Officer of the Watch (Yachts) Syllabus

Section 1 - Navigation & Radar.

January 2016

Duration

This module will be conducted over a minimum period of 20 days; that is 10 days of theory leading to a written examination and 5 days each for a generic ECDIS course and a 5 day Bridge Watch keeping course carried out on an approved simulator. The ECDIS and Watchkeeping courses need not be taken directly after the theory course.

The module will consist of sections on the Collision Regulations, Chart work, Buoyage, Electronic navigation aids, ECDIS, AIS, Radar and ARPA as described in detail later in this document.

Examination and Assessment

Navigational theory, ECDIS theory and radar plotting will be covered in the first two weeks of the course concluding with a written examination. The final 10 days of the course may be split into bridge simulator training and an approved MCA ECDIS course. There will however be no requirement to complete the ECDIS course directly after the bridge simulator course.

Part 1 In Course Assessment

The course assessment and examination will include demonstrating competence in:-

Basic Chartwork and position fixing, including:-

1. Running fix with tides and leeway;
2. Fixing position using compass bearings
3. Convert bearings from compass to true;
4. Clearing bearings and transits;
5. Calculating the Course to steer and course made good;
6. Converting courses from compass to true and true to compass;
7. Fixing position by Vertical and Horizontal angles;
8. Knowledge of chart symbols and abbreviations of ECDIS and paper charts;
9. The IALA system of buoyage A & B;

Operation and setting up of Electronic Navigation Aids including:-

1. GNSS;
2. ECDIS;
3. Echo sounders and logs;
4. Radar;
5. ARPA;
6. AIS;

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Part 2.   Bridge Simulator Training

The practical, simulation part of the course will occupy the third week and be the subject of continuous assessment. Training will be conducted in a radar and navigation systems bridge simulator where the candidates will be required to demonstrate competence in the use of radar, ARPA, and ECDIS as well as traditional navigational skills and compliance with the International Regulations for Prevention of Collision at Sea.

Bridge Simulator Performance Criteria

Evidence of the criteria set out below must be demonstrated by the candidates during the simulation week.

The candidate (as OOW) when in charge of the navigation will:

1. Demonstrate that the advantages and disadvantages of different radar and ARPA display modes are clearly understood with respect to target detection and tracking.
2. Make appropriate use of sea and ground stabilised radar displays selecting appropriate course and speed sensor inputs
3. Demonstrate the correct interpretation of radar information.
4. Demonstrate the correct methods of anti-collision radar plotting of targets.
5. Fix the vessel's position at appropriate intervals by the best means available and check the position by a second means when possible.
6. Monitor and maintain the planned track by Parallel Index when possible.
7. Utilise AIS target data to maintain situation awareness.
8. Take appropriate action to avoid a close encounter, or collision, with other vessels is in accordance with the International Regulations for Preventing Collisions at Sea:
9. Take appropriate action in ample time to ensure passing at a safe distance:
10. When, in the role of OOW, call the Master if in doubt
11. Verify collision avoidance maneuvers where appropriate, and subsequent return to track are effective, utilising the trial maneuver.

When navigating with ARPA and radar will;
1. Demonstrate the selection of display presentation; (stabilised relative motion displays and true motion displays).
2. Select the correct adjustment of all variable radar display controls for optimum display of data.
3. Select appropriate type of speed input.
4. Demonstrate the ARPA tracking controls:
   - Manual and automatic acquisition,

- Vector and graphic display of data.
- The selection of the time scale of vectors/graphics
- The use of exclusion areas when using automatic acquisition.

5. Demonstrate the performance checks of radar,
   - Heading and speed input sensors.
   - Performance monitor.
6. Obtain information in both relative and true modes of display and identify critical echoes.
7. Find a target's relative track.
8. Find the time to and predicted range of target's closest point of approach, courses and speeds of targets.
9. Detect changes of targets course and speed and understand the limitations of such information.
10. Recognise the effect of changes in own ship's course or speed or both.
11. Demonstrate the operation of the trial maneuver.
12. Demonstrate the use and limitations of the mapping facility

When Navigating by ECDIS will:

1. Maintain the ECDIS display at an appropriate range;
2. Maintain an appropriate look ahead;
3. Maintain appropriate safety settings and safety zone;
4. Display appropriate information and object layers;
5. Recognise and respond to alarms and warnings;
6. Monitor the integrity of the system by cross checking against appropriate PI information, radar overlay or ARPA overlay, as available;
7. Maintain a visual lookout at all times;
8. Maintain a VHF listening watch on the appropriate channels.

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Part 3.   Examination Syllabus

Duration
The navigational theory will be covered in the first 10 days of the course concluding with a written exam.

Content
The syllabus is