same fervor.
- The most crucial point would be to adhere to the orders, minimizing any scope of human error. However, it is only natural to err and therefore, any such error should be brought to a senior officer's notice immediately.

**Q) What are the rest periods required for watch keepers as per STCW 2010?** *(Mar-21, Jan-21, July-17, Jan-16)*

Ans:- Rest Periods:-

- The STCW Code has laid down regulations for mandatory rest periods for members of bridge team in order to prevent fatigue. The STCW Code has stipulated the following:-
  - Rest periods of at least 10 hours in any 24-hour period are required.
  - If rest is taken in two periods, one of those periods must be at least 6 hours.
  - The minimum period of 10 hours may be reduced to not less than 6 consecutive hours provided that any such reduction does not extend beyond two days, and not less than 70 (in case of UK 77) hours rest is provided during each seven-day period.
- The OOW must ensure that the seafarer assigned the watchkeeping duties:
  - Has been given instructions in keeping lookout
  - Knows what is expected of seafarer
  - Knows how and what observations to report
  - Suitably attired and protected from weather
  - Working hours are complied with and frequent relief is possible.

**Q) What is "Sole lookout" as per STCW code, explain in details.** *(March-19)* **OR**

**When can the officer of the watch be the Safe Lookout on bridge?** *(Oct-20, July-17, Jan-16)*

Ans:- Safe Lookout / Sole Lookout:-

- Under the STCW Code, the OOW may, be the sole lookout in daylight provided that on each such occasion:
- The situation has been carefully assessed and it has been established without doubt that it is safe to operate with a sole lookout.
- Full account has been taken of all relevant factors, including, but not limited to:
  - State of weather.
  - Visibility.
  - Traffic density.
  - Proximity of dangers to navigation.
  - The attention necessary when navigating in or near traffic separation schemes.
- When deemed necessary, assistance is immediately summoned to the bridge.
- If sole lookout watchkeeping practices are to be followed, clear guidance on how they should operate will need to be given in the SMS.

**Q) Describe in details the purpose & importance of "lookout" in keeping a safe bridge watch.** *(Sept-17)*

Ans:- The lookout helps in detect the following:

- Any kind of floating object
- Navigation mark or lights
- Any type of distress signal from other ships or ports
- Land
- Ice, irrespective of size or form
- Any type of ship irrespective of its size
- Sandbags or prominent navigational features
- Problem with any of the ship's navigation systems, including navigational lights
- Any kind of hazards or derelicts that can be dangerous to the ship's navigation

The main duties of a lookout are:

- To give utmost attention through sight, hearing, and any other means in order to assess any change in the operating environment
- Detecting and reporting on ships, shipwrecks, debris, shipwrecked person, and other navigational hazards
- Reporting on possibilities of collision, stranding, and other dangers to navigation
- The lookout should remain at his position at all times until he is relieved from his duties. On relieving, he should provide all the information to his reliever about things that he has reported.

**Q) What factors you will consider in determining the composition of navigational watch under STCW code.** *(Sept-21, March-19)*

Ans:- In determining that the composition of the navigational watch is adequate to ensure that a proper look-out can continuously be maintained, the master shall take into account all relevant factors, including those described in this section of the STCW Code, as well as the following factors:

1) Visibility, state of weather and sea.
2) Traffic density and other activities occurring in the area in which the vessel is navigating.

3) The attention necessary when navigating in or near traffic separation schemes or other routeing measures.
4) The additional workload caused by the nature of the ship's functions, immediate operating requirements and anticipated manoeuvres.
5) The fitness for duty of any crew members on call who are assigned as members of the watch.
6) Knowledge of and confidence in the professional competence of the ship's officers and crew.
7) The experience of each officer of the navigational watch, and the familiarity of that officer with the ship's equipment, procedures, and manoeuvring capability.
8) Activities taking place on board the ship at any particular time, including radio communication activities and the availability of assistance to be summoned immediately to the bridge when necessary.
9) The operational status of bridge instrumentation and controls, including alarm systems.
10) Rudder and propeller control and ship manoeuvring characteristics.
11) The size of the ship and the field of vision available from the conning position.
12) The configuration of the bridge, to the extent such configuration might inhibit a member of the watch from detecting by sight or hearing any external development.
13) Any other relevant standard, procedure or guidance relating to watchkeeping.
14) Arrangements and fitness for duty which has been adopted by the Organization.

**Watch arrangements**: - When deciding the composition of the watch on the bridge, which may include appropriately qualified ratings, the following factors, inter alia, shall be taken into account:
1) At no time shall the bridge be left unattended.
2) Weather conditions, visibility and whether there is daylight or darkness.
3) Proximity of navigational hazards which may make it necessary for the officer in charge of the watch to carry out additional navigational duties;
4) Use and operational condition of navigational aids such as radar or electronic position-indicating devices and any other equipment affecting the safe navigation of the ship;
5) Whether the ship is fitted with automatic steering.
6) Whether there are radio duties to be performed.
7) Unmanned machinery space (UMS) controls, alarms and indicators provided on the bridge, procedures for their use and limitations.
8) Any unusual demands on the navigational watch that may arise as a result of special operational circumstances.

**Q) Your vessel is at anchor, how will you take over your watch.** *(Jan-21, Nov-20, July-19, Jan-17)*
Ans:- Taking over an anchor watch:
1) Read instructions from Master or Chief Officer.
2) Check position of own vessel to ensure she is not dragging anchor.
3) Check UKC, maintain VHF watch for instruction.
4) Check distance of all other vessel's at anchorage. Look out for other vessel's dragging.
5) Look out for vessel's approaching the anchorage area.
6) Check the wind, sea, swell, continuously asses the visibility.
7) Read & sign all met warning's & nav warnings received during watch.

8) Establish compass error.
9) Check SAT-C for routine messages notify Master accordingly.
10) If bunker barge expected, keep look out for the same, if bunker barge is already alongside, keep track of all timings, ensure no sheen is visible, if so inform master.
11) Keep look out for bunker overflow.
12) Abide by all ISPS procedures, do not let unauthorized vessel(s) be alongside own vessel.
13) Ensure appropriate lights & shapes are displayed.
14) Ensure appropriate flags are hoisted/ lowered.
15) Keep eye on crew working on deck, stop any kind of unsafe practices, abide by all international & local regs.
16) Some boats/ launches may be expected carrying stores, crew, port officials, surveyors, auditors, inspectors, ship chandler etc., ensures these boats are tended to safety.
17) Test the controls as instructed.
18) Try out m/eng as instructed.
19) Keep track of vessel berthing/ unberthing intended berth.
20) Receive instructions from VTS/ Ports Control & notify all parties as instructed.
21) Follow Master's standing orders, bridge orders, call Master & doubt.
22) Abide by company's sms procedures, checklists and all additional measures as per Risk assessments.

**Q) Describe the responsibility of the OOW in the following circumstances: Approaching a port.** *(March-16)*

Ans:- Responsibility of the OOW - Approaching a port:-

1) The Master and all navigational watchkeeping officers should, well before hand, thoroughly study the Sailing Directions (Often referred to as the Pilot Book) and the chart of the approaches to the port.
2) The passage plan for arrival at the port should be prepared and kept handy so that the OOW would be able to monitor the navigation of the vessel at all times, even when the Master or the pilot is directing the process. This serves as a second check on the navigational safety of the ship.
3) Communicate to the arrival port, by VHF, the ETA of the ship as and when instructed by the Master.
4) Inform the Master at the time indicated by him.
5) Give notice to the engine room at the time or charted position, as instructed by the Master. Inform Master when this has been done.
6) Synchronise clocks of the bridge, the engine room and the auto-recorder of the bridge – ER telegraph.
7) Call up a seaman to act as the bridge messenger.
8) Change over to hand steering.
9) Switch on the other steering motor also.
10) Try out the steering system. After a long sea passage, it is necessary to try out the steering system about two hours before reaching confined waters. This done by:
    - Changing over to hand steering and then putting the helm hardover to one side and then the other whilst using one steering motor.
    - The same is then repeated while using the other steering motor.
    - If the ship is fitted with electro-hydraulic steering system, it is necessary to try out the steering on the electric and the hydraulic systems separately.

- On ships fitted with a shaft generator, it would normally be necessary to inform the Engine Room before making sudden helm movements in order to prevent the generator from tripping off. If this happens, a diesel generator would automatically come on but, in the intervening couple of minutes, there would be no electric supply on the ship.

11) Take in the log (retract log sensor).
12) If daytime, keep flags ready – Red Ensign, courtesy flag, house flag, G, Q, H, etc.
13) If night time, try out lights of Christmas Tree by switching them on momentarily.
14) Try out pneumatic whistle and electric klaxon by giving a very short blast on each.
15) Rig up the daylight signaling lamp and try it out on the mains and also the battery.
16) Check communication system to the forward and aft stations and to the steering gear compartment.
17) Have pilot ladder, life buoy with rope attached, heaving line and boat rope kept ready to be rigged (also flood light at night).
18) Give adequate notice to the crew for coming on arrival stations.
19) Electric power to be switched on to the windlass.
20) Keep a record of all events and their timings in the Bridge Notebook. The important entries are to be copied into the Mates Logbook later on.
21) Keep 'Pilot information card' ready for presentation to the pilot as soon as he enters the wheelhouse. This card contains the necessary information regarding the ship's particulars, navigational equipment, etc. in a standard format as given in the 'Bridge Procedure Guide' published by the International Chamber of Shipping (ICS). This card is separate from, and in addition to, the 'Wheel-house Poster' displayed in the wheelhouse.
22) After ringing Stand-By Below (SBB) on the telegraph, the Master would try out the engine by going astern. An entry, ''Engine tried out astern' should be made in the Bridge Notebook and later copied into the Ship's Logbook.
23) Anti-pilferage watch to be arranged on deck to commence before arrival port.
24) While going alongside, the pump room blowers should be switched off. This is to prevent sparks from the funnels of tugs used from being drawn into the pump room.

**Q) Describe the procedures for: Clearing the anchors** *(March-17)*

Ans;- Clearing the anchor(s) for arrival:-

- ensure power is on to forward windlass
- ensure the break is applied and windlass is in gear
- remove the guillotine bar or bow stopper and anchor lashings release the brake
- lower anchor(s) clear of the hawse pipe
- report to the bridge "Anchor(s) clear of hawse pipe and ready for letting go"
- await further instructions from the bridge.
- Always be alert to any changing circumstances e.g. excessive vibration or unusual noise of machinery.

Once the planned length of chain is in the water the guillotine bar should be dropped and secured, and the chain allowed to bear against the guillotine bar. The guillotine bar is designed to take the weight of the anchor cable.

The windlass should be out of gear and the brake applied. Throughout anchor period the appropriate anchor signals are to be used (ball, lights, bell and gong).

- During an anchoring operation the following factors should be considered:
- general safety procedures and precautions including PPE
- identify a safe anchorage with good holding ground
- identify a safe anchorage that lies within the Territorial
- Waters of the Port State Authority
- hinged-bar-type-chain-stopper
- local weather and forecasts
- good seamanship
- the direction of the current or tidal stream
- sufficient depth of water
- anchor to be used
- amount of cable to use / payout
- anticipated final manoeuvring prior to letting go or
- walking back
- method of letting go or walking back
- communications
- escape / abort route should circumstances dictate.

**Q) What factors would you consider in deciding the anchor position and amount of cable to use.** *(May-17)*

Ans:- **Arriving at the anchoring position**:

- Prior to anchoring, the direction and speed of the current or tidal stream and wind must be confirmed. Attempts should not, whenever possible, be made to anchor across the current, tidal stream or wind.
- When all the way has been taken off the vessel, the vessel's head should be close to the direction of the tidal stream or wind and the bow should not be swinging excessively.

**Planning for Anchoring**:

- Master Shall Identify a suitable anchoring position before entering the anchorage area.
- Conduct a planned approach including speed reduction in ample time and orienting the ships head prior anchoring to (a) Same as similar sized vessels around or (b) Stem the tide or wind whichever is stronger.
- Decide on which method of anchoring to be used and the number of shackles depending on the depth of water, expected weather and holding ground. A simple rule in determining length of cable to use:

Standard condition:
Length of cable = [(Depth of water in meters * 2) + 90 ] / 27.5
When good holding power cannot be expected:

(e.g. Strong Wind, Strong Current, Harder Sea bottom)

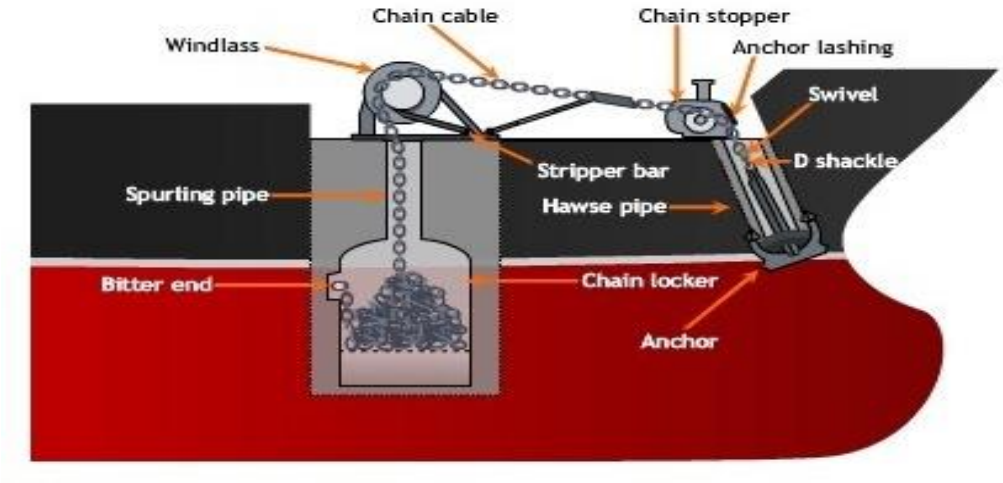
Length of cable = [(Depth of water in meters * 3) + 140 ] / 27.5

It is suggested the use of radar parallel indexing technique, an effective tool in maneuvering approach to anchoring position. A fix reference point is necessary in

establishing the intended anchoring position relative to this fix point.

**Q) Describe the procedures for: Anchoring** *(March-17)*

Ans:- Preparation for Anchoring:- The Chief Officer (or another experienced officer in lieu) must supervise letting go or weighing the anchors and should only assign experienced crew members to anchor work.




Prior to Anchoring, the Chief Officer should be aware of:

a) Approximate anchoring position.
b) Method of approach
c) Which anchor to use
d) Depth of water
e) Method of Anchoring
f) Final amount of Cables

Procedure of the Introduction to Anchoring:-

At the Forecastle: Check brakes are on and clear the voyage securing devices. (Anchor Lashings, Bow Compressed Bar etc.)

a) Start Hydraulic(Source of) Power of Windlasses
b) Check Anchor Shape / Light
c) Check Communication with the Bridge
d) Check Lighting on Forecastle including torch , at night time
e) Ensure all personnel are wearing Safety Helmets, Safety Shoes and Goggles.

Before Letting Go Anchor:

- The Chief Officer shall confirm that there is no craft or any obstacle under the bow and inform to the Bridge.
- The Master shall ensure that the vessels GPS speed at the time of anchoring is near-zero or indicates a slight sternway.
- The speed should be verified by visual transits and/or Radar ranges of Landmarks, if available or other fix conspicuous targets.
- Where means of communication between Bridge and the Anchoring party is by Portable radio, the identification of the ship should be clear to avoid misinterpretation of instructions from other user of such equipment in the vicinity.

Routine Anchoring Operation:-

There are 2 methods for Anchoring according to depth of the water:

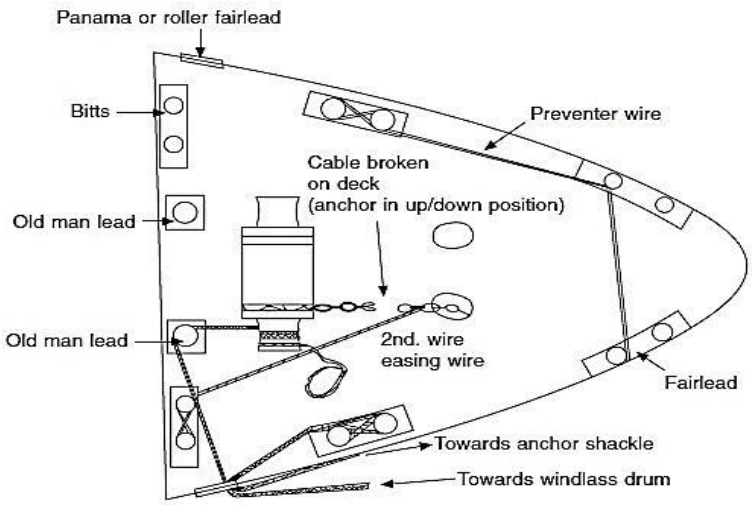
**Method 1** (Preferable for Container Ships / Depths up to 50m )
a) Walk out the anchor to Half a shackle above the sea bottom
b) Hold the cable on the brake and take the windlass out of gear
c) Stop the vessel over ground
d) Drop the anchor
e) Control the speed of cable flow by the brake , while not allowing pile-up
f) Bring anchor cable direction forward and confirmed anchor holds its position.

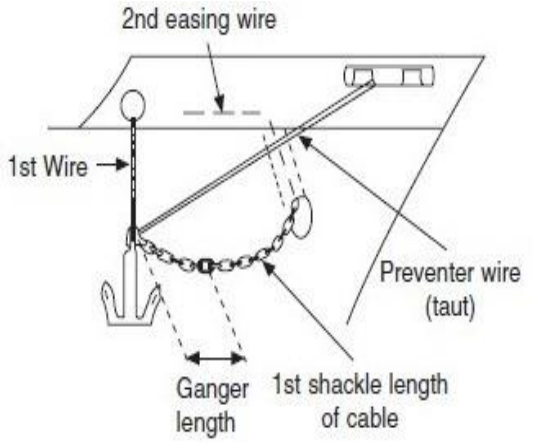
Disadvantages:
If the brake fails, or there is too much speed over ground, the cable will run out to the bitter end with consequent damage. The brake lining could also be damaged due to this Dynamic load (the Static load on brakes to restrain movement of an anchored vessel is much less).

**Method 2** (Suggested for Tankers / Depths over 50m )
a) Stop the vessel over ground
b) Walk out the anchor under power until the complete length of required cable is paid out and anchor holds it position on the seabed.
c) Bring anchor cable direction forward and confirmed anchor holds its position.

Disadvantages:
Vessel must be completely stopped to avoid major damage to Windlass.

**Q) Describe the procedures for: Securing the anchors for sea** *(March-17)*
Ans:- Sequence of Operation:-
1) The anchor should be walked back clear of the hawse pipe.
2) With the aid of a man in a bosun's chair, a heavy wire should be passed through the anchor crown 'D' shackle, this wire being led from the shoulder at a point from which it is intended to suspend the anchor. (The wire should be of sufficient SWL (safe working load) to accept the full weight of the anchor and a limited amount of cable.)
3) This wire should be secured aft of the fo'c'sle head, one end being turned up on bitts, while the other is turned on to the windlass drum (with heavy anchors, both parts should be turned up on bitts).
4) Rig a preventer wire, in a slack condition well forward of operations, in case the first wire should part once the cable is broken.
5) The anchor cable should be walked back to allow the first wire to accept full weight of the anchor. The first wire now being in the up/down position.
6) Continue to walk back on the cable to bring the next joining shackle on deck, securing this length in short bights. Engage bow stopper or other cable-securing arrangements.
7) Rig a second easing wire forward of the joining shackle, and take the weight of the amount of cable between the anchor and the joining shackle on deck.
8) Break the joining shackle.
9) Clear away cable securing, and walk back on the easing wire to bring the bare end clear of the hawse pipe.
10) Rig a hawser, with the aid of a bosun's chair, to recover the bare end inboard via the fairlead, thus leaving the hawse pipe clear.




The cable joining shackle should not be broken until the first wire has been secured (both parts of the bight), because if control of the first wire is lost, and the cable has already been broken, then the possibility of losing anchor and a length of cable becomes more than probable. This probability is increased with very heavy anchors, e.g. 20 tonnes.

**Q) Draw out a Checklist for anchoring.** *(July-18)*

Ans:-Checklist for Anchoring:

| Anchoring Appraisal and Planning | Tick |
|---|---|
| Anchoring plan checked and approved by the Master | |
| Anchoring position identified taking into account: | |
| • Availability of appropriate space at the anchorage | |
| • Proximity of navigational hazards including traffic | |
| • Scope of anchor cable required/available | |
| • Suitable seabed type and holding conditions | |
| • Tidal height checked to confirm that sufficient water is available for the duration of the anchorage | |
| • Tidal stream checked with particular reference to effect on slow speed manoeuvring | |
| • Weather conditions and available shelter | |
| Anchors, cables and winches checked and ready for use | |
| Engine room and anchor party informed of the time of anchoring | |
| Intended anchor position of the ship reported to the port authority | |
| Lights, shapes and sound signalling apparatus checked and ready for use | |
| Reduction to manoeuvring speed in ample time | |
| Security measures required by the Ship Security Plan (SSP) | |

**Q) Describe the dangers of using different rope types in one mooring system.** *(March-17)*

**Ans:-** Dangers of using different rope types in one mooring system**:-**

- Mooring lines are usually made from manila rope or a synthetic material such as nylon. Nylon is easy to work with and lasts for years, but it is highly elastic. This elasticity has advantages and disadvantages. The main advantage is that during an event, such as a high wind or the close passing of another ship, stress can be

spread across several lines.
- However, should a highly stressed nylon line break, it may part catastrophically, causing snapback, which can fatally injure bystanders.
- The effect of snapback is analogous to stretching a rubber band to its breaking point between your hands and then suffering a stinging blow from its suddenly flexing broken ends.
- Such a blow from a heavy mooring line carries much more force and can inflict severe injuries or even sever limbs. Mooring lines made from materials such as Dyneema and Kevlar have much less elasticity and are therefore much safer to use.
- However, such lines do not float on water and they do tend to sink. In addition, they are relatively more expensive than other sorts of line.
- Some ships use wire rope for one or more of their mooring lines. Wire rope is hard to handle and maintain. There is also risk associated with using wire rope on a ship's stern in the vicinity of its propeller.
- Mooring lines and hawsers may also be made by combining wire rope and synthetic line. Such lines are more elastic and easier to handle than wire rope, but they are not as elastic as pure synthetic line.
- Special safety precautions must be followed when constructing a combination mooring line.

**Q) How would you take over a bridge watch, during night and while navigating in piracy prone areas?** *(July-21, July-19, Jan-18, Jan-16)*

Ans:- Taking over watch at sea

1. Be on watch about 15 min before, at night time it helps to adjust the night vision.
2. Read and sign any orders from master in night order book / bridge order book.
3. Inspect all the charts likely to be used in the watch for the following:-
   a) Check courses to be steered and distances marked on the chart, also check the courses and distances as per the passage plan for the voyage.
   b) Ensure the largest scale chart to be used.
   c) Check courses are plotted clear of dangers to surface navigation.
   d) Check the no go areas, mark them if not done.
   e) Check the unit of depth and that the courses are plotted clear of shallows in accordance with company's UKC policy. Info regarding draft & display to be available on the bridge.
   f) Check estimated time for next alteration of course.
   g) Check wheel over positions, abort points & contingency anchorages.
   h) Check info related to parallel indexing.
   i) Check for land/ island on the chart, check radar conspicuous objects, check for approx time for the land fall on the radar.
   j) Check the nav marks and their characteristics, sector light etc, check general direction of buoyage system.
   k) Check the charts to find info regarding geodetic datum, geodetic datum may be unknown and so significant to surface navigation.
   l) Check if any reporting to be done to SRS/ VTS.
   m) Check for any instructions marked by master regarding notices to E/R, removing anchor lashings etc.
   n) Read all relevant notes on the chart:- local magnetic anomalies, current, submarine exercise areas, firing zones, PSSA, Marpol special areas, information pertaining to offshore installations, sand waves etc.
   o) Check the source data, very old survey may be unreliable for the soundings.

p) Check the T & P notices relevant to the chart.
q) Check if any low pressure marked on the chart. (including forecast for that low.)
r) Check if clocks / calendar to be advanced.
s) Refer to the routeing chart for all the climatological infos, check the normal atmospheric pressure for the area where the vessel is navigating.
t) Check last position plotted and means of position fixing fixing, always check the position plotting interval, it should be as per Masters / company's instructions.
u) Check tidal info by means of tide tables, tidal stream atlast & tidal diamonds.

4. Ensure all the relevant publications are available for use.
5. Read and sign the navigation & meteorological warnings rcvd on EGC, navtex, check if any information to relevant to own vessel.
6. Check the updates related to piracy, especially when plying in pirate infested area/ high risk area.
7. Check the weather fax rcvd during previous watch, check if any information is relevant to own vessel, any weather fax to be recvd in the watch (time & freq as per ALRS.)
8. Check if any commercial message is recvd and if Master informed.
9. Check the state of visibility. Check the manning level of the bridge is as per company's instructions. Manning level may be there for weather conditions.
10. Ensure watch keeping ratings are fit for watch, if sole look out, OOW must know how to call them just in case.
11. Understand the traffic situation, consult the outgoing OOW but must verify visually, also by means binoculars and radar, check ARPA info, some targets may have to be acquired if not done by outgoing OOW, always check the manning level of the bridge is as per company's instructions for traffic situation.
12. Check CPA/TCPA limits on ARPA, true vector / relative vector.
13. Check ARPA is sea stabilized or ground stabilized.
14. Check gyro & magnetic courses steered by auto pilot / auto pilot, course might have altered due to traffic.
15. If set was allowed, ask when it was allowed, check difference between gyro course and course made good.
16. Check the tachometer & note down RPM, if CPP check the pitch of the propeller, if on main eng on UMS mode, the duty eng must be known, (duty eng roster is sometimes available on bridge)
17. Check BNWAS to know the dormant period, confirm who is the back up officer.
18. Ensure VHF is switched on and level of volume is audible enough.
19. In case of selected ship (VOF), find if coded msg to be prepared.
20. Check GPS is on which geodetic datum, confirm cross track limits.
21. Check various settings on ECDIS.
22. Check VDR/ S-VDR remote module for any alarm.
23. Check auto pilot for the settings.
24. Check the radar picture & all settings and all the targets on PPI.
25. Identify the shore lights, some of vessels may not be visually identified due to shore light.
26. Check targets on AIS, check info reg draft & no. of crew is correct.
27. Adjust all the dimmers as required.
28. Check smoke detector panel. (no circuits to be kept isolated)
29. Check status of automatic fire doors / water tight doors (if fitted)
30. Check if any permit has been issued.
31. Should inquire as to where crew is working. (hold, tank etc).
32. Check nav lights are burning, confirm that it is matching with the status of nav light on the sentinel.

33. Confirm if the compressed air is available for ship's whistle.
34. Check that day light signaling lamp is working.
35. Check operational condition of all nav & GMDSS equipment.
36. Check if vessel is unusually trimmed or listed.
37. Ask if any ballast exchange in progress and the planned sequence.
38. Confirm if compass error established.
39. Change echo sounder unit same as that on the chart. (if applicable)
40. Master Gyro to be synchronized with all repeaters.
41. If daytime check for any sign of visual damages to ship.
42. Check wind, sea, swell etc.
43. Check any deck cargo if loaded is missing.
44. Check appropriate manual inputs for gyro is applicable.
45. Once outgoing OOW has plotted the position, check the position & cross track error.
46. Exchange courses, compare compasses.
47. Check if any action to be taken to abide with COLREGS.
48. Change settings an auto pilot if required.
49. Change settings on radar if required.
50. Comp c/list for taking over watch & relevant procedures in the SMS to be complied with.

PS:- Watch should not be taken over when course is being altered for traffic or in case of a way point.

**Q) Prepare a checklist for handing over a Navigational Watch at Sea in Restricted Visibility. Also enlist the other pressing activities which need to be undertaken onboard other than items in your bridge checklist.** *(July-19, March-17)* **OR**

**Draw up a Bridge Watch-keeping Checklist when navigating in Restricted visibility.** *(Jan-23, Jan-22, Nov-21, Jan-20, Jan-18, Aug-16)*

Ans:- **Navigation in restricted visibility**

- **Familiarization**: OOW must know each and every aspect of the ship including dimensions and the characteristics for restricted visibility situation, it is important that the OOW know the stopping distance of the ship also the blind sector of all the radars should be known, OOW must know when the Master should be informed as per Master's standing instructions.
- **Inform the Master**: During restricted visibility, it is important that the master is on the bridge. The OOW must constantly assess the state of visibility and inform the master immediately, once Master is on bridge hand over the con to him.
- **Inform E/R & reduction of speed**: OOW should notify the engine room, later on the tachometer must be checked to ensure RPM is being reduced, bring down the ship to maneuvering RPM, in order to comply with COLREGS rule no. 19. (Power Driven v/l must have engines ready for immediate maneuver).
- **Visual Observance:** Check all the targets visually, especially smaller targets that may not be picked up by radar.
- **Change in bridge watch keeping level:** It is important that enough man power is present on the bridge, additional officers and rating should be called on the bridge, lookout(s) must be posted at different locations on the ship, Master can consulted regarding the deployment of look outs, check for any sounding signal from other vessels in the vicinity.

- **Whistle**: - Ensure that the whistle is working properly by trying out all the whistles, start blowing the whistle below entering restricted visibility, as the rules applies to vessels navigating in or near the area of restricted visibility.
- **Navigation Lights**: Switch on the navigation lights if not already done, ensure all these lights are burning properly.
- **Radar & ARPA:** Switch on other radar, switch on the ARPA and start acquiring the targets, check AIS targets and compare data of both ARPA and AIS, adjust A/C rain & A/C sea as required.
- **Hand steering**: Revert to hand steering, switch on other steering pump if not done earlier.
- **Stop works on deck**: Stop any job which may prevent sound signal of other vessels to be heard properly. No one to be allowed on main deck, this is to prevent injury to personnel working on open deck in case collision/ allusion (physical contact with fixed or floating objects.)
- **Open Bridge Doors**: Ensure that the bridge doors are kept open and is without any obstruction for easy bridge wing access.
- **VHF**: Ensure VHF channel 16 is switched on and is audible enough for all the safety related messages.
- **Keeping record**: Keep record of all activities on the bridge.
- **Follow all procedures**: Follow all the important procedures as per SMS manual including compliance of any check list for restricted visibility, company instructions for bridge manning level must be complied with. Resting periods must be taken care, all precautions as per risk assessment to be fulfilled.
- **COLREG Rule -19**: Always comply with COLREG Rule – 19, if necessary; navigate with extreme caution till risk of collision is over.

CHECKLIST NAVIGATION IN RESTRICTED VISIBILITY:-

| BRIDGE CHECK LIST | | |
|---|---|---|
| 1 | Has the following equipment been checked to ensure that it is fully operational? | |
| | - Radar, ARPA or other plotting facilities | ☐ |
| | - VHF | ☐ |
| | - For signalling apparatus | ☐ |
| | - Navigation lights | ☐ |
| | - Echo sounder, if in soundings | ☐ |
| | - Watertight doors, as appropriate | ☐ |
| 2 | Have lookout(s) been posted and is a helmsman on standby? | ☐ |
| 3 | Have the Master and engine room been informed, and the engines put on standby? | ☐ |
| 4 | Are the COLREGS being complied with, particularly with regard to rule 19 and proceeding at a safe speed? | ☐ |
| 5 | Is the ship ready to reduce speed, stop or turn away from danger? | ☐ |
| 6 | If the ship's position is in doubt, has the possibility of anchoring been considered? | ☐ |
| 7 | Other checks: | ☐ |
| | - | ☐ |
| | - | ☐ |
| | - | ☐ |

**Q) Prepare a checklist for taking over a navigational watch at sea: Approaching a Heavy Weather Area.** *(Nov-21)*

Ans:- Here is a checklist for taking over a navigational watch at sea when approaching a heavy weather area:

1. Check the weather forecast and pay attention to any warnings of heavy weather in the area.
2. Familiarize yourself with the vessel's stability and ballasting plan to ensure it is properly prepared for heavy weather.
3. Verify that all navigational equipment is functioning properly and accurately, including the radar, GPS, and echo sounder.
4. Ensure the charts and publications covering the area are up-to-date and properly corrected.
5. Review the vessel's position, course, and speed and confirm that they are in line with the intended voyage plan.
6. Confirm the position and status of any other vessels in the vicinity, particularly those that may be a potential collision risk.
7. Review the vessel's heavy weather procedures and ensure that all crew members are familiar with their roles and responsibilities.
8. Check the communication systems, including the VHF radio and satellite communications, to ensure they are in good working order.
9. Ensure that the crew is aware of the potential hazards associated with heavy weather, including the risk of injury, damage to equipment, and loss of cargo.
10. Make a mental note of the vessel's draft and under keel clearance to ensure that the vessel has enough water depth to navigate safely in heavy weather.
11. Brief the outgoing watchkeeper about any issues that require attention or follow-up, such as weather trends or any other concerns.
12. Take over the watch in a calm and methodical manner, paying close attention to the vessel's position and course as well as any changes in the weather or sea conditions.

**Q) Describe the duties of OOW in restricted visibility when: At Anchor** *(July-18, Nov-17)*

Ans:- Duties of OOW:-

Before getting into restricted area and making the final approach:

- Engine room and anchor party should be informed of time of anchoring.
- Have anchors, lights/shapes and sound signalling appliances ready.

On anchoring, a fix on the anchor drop position should be made and the ship's swinging circle marked. The anchor position should be communicated to the port authority or VTS. While at anchor, the OOW should:

- Determine and plot ship’s position on the appropriate chart. Check should be maintained on the anchor position to ensure that the ship does not drag anchor, by taking bearings of fixed navigational marks or readily identifiable shore objects. Check should be made on under keel clearance. Position can also be checked using GPS anchor alarm, particularly when using DGPS mode.
- Observe meteorological and tidal conditions and the state of the sea.
- Particular attention should be paid to check anchor position after change of tide.
- Any wind shift or change of weather should be recorded.
- Ensure that the state of readiness of main engines and other machinery is in accordance with the Master’s instructions.

- A proper lookout must be maintained and ship inspection rounds periodically made, particularly if the ship is anchored in waters, which might present a risk of attack by pirates or armed robbers.
- Ensure that ship exhibits the appropriate lights and shapes and that appropriate sound signals are made in accordance with all applicable regulations.
- Take measures to protect the environment from pollution by the ship and applicable pollution regulations.
- Notify the Master and take all counter measures if ship drags anchor.
- The Master should be immediately notified if the ship drags her anchor, and if sea conditions or visibility deteriorate.

**Q) What are the duties of O.O.W when a vessel is at anchor?** *(May-16)* **OR What are the duties of OOW while keeping an anchor watch in a congested anchorage?** *(March-17)*

Ans:- Keeping Anchor Watch in Congested Anchorage:-

1) Ensure that the ship is not dragging anchor by fixing the position frequently.
2) Check compass error on ship's head on ebb tide and on flood tide at least once in a watch.
3) Display prominently, the times and heights of high water and low water for that day.
4) Check under-keel clearance regularly, especially at low water.
5) Ensure that anchor signals are displayed properly.
6) During daytime, ensure that necessary flags are hoisted correctly.
7) At night, ensure that the upper deck is properly illuminated.
8) Keep a good lookout for:
    a. Signals from shore station or other vessels.
    b. Passing vessels.
    **c. Vessels anchoring too closely.**
    d. Any small craft that may be in need of assistance.
    e. Pilot boat, if expected.
    f. Unauthorized boats that try to come alongside.
9) Keep VHF on channel in use in the port but guarding channel 16 also.
10) Maintain anti-pilferage watch on deck:
    a. In ports where piracy is known to occur special lookouts to be posted fore and aft provided with portable VHF sets.
    b. Hawse pipe covers to be shipped in place and secured against unauthorized access.
    c. Entrances to spaces not actually being used – masthouses, lockers, storerooms, accommodation, etc., to be locked. Such entrances should be well illuminated so as to deter anyone from attempting to break in.
    d. Any special instructions issued by the port, with regard to piracy, should be followed.
11) Gangway or pilot ladder should be kept ready, with proper lighting, a life buoy (with line attached), a heaving line and a boat rope ready.
12) Safe practices, as per 'Code of Safe Working Practices', are followed by all.
13) Keep an eye on crew working aloft, on deck or over the side.
14) Look over the side frequently to make sure that no oil is being pumped overboard.
15) Attend to any boats that come alongside.
16) Watch the weather carefully and inform the Master if there is any significant change in:

a. Barometric pressure.
b. Wind direction and force.
c. Direction and height of swell.
d. Storm signals, if any displayed by the port.

**Q) Describe the duties of OOW in restricted visibility when: When taking over a navigational watch at sea.** *(July-21, Nov-17)*

Ans:- Taking over a navigational watch at sea:-

1) Know your Ship inside-out: An efficient navigating officer must know each and every aspect of his or her ship in order to prevent any kind of accident. From dimensions to the characteristics of the ships, the officer should know how the ship will behave under different circumstances. For restricted visibility situation, it is important that the OOW know the stopping distance of the ship at any particular RPM in order to control the ship during emergencies.
2) Inform the Master:- During restricted visibility, it is important that the master is on the bridge. The OOW must call or inform the master regarding the navigating condition. The officer should also inform the engine room and ask the duty engineer to man the engine room incase it is on "unmanned" mode.
3) Appoint Adequate Man Power: It is important that enough man power is present on the bridge in order to keep a close watch on the ship's course. Additional personnel must be appointed as "lookout" at different locations on the ship. If there is traffic in the area, the officer must inform the engine room to have enough manpower so that the engine is also ready for immediate maneuvering.
4) Keep the Fog Horn Ready:- Ensure that the fog horn is working properly for the restricted area. If the horn is air operated, drain the line prior to opening the air to the horn.
5) Reduce Speed: Reduce the speed of the ship depending on the visibility level. If the visibility is less, bring down the ship to maneuvering RPM.
6) Ensure Navigation Equipment and Light Are Working Properly: Ensure that all important navigating equipment and navigation lights are working properly during restricted visibility. The OOW must ensure that the navigation charts are properly checked for correct routeing and a good radar watch is carried out.
7) Stop All Other Works: Though it's obvious, but never multi-task during restricted visibility even if there are more than sufficient people present on the bridge. Also stop all other deck work and order the crew to go to their respective rooms. This is to prevent injury to personnel working on open deck in case collision or grounding takes place.
8) Open/Close Bridge Doors: Ensure that the bridge door is kept open and is without any obstruction for easy bridge wing access (Considering that the bridge wing is not enclosed). Also, in case of dust or sand storm, close all the bridge openings.
9) Shut Ventilation: If the ship is passing through a sand storm, the ventilation fans and accommodation/ engine room ports must be closed to avoid sand particles from entering bridge, accommodation and engine room.
10) Follow All Procedures: Follow all the important procedures for restricted visibility as mentioned in COLREG Rule -19. Also monitor channel 16 in the radio and ensure that all important parameters of the ship such as latitude and longitude, time, speed etc. are noted in the log book.

**Q) What does the STCW say regarding performing a deck watch in general**

**and particularly on ships carrying hazardous cargo?** *(Sept-21)*
Ans:- The STCW Code provides guidance and requirements for the performance of a deck watch on ships, including those carrying hazardous cargo. Some of the key points to note are:

General Requirements:
- Deck watchkeepers must be trained, qualified and designated to perform watchkeeping duties in accordance with STCW requirements.
- They should be capable of performing the duties and responsibilities of a watchkeeper, which include maintaining a proper lookout, monitoring and controlling the ship's movement, and responding to emergencies.
- The minimum manning requirements for the deck watch should be in accordance with the ship's Safe Manning Document.

Ships carrying hazardous cargo:
- Deck watchkeepers on ships carrying hazardous cargo must receive additional training to familiarize themselves with the hazards associated with the cargo.
- They should be aware of the potential risks associated with the cargo, and the precautions that need to be taken to prevent accidents or incidents.
- They should be familiar with the procedures for handling, stowing and securing the cargo, as well as the emergency procedures in case of a spill, leak or other incident.
- The deck watch should be aware of the locations of the hazardous cargo on board, and the precautions to be taken when working in the vicinity of the cargo.

Overall, the STCW Code emphasizes the importance of having properly trained and qualified deck watchkeepers on board ships, especially those carrying hazardous cargo. Their responsibilities include maintaining a proper lookout, monitoring the ship's movement, and responding to emergencies, with due consideration to the hazards associated with the cargo.

**Q) List the duties and responsibilities of a navigation watch-keeper while vessel is navigation in: Pilot on Board** *(Oct-20, March-20, March-19, March-18, Jan-18)*
Ans:- Navigation with Pilot on Board:-
- Immediately on arrival in bridge, Pilot to be informed of ship’s heading, speed, engine setting and draft.
- Master pilot exchange to be carried out.
- Pilot informed of LSA provided on bridge, discuss about any ISPS requirement if any.
- Completed Pilot Card handed to pilot.
- Pilot referred to Wheelhouse Poster.
- Familiarization of bridge and communication systems to be given to pilot.
- Discuss about status of anchors.
- Any other relevant procedures / checklist as per SMS to be complied with.
- Details of proposed passage plan discussed with the pilot and agreed with the master including: UKC, radio communications and reporting requirements.
- Discuss about the watchkeeping arrangement and crew stand by arrangements including tose who are stand by forward, discuss about abort points and contingency anchorages.
- Responsibilities within the bridge team for the pilotage defined and clearly

understood.
- Discuss about requirement of local regulation including hoisting of a flag, shape of exhibition of light etc.
- Discuss about the following:-
  - Configuration of ropes (fwd & aft.)
  - Which line to be the first line (fwd & aft.)
  - Any mooring boat available
  - How many tugs & points where these tugs to be fast, power of the tugs (bollard pull etc), what time tugs expected in order to give notice to ship staff.
- Lighting arrangement for stations must be consulted prior to switching on lights especially for fwd stn (lights preferably facing fwd).
- Discuss about information related to berthing / anchoring arrangements.
- Discuss about expected traffic during transit, pilot change over arrangements, fender requirements. Discuss about instructions for pilot ladder / accommodation ladder.
- Watchkeeping level to be as per company's SMS.
- Progress of the ship and execution of orders being monitored by the master and OOW, position fixing to be done as per position plotting interval as ordered by Master, Parallel indexing technique to be used as and when possible.
- Traffic situation to be monitored, keep eye on all the vessels in the vicinity and data pertaining to CPA, TCPA, range, bearing, bow crossing range, bow crossing distance. Good look out to be maintained, long range scanning to be done to detect the object in ample time.
- Comply with COLREGS/ local regulations, effectiveness of action to be checked.
- UKC to be monitored.
- Any instruction as per Masters standing orders, bridge orders to be complied with.
- VTS to be reported (normally done by pilot), VHF to be maintained on required frequencies.
- E/R and ship's crew regularly briefed on the progress of the ship during pilotage.
- Arrangement to relieve officers, helmsman, look out, and those stand by for anchor party to be done.
- Ensure Master's orders and pilot's advice is complied with.
- Monitor all the displays on bridge – tachometer, rudder angle indicator, ROTI, anemometer etc, also displays for course steered and course made good, speed through water and speed over ground etc.

**Q) What is the role of a Pilot on board ship? What is the responsibility of the Bridge Team when a Pilot is on board and what is meant by the term "Challenge the Pilot"?** *(Aug-21)*

Ans:- The role of a Pilot on board ship is to assist the Master and the Bridge Team in safely navigating the vessel through restricted or unfamiliar waters, such as ports, narrow channels, or pilotage areas. The Pilot is an experienced navigator with knowledge of local conditions, such as tidal currents, shoals, or other hazards, and is responsible for advising the Bridge Team on the best course of action to safely navigate the vessel.

When a Pilot is on board, the Bridge Team has the responsibility to work closely with the Pilot to ensure the safe navigation of the vessel. This includes:

1. Cooperating with the Pilot: The Bridge Team should work closely with the Pilot and follow their instructions, as the Pilot has the authority to direct the vessel's

movements.
2. Monitoring the Pilot's actions: The Bridge Team should monitor the Pilot's actions and provide feedback as necessary, such as pointing out hazards or questioning the Pilot's decisions.
3. Challenging the Pilot: If the Bridge Team observes any unsafe actions or deviations from established procedures, they have the responsibility to challenge the Pilot and raise any concerns with the Master.

The term "Challenge the Pilot" refers to the Bridge Team's responsibility to question the Pilot's actions or decisions if they perceive any unsafe conditions or deviations from established procedures. Challenging the Pilot is an important safety measure to ensure that the vessel is safely navigated and that any potential hazards are identified and addressed in a timely manner.

**Q) What is the need for the "Master Pilot Exchange"?** *(Aug-21)*

Ans:- The Master Pilot Exchange (MPX) is a procedure that is carried out when a Pilot comes on board a vessel to assist with navigation in restricted or unfamiliar waters. The MPX is an important communication process between the Pilot and the Master, which helps to ensure a safe and effective navigation of the vessel.

The need for the Master Pilot Exchange arises from the fact that the Pilot and the Master may have different backgrounds, experiences, and expectations regarding the navigation of the vessel. The MPX allows the Pilot and the Master to exchange information about the vessel, the planned route, local conditions, and any other relevant information, which can help to ensure that the vessel is safely navigated through the pilotage area.

Some of the key benefits of the Master Pilot Exchange include:

- Improved communication: The MPX helps to establish clear lines of communication between the Pilot and the Master, which can help to avoid misunderstandings and errors.
- Shared knowledge: The MPX allows the Pilot and the Master to share their knowledge and expertise, which can help to identify potential hazards and determine the best course of action for the vessel.
- Enhanced situational awareness: The MPX helps to improve the situational awareness of both the Pilot and the Master, which can help to prevent accidents and ensure a safe and efficient navigation of the vessel.

**Q) List the exchange of information between the Master and Pilot when the pilot boards the vessel.** *(Sept-21)*

Ans:- When a Pilot boards a vessel, there is a formal exchange of information between the Master and the Pilot. The information exchange typically includes the following:

1. Pilot's name and rank
2. Pilot's license number
3. Pilot's experience in the area and with the type of vessel
4. Vessel's name, flag, and port of registry
5. Vessel's draft, length overall, beam, and air draft
6. Vessel's propulsion and steering systems

7. Vessel's speed and maneuvering characteristics
8. Vessel's current position, course, and speed
9. Vessel's intended route and destination
10. Navigational equipment and aids available on board
11. Communication equipment and procedures
12. Emergency procedures and contingency plans
13. Any restrictions or limitations on the vessel's maneuverability
14. Any local regulations or requirements for navigation, pilotage, or reporting
15. Any other relevant information that may affect the safe navigation of the vessel.

The exchange of information is critical to ensure effective communication and coordination between the Master and the Pilot during the pilotage operation. This helps to ensure that the vessel is safely maneuvered through the waterway and any potential risks or hazards are identified and addressed in a timely manner.

**Q) Explain your action as a watch keeping officer under following cases: Unmarked navigational mark sighted.** *(Jan-23)*

Ans:- As a watch keeping officer, my actions upon sighting an unmarked navigational mark would include:

- Taking note of the location of the unmarked navigational mark.
- Determining the closest charted navigational mark and estimating the position of the unmarked navigational mark.
- Assessing the potential impact of the unmarked navigational mark on the vessel's safe passage, such as the risk of grounding, collision or other hazards.
- Reducing the vessel's speed to a safe speed, and monitoring the situation closely.
- Alerting the bridge team and calling the Master to the bridge to inform them of the situation.
- Broadcasting a navigational warning to other vessels in the area.
- Taking appropriate action to avoid the unmarked navigational mark, such as altering course, if necessary.
- Reporting the sighting to the relevant authorities, such as the Coast Guard or other maritime authorities.
- Documenting the incident in the vessel's navigational logbook.

It is essential to take prompt action upon sighting an unmarked navigational mark to prevent any potential hazards to the vessel and crew

**Q) Explain the following terminology and expression used in anchor work: Anchor coming home** *(July-17)*

Ans:- Anchor Coming Home: When the anchor is being drawn Towards the ship in the operation of heaving away, by Means of the windlass or the cable holder/capstan, the Anchor is said to be coming home. Instead of the ship being drawn towards the anchor, the reverse is happening.

**Q) Explain the following terminology and expression used in anchor work: Foul Hawse** *(July-17)*

Ans:- Foul Hawse: this term is used to describe the crossing of the anchor cables,

when both cables are being used at the same time, as with a running standing or open moor, owing to the uncontrolled swinging of the vessel when Anchored with both anchors (moored).

**Q) Explain the following terminology and expression used in anchor work: To grow** *(July-17)*
Ans:- Grow:- The cable is said to grow when the exposed part of the chain above the surface, is seen to expand towards the Anchor.

**Q) Explain the following terminology and expression used in anchor work: Shortening-in-cable** *(July-17)*
Ans:- Shorten Cable: To heave in, a portion of the cable so as to reduce the scope.

**Q) Explain the following terminology and expression used in anchor work: To veer cable** *(July-17)*
Ans:- Veer Cable: To pay out cable under power, by walking back the gypsy of the windlass.

**Q) Explain Term "Responsibility" as per Rule 2 of Rule of the Road (RoR).** *(Oct-21)*
Ans:- According to Rule 2 of the International Regulations for Preventing Collisions at Sea (COLREGS), "Responsibility" means that a vessel is responsible for taking all necessary action to avoid collision, and should not rely solely on compliance with the rules. The term implies that a vessel has a duty to act in a proactive manner to avoid a collision, rather than simply following the rules and assuming that the other vessel will do the same.

Under Rule 2, the following factors are taken into account when determining a vessel's responsibility for avoiding a collision:
- The risk of collision
- The ability of the vessels to take avoiding action
- The presence of any special circumstances that may affect the safe navigation of the vessels, such as restricted visibility, traffic density, or vessel traffic services
- The limitations of the vessels, including their size, draft, and maneuverability.

## BRIDGE RESOURCE MANAGEMENT

**Q) What is Bridge Resource Management?** *(July-21)*
Bridge Resource Management (BRM) is a management system that aims to improve the safety and efficiency of navigation on a vessel's bridge. BRM is human factors approach that considers the capabilities, limitations, and behaviours of individuals and teams on the bridge, and seeks to optimize their performance through effective communication, coordination, and decision-making.

The objectives of BRM include:

- Enhancing situational awareness: BRM aims to improve the situational awareness of the bridge team, including the officer on watch, lookout, helmsman, and any other personnel on the bridge.
- Encouraging effective communication: BRM encourages effective communication between bridge team members, as well as with other personnel on board the vessel and with external parties such as other vessels, pilots, and shore-based authorities.
- Promoting effective decision-making: BRM promotes effective decision-making on the bridge, based on accurate and timely information, sound judgment, and consideration of potential consequences.
- Encouraging effective teamwork: BRM encourages effective teamwork among the bridge team, including clear roles and responsibilities, mutual support, and effective coordination.
- Supporting a safety culture: BRM supports a safety culture on board the vessel, where safety is a priority and all personnel are committed to safe and efficient operations.

**Q) What you mean by situational awareness.** *(Nov-21, Sept-18, July-18, July-16)*

**Explain situational Awareness and the conditions that affect Situational awareness of an OOW.** *(Aug-21, Jan-19, Aug-16)*

Ans:- **Situational awareness**

- Present state of weather, wind, sea state, swell and visibility and the meteorological forecast.
- Present draft and depth of water, proximity of hazards and effect of squat.
- State of tide and current and effect of the same.
- Communications with VTS and any safety related communication with all the stations.
- All the displays on bridge – tachometer, rudder angle indicator, ROTI, UKC, anemometer, inclinometer etc, also displays for course steered and course made good, speed through water and speed over ground.
- Awareness of own ship's configuration, maneuvering characteristics (turning circle, stopping distance etc).
- Awareness of the equipment and systems and the limitations. These include bridge equipment, communication equipment, propulsion and steering.
- Adjustment of various setting for example radar, auto pilot etc.

Many factors can cause you to lose situational awareness, data not observed, either because it is difficult to observe or your scanning of the environment is deficient due to:

- Passive, complacent behavior.
- Lack of training, lack of familiarization, lack of experience, lack of competency.
- Lack of interest, lack of motivation, fear, lack of communication skill.
- Over reliance on a person, system or equipment.
- Inability to understand change in traffic/ weather conditions.
- High work load, stress and fatigue.
- Ambiguity, confusion, distraction and interruptions etc.

**Q) Explain the principle of Bridge Resource Management (BRM).** *(July-21, March-20, Jan-20, May-16, March-16)*

Ans:- Principles of Good Management practices are:-

- Shared view of goals.
- Delegation of responsibilities
- Effective organization and sense of team owner ship in achieving goals.
- Bridge Resource Management (BRM), or as it is called Bridge Team Management (BTM), is the effective management and utilization of all resources, human and technical, available to the Bridge Team to ensure the safe completion of the vessel's voyage.
- BRM focuses on bridge officer's skills such as teamwork, team building, communication, leadership, decision making and resource management and incorporate this into the larger picture of organizational and regulatory management.
- BRM addresses the management of operational tasks, as well as stress, attitudes and risk. BRM recognizes there are many elements of job effectiveness and safety, such as individual, organizational and regulatory factors and they must be anticipated and planned for.
- BRM enables the bridge team to mark the abort points and various contingencies (anchorage and berth).
- BRM begins before the voyage with the passage plan and continues through the end of the voyage with the passage debrief, debriefing or evaluation helps in improvement.

**Q) Explain the importance of Bridge Resource Management on board & factors that affect the effective use of BRM. Illustrate with onboard situation.** *(May-17)* **OR**
**"Bridge resource management is essential in keeping a safe and efficient watch today." How would you interpret the above statement? Describe your role in the bridge team as an officer in-charge of the navigation watch.** *(Nov-17)*

Ans:- Benefits of BRM when correctly practiced on my vessel:-

- When BRM is practiced correctly onboard the result should be a Bridge Team that.
- Maintain its situational awareness hence avoids accidents.
- Continually monitors the progress of the vessel making appropriate adjustments and corrections as necessary to maintain a safe passage.
- Acquires relevant information early.
- Appropriately delegates workload and authority.
- Anticipates dangerous situations.
- Avoid becoming pre-occupied with minor technical problems and losing sight of the big picture.
- Decides on met warnings/ navigational warnings applicable to own vessel.
- Undertakes appropriate contingency plans when called for.
- Can be beneficial to make the short term strategy if required.
- Recognizes the development of an error chain; and
- Takes appropriate action to break the error-chain sequence.
- Debriefing can help in improvement of future passage plan and possible suggestion to improve SMS checklists / procedures.

BRM tends to develop confidence in each individual, as it focuses on the human factor so hence enables to fulfill the various requirements of charter party without

compromising with ship's safety.

**Q) How will you effectively use the various resources such as Navigational Equipment on the bridge and available man power for safe keeping a safe navigational watch at sea based on the principle of Bridge Resource Management?** *(July-16)*

**Q) List out the various publications and manuals you would require for safe navigation.** *(Nov-20)*

Ans:- Effectively use of Various resources with respect to Navigational Equipment: A mariner has many resources available to him for safe passage planning and execution and monitoring. Some examples include:

- Electronic equipment (i.e. radar, echo sounder, GPS / DGPS, ARPA, gyro compass, AIS etc).
- Charts and nautical publications, including electronic publications.
- Environmental factors (i.e. visibility, tide, wind, sea, swell & currents).
- Electronic Charting and Display information Systems (ECDIS).
- Vessel Traffic Services (VTS) and usage of IMO ship's routeing.
- All the displays on bridge tachometer, rudder angle indicator, ROTI, UKC, anemometer, inclinometer etc, also displays for course steered and course made good, speed through water and speed over ground.
- Internal and external communication equipment.
- Met warnings and navigational warning through ECG, Navtex etc.
- Bridge Personnel (i.e. Master, Officer on Watch (OOW), helmsman, lookout etc.)
- Persons with local knowledge (i.e. Pilot).

Implementing Bridge Resource Management on my vessel:- The Master can implement BRM by considering and addressing the following:

- Passage Planning:- covering ocean, coastal and pilotage waters. Particular attention is paid to high traffic areas, shallow waters, or pilotage waters where the plan incorporates appropriate margins of safety and contingency plans for unexpected (abort points and contingency anchorages).
- Passage Plan Briefing:- all bridge team members are briefed on the passage plan and understand the intended route and procedures to transit the route.
- Bridge Manning:- Master uses passage plan to anticipate areas of high workload and risk and sets manning levels appropriately.
- Bridge Team Training (ashore and on-the-job) – is given all bridge members and they are sure of their roles and responsibilities, both for their routine duties and their duties in the event of an incident / emergency.
- Master's Standing Orders- are read and signed before the commencement on the voyage. Orders are clear on the chain of command, how decision and instructions are given on the bridge and responded to, and how bridge team members bring safety concerns to the notice of the Master. Master's standing orders must not in conflict with company's standing orders/ procedures.
- Master / Pilot Exchange – the passage plan is discussed by the Master and the pilot and changes made as necessary. Any new information is communicated to the rest of the bridge team. When the pilot is onboard he/she should be supported as a temporary bridge team member, relevant checklists to be complied with, pilot advice can be challenged as and when required.
- End of Voyage Debriefing - provides the opportunity for the bridge team to review the passage plan's strengths and weaknesses, make suggestions for improved safety or communications, and improve team problem solving skills.

**Q) Explain the factors to be taken into account when determining bridge manning levels.** *(March-18, Nov-16)*

Ans:- Determination of minimum safe manning levels (SOLAS CHAPTER V – Annex 2):-

- The purpose of determining the minimum safe manning level of a ship is to ensure that its complement includes the grades/capacities and number of persons required for the safe operation of the ship and the protection of the marine environment.

- The minimum safe manning level of a ship should be established taking into account all relevant factors, including the following:
  - size and type of ship;
  - number, size and type of main propulsion units and auxiliaries;
  - construction and equipment of the ship;
  - method of maintenance used;
  - cargo to be carried;
  - frequency of port calls, length and nature of voyages to be undertaken;
  - trading area(s), waters and operations in which the ship is involved;
  - extent to which training activities are conducted on board; and
  - applicable work hour limits and/or rest requirements.

- The determination of the minimum safe manning level of a ship should be based on performance of the functions at the appropriate level(s) of responsibility, as specified in the STCW Code, which include the following:
  - navigation, comprising the tasks, duties and responsibilities required to:
  - plan and conduct safe navigation;
  - maintain a safe navigational watch in accordance with the requirements of the STCW Code;
  - manoeuvre and handle the ship in all conditions; and
  - moor and unmoor the ship safely;

- cargo handling and stowage, comprising the tasks, duties and responsibilities required to:
  - plan, monitor and ensure safe loading, stowage, securing, care during the voyage and unloading of cargo to be carried on the ship;

- operation of the ship and care for persons on board, comprising the tasks, duties and responsibilities required to:
  - maintain the safety and security of all persons on board and keep life-saving, fire-fighting and other safety systems in operational condition;
  - operate and maintain all watertight closing arrangements.
  - perform operations, as appropriate, to muster and disembark all persons on board;
  - perform operations, as appropriate, to ensure protection of the marine environment;
  - provide for medical care on board the ship; and
  - undertake administrative tasks required for the safe operation of the ship;

- In determining the minimum safe manning level of a ship, consideration should also be given to:

- the number of qualified and other personnel required to meet peak workload situations and conditions, with due regard to the number of hours of shipboard duties and rest periods assigned to seafarers; and
- the capability of the master and the ship's complement to co-ordinate the activities necessary for the safe operation of the ship and the protection of the marine environment.

**Q) Define 'Emergency'. How does SOLAS ensure that ship's crew can deal with various emergencies that may arise? Describe how this achieved on your last ship?** *(Sept-18)*

Ans:- Emergency:- A serious, unexpected, and often dangerous situation requiring immediate action.

To ensure that Ship's crew can deal with various emergencies, Emergency Training & Drills are given as per **SOLAS** Regulation 19

**Regulation 19 Emergency training and drills**

1) This regulation applies to all ships.
2) Familiarity with safety installations and practice musters:
    a. Every crew member with assigned emergency duties shall be familiar with these duties before the voyage begins.
    b. On a ship engaged on a voyage where passengers are scheduled to be on board for more than 24 h, musters of the passengers shall take place within 24 h after their embarkation. Passengers shall be instructed in the use of the lifejackets and the action to take in an emergency.
3) Drills:
    a. Drills shall, as far as practicable, be conducted as if there were an actual emergency.
    b. Every crew member shall participate in at least one abandon ship drill and one fire drill every month. The drills of the crew shall take place within 24h of the ship leaving a port if more than 25% of the crew have not participated in abandon ship and fire drills on board that particular ship in the previous month. When a ship enters service for the first time, after modification of a major character or when a new crew is engaged, these drills shall be held before sailing.
    c. Abandon ship drill
    d. Each abandon ship drill shall include:
        i. summoning of passengers and crew to muster stations with the alarm required by regulation 6.4.2 followed by drill announcement on the public address or other communication system and ensuring that they are made aware of the order to abandon ship;
        ii. reporting to stations and preparing for the duties described in the muster list;
        iii. checking that passengers and crew are suitably dressed;
        iv. checking that lifejackets are correctly donned;
        v. lowering of at least one lifeboat after any necessary preparation for launching;
        vi. starting and operating the lifeboat engine;
        vii. operation of davits used for launching liferafts;
        viii. a mock search and rescue of passengers trapped in their staterooms; and
        ix. instruction in the use of radio life-saving appliances.
    e. Different lifeboats shall, as far as practicable, be lowered in compliance with

the requirements of paragraph 3.3.1.5 at successive drills.

f. Except as provided in paragraphs 3.3.4 and 3.3.5, each lifeboat shall be launched, and manoeuvred in the water by its assigned operating crew, at least once every three months during an abandon ship drill.
g. In the case of a lifeboat arranged for free-fall launching, at least once every three months during an abandon ship drill the crew shall board the lifeboat, properly secure themselves in their seats and commence launch procedures up to but not including the actual release of the lifeboat (i.e., the release hook shall not be released). The lifeboat shall then either be free-fall launched with only the required operating crew on board, or lowered into the water by means of the secondary means of launching with or without the operating crew on board. In both cases the lifeboat shall thereafter be manoeuvred in the water by the operating crew. At intervals of not more than six months, the lifeboat shall either be launched by free-fall with only the operating crew on board, or simulated launching shall be carried out in accordance with the guidelines developed by the Organization.
h. As far as is reasonable and practicable, rescue boats other than lifeboats which are also rescue boats, shall be launched each month with their assigned crew aboard and manoeuvred in the water. In all cases this requirement shall be complied with at least once every three months
i. Emergency lighting for mustering and abandonment shall be tested at each abandon ship drill.

4) Fire Drills:

a. Fire drills should be planned in such a way that due consideration is given to regular practice in the various emergencies that may occur depending on the type of ships and the cargo.
b. Each fire drill shall include:
    i. reporting to stations and preparing for the duties described in the muster list required by regulation 8;
    ii. starting of a fire pump, using at least the two required jets of water to show that the system is in proper working order;
    iii. checking of fireman's outfit and other personal rescue equipment;
    iv. checking of relevant communication equipment;
    v. checking the operation of watertight doors, fire doors, fire dampers and main inlets and outlets of ventilation systems in the drill area; and
    vi. checking the necessary arrangements for subsequent abandoning of the ship.

**Q) With the respect to bridge resource management principles explain the following: Leadership** *(April-21, July-18)*

Ans:- *(Prepare your answer based on the Marks)*

Leadership: Becoming an effective leader is not easy, it requires Part Skill Development and Part Experience. Leadership is Action and not Position.

Leadership Principles: A principle is a "Tested form of Action", proven useful in the skill of leadership in isolation, principles are ineffective – must be applied based on the situation.

The Leadership Principles need to have these qualities:

1. Show interest
2. Positive approach
3. Complaints

4. Promises
5. Get the facts
6. Discussion basis
7. Design an approach
8. Explain why
9. Admit mistakes
10. Reasonable expectations
11. Be prompt
12. Compliment
13. Prepare for change

1. Show Interest: Develop a Relationship
   - Frequent personal contact – Listen to others.
   - Keep an open and honest attitude.
   - Take time to learn & understand other people's needs.
   - Sell ideas based on merit, value to others.
   - Never force a personal agenda
   - Offer suggestions to help others solve their OWN problems.
2. Positive approach:
   - Consider other person's feelings & objectives in planning what you do/say.
   - Plan before you speak.
   - Give "benefit of the doubt"
   - Avoid jumping to conclusions
   - Consider other's point of view and emotional state
   - Keep negative emotion out of discussion.
3. Complaints / Suggestions: View complaints not as personal criticism, but as valuable feedback and suggestions.
   - Address complaints quickly, listen to whole story.
   - Remain composed, calm – avoid interruptions.
   - Show problem is understood by restating it, ask questions to clarify misunderstandings.
   - Show appreciation, and indicate what will be done.
   - Follow Up with action.
4. Promises: Make few promises, and keep them.
   - Credibility lost when leadership fails to keep promises.
   - Ensure commitment is realistic and attainable.
   - Keep stakeholders informed of progress.
   - If situations change, and promise cannot be kept:
     - ✓ Immediately contact those affected, avoid rumours
     - ✓ Explain carefully and thoroughly the reasons.
     - ✓ Allow free feedback, consider others.
     - ✓ Follow up with mutually agreed corrective actions.
5. The Facts: Examine all facets of a situation
   - Evaluate evidence
   - Allow everyone involved to express viewpoint
   - Consider other's rights, what's fair.
   - Ignore unsubstantiated information.
   - Base decisions on logical thinking, not emotions.
6. Discussion basis: Keep it a business-like discussion
   - Stick to the subject
   - Listen respectfully
   - Avoid getting hung up on personalities
   - Grant that other person "may have something"

- Do not loose temper
- Plan the time and place for the discussion

7. Design an Approach: Approach appeals to other's motivations and emotions.
   - Be pleasant, remain calm.
   - Use questions, and listen to responses.
   - Observe body language, clues to other's feelings.
   - Give direct answers.
   - Speak in a manner the other participants understand / relate to
8. Explain Why: Reasons why/why not
   - Be truthful.
   - Show willingness to answer questions
   - Let others "in on the know"
   - Present the complete story.
   - MAY HAVE TO MODIFY FOR SHIP USE

**Q) With the respect to bridge resource management principles explain the following: Effective communication** *(Oct-21, Jan-20, July-18)*

Ans:- Effective Communication: Communication is at the heart of any relationship, be it familial, business, romantic, or friendly.

- Communication is not a one-way street.
- To have others open up to you, you must open up yourself first.
- By overcoming these barriers to communication, you can ensure that the statement you are making is not just heard, but also understood, by the person you are speaking with.
- In this way, you can be confident that your point has been expressed and understood.

**Types of Communication**:

Verbal Communication:

- Verbal communication continues to be the most important aspect of our interaction with other people.
- It's important to understand both the benefits and shortcomings of this most basic communication.

Non-verbal Communication:

- It is any kind of communication not involving words.
- When the term is used, most people think of facial expressions and gestures, but while these are important elements of non-verbal communication, they are not the only ones.
- Non-verbal communication can include vocal sounds that are not words such as grunts, sighs and whimpers.
- Even when actual words are being used, there are non-verbal sound elements such as voice tone, pacing of speed and so forth.

Effective Verbal Communication:

- It has more to do with listening than it does with speaking because you are always dealing with an audience.
- This is true no matter whether you are speaking to a crowd of thousands or to a party of one.
- Listening is key because when you address an audience, no matter the size, you have to meet its needs to communicate effectively, and to know the needs of your

audience, you have to listen.

Formal Communication:
- It can be considered as communication efforts that are "dressed up" to fit customary rules and ceremony e.g. in a written letter, the formal communication style will demand that the layout of the piece of written communication follow a specific format that includes the date, header, salutation, body of the letter, close, signature lines and any indicators of enclosures all placed neatly upon company letterhead or personal stationery.
- By contrast, an informal piece of written communication can be as simple as a jotted note to a friend on a torn slip of paper.

Informal Communication:
- If formal communication is viewed like dressing for a black tie affair, informal communication is like dressing casually and wearing slippers around the house.
- Much informal communication occurs on a person to person basis, in a face-to-face manner, without ceremony or fanfare.
- Other ways to communicate in an informal manner may include texting, post-it notes, an informal drop in visit to another person, or a quick and spontaneous meeting.

Communication through Body Language:
- Communication is how human beings interact with the world that surrounds them.
- There are many forms of communication, some being more effective at conveying the intent or feelings of the individual expressing than others.
- Many people have a hard time with communication, and can find it difficult to tell others what they think or to give them bad news.
- Sometimes, they can't find the right words to express the things they want to say.
- There are also those people who are not to be believed due to a history of dishonesty or embellishing the truth.
- One form of communication, however, is always honest and can always be counted on.

**Q) What is Bridge Team Management?** *(Jan-20)*

Ans:- Bridge Team Management:

Bridge Team Management is a structured approach towards the safe and efficient management of a ship's bridge team. It involves effective communication, planning, and coordination between all members of the bridge team to ensure the safe navigation of the vessel. The following are the key points of Bridge Team Management:

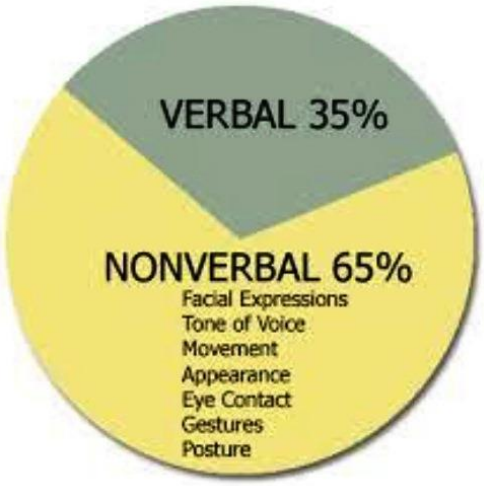
1. Effective communication: Bridge team management involves clear and concise communication between all members of the bridge team. This includes verbal and written communication, as well as the use of technology such as VHF radios, ECDIS, and AIS.
2. Leadership: The bridge team leader, usually the OOW, must provide effective leadership to the team. This involves setting clear objectives, establishing roles and responsibilities, and ensuring that everyone is working towards a common goal.
3. Situational awareness: All members of the bridge team must maintain a high level of situational awareness. This involves monitoring the vessel's position, speed, heading, and other relevant information, as well as keeping an eye on weather

conditions, traffic, and other potential hazards.
4. Risk assessment: The bridge team must conduct a thorough risk assessment, taking into account all relevant factors such as weather, traffic, and the vessel's capabilities. This involves identifying potential hazards and developing plans to mitigate them.
5. Planning: The bridge team must develop a clear plan for the safe navigation of the vessel. This includes identifying potential hazards, establishing safe operating procedures, and ensuring that everyone is aware of the plan.
6. Decision making: The bridge team must be able to make effective decisions based on the available information. This involves considering all relevant factors, evaluating the risks, and selecting the best course of action.
7. Continuous improvement: The bridge team must be committed to continuous improvement. This involves reviewing and evaluating procedures and practices, identifying areas for improvement, and implementing changes as necessary.

Overall, Bridge Team Management is a proactive approach to safe navigation that emphasizes effective communication, leadership, situational awareness, risk assessment, planning, decision making, and continuous improvement. It helps to ensure that all members of the bridge team are working together towards a common goal of safe and efficient navigation.

**Q) Importance of communication in Bridge Team Management.** *(Nov-18)* **OR**
**Q) Explain Communication & state why Communication is important when you are sailing with crew from different Nationalities?** *(Sept-18)*
**Q) Briefly describe Verbal and Non-Verbal communication?** *(Aprl-21)*
Ans:-

IMPORTANCE OF COMMUNICATION




Verbal Communication:
- Is either spoken or written
- Helps to build relationships
- Helps in task completion
- On its own can hinder effective communications
- The "how" it is said may be more important than "what" is said
- Written communications must be clear, precise and informative

Non – Verbal Communication:
Complements verbal communication by:

- Repeating what is being said
- Reinforces verbal communications
- Enables emphasis to be placed on certain words
- Contradicts the verbal message
- Substitutes for verbal behaviour

Debriefs – An Aid to Effective Communication:
Debriefs should be held as they:
- Enable learning
- Prevent repetition of errors
- Enable improvement
- Reinforce correct behaviour with positive feedback
- Emphasis positives

Dis-advantages of Ineffective Communication:
- Miscommunication
- Poor team performance
- Increase in the risk of an incident
- Threatens the safety of the vessel

Guidelines for Effective Bridge Communication:
- Give Respect
- Generate good body language
- Speak slowly and clearly
- Listen actively
- Simplicity
- Use pictures and diagrams
- Use standardised words and phrases (IMO SMCP)
- Never assume
- Be happy (smile)

**Q) Describe closed loop and open loop communications giving relevant examples.** *(Aug-21)* **OR**
**Q) What is meant by closed loop communication? How is it advantageous over open loop communication? Give two examples of each type of communication.** *(July-21)*
Ans:- Closed-loop communication in a maritime context refers to a communication process in which the sender confirms that the message has been received and understood by the receiver, and the receiver acknowledges the message, provides feedback, and confirms that the message has been correctly interpreted.

Two examples of closed-loop communication in a maritime context are:
1. The communication between a vessel's bridge team and a pilot during a port approach: The pilot gives an instruction to the bridge team, the team repeats the instruction back to the pilot for confirmation, and the pilot confirms that the message has been correctly interpreted.
2. The communication between a vessel's master and an engine room crew member during an emergency: The master gives an instruction to the crew member, the crew member repeats the instruction back to the master for confirmation, and the master confirms that the message has been correctly interpreted.

Open loop communication is a form of one-way communication in which the sender of the message does not receive any feedback or response from the receiver. In this type of communication, the sender simply sends the message and assumes that it has been received and understood by the receiver. Open loop communication is commonly used in situations where the message is simple, routine, and requires no feedback or response from the receiver. However, open loop communication can be ineffective in situations where there is a need for feedback or clarification, as there is no way for the sender to know whether the message has been received and understood as intended.

Closed-loop communication in a maritime context is advantageous over open-loop communication because it reduces the risk of misunderstandings, enhances situational awareness, and improves overall communication effectiveness.

Two examples of open-loop communication in a maritime context are:
1. A weather forecast broadcast over the radio to all vessels in the area: The message is provided to all vessels without requiring confirmation or feedback from any individual vessel.
2. A navigational warning issued by a coast guard or other maritime authority: The message is provided to all vessels without requiring confirmation or feedback from any individual vessel.

While open-loop communication can be useful in some maritime situations, closed-loop communication is more effective in reducing the risk of misunderstandings and improving communication accuracy and situational awareness, particularly in safety-critical situations.

**Q) Discuss the importance of 'Feedback' for effective communication on bridge.** *(Jan-19)*
Ans:- Feedback in the Communication Process:
Effective feedback is critical as it:
- Ensures that the sender and receiver are "on the same page".
- Closes the communication loop.
- Prevents the receiver misunderstanding the original intent of the message.

**Q) Explain Assertiveness with on board examples.** *(July-18, Nov-18)*
Ans:- Assertiveness is the ability to communicate what you feel is correct in an open and honest manner possibly without hurting the feelings of others.

Passive behaviour: Failing to state your needs, wants, opinions, feelings or beliefs in direct honest and appropriate ways, stating them in a way that others can easily disregard them.

Aggressive behaviour: Ignoring or dismissing the needs, wants, opinions, feelings, or beliefs of others. Expressing your own needs or wants in inappropriate ways.

Importance of Assertiveness:
- Effective communication brings about the achievement of individual and/ or shared

goals.
- Assertiveness increases your ability to reach these goals while maintaining your rights and dignity.

Guidelines for being assertive:
- Decide what you want
- Say it clearly and specifically
- Support what you say by how you say it.
- Don't be manipulated or sidetracked.
- Listen
- Aim for a working compromise or "win win" situation

Applicability on ship board work:
- Reprimanding or criticizing a member of staff
- Delegating an unpleasant task
- During appraisals
- Resolving conflicts
- Making sure the things on ship as per valid company requirement and regulations
- Maintaining discipline
- Economical control

**Q) What do you understand by Assertive Leadership?** *(Jan-22, Oct-21)*
Ans:- Assertive leadership is a leadership style in which a person confidently and proactively communicates their opinions, ideas, and decisions in a clear and concise manner. In the context of bridge procedures, assertive leadership can help to ensure effective communication and decision-making during critical situations. Some key aspects of assertive leadership on the bridge include:
- Clear communication: The assertive leader communicates their decisions and expectations clearly to the rest of the bridge team. They ensure that everyone understands their role and responsibilities during the current situation.
- Proactive decision-making: The assertive leader makes decisions quickly and confidently, based on the information available. They take a proactive approach to navigating the ship and avoiding potential hazards.
- Confidence: The assertive leader exudes confidence and competence, which can help to reassure the rest of the team and maintain calm during stressful situations.
- Active listening: While assertive leaders are confident in their own decisions, they also actively listen to input and feedback from other members of the team. This helps to ensure that everyone's expertise is taken into account and the best possible decisions are made.
- Adaptability: The assertive leader is able to adapt their leadership style to the specific situation at hand. They may need to take a more authoritarian approach during an emergency, for example, but can switch to a more collaborative style during routine operations.

**Q) Briefly explain the following, with reference to the Principles of Bridge Resource Management: Allocation, Assignment and prioritization of resources.**
*(Jan-23)*
Ans:- In the context of Bridge Resource Management (BRM), the principles of

allocation, assignment, and prioritization of resources refer to the effective and efficient use of available resources to manage the vessel's operations and enhance safety.

- Allocation of resources involves identifying the required resources for the safe and efficient operation of the vessel and ensuring that they are available when needed. This includes ensuring that the necessary equipment, personnel, and information are available and ready to use. For example, navigational equipment and charts should be checked and ready for use, and the crew members assigned to their respective duties.
- Assignment of resources involves delegating responsibilities and tasks to the appropriate crew members based on their skills, knowledge, and experience. This ensures that the crew is fully utilized, and the workload is distributed evenly. For example, the officer of the watch may delegate tasks to the helmsman or lookout, based on their abilities and experience.
- Prioritization of resources involves identifying and addressing critical issues that require immediate attention. This ensures that the most significant threats to safety are addressed first. For example, if a navigational hazard is detected, the officer of the watch should prioritize the safe navigation of the vessel, including taking the necessary action to avoid the hazard.

Overall, effective allocation, assignment, and prioritization of resources in BRM require clear communication, coordination, and teamwork among the crew members. By doing so, it enhances the safety of the vessel and the crew, and optimizes the use of available resources.

**Q) What are the effects of fatigue?** *(April-21)*

Ans:- Effects of Fatigue:-

1. Fatigue is a state of feeling tired, weary or sleepy due to prolonged mental or physical work, extended durations of anxiety, exposure to harsh environments or loss of sleep.
2. The result of Fatigue is impaired performance and diminished alertness.
3. The effects of Fatigue can be dangerous, the specialized nature of the maritime industry requires constant alertness and intense concentration from its workforce.
4. Fatigue is dangerous because it affects everyone regardless of skill, knowledge or training, and is linked to human body capabilities and frailties.
5. Fatigue is the extreme tiredness resulting from mental or physical exertion or illness. As a result, reduction in efficiency of a person will occur.
6. Reason for fatigue on board the ship is a combination of minimum manning, sequence of rapid turnaround, short sea passages and adverse Wx and traffic conditions, finds seafarers working long hours with insufficient opportunities for recuperative rest.
7. In these circumstances, Fatigue and reduced performances can lead to ill health and reduced life span among highly skilled seafarers who are in short supply.
8. The issue of adequate crewing and the effects of Fatigue upon health and safety are clearly and closely related.
9. In order to avoid accident / environmental damage, a more robust approach to the regulation and manning to be done. Manning level is needed to be addressed in a realistic way that prevents economic advantage accruing to those who operate with minimum crew. Another approach is the enforcement of existing legislation, elimination of false record-keeping, better training and guidance.

# IAMSAR

**Q) Write the contents of IAMSAR Volume III.** *(Nov-21, Oct-21, May-16)*
Ans:- Contents of IAMSAR VOL 3:-
Foreword
Abbreviations and acronyms
Glossary
Section 1 Overview
Section 2 Rendering assistance
Section 3 On-scene co-ordination
Section 4 On-board emergencies

Appendix A Regulation V/33 of the International Convention for the Safety of Life at Sea, 1974, as amended
Appendix B Search action message
Appendix C Factors affecting observer effectiveness
Appendix D Standard format for search and rescue situation report (SITREP)
Appendix E SAR briefing and debriefing form
Appendix F Own emergency
Appendix G Rendering assistance

**Q) Describe contents of Situation Report as per IAMSAR.** *(Aug-21)*
Ans:- A situation report (SITREP) is a critical communication tool used during search and rescue operations. The International Aeronautical and Maritime Search and Rescue (IAMSAR) guidelines outline the contents of a situation report, which typically includes the following information:

1. Identification of the reporting unit: This includes the name, call sign, and position of the vessel or aircraft providing the situation report.
2. Time and date of the report: The time and date of the report is essential to keep track of the timeline of the search and rescue operation.
3. Location and description of the search area: This includes the geographic location of the search area, the search pattern being used, and any significant landmarks or navigational aids in the area.
4. Weather and sea conditions: Information about the current weather conditions, including wind speed and direction, sea state, and visibility, is essential for planning search and rescue operations.
5. Search and rescue assets deployed: This includes a list of all search and rescue assets involved in the operation, including vessels, aircraft, and personnel.
6. Progress and results of the search: This includes details about any sightings or other developments in the search and rescue operation, as well as any progress made in locating the missing person or persons.
7. Plans for the next phase of the operation: This includes details about the next steps in the search and rescue operation, including any changes in search pattern or assets being deployed.
8. Other relevant information: This may include any other information that may be relevant to the search and rescue operation, such as information about the person or persons in distress, or any other hazards or obstacles that may affect the operation.

**Q) Purpose of IAMSAR.** *(Sept-21, Sept-19, July-19)*

Ans:- Purpose of IAMSAR:- The Purpose of IAMSAR Manual is to provide guidance to those who:

- Operate aircraft, vessels or other craft, and who may be called upon to use the facility to support search and rescue (SAR) operations.
- May need to perform on-scene co-ordinator functions for multiple facilities in the vicinity of a distress situation.
- Experience actual or potential emergencies, and may request SAR assistance.

To fulfill the above functions, the manual has been divided into three volumes as follows:

- Volume I – Organisation and Management (for administrations)
- Volume II – Mission Co-ordination (for Rescue Co-ordination Centre {RCC} personnel)
- Volume III – Mobile Facilities (for ships, aircraft, and coastal radio station (CRS) personnel.

Duties & Responsibilities of the On-Scene Co-ordinator (OSC):-

- Co-ordinating operations of all SAR facilities on-scene.
- Receiving the search action plan or rescue plan from the SMC (SAR Mission Co-ordinator) or planning the search or rescue operation, if no plan is otherwise available.
- Modifying the search action or rescue action plan as the situation on-scene dictates, keeping the SMC advised.
- Co-ordinating on-scene communications.
- Monitoring the performance of other participating facilities.
- Ensuring operations are conducted safely, paying particular attention to maintaining safe separations among all facilities both surface and air.
- Making periodic situation reports (SITREP's) to the SMC. The reports should include but not be limited to:
    - Weather and sea conditions.
    - The results of search to date.
    - Any actions taken
    - Any future plans or recommendations
- Maintaining a detailed record of the operation:
    - On-scene arrival and departure times of SAR facilities, other vessels and aircraft engaged in the operation.
    - Areas searched
    - Track spacing used
    - Sightings and leads reported
    - Actions taken
    - Results obtained
- Advising the SMC to release the facilities no longer required.
- Reporting the number and names of survivors to the SMC.
- Providing the SMC with the names and designations of facilities with survivors on board.
- Reporting which survivors are in each facility.
- Requesting additional SMC assistance, when necessary (e.g. medical evacuation).

**The Williamson Turn**

1) Note the position of the ship
2) Put wheel hard over to the side of the casualty
3) After the ship has altered course by about 60 degrees, put wheel hard over to the other side
4) When the vessel is 20 degrees short of the reciprocal course, wheel on midship

**The Scharnow Turn**

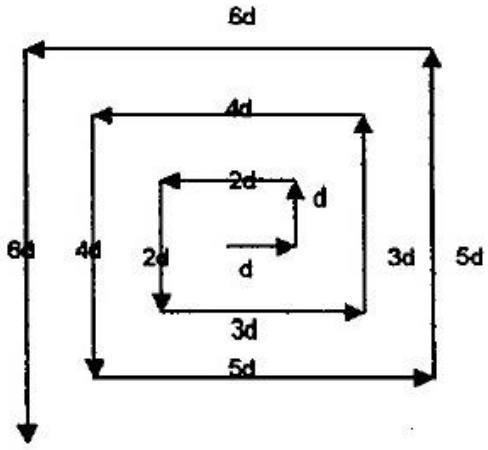
1) Put the rudder over hard toward the person
2) After deviating from the original course by about 240 degrees, shift the rudder hard to the opposite side.
3) When heading about 20 degrees short of the reciprocal course, put the rudder amidships so that vessel turns onto the reciprocal course.

**The Anderson Turn**

1) Stop the engines.
2) Put the rudder over toward the person
3) When clear of the person, go all ahead full, still using full rudder.
4) After deviating from the original course by about 240 degrees (about 2/3 of a complete circle), back the engines 2/3 or full.
5) Stop the engines when the target point is 15 degrees off the bow. Ease the rudder and back the engines as required.

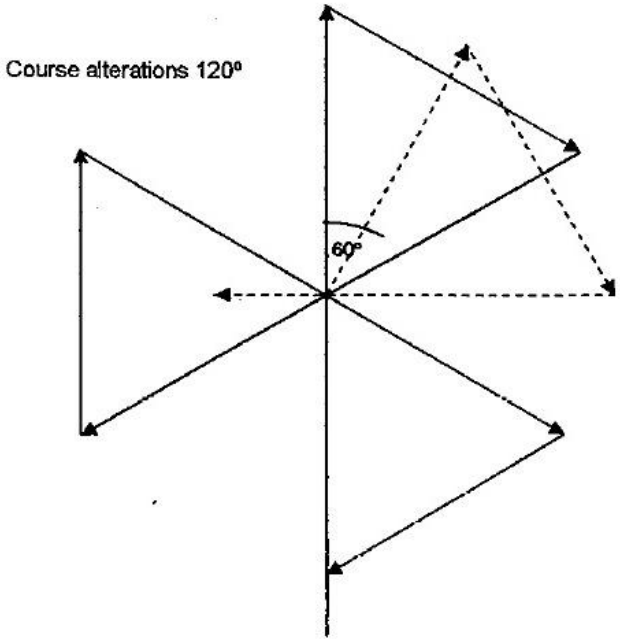
**Q) With suitable sketches, explain the 'Trackline' search patterns of IAMSAR.** *(Aug-16)* **OR**
**Q) With suitable sketches, explain the 'Sector' search patterns of IAMSAR.** *(Oct-21, Nov-17, Aug-16, May-16)* **OR**
**Q) What are the various search patterns recommended in the IAMSAR? Explain with sketches.** *(April-21, Sept-19, March-19, May-18, Jan-18, Sept-17, March-17, July-17, July-16, May-16, Jan-16)* **OR**
**Q) Explain coordinated search and when do we use this types of search.** *(Jan-21, Nov-18, March-18)*
**Q) Write with diagrams the various types of search pattern in case of Man Overboard.** *(Dec-20)*
Ans:- SEARCH PATTERNS:

1) EXPANDING SQUARE SEARCH:-



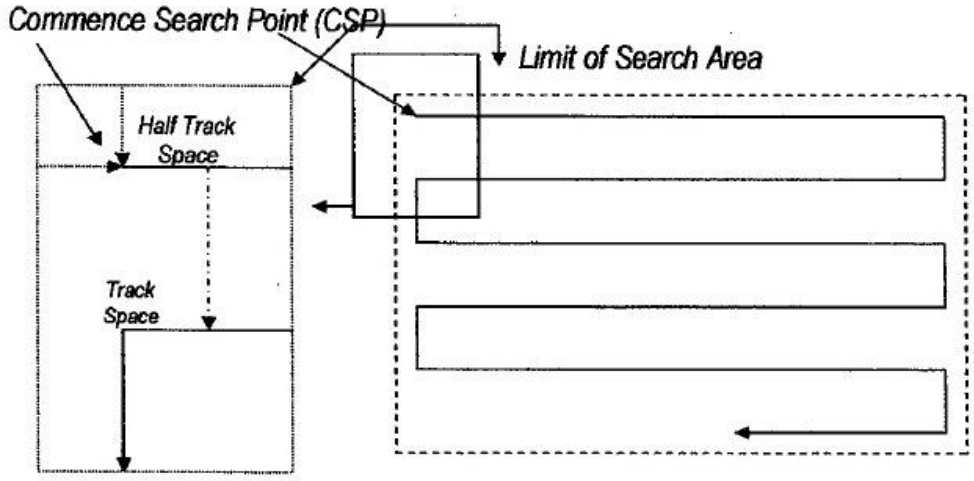
- Most effective when the location of the search object is known within relatively close limits.
- The commence search point is always the Datum Position.
- To be used by a single ship during a search.
- Often appropriate for vessels or small boats to use when searching for persons in the water or other search objects with little or no leeway.
- Accurate navigation is required.
- The first leg is usually oriented directly into the wind to minimize navigational errors.
- All course alterations are of $90^{O}$.
- Two first two legs will be of same length 'd'. 'd' will depend upon the visibility and the height of eye of the lookouts and the swell and sea height.
  Legs 3 and 4 will be a length of 2d.
  Legs 5 and 6 will be a length of 3d.
  Legs 7 and 8 will be a length of 4d.
  And so on until the area is fully searched.

2) SECTOR SEARCH:-




- Most effective when the position of the search object is accurately known and the search area is small.
- Used to search a circular area centred at the datum.
- Can be used by only one craft at a time at a certain location.
- An aircraft and a vessel may be used to perform independent sector searches of the same area.
- A suitable marker may be dropped at the datum and used as a reference point.
- The commence search point is where the ship or aircraft enters the area to be searched.

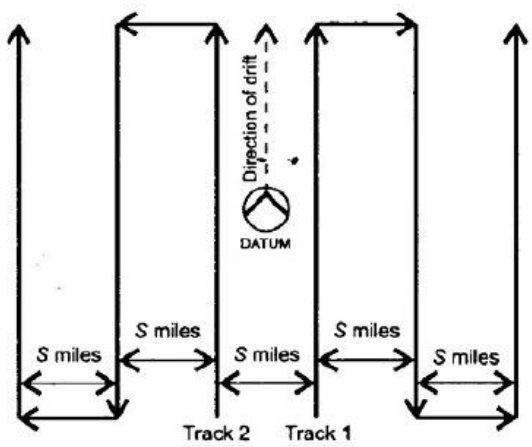
3) PARALLEL SWEEP (TRACK) SEARCH:-



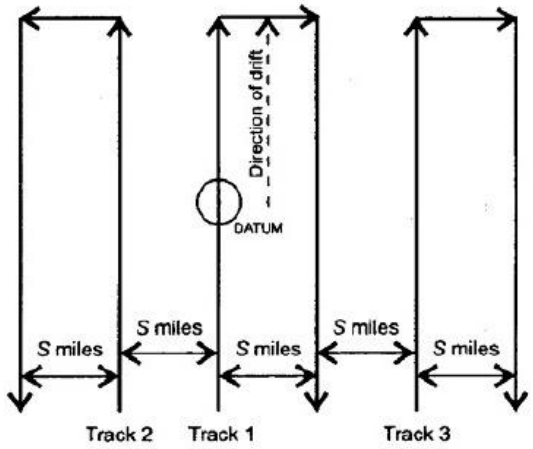

- Used to search a large area when the location of the search object is uncertain.
- Most effective over water or flat terrain.
- Usually used when a large search area must be divided into sub-area for assignment to individual search facilities on-scene at the same time.
- The commence search point is in one corner of the sub-area, one-half track space inside the rectangle from each of the two sides forming the corner.
- Search legs are parallel to each other and to the long sides of the sub-area.
- The main legs indicate the direction of drift.

Multiple vessels may be used as shown opposite:

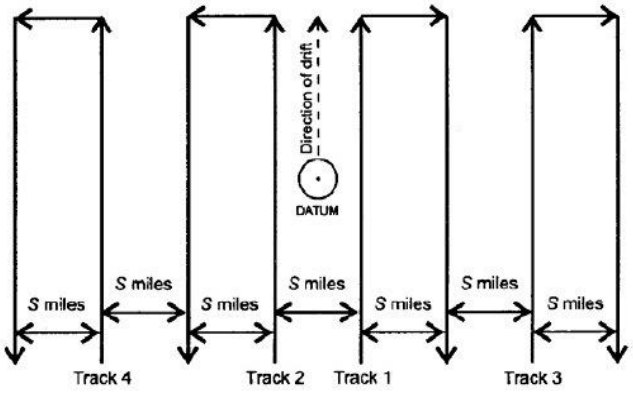
- Parallel sweep: for use by two ships.
- Parallel sweep: for use by three ships.
- Parallel sweep: for use by four ships.
- Parallel sweep: for use by five or more ships.



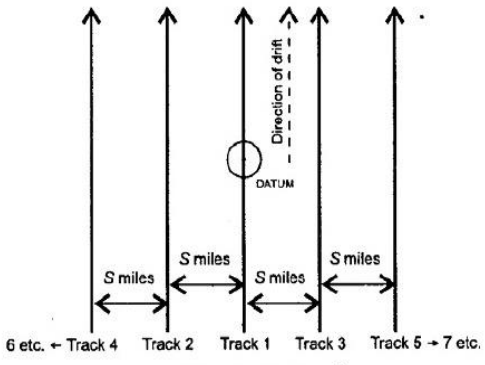

PATTERN 2
Parallel track search – 2 ships




PATTERN 3
Parallel track search – 3 ships

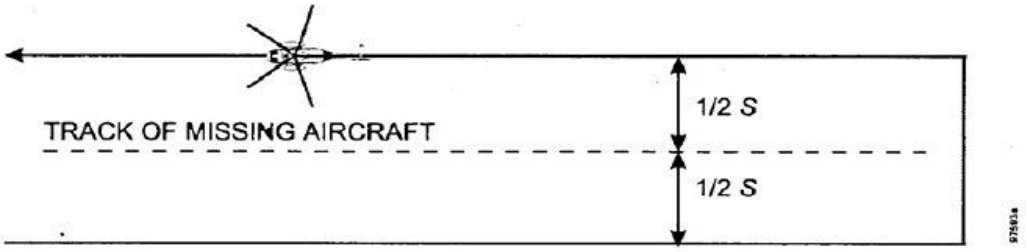



PATTERN 4
Parallel track search – 4 ships

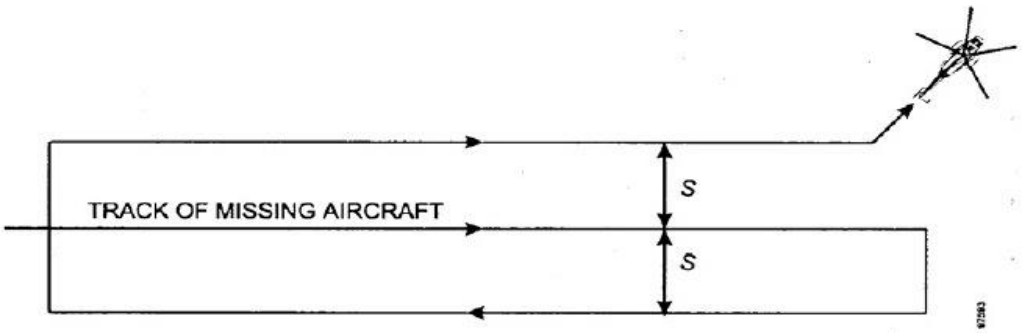



PATTERN 5
Parallel track search – 5 or more ships

4) TRACK LINE SEARCH (TS):-



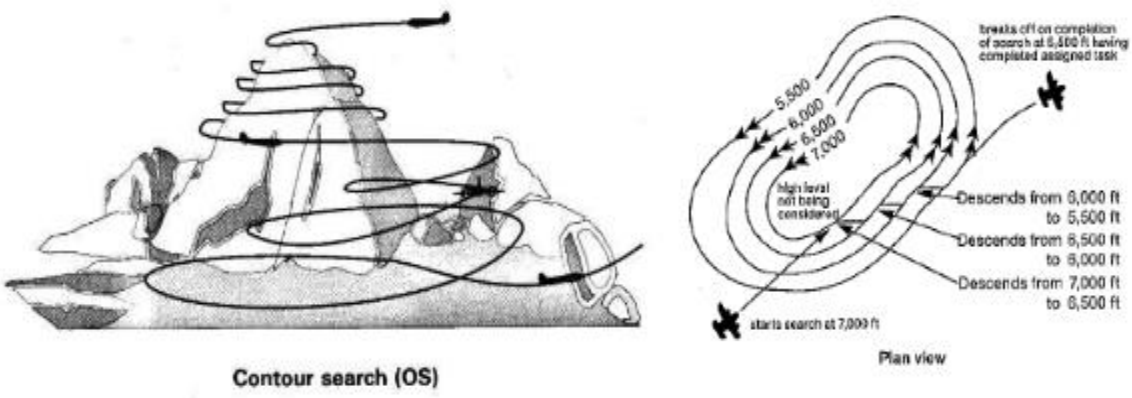

**Track line search, return (TSR)**




**Track line search, non-return (TSN)**

- Normally used when an aircraft or vessel has disappeared without a trace along a known route.
- Often used as initial search effort due to ease of planning and implementation.
- Consists of a rapid and reasonably thorough search along intended route of the distressed craft.
- Search may be along one side of the track line and return. in the opposite direction on the other side (TSR).
- Search may be along the intended track and once on each side, then search facility continues on its way and does not return (TSN).
- Aircraft are 'frequently used for TS due to their high speed.

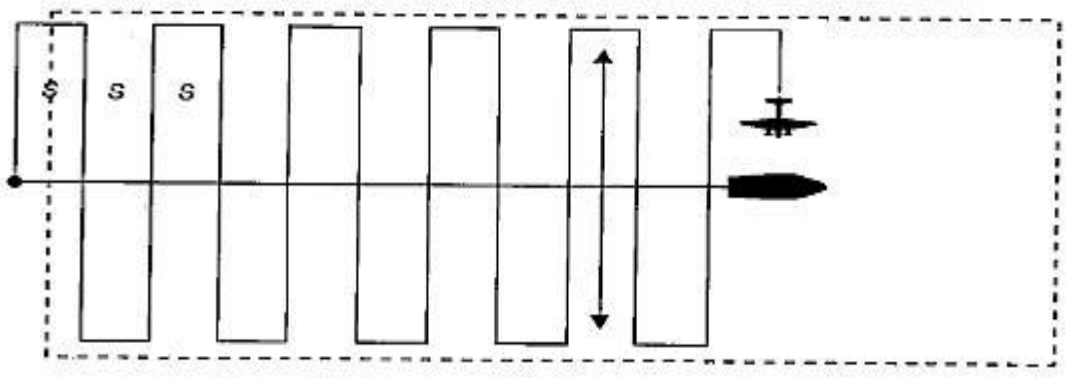
5) CONTOUR SEARCH (OS):-




Contour search (OS)

- Used around mountains and in valleys when sharp changes in elevation make other patterns not practical.
- Search is started from highest peak and goes from top to bottom with new search altitude for each circuit.
- Search altitude intervals may be 150 m to 300 m (500 ft to 1,000 ft).
- The aircraft may make a descending orbit away from the mountain before resuming the contour search at the lower altitude.
- The aircraft may spiral downwards around the mountain at a low but approximately constant rate of descent when there is not enough room to make a circuit opposite to the direction of search.
- If the mountain cannot be circled, successive sweeps at the same altitude intervals as listed above should be flown along its side.
- Valleys are searched in circles, moving the centre of the circuit one track spacing after each completed circuit.

6) CO-ORDINATED VESSEL-AIRCRAFT SEARCH PATTERN:-




*Creeping line search, co-ordinated (CSC)*

- Normally used only if there is an OSC present to give direction to and provide communications with the participating craft.
- Creeping line search, co-ordinated (CSC) is often used.
- The aircraft does most of the searching, while the ship steams along a course at a speed as directed by the OSC so that the aircraft can use it as a navigational checkpoint.
- The aircraft, as it passes over the ship, can easily make corrections to stay on the track of its search pattern.
- Gives a higher probability of detection than can normally be attained by an aircraft searching alone.
- Ship speed varies according to the speed of the aircraft and the size of the pattern.
- The relationship among the speed of the surface facility, the aircraft's speed,

the track spacing and the length of the search legs is defined by the following equation:

**Vs = (5 x Va)/ (L + 5)**

Where,
Vs is the speed of the surface facility in knots;
S is the track spacing in nautical miles;
Va is the aircraft's true air speed (TAS) in knots, and
L is the length of the aircraft's search leg in nautical miles.

**Q) What is Anderson's Turn and when & where can this be used?** *(Nov-18)*

Ans:- One turn ("Single turn, Anderson turn"):-

- Used during SAR situations.
- Fastest recovery method
- Good for ships with tight turning characteristics
- Used most by ships with considerable power
- Very difficult for a single-screw vessel
- Difficult because approach to person is not straight

**Q) List the "immediate actions" and "subsequent actions" that should be taken in a man over board situation.** *(Oct-21, Jan-20, March-19)*

Ans:- *MAN OVERBOARD*

**Immediate Actions** – it is very important that all the 6 actions mentioned below must be executed in quick succession.

1) Shout 'Man overboard on Stbd/port side' several times. Inform Bridge.
2) Change over to hand steering and put wheel hard over to the side the man has fallen overboard.
3) Release the MOB Marker from the Bridge wing on the side the man has fallen overboard.
4) Press the MOB button on the GPS receiver to mark the position for future reference. Many ECDIS also have this feature.
5) Sound "O" on the ship's whistle. This way the Master would rush to the Bridge. If not, call the Master. This would also alert all persons on deck.
6) Post a lookout as soon as possible.

**Subsequent action** – once the above actions are carried out, carry out the following subsequent actions

1) Carry out the Anderson turn or Williamson turn or Scharnow turn whichever is most suitable under the circumstances.
2) Soon after, announce on the PAS "Man overboard on ___ Side. Prepare rescue boats". Hearing the whistle and the announcement over the PAS, the rescue boat crew will start preparing the rescue boat. Maintain communication with this team.
3) Inform E/R about man overboard and ask them to prepare engines to manoeuvre as soon as possible. Do not use M/E emergency stop as it will not serve any purpose.
4) Send out Urgency signal on VHF Ch.16. This would alert all vessels in the vicinity and they would keep well clear of own vessel and not hinder the rescue activities. If external help is needed, Urgency signal must be upgraded to Distress signal.
5) Keep the man in sight. If not possible, keep the MOB marker in sight. Post additional lookouts for this purpose on Compass deck or other location as

appropriate.
6) Reduce speed and manoeuvre the ship close to the windward side of the man, creating a lee, if necessary, for the rescue boat.
7) The rescue boat must now be lowered and the man picked up. If the man is not easily visible from the boat, the Bridge team must guide the rescue boat. Once man is picked up, administer first aid and resuscitation in the boat itself.
8) The lifebuoy should be picked up and the boat hoisted back on board.
9) Urgency signal can now be cancelled and vessel can resume her course.
10) Maintain a record of all events and timing in the Manoeuvring Book. Appropriate entries must be made in the Ship's logbook.
11) Inform office after everything is under control.
12) The Master must hold an inquiry into the incident and make appropriate entries in the Official Log Book.

**Q) Describe the actions you as an OOW will take when man falls overboard in open sea and in extreme cold conditions.** *(Jan-23)*

Ans:- Actions an OOW may take in the event of a man overboard in open sea in extreme cold conditions:

- Raise the alarm and use the man overboard (MOB) button to activate the MOB alarm and mark the position of the person in the water.
- Execute a Williamson turn or a similar maneuver to return to the MOB location while considering the sea and weather conditions.
- Launch the rescue boat or life raft, if required, to recover the person from the water.
- Alert the crew and ensure they are appropriately dressed for the cold weather conditions.
- Monitor the vital signs of the person in the water and provide first aid as necessary once recovered.
- Notify the appropriate authorities and provide them with the location, course, and speed of the vessel.
- Prepare the vessel for the possibility of a helicopter or other emergency response aircraft landing onboard.
- Ensure the person is taken to a warm area of the vessel, given warm clothing, and provided with medical attention as needed.
- Consider any necessary actions to prevent hypothermia or other cold-related injuries to both the person in the water and the rescue team.

**Q) State the duties of SAR mission co-ordinator.** *(July-17, Nov-16)*

Ans:- SAR Mission Co-ordinator (SMC):- Each SAR operation is carried out under the guidance of an SMC. This function exists only for the duration of a specific SAR incident and is normally performed by the RCC chief or a designee. The SMC may have assisting staff.

The SMC guides a SAR operation until a rescue has been effected or it becomes apparent that further efforts would be of no avail.

The SMC should be well trained in all SAR processes, be thoroughly families with the applicable SAR plans, and:

- Gather information about distress situations.
- Develop accurate and workable SAR action plans.
- Dispatch and co-ordinate the resources to carry out SAR missions.

SMC Duties Include:-
- Obtaining and evaluating all data on the emergency.
- Ascertaining the type and quantity of emergency equipment carried by the distressed or missing craft.
- Ascertaining prevailing and forecast environmental conditions.
- If necessary, ascertaining movements and locations of vessels and alerting shipping in likely search areas for rescue, lookout and/or radio watch.
- Plotting the areas to search and deciding on methods and facilities to be used.
- Developing the search action plan and rescue action plan as appropriate.
- Co-ordinating the operation with adjacent RCCs when appropriate.
- Arranging briefing and debriefing of SAR personnel.
- Evaluating all reports and modify search action plan as necessary.
- Arranging for refueling of aircraft and, for prolonged search, making arrangements for the accommodation of SAR personnel.
- Arranging for delivery of supplies to sustain survivors.
- Maintaining in chronological order an accurate and up-to-date record.
- Issuing progress reports.
- Recommending to the RCC chief the abandoning or suspending of the search.
- Releasing SAR facilities when assistance is no longer required.
- Notifying accident investigation authorities.
- If applicable, notifying the state of registry of the aircraft or surface craft.
- Preparing a final report.

**Q) Describe National & Regional SAR system Organisation.** *(July-17, Nov-16)*
Ans:- National and Regional SAR System Organization:- Many States have accepted the obligation to provide aeronautical and maritime SAR co-ordination and services on a 24-hour basis for their territories, territorial seas, and where appropriate, the high seas.
- To carry out these responsibilities, States have established national SAR organizations, or, joined one or more other States to form a regional SAR organization associated with an ocean area or continent.
- A search and rescue region (SRR) is an area of defined dimensions associated with a rescue co-ordination center (RCC) within which SAR services are provided.
  1) SRRs help to define who has primary responsibility for coordinating responses to distress situations in every area of the world, but they are not intended to restrict anyone from assisting persons in distress
  2) the International Civil Aviation Organization (ICAO) regional air navigation plans (RANPS) depict aeronautical SRRs
  3) the International Maritime Organization (IMO) Global SAR Plan depicts maritime SRRS.

**Q) Enlist the preparations carried out on board en route to render the assistance to the distressed vessel as per IAMSAR.** *(April-21, Oct-20, July-19)*
Ans:- On-Board Preparations:
- A vessel en route to assist a distressed craft should prepare for possible
- SAR action on scene, including the possible need to recover people
- from survival craft or from the water. See "Recovery of survivors by
- assisting vessels" later in this section.

- Masters of vessels proceeding to assist should assess the risks they may
- Encounter on scene, including the risks such as those associated with
- leaking cargo, etc. Information should be sought as necessary from the
- distressed craft and/or from the RCC.

A vessel en route to assist a distressed craft should have the following equipment ready for possible use:

Life-saving and rescue equipment:
- lifeboat
- inflatable liferaft
- lifejackets
- survival suits for the crew
- lifebuoys
- breeches buoys
- portable VHF radios for communication with the ship and boats deployed
- line-throwing apparatus
- buoyant lifelines
- hauling lines
- non-sparking boat hooks or grappling hooks
- hatchets
- rescue baskets
- stretchers
- pilot ladders
- scrambling nets
- copies of the International Code of Signals
- radio equipment operating on MF/HF and/or VHF/UHF and capable of communicating with the RCC and rescue facilities, and with a facility for direction finding (DF)
- supplies and survival equipment, as required
- fire-fighting equipment
- portable ejector pumps
- binoculars
- cameras
- bailers and oars.

Signalling equipment:
- signalling lamps
- searchlights
- torches
- flare pistol with colour-coded signal flares
- buoyant VHF/UHF marker beacons
- floating lights
- smoke generators
- flame and smoke floats
- dye markers
- loud hailers.

Preparations for medical assistance, including:
- stretchers
- blankets
- medical supplies and medicines
- clothing
- food
- shelter.

Miscellaneous equipment:
- If fitted, a gantry crane for hoisting on each side of ship with a cargo net for recovery of survivors.
- Line running from bow to stern at the water's edge on both sides for boats and craft to secure alongside.
- On the lowest weather deck, pilot ladders and manropes to assist survivors boarding the vessel.
- Vessel's lifeboats ready for use as a boarding station.
- Line-throwing apparatus ready for making connection with either ship in distress or survival craft.
- Floodlights set in appropriate locations, if recovery at night.

**Q) Write notes on: Search & Rescue Co-ordinators (SCs)** *(Jan-20)*

Ans: SAR Co-ordinators:
- SCs are the top level SAR managers; each State normally will have one or more persons or agencies for whom this designation may be appropriate.
- SCs have the overall responsibility for:
  - establishing, staffing, equipping and managing the SAR system
  - establishing RCCs and rescue sub-centers (RSCs)
  - providing or arranging for SAR facilities
  - coordinating SAR training
  - developing SAR policies.

**Q) Write notes on: Search & Rescue Region (SRR)** *(Jan-20)*

Ans: A search and rescue region (SRR) is an area of defined dimensions associated with a rescue co-ordination center (RCC) within which SAR services are provided.

1) SRRs help to define who has primary responsibility for coordinating responses to distress situations in every area of the world, but they are not intended to restrict anyone from assisting persons in distress
2) The International Civil Aviation Organization (ICAO) regional air navigation plans (RANPS) depict aeronautical SRRs
3) The International Maritime Organization (IMO) Global SAR Plan depicts maritime SRRS.

**Q) Describe the role of MRCC and RCC in a Marine rescue operation.** *(Jan-23)*

Ans:- MRCC (Maritime Rescue Coordination Center) and RCC (Rescue Coordination Center) are both responsible for coordinating search and rescue operations in their respective areas of responsibility. Here are the roles of each:

1. MRCC:
   - Receives alerts and distress calls from ships or aircraft in distress.
   - Conducts search and rescue operations to locate and assist those in distress.
   - Coordinates with RCC, Coast Guard, Navy, or other agencies to provide assistance to those in distress.
   - Provides medical advice, logistical support, and other assistance to ships or aircraft in distress.
   - Monitors the distress situations and coordinates the response until the situation is resolved.

2. RCC:
- Coordinates search and rescue (SAR) operations in their designated area of responsibility.
- Acts as a central point for the receipt and coordination of distress alerts and information.
- Maintains constant communication with MRCCs and other relevant authorities.
- Coordinates the rescue operation by deploying appropriate resources (aircraft, ships, or shore-based facilities) to assist in the rescue operation.
- Continuously monitors and tracks the progress of the rescue operation until it is successfully concluded.
- Both MRCC and RCC play a crucial role in ensuring the safety and survival of those in distress at sea by coordinating and providing assistance during marine rescue operations.

**Q) As per IAMSAR describe: The 3 levels of co-ordination indicating the duties and responsibilities at each level.** *(Jan-22, Aug-21)*

Ans:- IAMSAR (International Aeronautical and Maritime Search and Rescue) is a set of guidelines and procedures developed by the International Maritime Organization (IMO) and the International Civil Aviation Organization (ICAO) to ensure effective search and rescue operations in the maritime and aeronautical domains. The IAMSAR manual outlines three levels of coordination for search and rescue operations, each with its own duties and responsibilities.

These levels are:

1) Local Co-ordination Centre (LCC): The LCC is responsible for the immediate response to a search and rescue incident within its designated search and rescue region. The LCC is responsible for initiating search and rescue operations, and coordinating the efforts of local resources, such as vessels and aircraft, in the search and rescue operation. The LCC is also responsible for maintaining contact with the person in distress and providing them with assistance until the rescue is completed.
2) Regional Co-ordination Centre (RCC): The RCC is responsible for the coordination of search and rescue operations within a larger geographic region, such as a state or country. The RCC is responsible for overseeing the efforts of the LCCs within its designated area of responsibility and coordinating the use of additional resources, such as specialized aircraft or vessels, if necessary. The RCC is also responsible for providing logistical support, such as medical or technical assistance, to the LCCs as required.
3) International Co-ordination Centre (ICC): The ICC is responsible for coordinating search and rescue operations on an international level, such as in cases where a search and rescue incident involves vessels or aircraft from different countries. The ICC is responsible for ensuring that all involved parties are working together effectively, and for providing assistance, such as information or resources, to the LCCs and RCCs as required. The ICC is also responsible for ensuring that all international agreements and protocols related to search and rescue operations are being followed.

In summary, the three levels of coordination in IAMSAR represent a hierarchical structure of responsibilities and duties for search and rescue operations, with each level providing support and resources to the lower levels as needed. This ensures that search and rescue operations are coordinated effectively and that all necessary

resources and expertise are being utilized to ensure the safety and well-being of the person(s) in distress.

**Q) Write notes on: Track Spacing** *(March-20, Jan-20)*

Ans: Most search patterns consist of parallel tracks or sweeps covering a rectangular area. The distance between adjacent tracks is called the track spacing.

Recommended uncorrected track spacings for merchant vessels are provided in the table following this discussion. Correction factors based on weather conditions and search object are provided in the table after the track spacing table. Multiplying the uncorrected track spacing (Su) by the appropriate weather correction factor (fw) produces the recommended track spacing (S):

$$S = Su \times fw$$

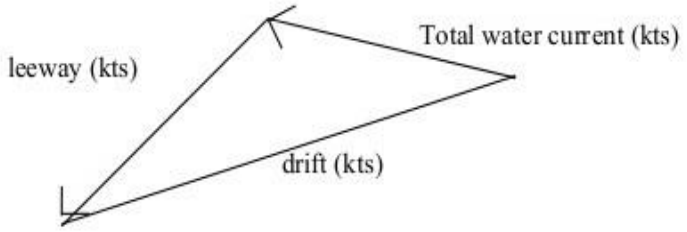
Changes in weather, number of assisting craft, etc., may occur, making it prudent to alter the track spacing.

The SMC must ensure that all searching ships and aircraft maintain safe separations from one another and accurately follow their assigned search patterns.

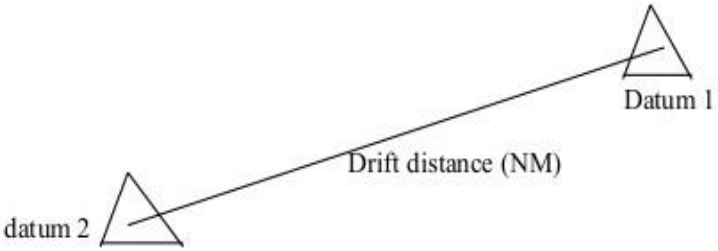
**Q) As per IAMSAR briefly defines: Datum** *(March-20)*

Ans:- It will be necessary to establish a datum, or geographic reference, for the area to be searched. The following factors should be considered:

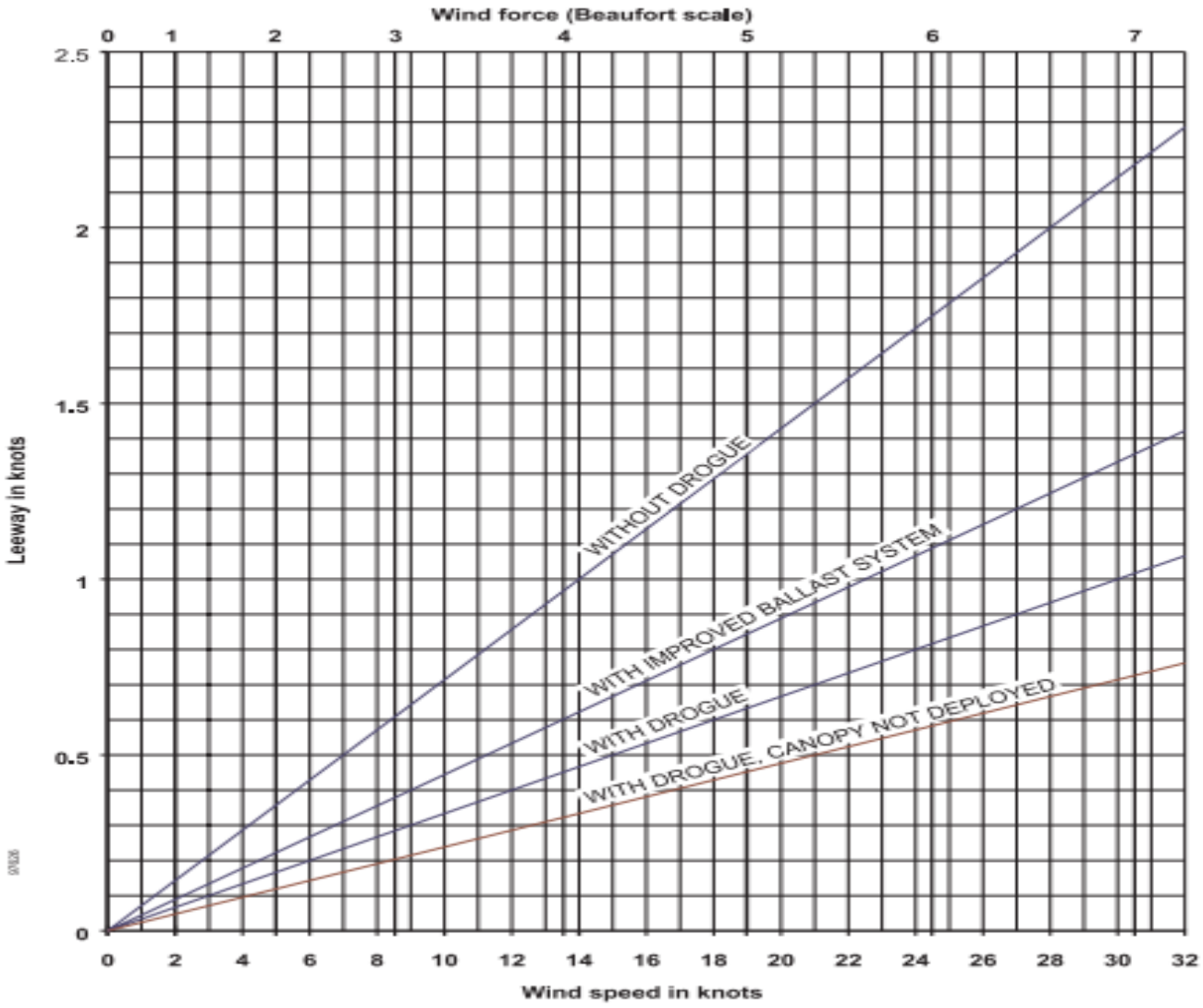
- reported position and time of the SAR incident
- any supplementary information such as DF bearings or sightings
- time interval between the incident and the arrival of SAR facilities
- estimated surface movements of the distressed craft or survival craft, depending on drift (The two figures following this discussion are used in calculating drift.) The datum position for the search is found as follows:
  - drift has two components: leeway and total water current
  - leeway direction is downwind
  - leeway speed depends on wind speed
  - the observed wind speed when approaching the scene may be used for estimating leeway speed of liferafts by using the graph following this discussion (Persons in the water (PIW) have no leeway while liferaft stability and speed vary with or without drogue or ballast.)
  - total water current may be estimated by using the computed set and drift of vessels at or near the scene
  - drift direction and speed is the vector sum of leeway and total water current
- drift distance is drift speed multiplied by the time interval between the incident time, or time of the last computed datum, and the commence search time
- datum position is found by moving from the incident position, or last computed datum position, the drift distance in the drift direction and plotting the resulting position on a suitable chart.




Computing drift speed and direction from total water current and leeway.




determining a new datum
( drift distance = drift speed X drift time)




**Liferaft leeway**

# VTS PROCEDURES

**Q) What is a vessel traffic service?** *(Mar-21, Mar-16)* **OR**
**How do VTS contribute to safety of life at sea?** *(Jan-23, Jan-16)*

Ans:- VESSEL TRAFFIC SERVICE (VTS):- A vessel traffic service (VTS) is a marine traffic monitoring system established by harbour or port authorities, similar to air traffic control for aircraft. Typical VTS systems use radar, closed-circuit television (CCTV), VHF radiotelephony and automatic identification system to keep track of vessel movements and provide navigational safety in a limited geographical area.

SOLAS CHAPTER V - REGULATION 12 - Vessel traffic services:-

1) **Vessel traffic services (VTS) contribute to safety of life at sea**, safety and efficiency of navigation and protection of the marine environment, adjacent shore areas, work sites and offshore installations from possible adverse effects of maritime traffic.
2) Contracting Governments undertake to arrange for the establishment of VTS where, in their opinion, the volume of traffic or the degree of risk justifies such services.
3) Contracting Governments planning and implementing VTS shall, wherever possible, follow the guidelines developed by the Organization*. The use of VTS may only be made mandatory in sea areas within the territorial seas of a coastal State.
4) Contracting Governments shall endeavor to secure the participation in, and compliance with, the provisions of vessel traffic services by ships entitled to fly their flag.
5) Nothing in this regulation or the guidelines adopted by the Organization shall prejudice the rights and duties of Governments under international law or the legal regimes of straits used for international navigation and archipelagic sea lanes.

**Q) What are the benefits of implementing a VTS?** *(Jan-20, May-19, July-18, March-18, March-16)*

Ans:- The purpose of VTS is to improve the maritime safety and efficiency of navigation, safety of life at sea and the protection of the marine environment and/or the adjacent shore area, work sites and offshore installations from possible adverse effects of maritime traffic in a given area. VTS may also have a role to play in security.

The benefits of implementing a VTS:-

- It allows identification and monitoring of vessels, strategic planning of vessel movements and provision of navigational information and navigational assistance.
- It can assist in reducing the risk of pollution and, should it occur, coordinating the pollution response. Many authorities express difficulty in establishing justifiable criteria for identifying whether VTS is the most appropriate tool to improve the safety and efficiency of navigation, safety of life and the protection of the environment.
- A VTS is generally appropriate in areas that may include any, or a combination, of the following:
  - high traffic density;
  - traffic carrying hazardous cargoes;

- conflicting and complex navigation patterns;
- difficult hydrographical, hydrological and meteorological elements;
- shifting shoals and other local hazards and environmental considerations;
- interference by vessel traffic with other waterborne activities;
- number of casualties in an area during a specified period;
- existing or planned vessel traffic services on adjacent waterways and the need for cooperation between neighbouring states, if appropriate;
- narrow channels, port configuration, bridges, locks, bends and similar areas where the progress of vessels may be restricted; and
- existing or foreseeable changes in the traffic pattern in the area.

**Q) State the objectives and limitations of the VTS systems.** *(Jan-20, May-19, Jan-17)*

Ans:- Objectives of VTS:-

1) The purpose of vessel traffic services is to improve the safety and efficiency of navigation, safety of life at sea and the protection of the marine environment and/or the adjacent shore area, worksites and offshore installations from possible adverse effects of maritime traffic.
2) A clear distinction may need to be made between a Port or Harbour VTS and a Coastal VTS. A Port VTS is mainly concerned with vessel traffic to and from a port or harbour or harbours, while a Coastal VTS is mainly concerned with vessel traffic passing through the area. A VTS could also be a combination of both types. The type and level of service or services rendered could differ between both types of VTS; in a Port or Harbour VTS a navigational assistance service and/or a traffic organization service is usually provided for, while in a Coastal VTS usually only an information service is rendered.
3) The benefits of implementing a VTS are that it allows identification and monitoring of vessels, strategic planning of vessel movements and provision of navigational information and assistance. It can also assist in prevention of pollution and co-ordination of pollution response. The efficiency of a VTS will depend on the reliability and continuity of communications and on the ability to provide good and unambiguous information. The quality of accident prevention measures will depend on the system's capability of detecting a developing dangerous situation and on the ability to give timely warning of such dangers.
4) The precise objective of any vessel traffic service will depend upon the particular circumstances in the VTS area and the volume and character of maritime traffic as set forth in 3.2 of these Guidelines and Criteria.

**Q) Describe the use of VTS in navigation.** *(July-18, May-17)*

Ans:- Use of AIS in VTS Operations:-

- Automatic Identification System (AIS) is a system that makes it possible to monitor and track ships from suitably equipped ships, and shore stations. AIS transmissions consist of bursts of digital data 'packets' from individual stations, according to a pre-determined time sequence.
- AIS makes navigation safer by enhancing situational awareness and increases the possibility of detecting other ships, even if they are behind a bend in a channel or river or behind an island in an archipelago.
- AIS can also solve the problem inherent with radars, by detecting smaller craft, fitted with AIS, in sea and rain clutter.

**Q) What is the function of a VTS System?** *(April-21)*

Ans:- Function of a VTS System:- Amongst the most important functions that a VTS may carry out are those related to, contributing to and thereby enhancing:

- Safety of life at sea.
- Safety of navigation.
- Efficiency of vessel traffic movement.
- Protection of the marine environment.
- Supporting maritime security.
- Supporting law enforcement and
- Protection of adjacent communities and infrastructure.

**Q) What are the different types of VTS System?** *(April-21)*

Ans:- There are two main types of VTS, surveilled and non-surveilled:-

- Surveilled systems consist of one or more land-based sensors (i.e. radar, AIS and closed circuit television sites), which output their signals to a central location where operators monitor and manage vessel traffic movement.
- Non-surveilled systems consist of one or more reporting points at which ships are required to report their identity, course, speed, and other data to the monitoring authority.
- They encompass a wide range of techniques and capabilities aimed at preventing vessel collisions, rammings, and groundings in the harbor, harbor approach and inland waterway phase of navigation.
- They are also designed to expedite ship movements, increase transportation system efficiency, and improve all-weather operating capability.

**Q) Explain the reporting procedures of VTS and SRS.** *(Nov-20, March-18, Nov-16)*

Ans:- Reporting procedures of VTS and SRS:- Standard Reporting Procedures, IMO Resolution A.851 (20) - 'General Principles for Ship Reporting Systems and Ship Reporting Requirements'.

Types of Communication Messages and Message Markers:-

- To facilitate shore-to-ship and ship-to-shore communication in a VTS environment, one of the following eight message markers should be used to increase the probability of the purpose of the message being properly understood.
- It is at the discretion of the shore personnel or the ship's officer whether to use one of the message markers and, if so, which marker is applicable to the situation.
- If used, the message marker is to be spoken preceding the message or the corresponding part of the message.
- The contents of all messages directed to a vessel should be clear; IMO Standard Marine Communication Phrases should be used where practicable.

**Q) How does VTS enhance safety of navigation?** *(Nov-21)*

Ans:- Vessel Traffic Services (VTS) is a shore-based service provided to vessels with

the aim of improving safety, efficiency, and environmental protection in ports and other waterways. VTS enhances safety of navigation in several ways:

1. Monitoring vessel movements: VTS uses radar and other surveillance equipment to monitor the movements of vessels in real-time, providing early detection of potential risks and enabling timely intervention to prevent accidents.
2. Providing navigational assistance: VTS provides navigational assistance to vessels, such as advice on the best routes to take, weather conditions, and tide levels, thereby reducing the risk of grounding, collision, or other navigational hazards.
3. Regulating vessel traffic: VTS monitors vessel traffic and provides guidance to vessels to ensure the safe and efficient movement of traffic in busy waterways, reducing the risk of collisions or other accidents.
4. Communication and coordination: VTS facilitates communication and coordination among vessels, pilots, and port operators, enabling quick and effective response to emergencies or other incidents.
5. Environmental protection: VTS monitors vessels to ensure compliance with environmental regulations and helps to minimize the risk of oil spills or other environmental hazards.

**Q) Enumerate the regulation in COLREGS for stand on vessels?** *(March-21)*

Ans:- Rule – 17 – Action by Stand-on Vessel:-

- Where one of two vessels is to keep out of the way the other shall keep her course and speed.
- The latter vessel may however take action to avoid collision by her manoeuvre alone, as soon as it becomes apparent to her that the vessel required to keep out of the way is not taking appropriate action in compliance with these Rules.
- When, from any cause, the vessel required to keep her course and speed finds herself so close that collision cannot be avoided by the action of the give-way vessel alone, she shall take such action as will best aid to avoid collision.
- A power-driven vessel which takes action in a crossing situation in accordance with sub-paragraph (a)(ii) of this Rule to avoid collision with another power-driven vessel shall, if the circumstances of the case admit, not alter course to port for a vessel on her own port side.
- This Rule does not relieve the give-way vessel of her obligation to keep out of the way.

## SHIP REPORTING SYSTEMS

**Q) Describe the contents and procedure of the ship reporting system.** *(Jan-22)*

Ans:- The ship reporting system is a procedure by which ships report their positions, movements, and other information to the relevant authorities. The information contained in a ship report may vary depending on the reporting system being used, but it typically includes:

1. Identification: The ship's name, call sign, and IMO number.
2. Position: The ship's current position, speed, and heading.
3. Voyage details: The ship's intended route, destination, and estimated time of arrival.
4. Cargo details: The type and quantity of cargo being carried.

5. Safety and security: Any safety or security issues on board the ship, such as equipment malfunctions, fires, or security threats.
6. Environmental concerns: Any environmental hazards or incidents, such as oil spills or discharge of pollutants.

The ship reporting system is a system designed to improve safety and efficiency of maritime traffic by providing accurate and timely information to ships and shore-based authorities. The procedure of the ship reporting system involves the following steps:

1. Notification: The first step is for the ship to notify the relevant authorities about its arrival, departure, or passage through a particular area. This notification can be made via radio or electronic means such as email or a ship reporting system.
2. Information exchange: Once the notification is received, the ship may be required to provide information such as the ship's name, call sign, destination, route, cargo, number of crew members, and any other relevant information.
3. Confirmation: The shore-based authorities will confirm receipt of the ship's notification and may provide additional information or instructions to the ship if necessary.
4. Monitoring: The ship's progress may be monitored by the shore-based authorities using various means such as radar, Automatic Identification System (AIS), and communication with the ship's crew.
5. Reporting: The ship may be required to provide periodic reports to the shore-based authorities on its position, speed, course, and any other relevant information.
6. Completion: Once the ship has completed its voyage or passage through the area, it must notify the authorities of its departure and any other relevant information.

The authorities then use this information to monitor vessel movements, manage traffic, and ensure safety and security at sea. The reporting systems used may include:

1. Automatic Identification System (AIS)
2. Long Range Identification and Tracking (LRIT)
3. Ship Reporting System (SRS)
4. Voluntary Observing Ships (VOS)
5. Global Maritime Distress and Safety System (GMDSS)

**Q) State the elements of the Ship's Routeing System.** *(July-21, Dec-20, Nov-20, Jan-19, July-18, May-17, Aug-16, Jan-16)*

Ans:- The objective of ships' routeing is to "improve the safety of navigation in converging areas and in areas where the density of traffic is great or where freedom of movement of shipping is inhibited by restricted sea room, the existence of obstructions to navigation, limited depths or unfavourable meteorological conditions". Ships routeing systems can be established to improve safety of life at sea, safety and efficiency of navigation, and/or increase the protection of the marine environment.

Elements used in traffic routeing systems include:

- Traffic separation scheme: a routeing measure aimed at the separation of opposing streams of traffic by appropriate means and by the establishment of traffic lanes.
- Traffic lane: an areas within defined limits in which one-way traffic is established, natural obstacles, including those forming separation zones, may constitute a

boundary.

- Separation zone or line: a zone or line separating traffic lanes in which ships are proceeding in opposite or nearly opposite directions; or separating a traffic lane from the adjacent sea area; or separating traffic lanes designated for particular classes of ship proceeding in the same direction.
- Roundabout: a separation point or circular separation zone and a circular traffic lane within defined limits.
- Inshore traffic zone: a designated area between the landward boundary of a traffic separation scheme and the adjacent coast.
- Recommended route: a route of undefined width, for the convenience of ships in transit, which is often marked by centreline buoys.
- Deep-water route: a route within defined limits which has been accurately surveyed for clearance of sea bottom and submerged articles.
- Precautionary area: an area within defined limits where ships must navigate with particular caution and within which the direction of flow of traffic may be recommended.
- Area to be avoided: an area within defined limits in which either navigation is particularly hazardous or it is exceptionally important to avoid casualties and which should be avoided by all ships, or by certain classes of ships.

Before Implementing or starting a TSS or Vessel routeing system the below mentioned information should be collected:

1) Data about the area and problem or threat thereof:
    a. Resources within are
    b. Potential navigation hazard.
    c. Environmental factors
2) Data about the ship traffic (e.g., vol., traffic patterns)
3) Information regarding existing measures
4) Foreseeable changes in traffic patterns
5) Information regarding incident history
6) Existing aids to navigation
7) Charts (are they up to date?)
8) IMO documents (models)

**Q) How will you know whether a routeing system is mandatory or voluntary?** *(July-21)*

Ans:- A routeing system may be mandatory or voluntary, and it is important for the mariner to know which one applies in order to ensure compliance with the applicable regulations. There are several ways to determine whether a routeing system is mandatory or voluntary:

1. Consult relevant charts and publications: Mandatory and voluntary routeing systems are usually depicted on navigation charts and other relevant publications. The chart or publication will indicate whether the routeing system is mandatory or voluntary.
2. Consult relevant regulations: The International Maritime Organization (IMO) has established regulations for mandatory and voluntary routeing systems. The relevant regulations, such as SOLAS and COLREGs, will indicate whether the routeing system is mandatory or voluntary.
3. Contact local authorities: Local authorities such as port authorities or coast guards can provide information on the applicable routeing systems in their jurisdiction and whether they are mandatory or voluntary.

4. Consult vessel's passage plan: The vessel's passage plan should indicate the applicable routeing systems and whether they are mandatory or voluntary.

Overall, it is important for the mariner to determine whether a routeing system is mandatory or voluntary to ensure compliance with the applicable regulations and to maintain the safety of the vessel and crew.

**Q) When are ships required to make reports?** *(April-21)*

Ans:- The SRS may be voluntary or obligatory:

- The voluntary reporting systems are based on mutual solidarity, and they are usually set up in the areas where unfavorable weather conditions prevail. The obligatory reporting systems rest on the stipulations of the International Convention on the Safety of Life at Sea (SOLAS).
- In keeping with these provisions, they only authorised organisation for issuing instructions, defining conditions and rules with a view to founding and regulating the SRS is the International Maritime Organisation (IMO). In compliance with the SOLAS, the obligatory SRS may refer to all or some individual types of ships, excepting military and subsidiary.

**Q) What kind of reports does a ship need to send out?** *(April-21, May-17, Jan-16)*

Ans:- Reports should be sent as follows:

- Sailing plan (SP) - Before or as near as possible to the time of departure from a port within a reporting system or when entering the area covered by a system.
- Position report (PR) - When necessary to ensure effective operation of the system.
- Deviation report (DR) - When the ship's position varies significantly from the position that would have been predicted from previous reports, when changing the reported route, or as decided by the master.
- Final report (FR) - On arrival at destination and when leaving the area covered by a system.
- Dangerous goods report (DG) - When an incident takes place involving the loss or likely loss overboard of packaged dangerous goods, including those in freight containers, portable tanks, road and rail vehicles and shipborne barges, into the sea.
- Harmful substances report (HS) - When an incident takes place involving the discharge or probable discharge of oil (Annex I of MARPOL) or noxious liquid substances in bulk (Annex II of MARPOL).
- Marine pollutants report (MP) - In the case of loss or likely loss overboard of harmful substances in packaged form, including those in freight containers, portable tanks, road and rail vehicles and shipborne barges, identified in the International Maritime Dangerous Goods Code as marine pollutants (Annex III of MARPOL).
- Any other report - Any other report should be made in accordance with the system procedures as notified in accordance with paragraph 9 of the General Principles.

**Q) Briefly describe the various reports to be made to shore authorities while participating in ship reporting systems.** *(July-21)*

Ans:- Ship reporting systems are designed to enhance the safety and efficiency of shipping by providing information to shore authorities about the location, course, and speed of vessels. There are several reports that are typically made to shore authorities while participating in ship reporting systems:

1. Position reports: These reports provide information about the vessel's current position, course, speed, and other relevant details. Position reports are typically made at regular intervals, such as every six hours or at specific reporting points.
2. Voyage reports: Voyage reports provide information about the vessel's intended route, estimated time of arrival at various ports, and other details relevant to the voyage. These reports are typically submitted before the voyage begins and may be updated as necessary during the voyage.
3. Hazard reports: Hazard reports provide information about any hazards that the vessel has encountered or observed, such as navigational hazards or weather conditions that may pose a risk to other vessels.
4. Incident reports: Incident reports provide information about any accidents, incidents, or other unusual occurrences that have taken place on board the vessel.
5. Pollution reports: Pollution reports provide information about any spills, leaks, or other environmental incidents that may have occurred on board the vessel.

**Q) What is the importance of Ship Reporting Systems for safe navigation?** *(Jan-19)*

Ans:- Importance of Ship Reporting Systems for safe navigation:-

1) Ship reporting systems contribute to safety of life at sea, safety and efficiency of navigation and/or protection of the marine environment. A ship reporting system, when adopted and implemented in accordance with the guidelines and criteria developed by the Organization pursuant to this regulation, shall be used by all ships, or certain categories of ships or ships carrying certain cargoes in accordance with the provisions of each system so adopted.
2) The Organization is recognized as the only international body for developing guidelines, criteria and regulations on an international level for ship reporting systems. Contracting Governments shall refer proposals for the adoption of ship reporting systems to the Organization. The Organization will collate and disseminate to Contracting Governments all relevant information with regard to any adopted ship reporting system.
3) The initiation of action for establishing a ship reporting system is the responsibility of the Government or Governments concerned. In developing such systems provision of the guidelines and criteria developed by the Organization shall be taken into account.
4) Ship reporting systems not submitted to the Organization for adoption do not necessarily need to comply with this regulation. However, Governments implementing such systems are encouraged to follow, wherever possible, the guidelines and criteria developed by the Organization. Contracting Governments may submit such systems to the Organization for recognition.
5) Where two or more Governments have a common interest in a particular area, they should formulate proposals for a co-ordinated ship reporting system on the basis of agreement between them. Before proceeding with a proposal for adoption of a ship reporting system, the Organization shall disseminate details of the proposal to those Governments which have a common interest in the area covered by the proposed system. Where a co-ordinated ship reporting system is adopted and established, it shall have uniform procedures and operations.
6) After adoption of a ship reporting system in accordance with this regulation, the

Government or Governments concerned shall take all measures necessary for the promulgation of any information needed for the efficient and effective use of the system. Any adopted ship reporting system shall have the capability of interaction and the ability to assist ships with information when necessary. Such systems shall be operated in accordance with the guidelines and criteria developed by the Organization pursuant to this regulation.

7) The master of a ship shall comply with the requirements of adopted ship reporting systems and report to the appropriate authority all information required in accordance with the provisions of each such system.
8) All adopted ship reporting systems and actions taken to enforce compliance with those systems shall be consistent with international law, including the relevant provisions of the United Nations Convention on the Law of the Sea.
9) Nothing in this regulation or its associated guidelines and criteria shall prejudice the rights and duties of Governments under international law or the legal regimes of straits used for international navigation and archipelagic sea lanes.
10) The participation of ships in accordance with the provisions of adopted ship reporting systems shall be free of charge to the ships concerned.
11) The Organization shall ensure that adopted ship reporting systems are reviewed under the guidelines and criteria developed by the Organization.

**Q) Explain how the ship reporting system provides the necessary information for search and rescue in case of distress?** *(July-16)*

Ans:- Ship Reporting System:-

- A ship reporting system enables the SMC to quickly:
  - identify vessels in the vicinity of a distress situation, along with their positions, courses, and speeds
  - be aware of other information about the vessels, which may be valuable (whether a doctor is aboard, etc.)
  - know how to contact the vessels.
- Masters of vessels are urged to send regular reports to the authority operating a ship reporting system for SAR.

*The Automated Mutual-Assistance Vessel Rescue (AMVER) System*:-

- AMVER is a worldwide system operated exclusively to support SAR and make information available to all RCCS.
  - there is no charge for vessels to participate in, nor for RCCs to use AMVER
  - many land-based providers of communications services world-wide relay ship reports to AMVER free of charge.
- Any merchant vessel of 1 000 gross tons or more on any voyage of greater than 24 hours is welcome to participate.
- Benefits of participation include:
  - improved likelihood of rapid aid during emergencies
  - reduced number of calls for assistance to vessels unfavorably located to respond
  - reduced response time to provide assistance.

**Q) Write short notes on INSPIRES with respect to Ship Reporting System.** *(Oct-20)*

Ans:- INDIAN Ship position and information reporting system (INSPIRES) :-

Indian navy in co-ordination with DG of Shipping has established INSPIRES to

exercise effective open ocean vessel management, to provide security to vessel, weather forecast to enhance safety of navigation and monitor incidence of pollution. An Indian Naval communication center (COMCENs) Mumbai and Vizag are functioning as the shore stations for receiving INSPIRES messages from vessels. All Indian vessels including coasting/ fishing vessels of tonnage 300 GRT and above shall participate in this reporting system. All vessels other than Indian ships of tonnage 100 GRT and above are encouraged to participate in this reporting system.

INDIAN SHIP REPORTING SYSTEM:
INDIAN SHIP POSITION AND INFORMATION REPORTING SYSTEM (INSPIRES) SHIP REPORTING SYSTEM FOR SAR (INDSAR):
The INSPIRES has been established to achieve the following objectives:
(i) To provide up to date information on shipping for search and rescue.
(ii) For effective vessel traffic management service.
(iii) For weather forecasting.
(iv) For prevention and containment of marine pollution.
This reporting system has wider area of coverage in the Indian Ocean. An Indian Naval Communication Centre (COMCENs) Mumbai and Vishakhapatnam are functioning as the shore stations for receiving INSPIRES messages from all vessels.

**Q) Enumerate the regulation in COLREGS for stand on vessels?** *(Jan-21)*
**Q) Explain terms STAND-ON VESSEL.** *(Nov-21)*
Ans:- Regulation in COLREGS - Rule 17 - Action by stand-on vessel
(a) (i) Where one of two vessels is to keep out of the way the other shall keep her course and speed.
(ii) The latter vessel may however take action to avoid collision by her manoeuvre alone, as soon as it becomes apparent to her that the vessel required to keep out of the way is not taking appropriate action in compliance with these Rules.
(b) When, from any cause, the vessel required to keep her course and speed finds herself so close that collision cannot be avoided by the action of the give-way vessel alone, she shall take such action as will best aid to avoid collision.
(c) A power-driven vessel which takes action in a crossing situation in accordance with subparagraph (a)(ii) of this Rule to avoid collision with another power-driven vessel shall, if the circumstances of the case admit, not alter course to port for a vessel on her own port side.
(d) This Rule does not relieve the give-way vessel of her obligation to keep out of the way.

**Q) Explain your understanding of the following terms: 'Safe Speed' as per Rule 6 & Rule 19.** *(Jan-21, Jan-18, Sept-17)* **OR**
**Explain Rule 6 "Safe Speed" as per COLREGS** *(Nov-21, May-17)*
Ans:- COLREGS - RULE 6 - Safe Speed:- Every vessel shall at all times proceed at a safe speed so that she can take proper and effective action to avoid collision and be stopped within a distance appropriate to the prevailing circumstances and conditions.
In determining a safe speed the following factors shall be among those taken into account:
a) By all vessels:
i. the state of visibility;

ii. the traffic density including concentrations of fishing vessels or any other vessels;
iii. the maneuverability of the vessel with special reference to stopping distance and turning ability in the prevailing conditions;
iv. at night the presence of background light such as from shore lights or from back scatter of her own lights;
v. the state of wind, sea and current, and the proximity of navigational hazards;
vi. the draught in relation to the available depth of water.

b) Additionally, by vessels with operational radar:
i. the characteristics, efficiency and limitations of the radar equipment;
ii. any constraints imposed by the radar range scale in use;
iii. the effect on radar detection of the sea state, weather and other sources of interference;
iv. the possibility that small vessels, ice and other floating objects may not be detected by radar at an adequate range;
v. the number, location and movement of vessels detected by radar;
vi. the more exact assessment of the visibility that may be possible when radar is used to determine the range of vessels or other objects in the vicinity.

COLREGS - Rule 19 - Conduct of vessels in restricted visibility:-

a) This Rule applies to vessels not in sight of one another when navigating in or near an area of restricted visibility.
b) Every vessel shall proceed at a safe speed adapted to the prevailing circumstances and conditions of restricted visibility. A power-driven vessel shall have her engines ready for immediate manoeuvre.
c) Every vessel shall have due regard to the prevailing circumstances and conditions of restricted visibility when complying with the Rules of section I of this part.
d) A vessel which detects by radar alone the presence of another vessel shall determine if a close-quarters situation is developing and/or risk of collision exists. If so, she shall take avoiding action in ample time, provided that when such action consists of an alteration of course, so far as possible the following shall be avoided:
i. an alteration of course to port for a vessel forward of the beam, other than for a vessel being overtaken;
ii. an alteration of course towards a vessel abeam or abaft the beam.
e) Except where it has been determined that a risk of collision does not exist, every vessel which hears apparently forward of her beam the fog signal of another vessel, or which cannot avoid a close-quarters situation with another vessel forward of her beam, shall reduce her speed to the minimum at which she can be kept on her course. She shall if necessary take all her way off and in any event navigate with extreme caution until danger of collision is over.

**Q) Explain terms LOOKOUT** *(Nov-21)*

Ans:- As per COLREGS (International Regulations for Preventing Collisions at Sea), COLREG Rule 5, the term "lookout" refers to a person or persons who maintain a continuous watch on the surroundings of the vessel and the presence of other vessels or objects in the vicinity that may pose a threat of collision. The lookout should not only keep a lookout visually but also use all available means appropriate to the prevailing circumstances and conditions to detect and identify potential dangers. The lookout should be in a position to take appropriate action to avoid collision and should be relieved periodically to maintain alertness. The responsibilities of the lookout

include:

- Maintaining a constant visual and audible watch.
- Identifying and assessing potential risks of collision with other vessels or objects in the vicinity.
- Communicating relevant information to the Officer of the Watch (OOW).
- Monitoring and interpreting radar and other electronic data to detect potential hazards.
- Taking appropriate action to avoid collision, if necessary.

**Q) Explain your understanding of the following terms: 'Navigate with extreme caution' as per Rule 19.** *(Jan-21, Sept-17)*

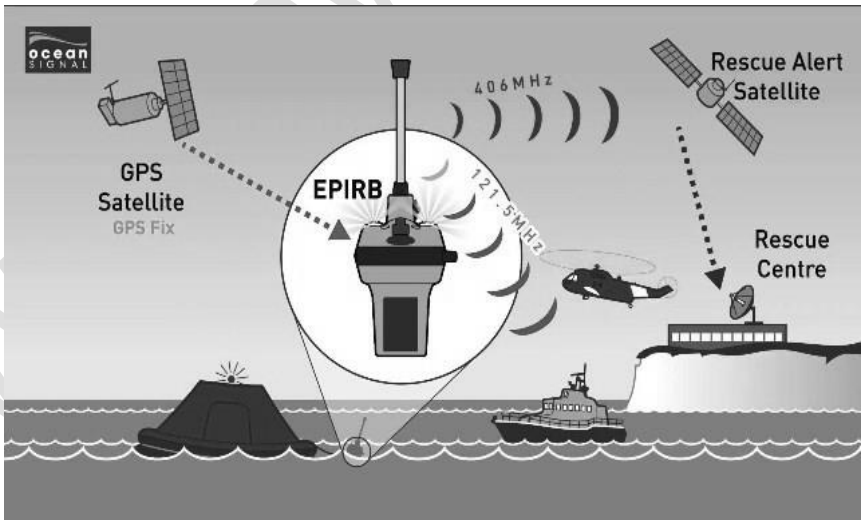
Ans:- : COLREGS 'Navigate with extreme caution' as per Rule 19 :- The term 'navigate with caution' was used in the 1960 and previous Regulations. For a vessel without operational radar which hears a fog signal forward at the beam it has generally been interpreted to mean that the way should at least be run off.

## SAFETY

**Q) Explain the use of EPIRB.** *(Nov-18)*

Ans:- EPIRB:

- EPIRB stands for Emergency Position Indicating Radio Beacon.
- An EPIRB is meant to help rescuers locate you in an emergency situation, and these radios have saved many lives since their creation in the 1970s.
- Boaters are the main users of EPIRBs.




- A modern EPIRB is a sophisticated device that contains:
  - A 5-watt radio transmitter operating at 406 MHz (see How the Radio Spectrum Works for details on frequencies).
  - A 0.25-watt radio transmitter operating at 121.5 MHz.
- A GPS receiver once activated, both of the radios start transmitting. Approximately 24,000 miles (39,000 km) up in space, a GOES weather satellite in a geosynchronous orbit can detect the 406-MHz signal. Embedded in the signal is a unique serial number, and, if the unit is equipped with a GPS receiver, the exact location of the radio is conveyed in the signal as well. If the EPIRB is properly registered, the serial number lets the Coast Guard know who owns the EPIRB.

Rescuers in planes or boats can home in on the EPIRB using either the 406-MHz or 121.5-MHz signal.

**Q) Explain the use of SART** *(Nov-18)*

Ans:- S.A.R.T.S. Search And Rescue Transponders:


- The purpose of the SART is to indicate the position of persons or vessels in Distress. They operate on 9 Ghz(3 Cm X-Band Radar) and only transmit when interrogated by the SAR vehicles radar when within 5 Nautical miles.
- The transmission produces a distinct line on the radar of about 12 blips extending out from the SART's position along its line of bearing.
- The Interval Between Each Blip Is 0.6 Miles.
- At 1 nautical mile the blips shall change to wide arcs and become complete circles as the SART is close to the interrogated SAR's radar.
- The blip closest to the SAR's radar is the actual location of the SART vehicle.

**Q) Explain the use of Immersion Suits** *(Nov-18)*

Ans:- Immersion suits:-

- SOLAS Chapter III, Reg.22. All passenger ships shall carry for each l/boat on the ship at least 3 "immersion suits" and in addition a "Thermal Protective Aid" (TPA) for every person to be accommodated in the lifeboat and not provided with an immersion suit.
- These immersion suits and TPA need not be carried :
  - for persons to be accommodated in totally enclosed or partial enclosed lifeboats,
  - if the ship is constantly engaged on voyages in warm climates, where in opinion of the Administration, they are unnecessary.

- This is a suit designed to protect the wearer from loss of body heat when immersed in cold waters, and constructed from waterproof materials;
- Shall be able to be unpacked and donned without assistance within 2 minutes;
- Shall cover the whole body with the exception of the face; hands shall be covered unless permanently attached cloves are provided;
- It shall be provided with arrangements to minimise the amount of free air in the legs of the suit to stop the wearer being unbalanced in the water;
- Following a jump into the water from a height of 4.5 metres there is to be no ingress of water into the suit;
- Must be fitted with retro-reflective tape;

**Q) Explain the use of EEBD.** *(Nov-18)*

Ans:- Emergency escape breathing devices (EEBD):-
- An EEBD is a supplied air or oxygen device only used for escape from a compartment that has a hazardous atmosphere and shall be of an approved type.
- EEBDs shall not be used for fighting fires, entering oxygen deficient voids or tanks, or worn by firefighters. In these events, a self-contained breathing apparatus, which is specifically suited for such applications, shall be used.
- The EEBD shall have a service duration of at least 10 min.
- The EEBD shall include a hood or full face piece, as appropriate, to protect the eyes, nose and mouth during escape.
- Hoods and face pieces shall be constructed of flame-resistant materials and include a clear window for viewing.
- An inactivated EEBD shall be capable of being carried hands-free.
- An EEBD, when stored, shall be suitably protected from the environment.
- Brief instructions or diagrams clearly illustrating their use shall be clearly printed on the EEBD. The donning procedures shall be quick and easy to allow for situations where there is little time to seek safety from a hazardous atmosphere.

## WATCHKEEPING EMERGENCIES

**Q) While keeping bridge watch at sea, what action would you take when following alarms are activated: Gyro Failure.** *(Mar-21, Mar-16)*

Ans:- Action in case of Gyro Compass failure:-
1) Inform the Master
2) Change over to 2nd gyrocompass if available, Otherwise, following procedure to be followed.
3) Change over to Hand steering for steering with magnetic compass.
4) Apply Compass deviation value to magnetic compass course with the help Deviation card and observation,
5) Consider effect on other navigational and communication equipment which have a gyro feed especially Radar/ ARPA and ECDIS and enter headings manually.
6) Plot positions more frequently to confirm course made good and accordingly allow correction to course steered. In coastal waters, make good use of parallel indexing technique to keep vessel on charted track.
7) Also secure True course run (Course made good) by plotting GPS position and verify with Heading of Magnetic compass.
8) Reduce speed if considered necessary.
9) In the meantime, to check Instruction Manual for troubleshooting guide.

**Q) Describe the immediate actions to be taken in case of steering failure.** *(Jan-17)* **OR**
**While keeping bridge watch at sea, what action would you take when following alarms are activated: Steering Failure.** *(Mar-21, Mar-16)*

Ans:- Action in case of Steering Gear Failure:
- If on Auto-Steering, the first action is to change over to Hand steering.
- The 1st suspect is 'Telemotor failure'.
- Switch over to other Telemotor 'System' (Marked as System 1 / 2).
- It that still does not solve the problem, the next suspect is the Steering Motor.
- Change from Steering Motor 1 to Steering Motor 2.
- It that still does not solve the problem, next suspect is failure of both telemotor

system.
- Turn the mode selection switch to NFU (non-follow up steering)
- Even if this does not work, it means that all means from steering from the bridge have failed and the last resort of Emergency steering from the Steering gear compartment has to be resorted to.
- After each corrective step, the rudder would have to be tried out. Before doing it, pay heed to traffic around to avoid any Closed Quarter' situation.
- If in restricted waters with traffic around, if steering is not restored immediately,
  - Reduce to Minimum Steerage way.
  - Inform ships around through safety message and burn NUC lights or hoist NUC shapes.
  - Inform Master and the Engine Room.
- Such efficiency can only be achieved by planned and frequent training by simulating steering gear failures.
- Details of drills and their periodicity is strictly laid down in ships training manual.
- Company Superintendents and Surveyors are very particular that these drills are carried out regularly and recorded correctly as per the ISM procedures.

**Q) List the immediate and subsequent actions that you will take in the event of a steering failure in a TSS.** *(Jan-22)*

Ans:- Here are the immediate and subsequent actions that can be taken in the event of a steering failure in a Traffic Separation Scheme (TSS):

Immediate actions:
1. Alert the Master, Engine Room, and the crew.
2. Inform the VTS about the steering failure and seek assistance.
3. Sound the alarm to alert the crew and passengers.
4. Reduce the speed of the vessel or bring it to a stop if necessary.
5. Turn on the emergency steering system, if available.
6. Manually steer the vessel using the emergency tiller or other available steering equipment.
7. Make sure that the engines are in neutral or astern to avoid further collision.

Subsequent actions:
1. Investigate the cause of steering failure and take corrective measures.
2. Repair or replace the faulty steering equipment.
3. Inform the flag state and classification society about the incident.
4. Review and revise the steering gear maintenance plan.
5. Conduct a safety meeting to discuss the incident and take corrective actions.

It is important to note that the actions taken in case of steering failure may vary depending on the specific circumstances of the incident, vessel type, and equipment available onboard.

**Q) How will you know your vessel is dragging anchor?** *(Jan-17, May-16)*

Ans:- Checks to be performed:
- One of the fundamental principles of the anchor watch is to ensure that the vessel does not break her anchor out and drag away from the anchor position. To this end, the weather conditions, state of currents and tides should be continuously

monitored throughout the watch period.
- Normal procedure for the watch officer at anchor would be to regularly verify the ship's position.
- Where dragging is suspected, the ship's position would be expected to change.

Such movement may be ascertained by any or all of the following methods:
1) Check the anchor bearings of the fixed landmarks. These references should be retained on the chart during the period of the anchorage; they should also be entered in the ship's deck logbook. If they are changing, the ship's position is changing and the vessel must be assumed to be dragging.
2) Obtain an immediate positional check from the GPS operation, to ensure that the instrument co-ordinates correspond to the Latitude and Longitude of the ship's anchored position. Any discrepancy in position, the vessel must be assumed to be dragging its anchor.
3) Engage the variable range marker of the ship's radar onto a fixed land object. If the range between ship and landmark opens or closes then the vessel can be assumed to be dragging its anchor.
4) Direct observation and hand contact with the anchor cable may give further indication that the ship is dragging its anchor. A dragging anchor would usually generate excessive vibration through the length of the cable, which could also indicate dragging (depending on the nature of the holding ground).
5) A hand lead over the bridge wing with the lead on the sea bed. If the vessel was dragging its anchor the lead of the line to the lead would stretch forward towards the position of the anchor, indicating that the ship was dragging its anchor.
6) The use of beam transit bearings is also considered as a good indicator that the vessel may be dragging her anchor. However, the use of transits alone should not be accepted as being totally reliable, and would normally be used in conjunction with other methods of ascertaining movement in the ship's position.

**Q) Explain the actions of OOW in case of dragging anchor.** *(Sept-19, May-18, July-17, Jan-16)*

Ans:- Own Ship is Dragging Anchor:-
1) Inform Master.
2) Inform engine room 'This is an emergency, get engines ready as soon as possible and let us know when you are ready. Switch on power to windlass'.
3) Call anchor stations.
4) Call for a messenger on the bridge because the quartermaster would be manning the wheel.
5) Switch on steering motors.
6) Switch on radar/ ARPA.
7) Try out pneumatic whistle and electric klaxon.
8) The VHF would already be on, while at anchor, guarding Channel 16.
9) Keep a record of all happenings, and their timings in the Bridge Notebook.
10) Carry out Master's orders.
11) If the Master is ashore, the Chief Officer would automatically take charge of the situation.
12) In the rate circumstance of both of them being ashore, the Second officer would have to manage. In such a case, the following point would be of great importance:
    a. The length of cable paid out is only to ensure that the pull on the anchor shank, while it is on the sea bed, is horizontal. Once that is assured, paying

out more cable would NOT help.

b. Heaving up anchor, manoeuvring the ship, and re-anchoring should ONLY be a last resort by the Second Officer.

13) Inform harbor control by VHF, 'My ship is dragging anchor. Require a pilot immediately to re-anchor'.

**Q) Describe your actions as the "Officer in charge of Watch" in the following situations: Vessel dragging anchor towards another vessel 2 miles away.** *(July-16, May-16)*

Ans:- Another vessel dragging her anchor onto another vessel:-

1) Sound 'U' on the whistle: This will also attract the attention of other ships, if any, in the vicinity but none of them would know who is sounding the whistle and for whom the signal is intended. The other ships would thus be alerted and become witnesses.
2) Inform Master: On hearing the whistle, the Master of the own ship would rush to the bridge.
3) Call up the other ship by VHF. At this close range, the other ship's name wold be clearly visible. Inform him that he is dragging anchor on to us.
4) Call anchor stations urgently.
5) Switch on radar/ ARPA.
6) Keep a record of all happenings, and their timings in the Bridge Notebook.
7) Carry out Master's orders.

**Q) Describe your actions as the "Officer in charge of Watch" in the following situations: Fire in Engine room.** *(Mar-21, Dec-20, May-18, Sept-17, July-16)*

Ans: - Action in case of Engine Room fire at sea:-

1) Raise the alarm.
2) Inform the master
3) Reduce the vessels speed & engage manual steering. Display NUC (NOT UNDER COMMAND) lights, Weather reports, open communication with other vessels in the vicinity and send urgency signal.
4) Close all ventilation, fire and watertight doors.
5) Muster all crew- take a head count. Emergency fire p/p running.
6) Isolate all electrical units. Commence boundary cooling.
7) Fight fire by conventional means.
8) Main fire party to be properly equipped. Back up party ready at all times.
9) C/O not to enter as he monitors progress and communication with the bridge. Proper communication between bridge and engine room. Keep bridge informed accordingly of sequence of events.
10) At all times fire fighters to be well equipped with breathing apparatus and fireman suit. Checks on apparatus must be carried out prior to entering space.

**Q) What are the immediate and subsequent actions of an OOW in case of a fire that starts in the Engine Room while the vessel is out at sea. Assume you are on a general cargo vessel and the fire gets Out of Control.** *(Aug-21) (25 Marks)*

Ans:- In the event of a fire in the Engine Room, the OOW should take immediate and

subsequent actions to ensure the safety of the vessel and all personnel on board. The following are the key steps that the OOW should take:

Immediate Actions:

- Raise the alarm: The OOW should immediately raise the alarm to alert the crew and the Master. The alarm should be sounded in accordance with the ship's procedures and should be audible throughout the vessel.
- Shut down ventilation systems: The OOW should immediately order the shutdown of all ventilation systems to prevent the spread of smoke and fire to other parts of the vessel.
- Deploy firefighting team and equipment: The OOW should deploy the ship's firefighting team and equipment to the Engine Room to control the fire. The team should be equipped with fire extinguishers, hoses, and other firefighting equipment.
- Activate emergency fire pumps: The OOW should activate the ship's emergency fire pumps and fire extinguishing systems to assist in controlling the fire.
- Prepare for abandon ship: The OOW should prepare to abandon ship if the situation becomes uncontrollable. This includes ensuring that all crew members are wearing appropriate personal protective equipment and have access to life-saving equipment.

Subsequent Actions:

- Activate distress alert and Mayday call: If the fire becomes out of control, the OOW should activate the ship's distress alert and initiate a Mayday call to nearby vessels and shore-based authorities.
- Initiate evacuation: The OOW should initiate an evacuation of all personnel on board to the designated life-saving appliances. This includes ensuring that all crew members are wearing appropriate personal protective equipment and have access to life-saving equipment.
- Deploy life rafts and life-saving equipment: The OOW should deploy the ship's life rafts and other life-saving equipment as necessary.
- Maintain a safe distance: The OOW should maintain a safe distance from the burning vessel and await the arrival of rescue vessels.
- Provide regular updates: The OOW should provide regular updates to the relevant authorities on the status of the situation. This includes providing updates on the crew's status, the condition of the vessel, and any actions that have been taken to control the fire.

In conclusion, the OOW's primary responsibility is to ensure the safety of all personnel on board and take all necessary actions to control the fire and prevent its spread. This includes implementing the necessary firefighting procedures, deploying firefighting teams and equipment, preparing for abandon ship, and providing regular updates to the relevant authorities.

**Q) Your vessel, an oil tanker, suffers fire in the pump room while at anchor. Explain your actions in details with the help of a suitable checklist.** *(Jan-21, March-19, Sept-18)*

Ans:- Fire in the Engine Room / Pump room in Port:-

1) Shout 'Fire in the engine room/ Pump room' loudly many times.
2) Have the ship's fire alarm sounded.
3) Announce the location of the fire to the ship's staff, via the PAS (Public Address System).

4) Establish portable VHF contact with the Master and the Chief Officer. (On modern ships, whilst in port, the Master, Chief Officer and the OOW have their portable VHF sets on all the time, switched to a common channel referred to as the internal working of the ship).
5) Have the port fire brigade informed, either by the telephone of by VHF.
6) Inform the Port Control by VHF or telephone.
7) Have the company's agents informed by telephone. In many ports, a telephone is available at the head of the gangway itself. If not, the call may be made through the VHF itself.
8) Carry out Master's orders. Orders, such as those listed below, should be anticipated by the OOW (Officer On Watch) and, if and when necessary, he should remind the Master. In the interests of overall efficiency, most Masters would welcome such reminders from the OOW so long as they are given respectfully, tactfully and at the proper time.
9) If the Master is ashore, the Chief Officer would take charge.
10) In the very rate circumstance of both, the Master and the Chief Officer, being ashore at this time, the Second Officer would have to manage until one of them comes back. Most companies have standing orders that the Master and the Chief Officer must not go ashore at the same time.
11) In any case, since the fire is in the engine room, the senior most engineer on board at that time – Chief Engineer, Second Engineer or the EOW (engineer on watch) – would take charge of the fire fighting at the scene of the fire. Their intimate knowledge of the layout of the equipment in the engine room is invaluable.
12) The EOW would commence fighting the fire as soon as it is detected – try to extinguish it right away by using all appropriate means – extinguishers, water jet or water spray.
13) Port control may insist on towing the ship out to anchorage in case they feel that other ships nearby and/ or the port itself may be endangered.
14) If the fire cannot be effectively tackled within the first fifteen minutes or so, it may be prudent to flood the space with $CO_2$. Total flooding $CO_2$ has a high success rate in extinguishing fires in the engine room.
15) The procedure to inject $CO_2$ into the Engine Room would broadly fall into four heads:-
    a. Evacuate all personnel inside.
    b. Trip quick closing valves.
    c. Seal off all sources of inlet of air.
    d. Release $CO_2$.
    e. Effect boundary cooling if necessary.
16) Evacuation of personnel:-
    a. The order to evacuate the ER should be shouted locally and, if possible, announced on the PAS.
    b. As soon as the persons inside have come out, the entrance doors should be effectively shut. This is to prevent:
        i. Air from entering the ER.
        ii. Smoke from the ER from coming into the accommodation.
        iii. $CO_2$ when released, from coming into the accommodation.
    c. A sentry should be posted at each entrance to the ER to restrain any persons from entering the ER without specific permission from the person designated for this purpose – normally the Chief Engineer. If any person is given such permission, the sentry should note the names and timings, in and out. A head count / tally should be taken of all ship's staff outside to ensure that there is nobody left in the ER. This is very important because any person left

inside would certainly lose his life when $CO_2$ is injected.

17) Tripping of quick closing valves:
   a. All oil storage tanks in the ER would have quick closing valves operable from outside the ER. Once these valves are closed, outflow of oil from storage tanks is prevented. All running machinery would, as a result of this, come to a stop. Also, if any pipeline now gets breached due to any cause, the contents of the tank would not empty into the ER. Inadvertent feeding of the fire would thus be averted.
   b. Tripping levers of quick closing valves would be in a steel box located outside the ER, in a suitable place like the accommodation or the boat deck. The box would be covered by a glass panel.
   c. Each lever would be labeled indicating which tank it pertains to. Operation would involve breaking the glass and pulling the appropriate lever. In case of fire, it would be prudent to pull all the levers inside.
   d. For testing purposes, the panels may opened, without breaking the glass, by using a key kept with the Chief Engineer or the Second Engineer.

18) Sealing off air inlets to Engine Room:
   a. Switch off the blowers of the ER.
   b. Shut the WT door between the ER and shaft tunnel. This may be done from the ER itself and also a point outside the ER with an indicator clearly showing whether the door is open or shut.
   c. The doors leading from the deck/ accommodation have already been shut, and sentries posted, as part of the procedure for evacuation of personnel.
   d. If skylights are provided for the ER, shut and screw them down tight. Most ships of today do not have openable skylights.
   e. Shut the fire dampers on the ventilator coamings leading to the ER.
   f. Shut the inlets of the blowers are running because of automatic electric supply from the emergency generator, switch them off before shutting their intakes.
   g. Shut the funnel flaps- ventilation outlets fitted in or on the funnel.
   h. Close the door leading into the funnel.
   i. The engine room should now be effectively sealed off against entry of air.

19) Release of $CO_2$ into the engine room:
   a. Break glass of the panel and take out the key inside.
   b. Use that key to open steel panel.
   c. Alarm will sound in ER warning all persons to come out of ER.
   d. Pull lever marked 'ER Master valve'.
   e. On specific orders of the Master, pull lever marked '$CO_2$'.

**Q) Describe actions to be taken as OOW in case of FIRE in the cargo hold of your vessel when vessel is: In Port** *(Jan-20, March-18, Nov-16)*

Ans:- Fire in a Cargo Hold: In Port:- Fire in a cargo hold indicates that the ship is a dry cargo ship and not a tanker.

1) Shout 'Fire' many times.
2) Sound the fire alarm. While the crew is scrambling to fire stations, the OOW can initiate communications with various authorities.
3) Announce the location of the fire on the PAS (Public Address System) of the ship.
4) Establish contact with the Master and the Chief Officer by portable VHF.
5) Stop cargo operations in that hold and evacuate all persons from it as soon as possible.

6) Cargo work in other holds would come to a stop automatically and the stevedores would come up on deck owing to their curiosity. If and when that happens send all those persons also ashore.
7) Have the port fire brigade informed, either by telephone or by VHF.
8) Inform the port control by VHF or telephone.
9) Carry out Master's orders. Orders, such as those listed below should be anticipated by the OOW and if an when necessary, he should remind the master. In the interests of overall efficiency, most Masters would welcome such reminders from the OOW so long as they are given respectfully, tactfully and at the proper time.
10) If the Master is ashore, the chief officer would take charge. In the very rare circumstance of both the Master and the Chief Officer, being ashore at this time, the Second Officer would have to manage until one of them comes back.
11) Have the company's agents informed by telephone. In many ports, a telephone is available at the head of the gangway itself. If not, the call may be made through the VHF itself.
12) Switch off the inlet blowers of the hold, in case they are on. If there is too much smoke, it may be useful to switch on one blower in the exhaust mode so that the crew could tackle the fire locally. This would, no doubt, cause air to enter the hold. The OOW would have to use his discretion at that time, depending on the nature extent and accessibility of the seat of fire.
13) Fight the fire immediately – try to extinguish it right away by using appropriate extinguishers or a well-aimed fire hose.
14) Take care to avoid undue water damage to other cargo in the hold. Cases have been known where the water used to fight a fire caused more damage than the fire itself might have done!
15) Port control may insist on towing the ship out to anchorage in case they feel that other ships nearby and/or the port itself may be endangered.
16) Hopefully, the above situation would be avoided by either extinguishing the fire or bringing it under control by injecting $CO_2$ before the tugs arrive.

*Assuming that the actions already taken have not been entirely successful*:
17) Shut off the exhaust blower of that hold, in case it is on.
18) Close the hatch and batten it down.
19) Make sure that there is nobody inside the hold. Seal off the entrance and post a sentry there to prevent anyone from going inside. This is a very important because somebody may go inside, without the knowledge of the OOW and subsequently lose his life when $CO_2$ is injected.
20) Shut the fire dampers on the ventilator coamings of that hold.
21) Inject $CO_2$ into the hold.
22) In case any boundary of the hold is getting warm, cool it by spraying water from the fire main, wherever practicable.
23) After injecting CO2 into hold, it is **NOT** advisable TO OPEN THE HATCH UNTIL The Master specifically decides to so.

**Q) Describe actions to be taken as OOW in case of FIRE in the cargo hold of your vessel when vessel is: At sea** *(July-19, Nov-16)*

Ans:- Fire in a Cargo Hold: At Sea:- Fire in a cargo hold indicates that the ship is a dry cargo ship and not a tanker. Fire in a cargo hold, whilst out at sea, would normally be detected by the Smoke Detector Unit on the bridge. Also, smoke would be seen to come out from the ventilators.

For illustration purposes, let's assume that fire is in No: 2 hold containing general

cargo.
1) Sound the alarm.
2) Shut off the blowers of that hold.
3) Announce on the PAS (Public Address System), 'Fire in No: 2 Hold.'
4) Mark the position quickly, for future reference, by passing the 'Man overboard' button on the GPS receiver. Such a button is available on most types of receivers.
5) The Master would come rushing to the bridge after hearing the fire alarm, possibly before the announcement on the PAS.
6) Inform the Engine room, 'Fire in no:2 cargo hold. Open water on deck'.
7) Mark the own ship's position, by a cross on the chart, for ready reference by the Master. Clearly write the latitude, longitude, ship's time and UTC of the incident.
8) Consult Master whether to change over to hand steering.
9) Keep a record of all events, and their timings, in the Bridge Notebook.
10) Entries in the Mate's Logbook should be made at a subsequent, convenient time.
11) Carry out Master's orders. Orders, such as those listed below should be anticipated by the OOW and, if and when necessary, he should remind the Master.
12) Communications officer to send 'Urgency Signal".
13) The ship's staff would go about their respective fire stations:-
    a. The Third Officer would be on the bridge assisting the Master.
    b. The Second Officer would be in charge of the Boat Deck Party getting all the boats swung out, brought to the embarkation deck and prepared for lowering.
    c. The Chief Officer would be in charge of the Attack Party at the seat of the fire.

**Q) Describe the precautions and actions to be taken on detecting a galley fire while at sea.** *(Nov-20)*

Ans:- Immediate action: The chances of success in any firefighting operation is best in the first few minutes, before the fire spreads. The person who detects the fire first should raise the alarm and also fight it right away with all available, appropriate means. The actions are elaborated below.

Further actions to be taken are:
1) Shout 'Fire in the galley' loudly many times.
2) Have the ship's fire alarm sounded.
3) Announce the location of the fire, to the ship's staff, via the PAS (Public Address System).
4) Inform the Port Control by VHF or telephone.
5) Have the company's agents informed by telephone.
6) Carry out Master's orders. Orders, such as those listed below, should be anticipated by the OOW (Officer on Watch) and, if and when necessary, he should remind the Master. In the interests of overall efficiency, most Masters would welcome such reminders from the OOW so long as they are given respectfully, tactfully and at the proper time.
7) If the cause is an electrical short circuit, the action should be:
    a. Switch Off power supply to the equipment or if necessary, to the entire galley.
    b. Use an appropriate extinguisher – either a $CO_2$ or a dry powder type.
8) If it is liquid on fire – oil or cooking fat – a foam extinguisher should be used.
9) If oily rags are on fire, any extinguisher or just water would do.
10) The use of blankets, provided as per of fire fighting equipment for the galley, for the purpose of smothering the fire should be considered.
11) If the fire cannot be effectively tackled within the first five minutes or so, it

would be prudent to tackle it as a full-scale operation. This exercise is well covered in fire fighting courses:

a. Evacuate any persons inside.
b. Shut off exhaust blowers of the galley.
c. Seal off all sources of inlet of air – portholes, entrance doors, etc.
d. Use a water spray through a porthole or an entrance door.
e. Effect boundary cooling if necessary.

**Q) Describe your actions as the "Officer in charge of Watch" in the following situations: Collision with another vessel.** *(Oct-20, March-20, Aug-16)*

Ans:- Collision at sea:- The first four duties mentioned below are extremely urgent and must be executed in very quick sequence.

1) Stop engine.
2) Mark the position quickly, for future reference, by pressing the 'Man overboard' button on the GPS receiver. Such a button is available on most types of receivers.
3) Inform engine room:
    a. We have collided with another ship.
    b. I am sounding the General Alarm purely as a precaution.
    c. Keep engine room watch keepers below until further orders.
    d. Sound all tanks and bilges of engine room.
    e. Report any leak or damage as soon as it is noticed.
4) Sound the General Alarm – the Master will rush to the bridge on hearing this so there is no need to inform him separately. The rest of the ship's company, except the engine room watch keepers, would rush to the boat deck.
5) Change over to hand steering.
6) Switch on ARPA/ Radar if not already on.
7) If possible, read the name and port of registry of the other ship. The use of the daylight signaling lamp would be necessary during darkness.
8) If night time, switch on floodlights on deck.
9) Mark the own ship's position by a cross on the chart, for ready reference by the Master. Clearly write the latitude, longitude, ship's time and UTC of the collision. These particulars will be required for sending out radio messages later on.
10) Display NUC signal – by day: two black balls. By night: two all round red lights in lieu of the masthead lights. The side lights and the stern light should be switched off only after the ship has completely lost all headway.
11) Keep a record of all events, and their timings, in the Bridge Notebook.
12) Entries in the Mate's Logbook should be made at a subsequent, convenient time.
13) Carry out Master's orders. Orders, such as those listed below, should be anticipated by the OOW and if and when necessary, he should remind the Master. In the interest of overall efficiency, most Masters would welcome such reminders from the OOW so long as they are given respectfully, tactfully and at the proper time.
14) Communications officer to send 'Urgency Signal".

**Q) Your vessel ran aground, enumerate the action to be taken.** *(Jan-17)* **OR** ***Describe the duties of a OOW after your vessel an oil tanker has run aground?*** *(Sept-19, Nov-18, May-18)*

Ans:- Vessel Ran Aground:-

1) Stop Engine.
2) Sound the General Alert.
3) Announce on the Public Address System (PAS), 'Our Ship has run aground'.
4) The Master will rush to the bridge on hearing 2 & 3 above. This saves the time required to inform him by telephone.
5) Mark the position quickly, for future reference, by pressing the 'Man overboard' button on the GPS receiver. Such a button is available on most of receivers.
6) Inform engine room:
    a. Vessel has run aground.
    b. Change over to higher sea suction.
    c. Sound all tanks and bilges of engine room.
    d. Report any leak or damage as soon as it is noticed.
7) Switch steering from auto to manual.
8) If the ship has a log sensor unit protruding below the hull, retract it.
9) Display signal for vessel aground.
10) Mark the own ship's position, by a cross on the chart, for ready reference by the Master. Clearly write the latitude, longitude, ship's time and UTC of the incident. These particulars will be required for sending out radio messages later on.
11) Keep a record of all events, and their timings, in the Bridge Notebook.
12) Entries in the Ship's Logbook should be made at a subsequent, convenient time.
13) Carry out Master's orders. Orders, such as those listed below, should be anticipated by the OOW and, if and when necessary, he should remind the Master.
14) Render first aid to any persons on board who may have suffered injuries – the sudden arrest of the ship's movement may have caused them to lose their balance and get hurt.
15) Communications officer to send 'Urgency Signal".
16) One seaman and a cadet (if there is no cade on board, then another seaman) to sound all tanks and bilges and report. A report should come to the bridge, by portable VHF, as soon as each sounding is obtained.
17) The OOW should have the Tank and Bilge Sounding Book brought to the bridge for reference.
18) As soon as each sounding is obtained, the OOW should note it down in the bridge notebook, compare it with the last recorded sounding of the bilge or tank and then report the sounding and its variation to the Master.
19) Two examples of the entry to be made in the Bridge Notebook, immediately after a sounding report is received, and the oral report to be made to the Master by the OOW soon thereafter.
20) One nautical officer to read the draft forward and aft and report to the bridge.
21) The drafts reported should be noted in the Bridge Notebook.
22) Start pumping out water from those water tanks and bilges where the sounding has increased.
23) If pumping out does not cause any change of sounding, it means that the compartment is bilged.
24) If the sounding drops while pumping out, but increases thereafter, it means that there is a leak into the compartment – pumps could ensure buoyancy from that compartment and consequent decrease of mean draft and change of trim.
25) Carry out the procedures contained in SOPEP of the ship.
26) Further actions will be to:
    a. Ensure safety of life of those on board.
    b. Limit any further damage to ship.
    c. Minimize environmental pollution.

d. Refloat the ship.

27) Subsequent action will depend on the prevailing circumstances.

**Q) Describe the responsibility of the OOW in the following circumstances: Action on receiving storm warning.** *(Jan-21, March-18, March-16)*

**Q) Explain your action as Bridge Watch keeping officer under following circumstances: Vessel at sea starts encountering gale force winds.** *(Sept-19, May-18)*

Ans:- Actions on receiving storm warning:-

1) Prepare for the onset of stormy weather with strong winds.
2) Inform Master.
3) Inform Chief Officer.
4) Inform Catering Staff.
5) Inform Engine Room.
6) Secure all movable equipment on the bridge.
7) Switch on ARPA and commence plotting.
8) Switch on navigation lights. Later on, clouds may result in partial darkness; rain and/or spray may result in decrease of visibility.
9) Switch on second steering motor also.
10) Try out pneumatic whistle, electric klaxon and also foghorn.
11) Keep a record of all relevant actions/ events in the Bridge Notebook.
12) Inspect the chart and ensure that the intended course is safe bearing in mind the following points:
    a. More under keel clearance would be required because of pitching, rolling and heaving.
    b. The ship would be more difficult to manage in bad weather and hence it may be necessary to give dangers a wider berth than in calm weather.
    *c.* Failure of main engine, failure of generators, failure of steering systems, etc, in bad weather, as some of the possibilities that must not be overlooked.

**Q) List the duties and responsibilities of a navigation watch-keeper while vessel is navigation in: Restricted waters / Coastal Waters** *(Nov-20, Oct-20, March-19, Jan-18)*

Ans:- The maneuvering characteristics of the ship and any limitations or peculiarities that the ship may have, including reliability problems with its propulsion and steering systems, may influence the route selected through coastal waters.

Mentioned below are the duties and responsibilities:-

- In shallow water, particularly if the ship is operated at speed, ship squat needs to be observed as it can reduce under keel clearances.
- Ships' routing schemes and reporting systems along the route, as well as vessel traffic services, should be taken into account.
- Coastal weather bulletins, including gale warnings and coastal navigational warnings broadcast by coast radio stations and NAVTEX, may require changes to be made to the route plan.

*Monitoring the route plan*:-

- It is important that when a route is planned through coastal or restricted waters, due consideration is given to ensuring that the progress of the ship can be effectively monitored.
- Of particular importance is the need to monitor the position of the ship

approaching the wheel over position at the end of a track, and checking that the ship is safely on the new track after the alteration of course.
- Distinctive chart features should be used for monitoring the ship's position visually, by radar and by echo sounder, and therefore need to be an integral part of the route plan.

*Visual monitoring techniques*:-
- Ahead, transits can provide a leading line along which a ship can safely steer. Abeam, transits provide a ready check for use when altering course. At anchor, several transits can be used to monitor the ship's position.
- Bearing lines can also be effectively used. A head mark, or a bearing line of a conspicuous object lying ahead on the track line, can be used to steer the ship, while clearing bearings can be used to check that a ship is remaining within a safe area.

**Q) Your X-band radar picks up a SART signal. What actions will you take as OOW and how is your vessel expected to respond to this situation?** *(July-21)*

Ans:- As the Officer on Watch (OOW) on a vessel, if my X-band radar picks up a SART (Search and Rescue Transponder) signal, I would take the following actions:
1. Verify the signal: Firstly, I would verify that the signal is indeed from a SART and not from any other source such as a radar reflection, radio transmission, or other electronic equipment.
2. Alert the crew: I would immediately alert the bridge team and the rest of the crew that a SART signal has been detected.
3. Initiate search and rescue procedures: I would immediately initiate search and rescue procedures as per the vessel's procedures and contact the relevant authorities for assistance if required.
4. Locate the source of the signal: I would use the vessel's radar and other navigational equipment to locate the source of the SART signal and determine the vessel or person in distress.
5. Maintain a safe speed and course: I would maintain a safe speed and course while carrying out the search and rescue procedures, and ensure that the vessel is prepared to render assistance as required.

In response to this situation, the vessel is expected to:
1. Maintain a listening watch: The vessel is expected to maintain a continuous listening watch on the VHF radio and other communication equipment to receive any distress call or message from the vessel in distress.
2. Proceed to the location: If the vessel is able to proceed to the location of the SART signal without endangering the vessel or crew, the vessel is expected to do so and render assistance as required.
3. Report to relevant authorities: The vessel is expected to report the detection of the SART signal and the actions taken to the relevant authorities such as the Coast Guard, Port Authority or other rescue coordination centers.
4. Cooperate with other vessels: If other vessels are in the vicinity, the vessel is expected to cooperate with them and coordinate the search and rescue operations.
5. Overall, detecting a SART signal is a serious matter and requires immediate action by the OOW and the vessel to ensure the safety of the persons or vessels in distress.

**Q) While on watch, bunker operations are in progress. Should an oil spill occur, what action will you take as OOW?** *(July-21)*

Ans:- If an oil spill occurs during bunker operations while I am on watch as OOW, I would take the following actions:

1. Notify the master: I would immediately inform the master of the spill and provide a detailed report on the extent and nature of the spill.
2. Initiate emergency response procedures: I would initiate the vessel's emergency response procedures, including activating the spill response team and implementing the spill response plan.
3. Contain the spill: I would take immediate steps to contain the spill by deploying booms or other containment devices around the spill area, and directing the bunker crew to take action to stop the flow of oil if possible.
4. Minimize the impact: I would take steps to minimize the impact of the spill on the environment by directing the spill response team to deploy appropriate cleanup equipment and materials, such as skimmers, absorbents, or dispersants.
5. Document the spill: I would ensure that accurate records of the spill, including its location, extent, and any response actions taken, are documented in the vessel's logbook and reported to relevant authorities as required by regulations.

Overall, in the event of an oil spill during bunker operations, my priority as OOW would be to take immediate action to contain the spill, minimize its impact on the environment, and ensure that appropriate response procedures are followed in accordance with applicable regulations and best practices.

**Q) State your actions on receiving a distress alert on VHF DSC channel 70.** *(Sept-21, July-21)*

Ans:- If I receive a distress alert on VHF DSC channel 70, my actions as the officer on watch would be as follows:

1. Acknowledge the distress alert: I would acknowledge the receipt of the distress alert by transmitting a DSC acknowledgement message, using the appropriate format and coding, to confirm to the distressed vessel that their alert has been received.
2. Confirm the nature and location of the distress: I would use VHF radio to contact the distressed vessel and attempt to confirm the nature and location of the distress. If the vessel is unable to communicate effectively or is out of range, I would attempt to triangulate the position of the distress using any available information, such as the vessel's MMSI number, the time of the distress alert, or any other relevant data.
3. Initiate appropriate response: Based on the nature and location of the distress, I would initiate the appropriate response, which may involve notifying the master, activating the vessel's emergency response procedures, or coordinating with other vessels or authorities in the area.
4. Maintain communication with the distressed vessel: I would maintain communication with the distressed vessel, providing assistance and support as required, and providing regular updates on the progress of the response.
5. Document the incident: I would ensure that accurate records of the incident, including all communication, response actions taken, and any other relevant details, are documented in the vessel's logbook and reported to relevant authorities as required by regulations.

Overall, my priority in response to a distress alert on VHF DSC channel 70 would be

to acknowledge the alert, confirm the nature and location of the distress, initiate an appropriate response, maintain communication with the distressed vessel, and document the incident in accordance with applicable regulations and best practices.

**Q) While keeping Bridge watch at sea, list actions would you take when following alarms are activated: Fire Alarm** *(Nov-21)*

Ans:- Fire Alarm:

1. Immediately inform the Master and Chief Engineer about the fire alarm activation.
2. Take immediate action to locate the source of fire by checking the fire detection panel and CCTV system.
3. Alert the crew members and assign them duties to extinguish the fire as per the Fire Fighting Plan.
4. Inform the Engine Room to stop the ventilation system and close the fire dampers.
5. Activate the general alarm to alert the entire crew.
6. Use the fire extinguishing system to contain the fire if required.
7. Contact the nearest coastal station or ship in the vicinity for assistance.
8. Prepare to abandon ship if the fire cannot be contained.

**Q) While keeping Bridge watch at sea, list actions would you take when following alarms are activated: Gyro Failure** *(Nov-21)*

Ans:- Gyro Failure:

1. Inform the Master and the Chief Officer about the gyro failure.
2. Switch to the standby gyro compass and align it with the standard compass.
3. Verify the accuracy of the standby gyro compass with celestial observations, if possible.
4. Check the other navigational equipment such as GPS, AIS, and radar for position and course information.
5. Inform the Engine Room to start the steering gear pumps and change over to manual steering if required.
6. Arrange for the repair of the gyro compass at the next port of call.
7. Notify the relevant authorities and flag state about the gyro failure and corrective actions taken.

**Q) While keeping Bridge watch at sea, list actions would you take when following alarms are activated: VHF DSC Distress Alert** *(Nov-21)*

Ans:- VHF DSC Distress Alert:

1. Acknowledge the distress alert by pressing the "DISTRESS ACKNOWLEDGE" button on the VHF radio.
2. Inform the Master and other bridge team members about the distress alert and the vessel's position.
3. Check the identity of the vessel in distress and its position using the AIS, radar, and other navigational equipment.
4. Attempt to establish communication with the vessel in distress on VHF Channel 16 and offer assistance.
5. Inform the relevant coastal authorities and flag state about the distress alert and any actions taken.
6. Monitor the progress of the rescue operation and offer any further assistance

required.

# MANOEUVERING

**Q) With simple diagrams, describe briefly: Maneuvering data displayed on the Bridge.** *(April-21, Jan-21, May-18)*

**OR**

**Describe the maneuvering data displayed in the Wheelhouse Poster & the Pilot Card.** *(March-20, Sept-19, May-19, Nov-17, July-17, Jan-16)*

Ans:- Provision and Display of Maneuvering Information on Board Ships:

THE ASSEMBLY,

RECALLING Article 15(j) of the Convention on the International Maritime Organization concerning the functions of the Assembly in relation to regulations and guidelines concerning maritime safety.

RECALLING ALSO that it adopted by resolution A. 209(VII) the Recommendation on information to be included in the Maneuvering Booklets in order to ensure uniformity of such information on board ship.

NOTING the importance attached to further enhancement of the safety of navigation.

RECOGNIZING CONSIDERED the recommendation made by the Maritime Safety Committee at its fifty-third session:

1) ADOPTS the Recommendation on the provision and the Display of Manoeuvring Information on Board Ships, as set out in the Annex to the present resolution, which supersedes the Recommendation adopted by resolution A.209 (VII);
2) INVITES all Governments concerned to the steps to give effect to the Recommendation as soon as possible.
3) REQUESTS the Maritime Safety Committee to keep the Recommendation under review for the purpose of improvement based on new developments in techniques and in the light of experience gained in its application.

ANNEX

RECOMMENDATION ON THE PROVISION AND THE DISPLAY OF MANOEUVRING INFORMATION ON BOARD SHIPS

1) INTRODUCTION
   a) In pursuance of the Recommendation on data Concerning Manoeuvring Capabilities and Stopping Distances of Ships, adopted by resolution A.160(ES.IV), and paragraph 10 of regulation II/1 of the International Convention on Standards of Training, Certification and Watchkeepoing for Seafarers, 1978. Administrations are recommended to require that the manoeuvring information given herewith is on board and available to navigators.
   b) The manoeuvring information should be presented as follows:
      1) Pilot card
      2) Wheelhouse poster
      3) Manoeuvring booklet

2) APPLICATION:
   a) The Administration should recommend that manoeuvring information, in the form of the models contained in the appendices, should be provided as follows:

1) For all new ships to which the requirements of the 1974 SOLAS Convention, as amended, apply, the pilot card should be provided.
2) For all new ships of 100 metres in length and over, and all new chemical tankers and gas carriers regardless of size, the pilot card, wheelhouse poster and manoeuvring booklet should be provided.

b) The administration should encourage the provision of manoeuvring information on existing ships and ships that my pose a hazard due to unusual dimensions or characteristics.
c) The manoeuvring information should be amended after modification or conversion of the ship which may alter its manoeuvring characteristics or extreme dimensions.

3) MANOEUVRING INFORMATION:-

1. Pilot card (appendix 1)**:-** The pilot card, to be filled in by the master, is intended to provide information to the pilot on boarding the ship. This information should describe the current condition of the ship, with regard to its loading, propulsion and manoeuvring equipment, and other relevant equipment. The contents of the pilot card are available for use without the necessity of conducting special manoeuvring trials.

2. Wheelhouse poster (appendix 2):- The wheelhouse poster should be permanently displayed in the wheelhouse. It should contain general particulars and detailed information describing the manoeuvring characteristics of the ship, and be of such a size to ensure ease of use. The manoeuvring performance of the ship may differ from that shown on the poster due to environmental, hull and loading conditions.

3. Manoeuvring Booklet (appendix 3):- The manoeuvring booklet should be available on board and should contain comprehensive details of the ship's manoeuvring characteristics and other relevant data. The manoeuvring booklet should include the information shown on the wheelhouse poster together with other available manoeuvring information. Most of the manoeuvring information in the booklet can be estimated but some should be obtained from trials. The information in the booklet may be supplemented in the course of the ship's life.

Res. A.601(15)

## APPENDIX 1

## PILOT CARD

Ship's name _____ Date _____

Call sign _____ Deadweight _____ tonnes Year built _____

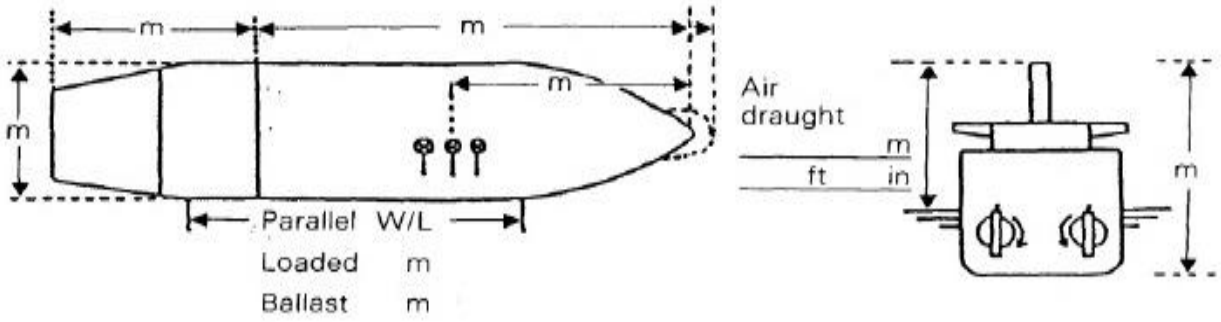
Draught aft _____m/____ft ____in, Forward _____m/____ft ____in, Displacement _____tonnes

SHIP'S PARTICULARS

Length overall _____m, Anchor chain: Port _____shackles, Starboard _____shackles,

Breadth _____m Stern _____shackles

Bulbous bow Yes/No (1 shackle = _____m/_____fathoms)




Type of engine _____ Maximum power _____kW (_____HP)

| Manoeuvring engine order | Rpm/pitch | Speed (knots) | |
|---|---|---|---|
| | | Loaded | Ballast |
| Full ahead | | | |
| Half ahead | | | |
| Slow ahead | | | |
| Dead slow ahead | | | |
| Dead slow astern | | Time limit astern _____min | |
| Slow astern | | Full ahead to full astern _____s | |
| Half astern | | Max. no. of consec. starts _____ | |
| Full astern | | Minimum RPM _____ _____knots | |
| | | Astern power _____% ahead | |

Res. A.601(15)

APPENDIX 1 *(continued)*

STEERING PARTICULARS

Type of rudder _____ Maximum angle _____ °

Hard-over to hard-over _____ s

Rudder angle for neutral effect _____ °

Thruster: Bow _____ kW (_____ HP) Stern _____ kW (_____ HP)

CHECKED IF ABOARD AND READY

Anchors ☐

Whistle ☐

Radar ☐ 3 cm ☐ 10 cm

ARPA ☐

Speed log ☐ Doppler: Yes/No

- Water speed ☐
- Ground speed ☐
- Dual-axis ☐

Engine telegraphs ☐

Steering gear ☐

Number of power units operating ☐

Indicators:

- Rudder ☐
- Rpm/pitch ☐
- Rate of turn ☐

Compass system ☐

Constant gyro error ± _____ °

VHF ☐

Elec. pos. fix. system ☐

Type _____

OTHER INFORMATION:

APPENDIX 2

Res. A.601(15)

## WHEELHOUSE POSTER

Ship's name _____, Call sign _____, Gross tonnage _____, Net tonnage _____

Max. displacement _____tonnes, and Deadweight _____tonnes, and Block coefficient _____ at summer full load draught

Draught at which the manoeuvring data were obtained

| Loaded | Ballast |
|---|---|
| Trial/Estimated | Trial/Estimated |
| ___m forward | ___m forward |
| ___m aft | ___m aft |

### STEERING PARTICULARS

Type of rudder(s) _____

Maximum rudder angle _____°

Time hard over to hard-over
- with one power unit _____s
- with two power units _____s

Minimum speed to maintain course propeller stopped _____ knots

Rudder angle for neutral effect _____°

### ANCHOR CHAIN

| | No. of shackles | Max. rate of heaving (mm/shackle) |
|---|---|---|
| Port | | |
| Starboard | | |
| Stern | | |

11 shackle = ____m/____fathoms)

### PROPULSION PARTICULARS

Type of engine _____, ___kW (___HP). Type of propeller _____

| Engine order | Rpm/pitch setting | Speed (knots) Loaded | Ballast |
|---|---|---|---|
| Full sea speed | | | |
| Full ahead | | | |
| Half ahead | | | |
| Slow ahead | | | |
| Dead slow ahead | | | |
| Dead slow astern | | Critical revolutions ___rpm<br>Minimum rpm ___ ___knots | |
| Slow astern | | Time limit astern ___min | |
| Half astern | | Time limit at min. revs ___min<br>Emergency full ahead to full astern ___s | |
| Full astern | | Stop to full astern ___s<br>Astern power ___% ahead<br>Max. no. of consecutive starts ___ | |

### THRUSTER EFFECT at trial conditions

| Thruster | kW (HP) | Time delay for full thrust | Turning rate at zero speed | Time delay to reverse full thrust | Not effective above speed |
|---|---|---|---|---|---|
| Bow | | s | °/min | min s | knots |
| Stern | | s | °/min | min s | knots |
| Combined | | s | °/min | min s | knots |

### DRAUGHT INCREASE (LOADED)

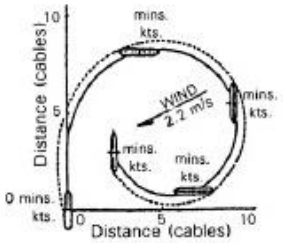
| Estimated Squat Effect | | | Heel Effect | |
|---|---|---|---|---|
| Under keel clearance | Ship's speed (knots) | Max. bow squat estimated (m) | Heel angle (degree) | Draft increase (m) |
| m | | | 2 | |
| | | | 4 | |
| | | | 8 | |
| m | | | 12 | |
| | | | 16 | |

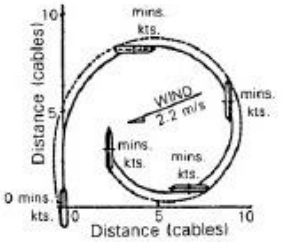
APPENDIX 2 (continued)

Res. A.601(15)

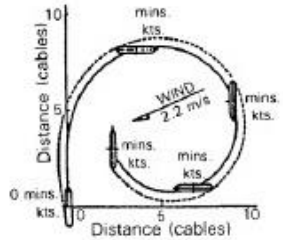
## TURNING CIRCLES AT MAX. RUDDER ANGLE

LOADED Water depth/draught ratio = 1.2



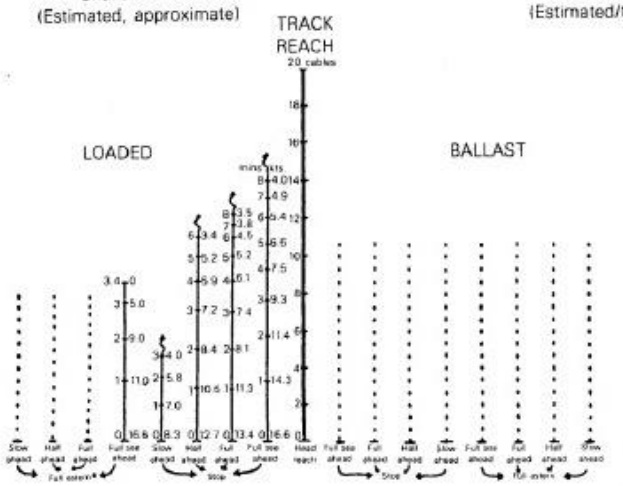




BALLAST




1 cable = 0.1 nautical mile

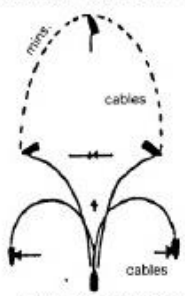
TRACK REACH



LOADED BALLAST

STOPPING CHARACTERISTICS

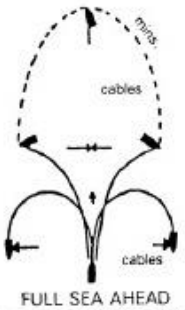
EMERGENCY MANOEUVRES




FULL SEA AHEAD

Comparison of turning (max. rudder) and full astern stopping ability (rudder amidships)

EMERGENCY MANOEUVRES




FULL SEA AHEAD

Comparison of turning (max. rudder) and full astern stopping ability (rudder amidship)

**Q) What information is contained in the Wheel House Poster?** *(Sept-21)*

Ans:- *(Refer the previous Wheel House Poster diagram)*

The Wheel House Poster is a key document displayed in the wheelhouse of ships that provides critical information to the navigational team. The information contained in the Wheel House Poster typically includes:

1. Ship's particulars - including name, call sign, IMO number, port of registry, gross tonnage, and length overall.
2. Navigation equipment - including radar, GPS, ECDIS, AIS, echo sounder, and speed log.
3. Communication equipment - including VHF radio, MF/HF radio, and satellite communication.
4. Emergency procedures - including fire fighting, man overboard, collision, grounding, and abandon ship procedures.
5. Navigation lights and shapes - including a diagram of the ship's lights and shapes for different situations.
6. Steering and propulsion systems - including information on the ship's rudder, engines, and thrusters.
7. Signals and codes - including the International Code of Signals and other relevant codes and signals.
8. Distress frequencies - including VHF channel 16, MF/HF frequency 2182 kHz, and satellite emergency frequencies.
9. Local regulations and procedures - including information on pilotage, traffic separation schemes, and other local rules and regulations.

**Q) List all the information that you will get from Pilot Card?** *(Oct-21)*

Ans:- *(Refer the previous Pilot Card diagram)*

A Pilot Card is a document that provides important information to the pilot who will be boarding the ship to assist in navigation. The following are the information typically provided in a pilot card:

- Ship's particulars, such as name, call sign, flag, length, beam, draft, air draft, and displacement
- Navigation equipment and aids available onboard, such as radar, GPS, gyro compass, echo sounder, ECDIS, etc.
- Communication equipment available onboard, including VHF radios, satellite phones, etc.
- Details of ship's propulsion system, including horsepower, number of engines, fuel type, and maneuvering capabilities
- Restrictions or limitations of the ship, such as shallow water operation limits, turning radius, maximum speed, etc.
- Emergency procedures, including procedures for man overboard, fire, abandon ship, etc.
- Ship's cargo, if applicable, including type of cargo, stowage location, and hazardous materials information.

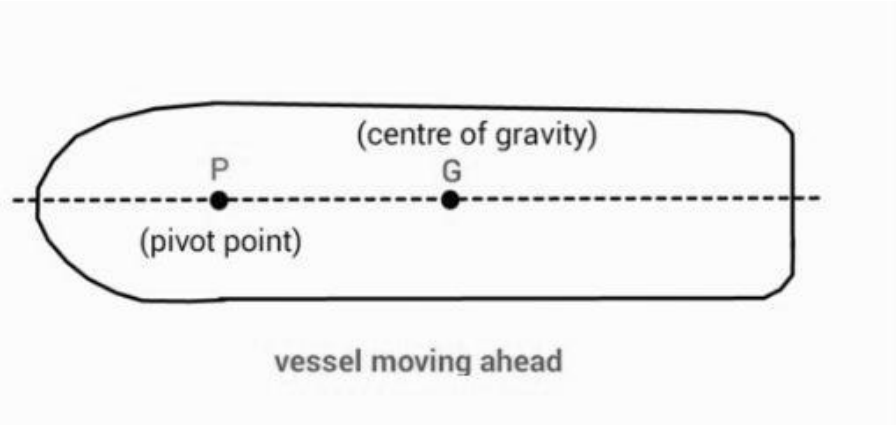
**Q) Explain the Pivot point of vessel and effect of wind on ship handling?** *(Oct-21, March-20, March-19, July-18, Aug-16, July-16, May-16)*

Ans:- Pivot Point:-

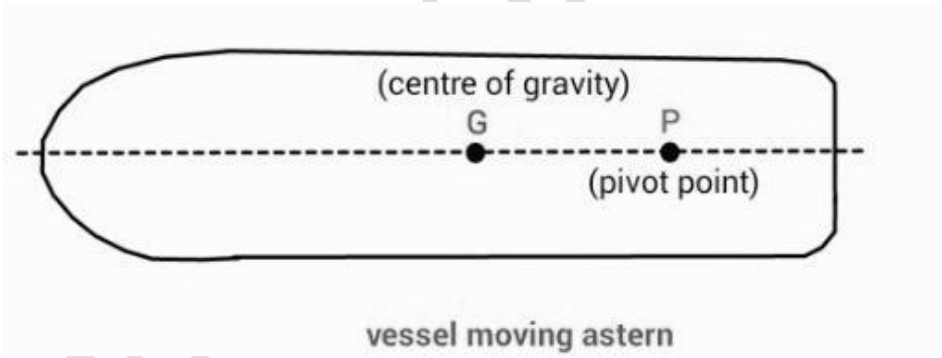
The turning effect of a vessel will take effect about the ship's 'pivot point' and this position, with the average design vessel, lies at about the ship's Centre of Gravity, which is generally nearly amidships (assuming the vessel is on even keel in calm water conditions).

As the ship moves forward under engine power, the pivot point will be caused to move forward with the momentum on the vessel. If the water does not exert resistance on the hull the pivot point would assume a position in the bow region.

However, practically the pivot point moves to a position approximately 0.25 of the ships length (L) from the forward position.




Similarly, if the vessel is moved astern, the stern motion would cause the Pivot Point to move aft and adopt a new position approximately 0.25 of the ship's length from the right aft position.

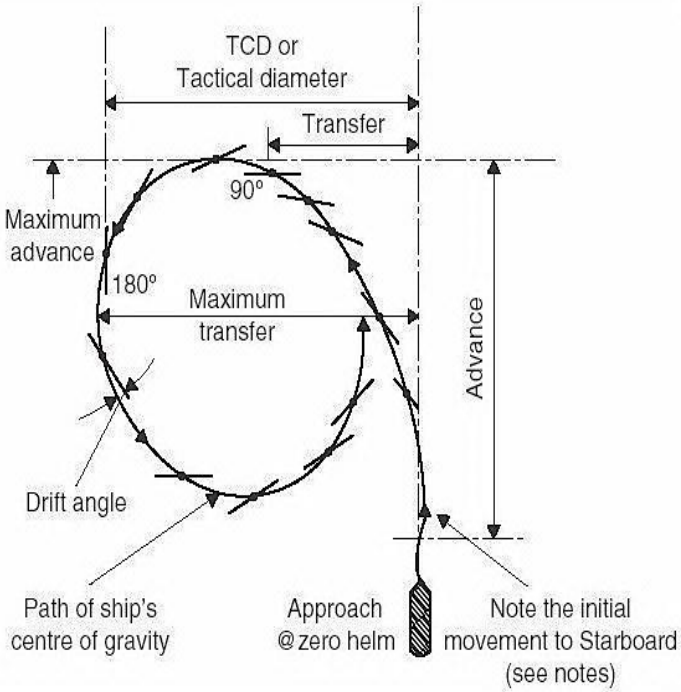



The pivot point at anchor:- It should be noted that when the vessel goes to anchor the pivot point moves right forward and effectively holds the bow in one position. Any forces acting on the hull, such as from wind or currents, would cause the vessel to move about the hawse pipe position.

Use of the rudder can, however, be employed when at anchor, to provide a 'sheer' to the vessel, which could be a useful action to angle the length of the vessel away from localized dangers.

**Q) Draw the turning circle diagram of a ship and define the following terms: Advance, Transfer, Drift Angle, Tactical Diameter** *(Jan-23, Nov-21, Sept-21, Nov-20, Jan-20, March-19, Nov-18, Sept-18, July-18, March-18, Jan-18, May-17, July-16)*

Ans:- **Turning Circle**:- The circle is the path of the ship's pivot point as it executes a 360° turn. In shallow water, the rate of turn is likely to be decreased, so the vessel will have a larger turning circle.




**Advance**:-

- Defined by the forward motion of the ship, from the moment that the vessel commences the turn.
- It is the distance travelled by the vessel in the direction of the original course from commencing the turn to completing the turn.
- It is calibrated between the course heading when commencing the turn, to when the vessels head has passed through 90°.

**Transfer: -**

- Defined by that distance which the vessel will move perpendicular to the fore and aft line from the commencement of the turn.
- The total transfer experienced during a turn will be reflected when the ship's head has moved through a course heading of 180°.
- The amount of transfer can be calibrated against the ship's change of heading and is usually noted at 90° and 180°.

**Tactical diameter** –

- Tactical diameter is defined by the greatest diameter scribed by the vessel from commencing the turn to completing the turn.
- When the vessel is trimmed by the stern, the tactical diameter of turn is increased.
- When the vessel is trimmed by the head, the tactical diameter of turn is decreased.
- The vessel with a list will take longer to execute the turn, and when turned into the list, will develop a larger circle.
- The vessel with a right-hand turn propeller, if making a turn to port, will end up with a smaller diameter than starboard due to the effect of transverse thrust.
- Final diameter – Is defined as the internal diameter of the turning circle where no allowance has been made for the decreasing curvature as experienced with the tactical diameter.

**Drift angle**:

- Drift angle is the angle between the axis of a ship when turning and the tangent to the path on which it is turning.

**Q) Why is the turning circle of a ship larger when in shallow water?** *(July-21)*
Ans:- The turning circle of a ship is larger when in shallow water due to the effect of squat. Squat is the hydrodynamic phenomenon that occurs when a vessel is sailing in shallow water, where the depth of the water is less than the draft of the vessel. When a vessel sails in shallow water, the water displaced by the hull has less room to move aside and creates a bow wave and a stern wave. These waves combine and create a low-pressure zone beneath the hull, which results in the vessel sinking deeper into the water, causing a decrease in the clearance between the keel and the seabed.

As a result, when the vessel turns, the deeper draft aft of the ship encounters the shallow water first, causing the stern of the ship to sink even deeper into the water. This creates a resistance to turning, which means the vessel requires a larger turning circle to maintain its heading.

Overall, the effect of squat causes the turning circle of a ship to be larger in shallow water due to the increased resistance to turning caused by the vessel's deeper draft and decreased clearance between the keel and the seabed.

**Q) How does pivot point effect maneuvering of vessel in following conditions: When going ahead.** *(March-20, Aug-16)*
Ans:- The effects of transverse thrust **when going ahead** are so minimal they can generally be ignored but when operating astern propulsion, the water flow expels water in the forward direction. This in turn is deflected by the hull form causing a sideways push on the hull.

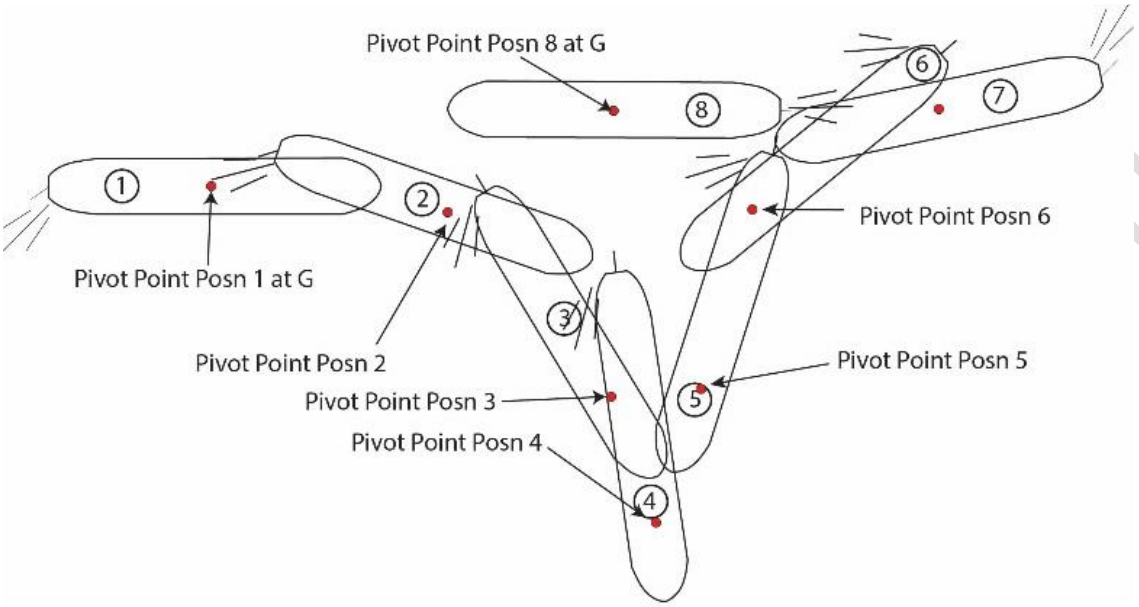
**Q) How does pivot point effect maneuvering of vessel in following conditions: Effect of wind when vessel stopped.** *(Aug-16)*
Ans:- When Vessel Stopped:- The ability of the ship to maintain course headings under relative wind speeds, should also be noted; together with the drifting **effects on the vessel under the influence of wind**, when the vessel is without engine power.
At anchor: Any forces acting on the hull, such as from wind or currents, would cause the vessel to move about the hawse pipe position.

**Q) How does pivot point effect maneuvering of vessel in following conditions: When anchored.** *(Aug-16)*
Ans:- The Pivot Point at Anchor:-
- It should be noted that when the vessel goes to anchor the pivot point moves right forward and effectively holds the bow in one position.
- Any forces acting on the hull, such as from wind or currents, would cause the vessel to move about the hawse pipe position.
- Use of the rudder can, however, be employed when at anchor, to provide a 'sheer'

to the vessel, which could be a useful action to angle the length of the vessel away from localized dangers.

**Q) Sketch and describe the execution of a Short Round Turn for a vessel with a high hand propeller when in restricted waters.** *(Aug-21)*

Ans:-



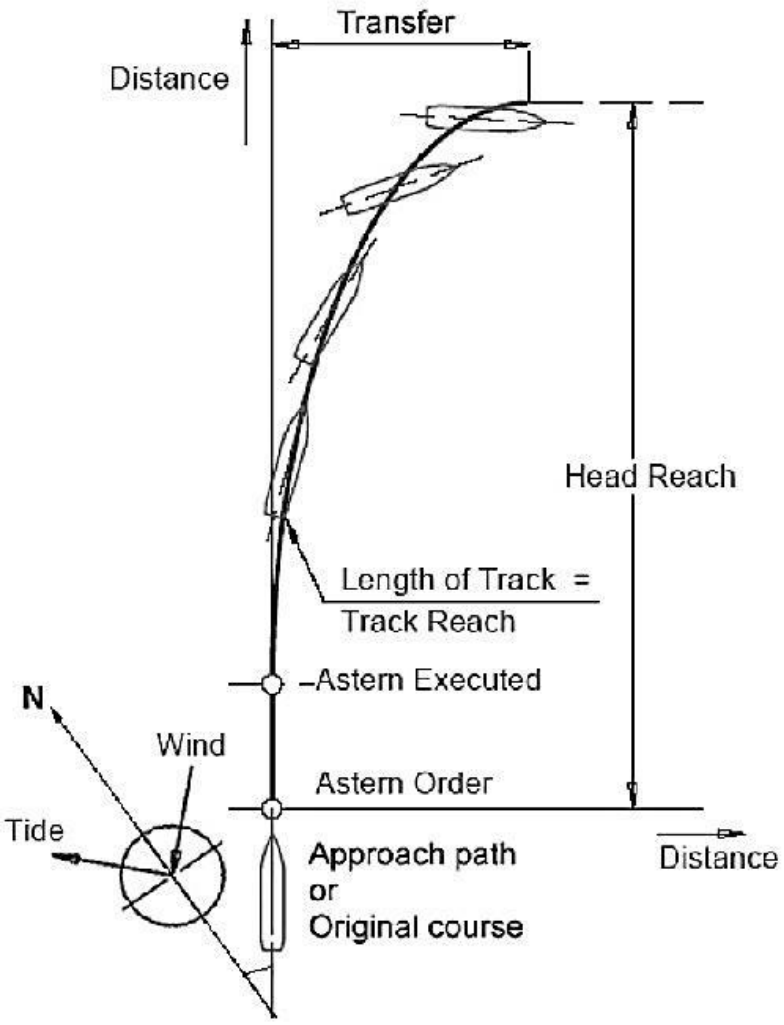

A Short Round Turn is a manoeuvre that is used to turn a vessel around 180 degrees in a confined area, such as a narrow channel or a small harbour. The following are the steps involved in executing a Short Round Turn for a vessel with a high hand propeller in restricted waters:

1. Assess the situation: Before initiating the manoeuvre, the OOW should assess the current situation, taking into account factors such as wind, current, vessel traffic, and water depth.
2. Reduce speed: The vessel's speed should be reduced to a minimum to ensure maximum control during the manoeuvre.
3. Turn rudder to full: The rudder should be turned to full, in the direction of the intended turn.
4. Apply hard astern power: The engines should be put in full astern, which will bring the vessel to a stop and begin the turn.
5. Apply hard ahead power: Once the vessel has stopped and begun to turn, the engines should be shifted to full ahead on the opposite side of the rudder to complete the turn.
6. Use bow thruster: If the vessel is equipped with a bow thruster, it can be used to assist with the turn, especially in areas with high winds or currents.
7. Monitor the turn: During the turn, the OOW should monitor the vessel's position, speed, and heading, making any necessary adjustments to the rudder and engines.
8. Exit the turn: Once the vessel has completed the turn, the engines can be shifted back to neutral, and the vessel can proceed on its new course.

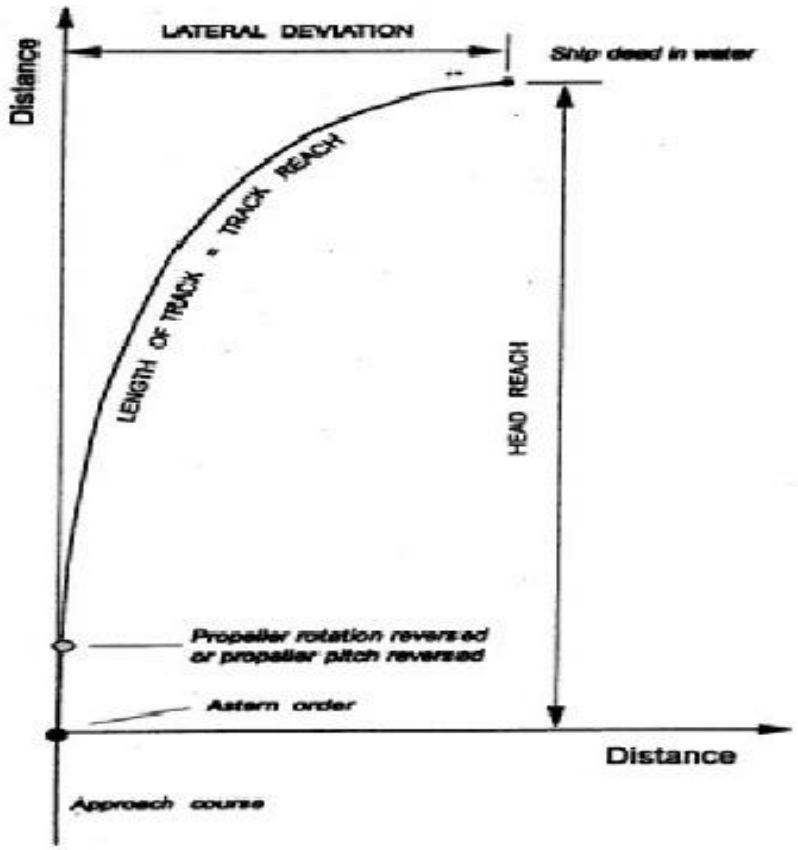
**Q) With simple diagram, describe briefly: With respect to stopping distance, explain head reach and track reach.** *(Jan-23, Dec-20, Nov-20, March-19, Jan-18,*

*Jan-17)*

Ans:- **Head Reach** is defined as a distance along the direction of the course at the moment when the "full astern" command was given. The distance is measured from the moment when the "full astern" command is given until the vessel is stopped dead in the water.




**Track Reach** is defined as a distance along the vessel's track that the vessel covers from the moment that the "full astern" command is given until ahead speed changes sign.

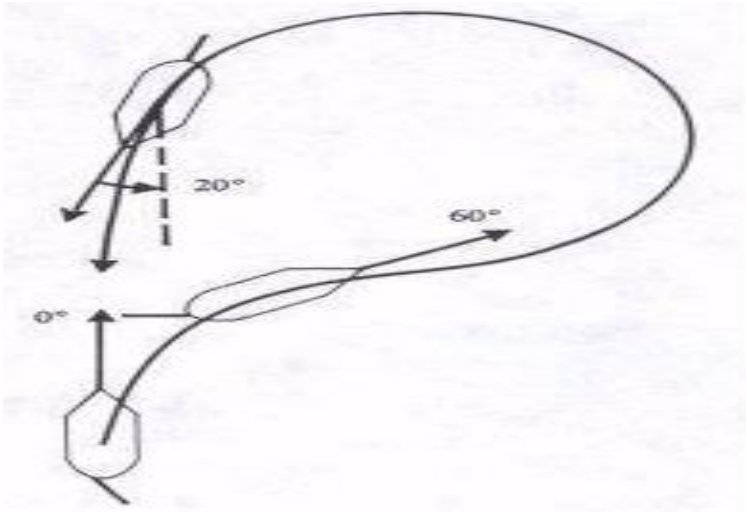



Track Reach Criteria:-

- The stopping ability of the vessel is judged using a full astern crash stop maneuver. Based on IMO requirements the track reach should generally not exceed 15 ship lengths (measured along the path).
- However, in the case of low-powered large displacement vessels, this value may be modified, but in no case should exceed 20 ship lengths, subject to special consideration and approval by the Bureau.
- Determination of whether a vessel falls into the category of "low powered large displacement vessels" also will be done by the Bureau.

**Q) With simple diagram, describe briefly: Williamson's Turn** *(Sept-19, May-18, Jan-17)*

Ans:-




**In order to execute a Williamson Turn:**

- Note the position of the ship.
- Put the wheel hard over to one side.
- After the ship has altered course by about 60 or 70 degrees, put the wheel hard over to the other side.
- Steady up on the reciprocal of the original course.
- The ship would come back to the original position or nearly so.

**When is Williamson Turn the best method:**

- When a man is missing and, after a search of the ship, is presumed to have fallen overboard some time earlier, the Master would like to proceed on the reverse track as exactly as possible, in the hope of sighting the man and rescuing him, in the past, people have been rescued like this after several hours in the water.
- In poor visibility.

**To test the efficacy of a Williamson Turn:**

- Drop two markers (empty, 20-litre paint drums would do), one at a time, with an interval of about a minute between them.
- The markers would thus be about a quarter of a mile apart, on the course of the ship.
- After about another minute, carry out a Williamson Turn.
- As soon as the ship is heading in the opposite direction, the markers should appear in transit, or nearly so.
- The author tried out this maneuver, to port and to starboard, in light and loaded conditions, on a handy size bulk carrier (displacement 60,000 tones) in 1992. The results were very good.

**Q) With the help of suitable sketch define the following: Transfer** *(Sept-17)*

Ans:- Transfer:- Defined by that distance gained by a vessel engaged in a turning manoeuvre which is perpendicular to the original course.

**Q) With the help of suitable sketch define the following: Scope** *(Sept-17)*

Ans:- Scope:- The amount of anchor cable deployed, measured from the mouth of the hawse pipe to the anchor crown 'D' shackle.

**Q) What smells the ground? Explain with diagram how it affects ship maneuvering.** *(July-19, March-18)*

Ans:- Shallow water effects on a ship w.r.t "Draft & Maneuverability.":-

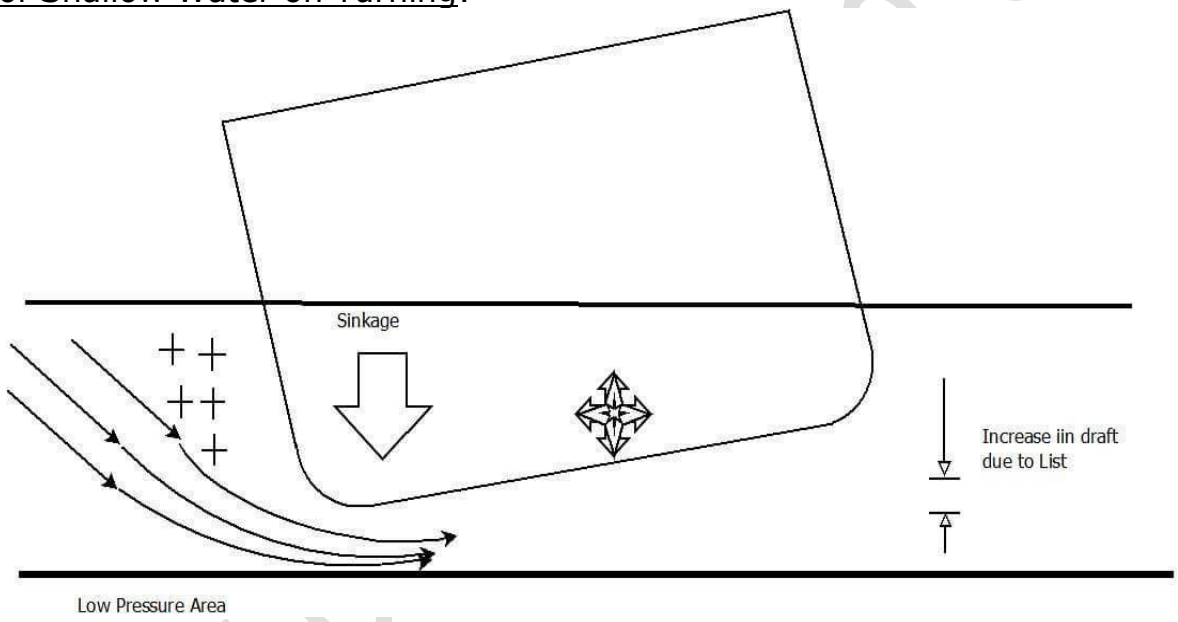
- When a ship nearing an extremely shallow depth of water, such as a shoal, she is likely to take a sudden sheer, first towards it and then violently away. This is called ***smelling the ground***, and the movements of a sluggish ship may suddenly become astonishingly lively.
- Due to the fact that the water displaced by a hull moving through shallow water is not easily replaced, the bow wave and stern wave of the vessel increases in height. Further, the trough which normally exists under the quarter becomes deeper and after part of the ship is drawn downwards towards the bottom. By reducing speed, the wave heights and trough depth will be diminished, and the vessel will not, therefore, close the bottom or squat.

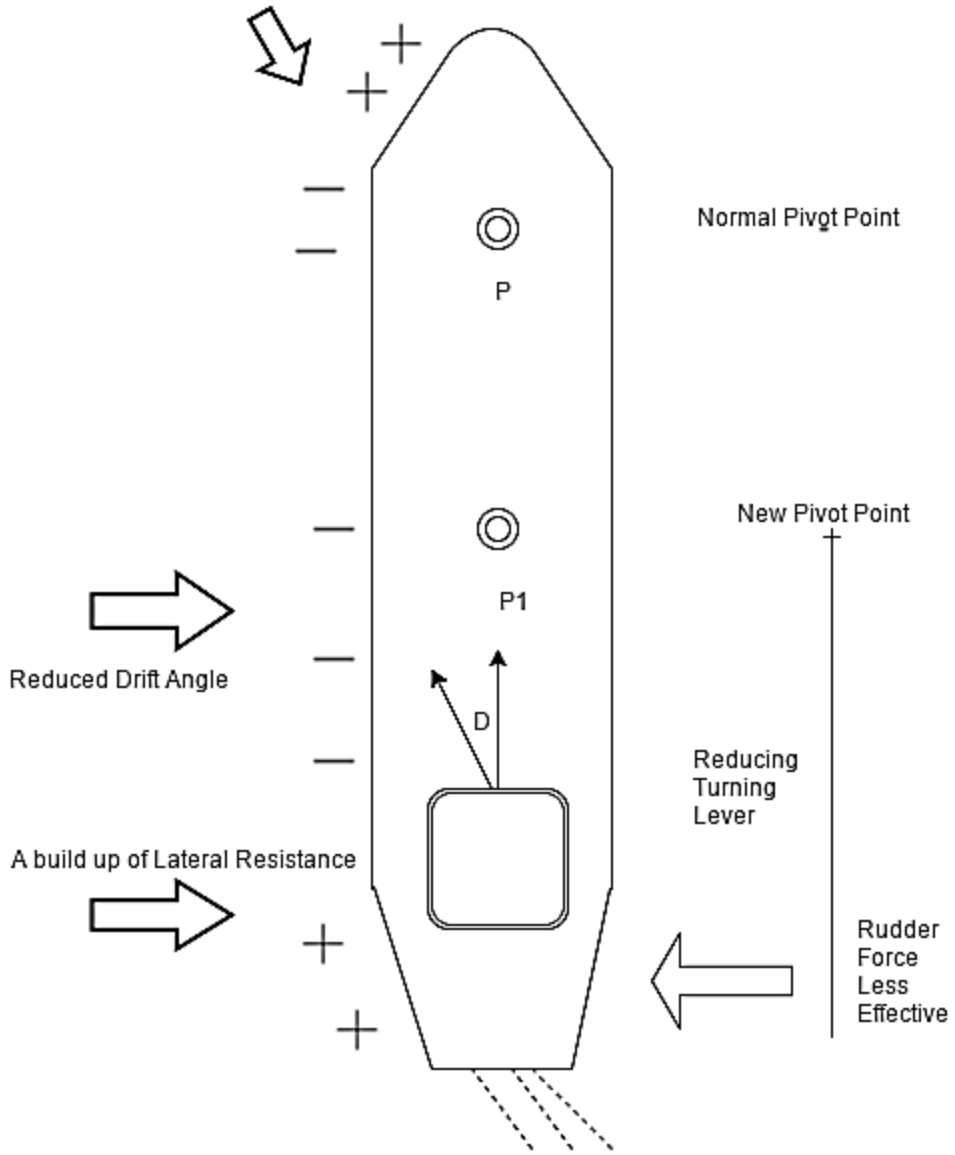
- The speed of a vessel moving in shallow water should always be moderate; if the speed is increased the keel will close with the ground and the ship will sheer about unpredictably. If the bow wave and stern wave are observed to be higher than is prudent speed should be reduced – but not suddenly. If the speed is taken off rapidly the stern wave will overtake the vessel and cause her to take a sheer, which in a narrow channel could be disastrous.

Summary of shallow water effect on manoeuvring include:

- Bow wave increases.
- Maneuvering becomes sluggish.
- The engine load increases.
- The ship speed over water reduces.
- Stopping distance and time increases.
- The turning circle increases to a great extent.
- Rolling and Pitching reduces.
- The ship may start to vibrate.

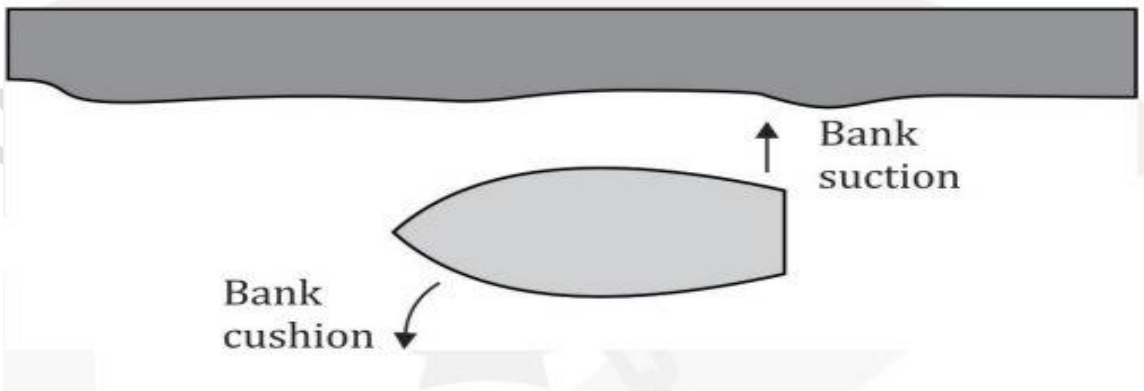
Effect of Shallow Water on Turning:






**Q) Write short notes on the following: Bow cushion & Bank suction** *(Oct-21, Jan-21, Sept-19, May-18, Nov-17)*

Ans:- Bow Cushion and Bank Suction Effect:-




- In a restricted channel, when the ship moves near the bank, the bow is pushed away from the bank, an effect known as bow cushion, and the vessel is bodily attracted toward the bank, an effect known as bank suction.
- The bank cushion results from high pressure buildup between the bank and the bow of the ship, and the bank suction is caused by loss of pressure and increased

velocity of water in the restricted space between the vessel and the bank.

**Q) Write short notes on the following: Transverse Thrust** *(April-21, Jan-21, March-20, Sept-19, July-18, May-18, Nov-17, Sept-17, May-17)*

Ans:- Transverse thrust

- Transverse Thrust effects are a cause of the single propeller action where water is displaced to one side or another, causing a movement of the hull from the deflection of the water flow.
- The effects of transverse thrust when going ahead are so minimal they can generally be ignored but when operating astern propulsion, the water flow expels water in the forward direction.
- This in turn is deflected by the hull form causing a sideways push on the hull.
- The ship handler should be aware of his or her own vessel's performance when going astern and the diagram below goes some way to explaining the movement of the vessel with alternative propeller systems.

**Q) Your vessel is transiting a river. Describe with illustration the various effects of your vessel is subjected. When: when the UKC is less** *(Nov-16)*

**OR**

**Define Squat, list various Shallow water effects experienced by the vessel on entering shallow channel.** *(Oct-21, April-21, Mar-21, Jan-21, Jan-20, Sept-19, May-18, Nov-17, March-16)*

Ans:- Squat:-

- In figure 6-3 the ship is running on even keel with a small under keel clearance and, therefore, water which would normally pass under the ship is now severely restricted.

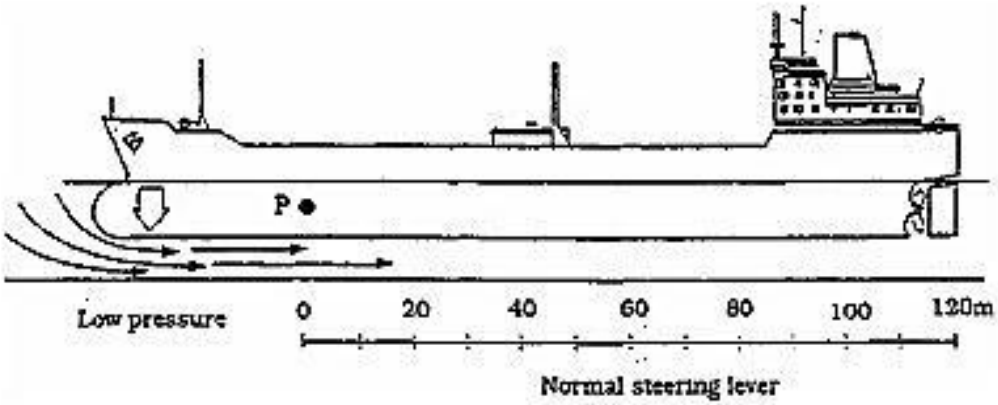



Figure 6-3 Shallow water

- This result in two things, firstly the build of water ahead of the ship, longitudinal resistance pushes the pivot point back from P to PP and the steering lever is reduced. Secondly the water being forced under the bow, at a higher speed than normal, creates a low pressure and loss of buoyancy. The ship will now 'Squat by the Bow' which in turn makes the problem even worse. Several cases have been reported of large ships running in shallow water and experiencing bow sinkage of up to 2 metres!

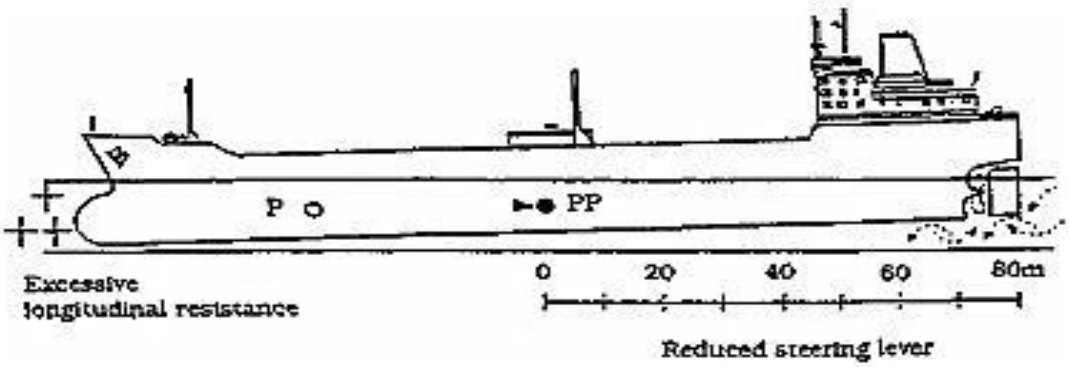



Figure 6-4 The effect of squat (water pressure)

- In addition to the possibility of grounding forward there also exists the possibility of losing control and sheering violently out of a channel. If the helmsman allows a small swing to develop, longitudinal resistance ahead of the ship will be brought round onto the exposed bow, (as in figure 6-5) which in turn will encourage a violent swing in the same direction as the helm. Counter helm to correct the swing may be sluggish because as we have seen, the steering lever is reduced. Once the ship does respond, it may now sheer violently the other way. A chain reaction then sets in, with the ship sheering badly from one side to the other and failing to respond correctly to the helm. The effect can be extremely rapid, with the ship out of the channel and aground in just a few minutes. Excessive speed is the main contributing factor under such circumstance; reduced speeds are essential to avoid such violent forces building up.

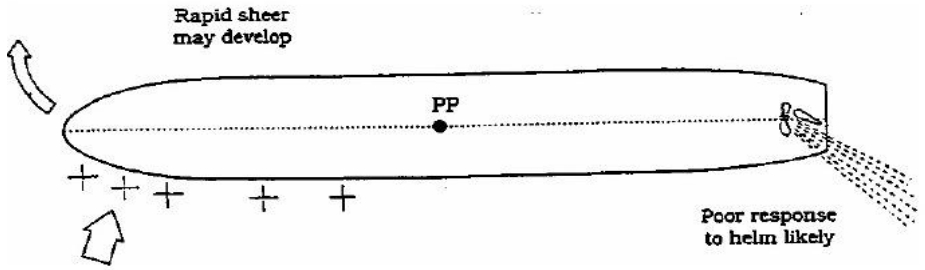



Figure 6-5 The effect of squat (helm response)

- Trim is also important and in some districts the pilotage authority may refuse to handle certain ships if they are trimmed by the head and may even request a small trim by the stern. The latter does, in any case, improve the steering lever and therefore the handling of a ship, it may also be intended as an allowance for squat by the bow and very much a decision based upon local knowledge and experience.

Effect:-

- Water displaced by the hull is not easily replaced.
- Bow wave and stern wave increase in height.
- Trough becomes deeper and after part is drawn downwards.
- Under keel clearance decreases.

**Squat varies on the following factors**:-

Ship's speed: - Squat is directly proportional to the square of speed.

Squat $\alpha$ $V^2$ (V = speed in knots)

Block co-efficient: - Squat directly varies with $C_B$.

Squat $\alpha$ $C_B$

Blockage factor (S):- it is the ration between cross section of the vessel and cross section of the canal or river. Squat varies with blockage factor as.

Squat $\alpha$ $S^{0.81}$

So, in confined water, squat is more than in open water.

Squat may be calculated by the following simplified formulae:

Squat = $(C_B \times V^2) / 100$ (In open waters)

Squat = $2 \times (C_B \times V^2) / 100$ (In confined waters)

**Q) Your vessel is transiting a river. Describe with illustration the various effects of your vessel is subjected. When: Passing close to river bank** *(Nov-16)* **OR**

**Define Shallow water, list various shallow water effects experienced by the vessel on entering shallow channel.** *(Sept-18, March-16)* **OR**

**Explain in brief the factors affect the ship maneuvering in narrow channel.** *(Oct-20)*

Ans:- Shallow Water:-

- It would be wrong to imply that bank effect is only experienced within the domain of canals and rivers with steep sided banks, as illustrated in figure 6-6. To a ship running in shallow water, with adjacent but gently shelving mud or sand banks, such as low lying estuarial areas, figure 6-7, the effect can be far more insidious and violent.
- There are many cases, in the archives of casualty investigation, where groundings and collisions have occurred in such areas, due to drastic loss of control, whilst the ship was under the combined influence of shallow water and bank effect.
- One noticeable feature in some of these casualties, is the tendency of the Master to immediately reduce revolutions, or even stop the engine, when faced with the ship sheering the wrong way and apparently failing to respond to progressively larger angles of helm. Whilst this is of paramount importance, if it is evident that grounding or collision is imminent, in other circumstances it is suicide. Hard over rudder and a healthy 'kick ahead' are essential to regaining control.
- These are of course generalities and every event is dictated by a set of unique circumstances.
- It is clear that many ships work daily in shallow water without any problems what so ever, just occasionally however, all the ingredients, shallow water, bank effect, excessive speed, poor trim, come together and combine in an insidious manner to create another casualty.

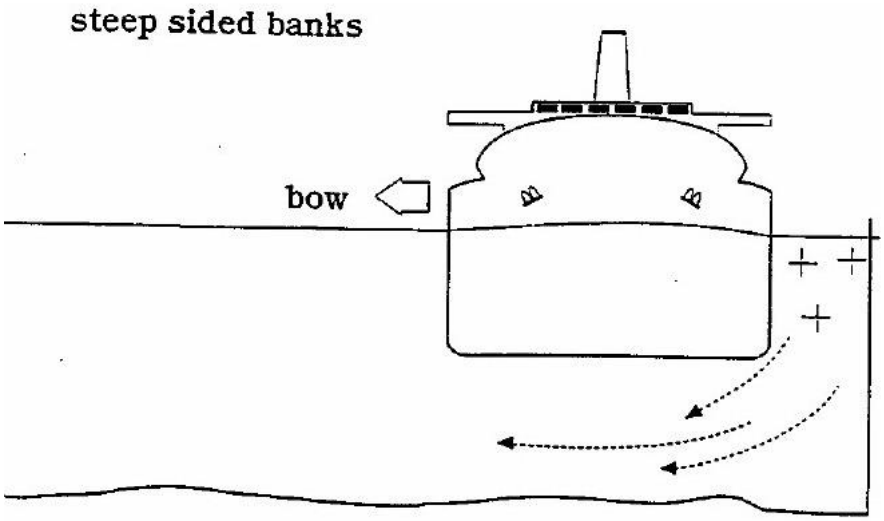



Figure 6-6 Bank configuration - steep sided

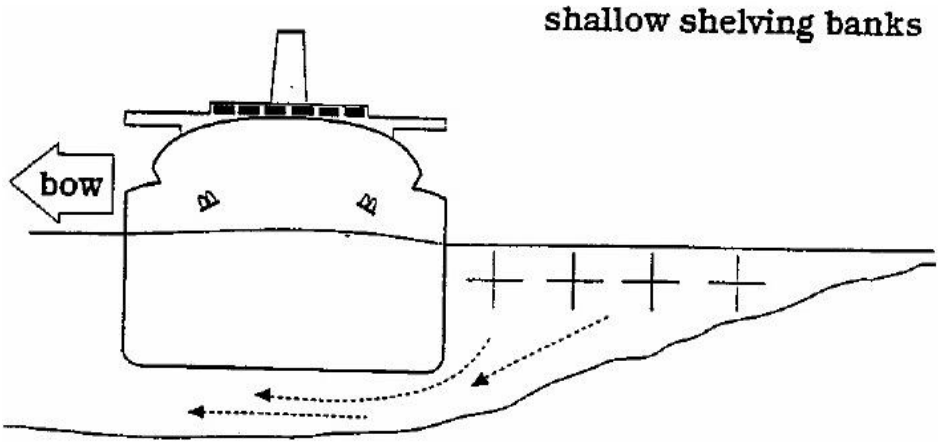
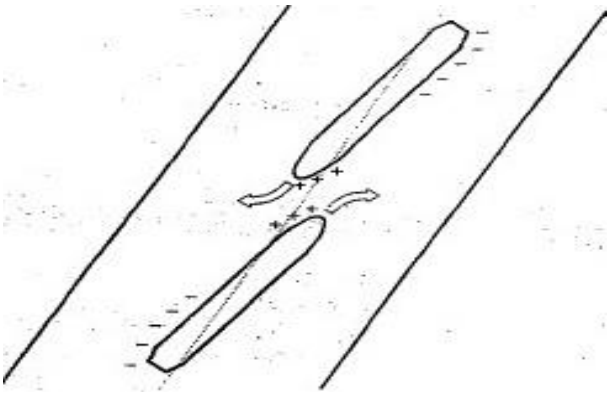


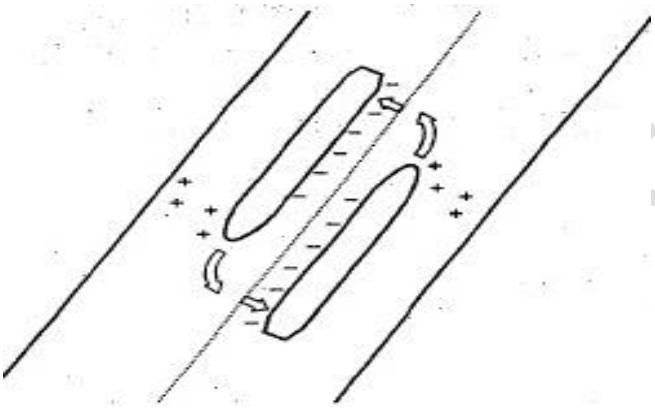

Figure 6-7 Bank configuration - shallow shelving

**Q) Write short notes on followings: Interaction between vessels** *(Sept-19, May-18)*

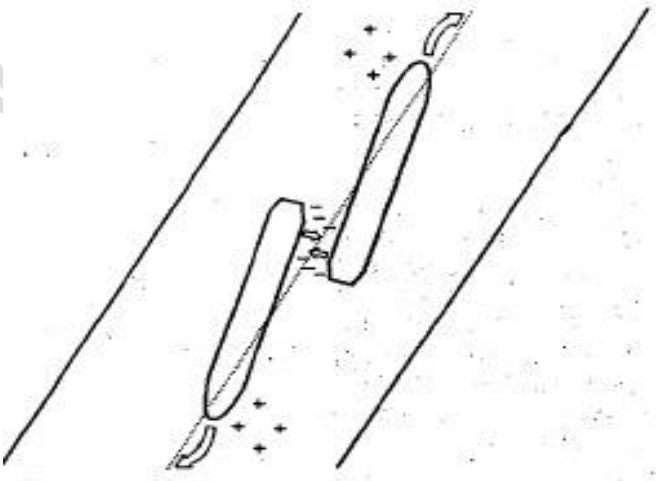
Ans:- Ship to Ship Interaction: With ship to ship interaction there are two cases to consider, vessels meeting one another and a vessel overtaking another. In both cases the effects are caused by the interaction of each vessel's positive and negative pressure areas.



Consider two vessels meeting. On close approach, the combined positive bow pressure zones encourage the respective bows to be repelled and, if speed is excessive, may require vigorous corrective helm.



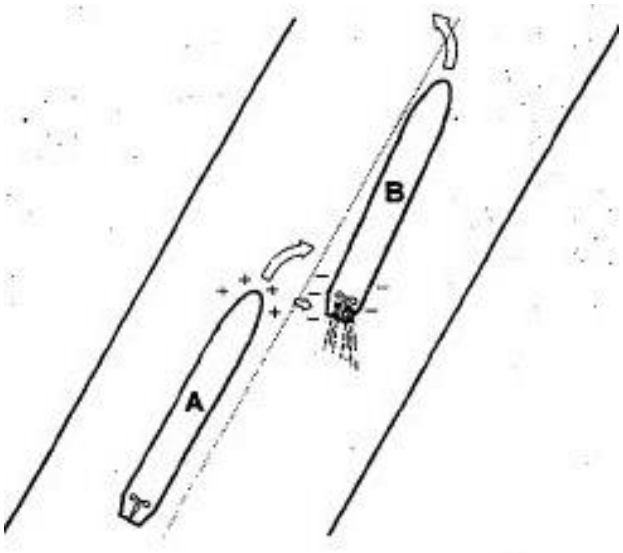
When abeam, the combined low pressure zones encourage a suction which, if the vessels are very close, can cause a violent broadside collision. The bow of each vessel now comes under the influence of the other vessel's stern, which also means the rudder of each vessel is being affected by the positive pressure of the other vessel's bow. This causes each vessel to take a sheer towards the other vessel and if in a narrow channel or fairway, for the stern to be cast towards the boundaries of that channel or fairway.



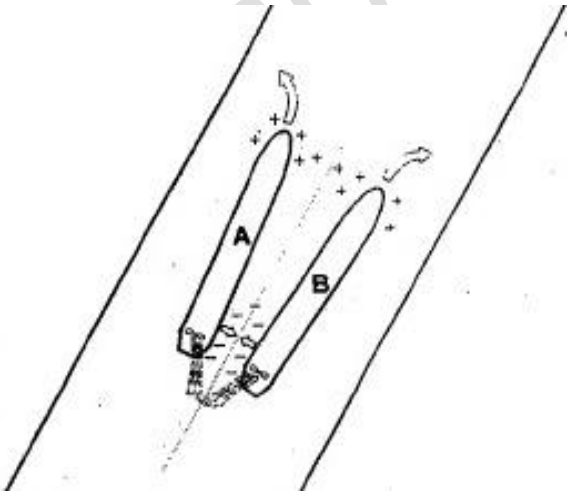
As each vessel draws clear, the combined low pressure zones cause the sterns to be drawn towards each other and assist the vessels to regain their original track.

Now consider two vessels where one is overtaking another. As the overtaking vessel, A, approaches the stern of the other vessel, B, its forward pressure zone will act upon that other vessel's stern. This will have two effects: one, to produce a temporary

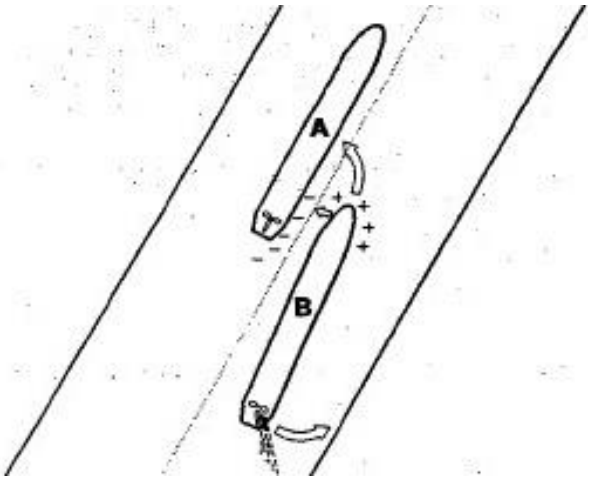
causing vessel B to want to sheer across the bows of vessel A. The bow of vessel A may also be drawn to the stern of vessel B due to the imbalance of pressure zones.




When the vessel's bows are abeam of each other the now powerful combined positive pressure zone will cause the bows of both vessels to turn outwards, this latter may require vigorous corrective action. The suction between the two vessels caused by the combined negative areas is present for a much longer time than when vessels are meeting and so great care must be taken to ensure that the sterns are not drawn towards each other.




Where there is some disparity of vessel size the smaller vessel may experience a temporary loss of speed through operating in partially disturbed water.




As vessel A draws clear, the rudder is now affected by the positive pressure zone of vessel B and may be sent into a sheer across the bow off vessel B.

These effects can also be observed when a vessel is passing a moored vessel.

**Q) Your vessel is transiting a river. Describe with illustration the various effects of your vessel is subjected. When: Passing another vessel close by** *(May-19, Nov-16)*

Ans:- Passing:- In the interests of both simplicity and clarity the sequence of events during a 'meeting end on' manoeuvre are contained in figures 6-8, 6-9 and 6-10.

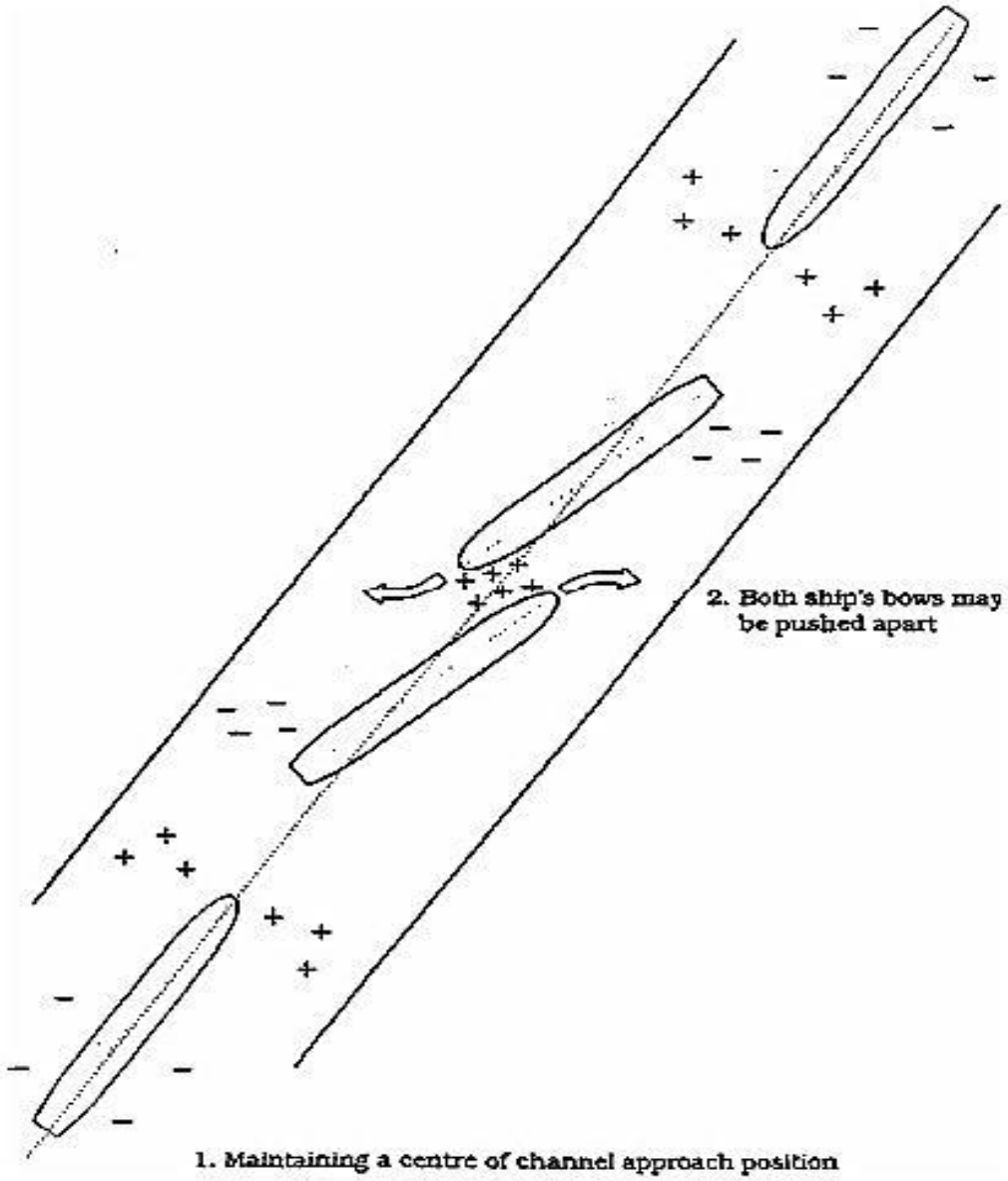



Figure 6-8 Passing - Phase 1

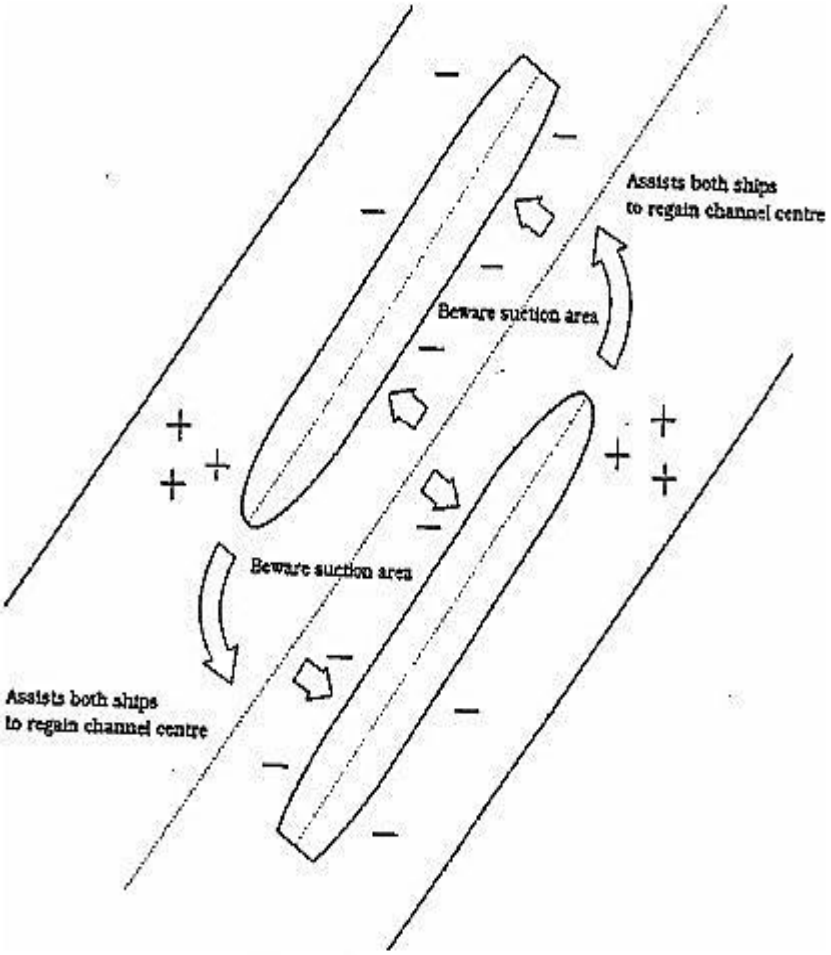



Figure 6-9 Passing - Phase 2

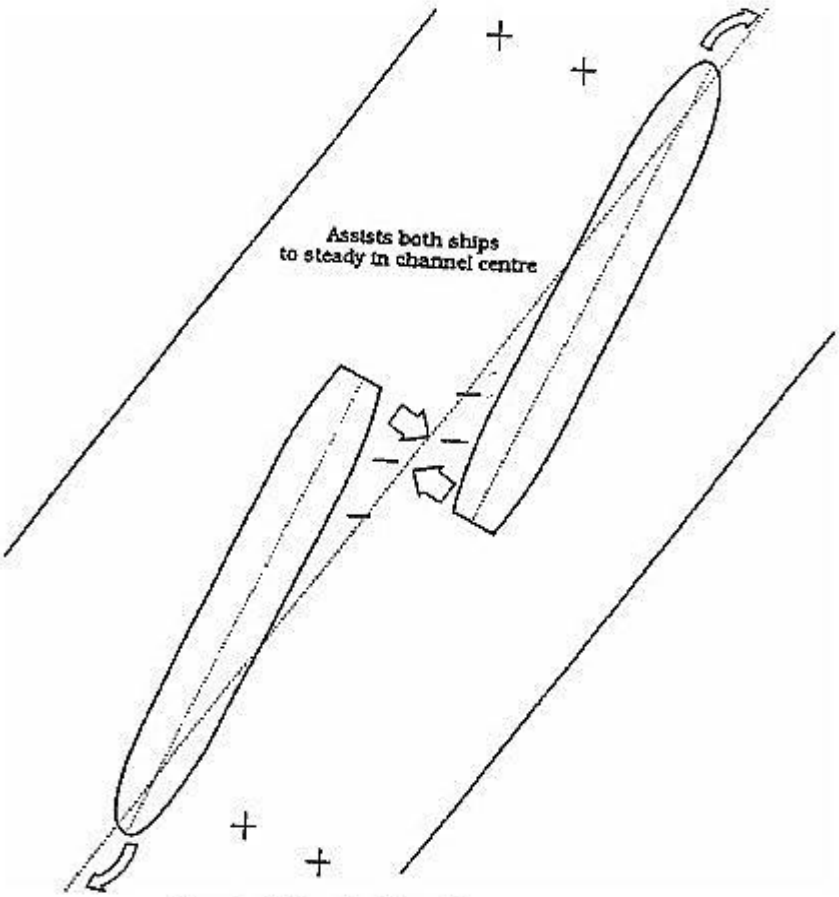


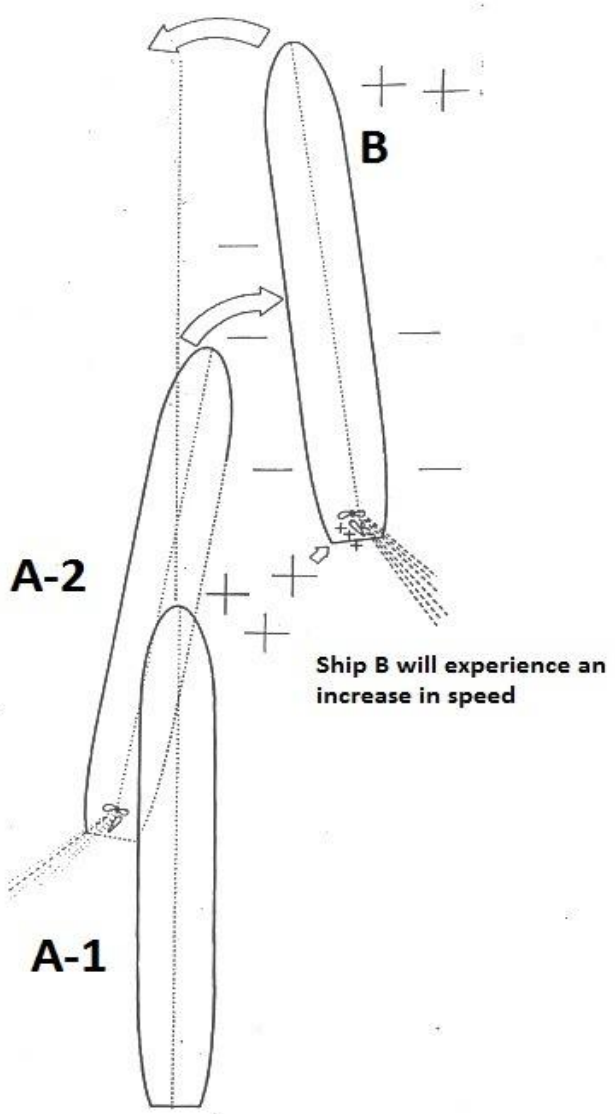

Figure 6-10 Passing - Phase 3

The following general points should be noted:-

a) Prior to the manoeuvre each ship remains in the centre of the channel for a long as possible. Failure to do so, could expose either ship to bank effect, leading to a sheer across the path of the oncoming ship or grounding.
b) Speed should be low to reduce the interactive forces. There is then, plenty of reserve power for corrective 'kicks ahead'.
c) If the ships pass from deep to shallow water, at any time during the manoeuvre, the forces will increase drastically and extreme caution should be exercised.
d) The smaller of two ships and tugs, are likely to be the most seriously affected. Large ships should be aware of this and adjust their speed accordingly.
e) Figures 6-8 to 6-13 illustrate the anticipated sheers that may develop throughout each manoeuvre and the maximum corrective helm that may be required, in this case 35°.
f) The engines should be brought to dead slow ahead for the manoeuvre, particularly turbine or fixed pitch propeller ships, so that power is instantly available to control the ship with 'kicks ahead'.
g) On completion of the manoeuvre each ship should regain the centre of the channel as quickly as possible to avoid any furtherance of bank effect.

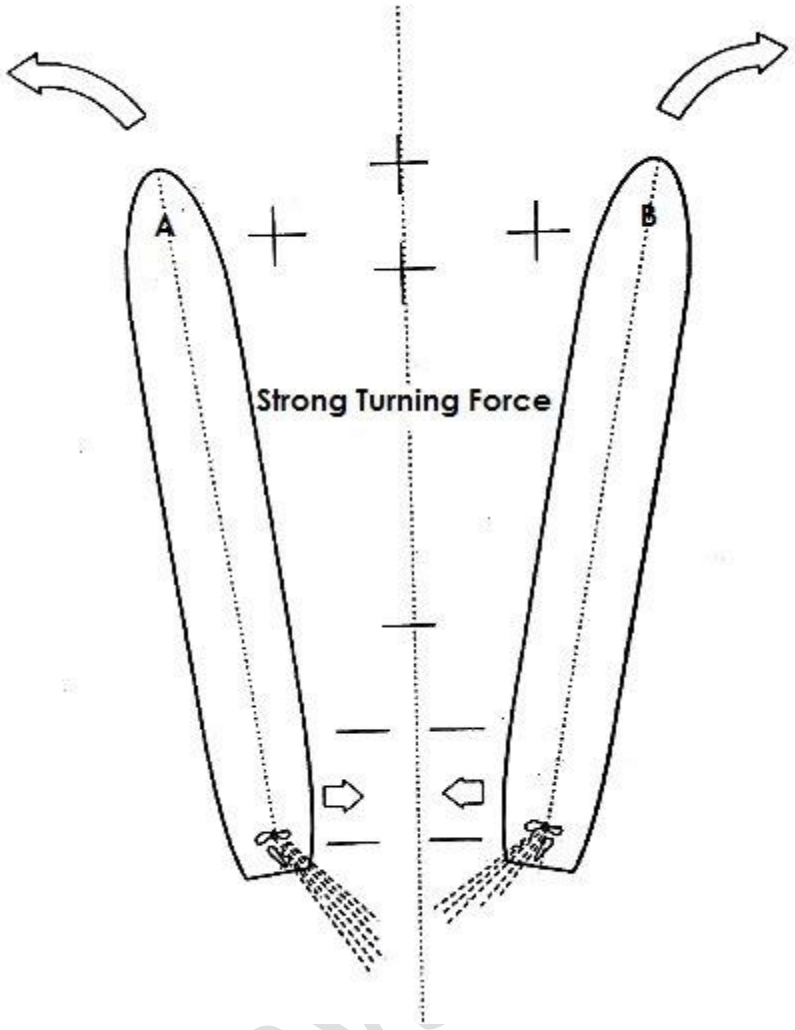
**Q) Your vessel is transiting a river. Describe with illustration the various effects of your vessel is subjected. When: Overtaking another vessel.** *(April-21, Jan-19, Nov-16)*

Ans:- Overtaking another vessel:- The overtaking operation is shown in figures.



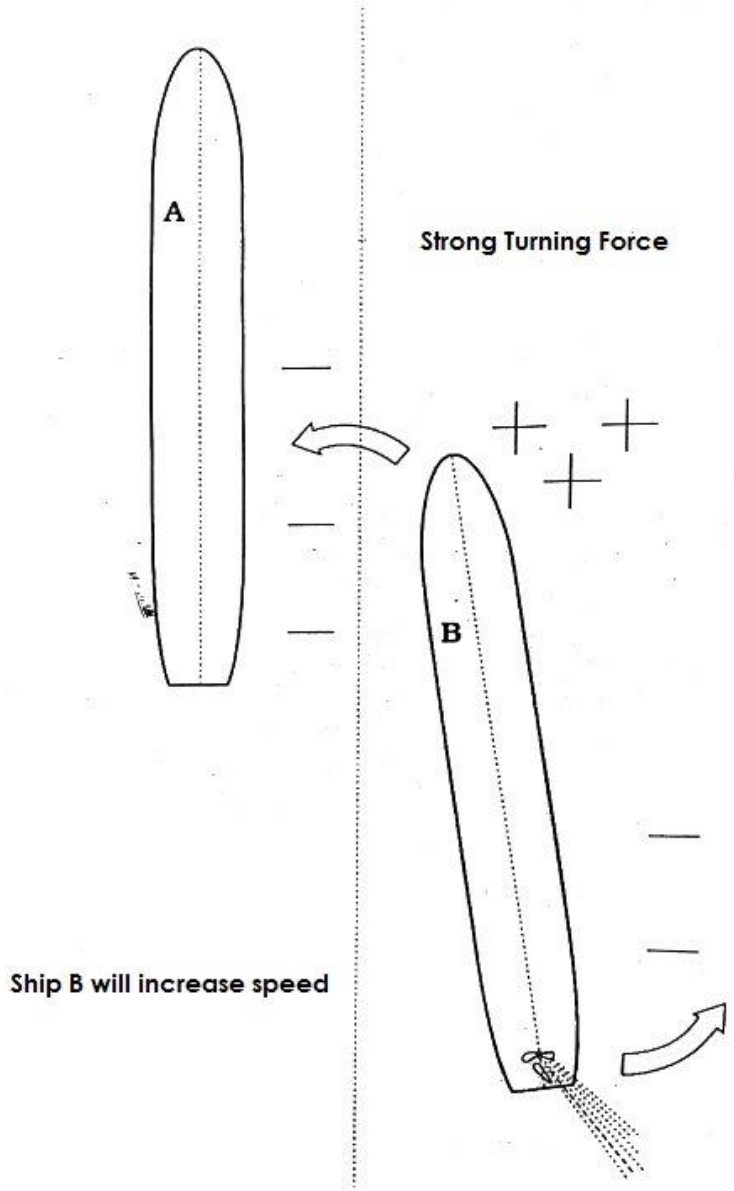

## OVERTAKING - PHASE 1

- The ship to be overtaken – Consider the consequences of Bank Effect, Shallow Water and likely sheer – before moving over to STBD side of channel.
- As V/L 'A' approaches V/L 'B', the pressure domain of bow of 'A' interacts with Stern of 'B', push her stern away causing 'B' to sheer across the path of 'A' the overtaking V/L.
- Additionally 'A' will sense the low pressure of 'B' and may display heightened tendency to swing towards 'B'.
- Ship 'B' may experience 'A' push forward due to pressure domain of the bows of 'A'.
- The forces experienced by the two ships are very powerfull and will demand substantial corrective action.




## OVERTAKING - PHASE 2

- Two ships abeam.
- Will experience powerfull pressure zone at bows and low pressure abaft their respective pivot point.
- Bow will swing out & stern sucked in initiate corrective action will in time should the two V/L be allowed too close the smaller of the two will get dragged with the bigger.
- It is essential to reduce speed (Power) on each to break suction effect.




## OVERTAKING - PHASE 3

- Overtaking V/L passing ahead of overtaken V/L the overtaken V/L may sense the effect of
  - Its bow being sucked towards 'A'
  - Bank effect.
- Caution will once again be the need of the manoeuvre.

The following general points should be noted:-

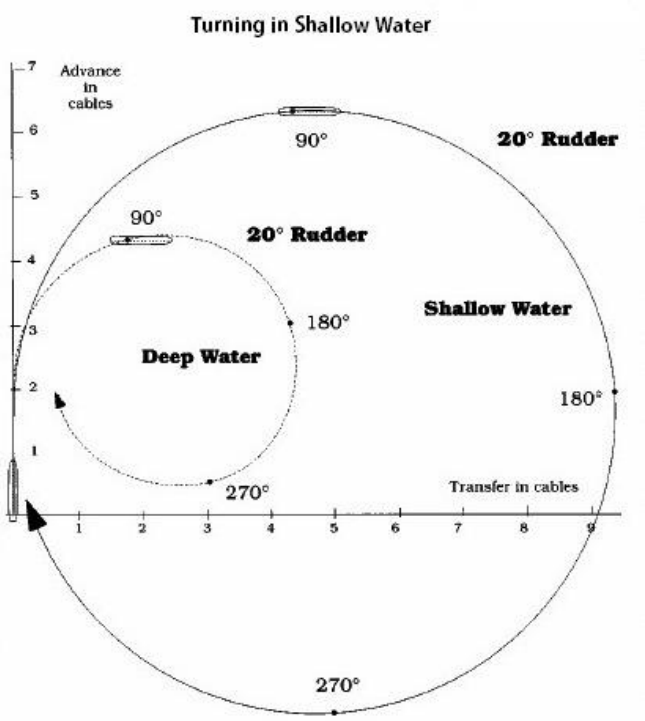
a) Prior to the manoeuvre each ship remains in the centre of the channel for a long as possible. Failure to do so, could expose either ship to bank effect, leading to a sheer across the path of the oncoming ship or grounding.
b) Speed should be low to reduce the interactive forces. There is then, plenty of reserve power for corrective 'kicks ahead'.
c) If the ships pass from deep to shallow water, at any time during the manoeuvre, the forces will increase drastically and extreme caution should be exercised.
d) The smaller of two ships and tugs, are likely to be the most seriously affected. Large ships should be aware of this and adjust their speed accordingly.
e) Figures illustrate the anticipated sheers that may develop throughout each manoeuvre and the maximum corrective helm that may be required, in this case 35°.
f) The engines should be brought to dead slow ahead for the manoeuvre, particularly

turbine or fixed pitch propeller ships, so that power is instantly available to control the ship with 'kicks ahead'.

g) On completion of the manoeuvre each ship should regain the centre of the channel as quickly as possible to avoid any furtherance of bank effect.

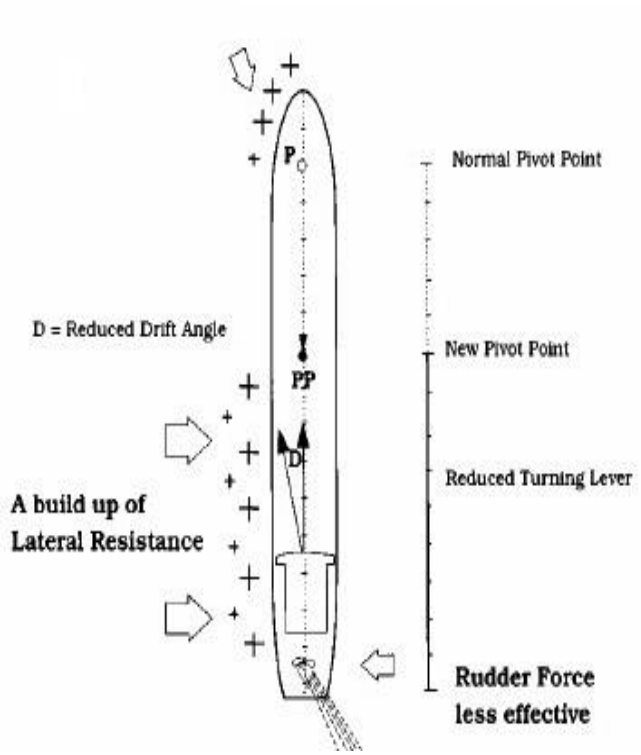
**Q) Explain why the turning circle of the vessel increases in shallow waters.** *(Jan-19)*

Ans:-




**<u>Turning in Shallow Water</u>**:

- As the stern of the ship commences to turn to port, the water pressure building up on the port side is more than when in deep waters, abaft the pivot point, due to the restriction under the keel in shallow waters.
- First the rudder force has to overcome a much larger lateral resistance and is therefore less efficient.
- Secondly, at the bow, because of the reduced UKC, water which would normally pass under the ship is now restricted and then is a buildup of pressure, both ahead of the ship and on the port bow. This now pushes the pivot point back from P to PP reducing the lever.
- With the combination of these 2 effects, the ship is rapidly losing the rudder efficiency enjoyed in the deep water.



**Q) What are the various methods to monitor a radial turn?** *(Jan-23)*
Ans:- Monitoring the radial turn of a ship's propeller is important to ensure the smooth and safe operation of the vessel. There are various methods that can be used to monitor the radial turn, including:

1. Shaft vibration monitoring: This method involves using sensors to measure the vibration of the propeller shaft. If the radial turn is excessive, it can cause an increase in vibration, which can be detected by the sensors.
2. Pressure pulse monitoring: This method involves using pressure sensors to measure the pressure changes in the hydraulic oil that powers the pitch control system of the propeller blades. If the radial turn is excessive, it can cause a change in the pressure pulse pattern, which can be detected by the sensors.
3. Electro-hydraulic servo monitoring: This method involves monitoring the hydraulic pressure and flow rate of the electro-hydraulic servo system that controls the pitch angle of the propeller blades. If the radial turn is excessive, it can cause a change in the hydraulic pressure and flow rate, which can be detected by the monitoring system.
4. Bearing temperature monitoring: This method involves using temperature sensors to monitor the temperature of the bearings that support the propeller shaft. If the radial turn is excessive, it can cause an increase in bearing temperature, which can be detected by the sensors.
5. Performance monitoring: This method involves monitoring the performance of the propeller, such as the fuel consumption, speed, and power output of the engine. If the radial turn is excessive, it can cause a decrease in the performance of the propeller, which can be detected by the monitoring system.

Overall, a combination of these methods may be used to effectively monitor the radial turn of a ship's propeller and ensure the safe and efficient operation of the vessel.

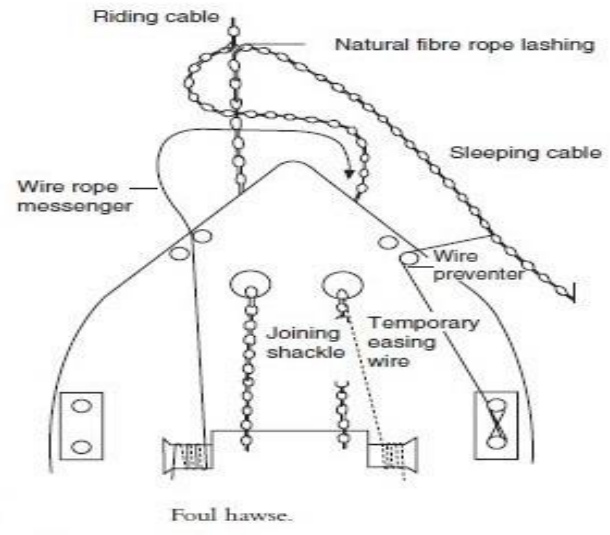
**Q) What would be the effect of wind from the Port beam, on a Car Carrier that is: stopped and drifting** *(July-21)*
Ans:- Stopped and drifting: If the Car Carrier is stopped and drifting, wind from the port beam would cause the vessel to drift to starboard, with the bow turning downwind. This could potentially cause the vessel to drift towards other vessels, fixed structures, or navigational hazards.

**Q) What would be the effect of wind from the Port beam, on a Car Carrier that is: moving ahead** *(July-21)*
Ans:- Moving ahead: If the Car Carrier is moving ahead, wind from the port beam would cause the vessel to heel to starboard, with the windward side of the vessel rising and the leeward side sinking. This could potentially affect the vessel's stability, and require the master to adjust the vessel's speed, heading, or ballast to maintain stability and safe operations.

**Q) What would be the effect of wind from the Port beam, on a Car Carrier that is: moving astern?** *(July-21)*

Ans:- Moving astern: If the Car Carrier is moving astern, wind from the port beam would cause the vessel to drift to port, with the stern turning downwind. This could potentially cause the vessel to drift towards other vessels, fixed structures, or navigational hazards.

**Q) Define and explain Term: Foul Hawse** *(Oct-21)*
Ans:- Foul Hawse:




This term is used to describe the crossing of the anchor cables, when both cables are being used at the same time, as with a running, standing or open moor, owing to the uncontrolled swinging of the vessel when anchored with both anchors (moored).

Clearing a Foul Hawse: The object of this operation is to remove the foul turns in the two anchor cables caused by the vessel turning with the tide change continually in the same direction (Figure). It is a lengthy operation and should be started as soon as the vessel has swung and is riding at her new position; this will provide a six-hour interval before the tide turns again and the vessel assumes another position. To this end all preparatory work should be carried out before the vessel swings.

**Q) List the factors to be taken into account when allowing for Under Keel Clearance (UKC)** *(Aug-21)*
Ans:- The following factors should be taken into account when allowing for Under Keel Clearance (UKC):
1. Vessel draft
2. Tidal range and state
3. Water density and temperature
4. Ship squat
5. Trim and heel of the vessel
6. Vessel speed and maneuverability
7. Bathymetry of the area
8. Allowable UKC as per the port authority regulations and vessel design
9. Weather conditions, including waves, wind, and currents
10. Type of cargo being carried and its weight distribution
11. Type and condition of the ship's hull and propeller
12. Navigation aids and visibility

13. Depth of the channel or berth
14. Potential for bank suction or interaction
15. Presence of other vessels or obstructions in the vicinity.

All of these factors should be carefully considered to determine the appropriate UKC required for the safe navigation of the vessel in the particular area.

## PASSAGE PLANNING

**Q) List out the various publications and manuals you would require for safe navigation.** *(Dec-20, July-16)*

Ans:- **The nautical publication required for passage planning:-** The list of publications to be consulted when planning an Ocean Passage are as follows:-

1) Ocean Passages for the World
2) Mariner's Handbook
3) Chart catalogue
4) NP 5011
5) Routeing chart
6) Ocean Current charts and current atlases
7) Ice Charts
8) Sailing Directions
9) Admiralty Tide Tables
10) Admiralty List of Lights and Fog Signals
11) Admiralty List of Radio Signals
12) Distance Tables
13) Guide to Port Entry
14) Weekly Notice to Mariners
15) Annual Summary of Notices
16) M-Notices
17) Navigation warnings (T & P Notices).
18) IMO Ship's Routeing
19) Nautical Almanac
20) Sight Reduction Tables
21) Nooris Tables
22) Collision Regulations and INTERCO

**Q) Explain the difference between Raster and Vector Charts.** *(April-21, May-18, Sept-17, Jan-17, Jan-16)*

Ans:- Difference between Raster Chart and a Vector Chart

| Raster Chart (RNC) | Vector Chart (ENC) |
|---|---|
| The Entire Chart is stored as one single layer and therefore information stored cannot be displayed selectively. | Information is stored in layers and hence can be displayed selectively. |
| Customization is not possible. | Customization is possible as chart can be designed as per the requirement. |
| Direct copy of paper chart. | Computer generated chart. |
| Seemless Chart not possible | Seamless chart is feature. |

| | |
|---|---|
| Display regeneration takes time | Display regeneration is faster. |
| Same symbols and colour as of paper chart. | Symbols as per IHO. |
| Scale of chart cannot be changed | Each chart can be viewed on different scale |
| Cheaper and simple to produce | Costly and time consuming to produce. |
| With recent approval worldwide coverage is available. | Worldwide coverage will take time |
| Memory requirement is higher | Comparatively less memory required. |
| This is intrim to ENC where ENC is not available. | When ENC available RNC will be phased out. |
| During look ahead, other Chart may be on different scale. | All Charts will be on same scale. |
| Since Chart in single layer. No info will be lost. | Loss of information possible. |

**Q) State the advantages and disadvantages of Raster and Vector charts.** *(Jan-22)*

Ans:- State the advantages and disadvantages of Raster and Vector charts.

Advantages of Raster charts:

- They are often more detailed and show more information than vector charts.
- Raster charts are usually cheaper and more readily available than vector charts.
- They are easier to read and interpret for mariners who are accustomed to using paper charts.
- They can be used on older electronic chart systems that cannot handle vector charts.

Disadvantages of Raster charts:

- They cannot be easily scaled without losing detail or becoming pixelated.
- They do not contain as much information about the charted area as vector charts.
- They require more storage space than vector charts.
- They cannot be easily updated or corrected.

Advantages of Vector charts:

- They can be easily scaled without losing detail.
- They contain more information about the charted area than raster charts.
- They are easier to update and correct than raster charts.
- They allow for more accurate navigation, as they are based on precise geographic data.

Disadvantages of Vector charts:

- They can be more expensive than raster charts.
- They require newer electronic chart systems that can handle vector data.
- They can be more difficult to read and interpret for mariners who are accustomed to using paper charts.
- They may not be as readily available as raster charts.

**Q) Explain the methods of updating Electronic Nautical Charts (ENCs).** *(Sept-21)*

Ans:- Electronic Nautical Charts (ENCs) are digital versions of traditional paper charts that are used for navigation on ships. To ensure the accuracy of ENCs, they need to be updated regularly with the latest hydrographic and navigational information. There are several methods for updating ENCs:

1. Notices to Mariners (NtMs): NtMs are issued by national hydrographic offices (HOs) and other authorized agencies to provide information on changes to nautical charts and publications. They contain information on new hazards, changes in buoyage or other aids to navigation, and other navigational information.
2. Chart Correction Tracings (CCTs): CCTs are paper overlays that are used to update paper charts. They can also be used to update ENCs by scanning the CCT and importing the changes into the ENC.
3. Automatic Updating Services (AUS): AUS are electronic services that provide automatic updates to ENCs. They use a variety of methods to receive updates, such as email, satellite, or internet. AUS can be configured to provide automatic updates to ENCs at regular intervals.
4. Electronic Chart Display and Information System (ECDIS) Updating: ECDIS can be used to update ENCs using electronic files or by manual data entry. ECDIS provides an efficient and effective means of updating ENCs.

**Q) On a passage from Mumbai to Cochin in the month of August, state all preparations you will make to prepare your vessel for encountering heavy weather?** *(Mar-21)*

Ans:- When preparing for heavy weather during a passage from Mumbai to Cochin in the month of August, the following preparations can be made:

1. Checking the weather forecast and monitoring any incoming storms or weather patterns.
2. Ensuring that all crew members are briefed and trained in heavy weather procedures and safety precautions.
3. Securing all loose gear and equipment on deck and ensuring that all hatches, doors, and windows are properly closed and secured.
4. Checking the condition of all mooring and towing equipment to ensure they are in good working order.
5. Conducting a thorough inspection of the hull, deck, and superstructure to identify any areas that may be vulnerable to heavy weather.
6. Checking and securing all cargo to prevent shifting during heavy weather.
7. Ensuring that all lifesaving and firefighting equipment is ready and easily accessible.
8. Reducing speed and altering course to minimize the effects of heavy weather.
9. Maintaining regular communication with the shore and other vessels in the vicinity to stay informed of weather conditions and other potential hazards.
10. Ensuring that all crew members have proper safety gear and protective clothing to withstand heavy weather conditions.
11. Preparing the vessel's steering and propulsion systems to operate effectively in heavy weather conditions.
12. Monitoring the vessel's stability and ensuring that ballast tanks and other systems are properly adjusted to maintain stability during heavy weather.

**Q) Explain Purpose and Working of a Course Recorder?** *(Oct-21)*
Ans:- A course recorder is an instrument used to record the ship's course over a period of time. Its purpose is to provide a permanent record of the ship's track, which can be used for navigation, voyage planning, and analysis of ship performance.

The course recorder consists of a recording stylus, which is attached to a pen arm that moves across a rotating chart. The chart is typically marked with compass bearings and time intervals. As the ship travels, the stylus traces a line on the chart, indicating the ship's course.

The course recorder is typically connected to the ship's gyro compass, which provides a stable reference for the ship's course. The gyro compass sends electrical signals to the course recorder, which are then used to move the pen arm and record the ship's course.

Modern course recorders may also be connected to other navigational instruments, such as GPS, to provide a more accurate and comprehensive record of the ship's track.

Overall, the course recorder serves as an important tool for navigation and ship performance analysis, providing a permanent record of the ship's course over time.

**Q) What are the dangers associated while navigating in a Heavy Weather Area?** *(Oct-21)*
Ans:- Navigating in heavy weather areas poses several dangers, including:

- Loss of stability: Waves can cause the ship to roll, pitch and yaw, which can lead to loss of stability and capsizing if not managed properly.
- Structural damage: Large waves and strong winds can cause damage to the ship's structure, such as deck fittings, windows, and even the hull.
- Reduced visibility: Heavy rain, spray, and fog can reduce visibility, making it difficult to spot other vessels, navigational hazards, and even the shoreline.
- Slower response time: In heavy weather conditions, the ship may take longer to respond to helm orders, making it more difficult to avoid collisions or grounding.
- Crew fatigue: Navigating in heavy weather can be physically and mentally exhausting for the crew, leading to fatigue and decreased performance.
- Equipment failure: Heavy weather conditions can put a strain on the ship's equipment, such as the propulsion system and steering gear, leading to potential failures.
- Increased risk of injury: Crew members are at an increased risk of injury from slipping, tripping, and falling in heavy weather conditions.
- Cargo shifting: The motion of the ship in heavy weather conditions can cause cargo to shift, leading to instability and potentially causing the ship to capsize.

Overall, navigating in heavy weather areas requires extra caution and attention to ensure the safety of the crew and the vessel.

**Q) What are the dangers associated with and precautions to take while navigating in shallow waters?** *(Nov-21)*
Ans:- Navigating in shallow waters can pose several dangers to a vessel. Some of

these dangers and precautions to take include:

1. Grounding: Shallow waters increase the risk of grounding, which can lead to hull damage, oil spills, and other environmental hazards. To avoid grounding, vessels should maintain a safe speed and refer to updated navigational charts and pilotage services.
2. Under keel clearance (UKC): Shallow waters reduce the UKC, which can cause a vessel to hit the seabed, leading to grounding. The vessel should be loaded in accordance with the approved loading plan, and the UKC should be continuously monitored.
3. Navigational hazards: Shallow waters can have submerged rocks, sandbanks, or other obstructions that can damage the vessel or cause grounding. To avoid these hazards, the vessel should use updated navigational charts, maintain a safe speed, and use available navigational aids like radar, GPS, and depth sounders.
4. Tidal range and current: Shallow waters can be affected by tidal range and current, which can cause the vessel to drift off course. The vessel should refer to updated tidal tables, monitor the tidal range and current, and adjust the course and speed accordingly.
5. Manoeuvrability: Shallow waters can reduce the vessel's manoeuvrability, making it harder to turn, stop, or change course. The vessel should maintain a safe speed, be aware of the vessel's manoeuvring characteristics in shallow waters, and use tugboats or other assistance when necessary.
6. Weather: Shallow waters can be affected by adverse weather conditions like high winds, waves, and storms, which can make navigation more challenging. The vessel should monitor the weather forecast, take appropriate precautions, and consider altering course or seeking shelter if necessary.

**Q) Write short notes with comparison on the following: ECS (Electronic Chart System) vs Paper Charts.** *(Nov-21)*

Ans:- Electronic Chart Systems (ECS) and paper charts are two methods used for navigation on ships. Here are some points of comparison between the two:

ECS (Electronic Chart System):

- ECS is a computer-based system that uses electronic charts for navigation.
- It provides real-time information on the ship's position, speed, and direction, and can display additional information such as weather, tides, and currents.
- ECS offers various features such as route planning, automatic route checking, and collision avoidance.
- It allows for easy updating of charts and provides an efficient way of managing and storing chart data.
- ECS can be integrated with other ship systems, such as AIS and radar, to provide a comprehensive view of the ship's surroundings.
- The use of ECS is mandatory on some types of vessels, such as passenger ships, tankers, and high-speed craft.

Paper Charts:

- Paper charts are traditional navigational tools that use paper maps to plot the ship's course.
- They require manual plotting of the ship's position using a compass, dividers, and other navigational tools.
- Paper charts provide a reliable backup in case of electronic failures or malfunctions.

- They offer a comprehensive view of the surrounding area and allow for easy identification of nearby hazards.
- Paper charts require regular updates, which can be time-consuming and may result in errors or omissions.
- They can be bulky and require a significant amount of storage space.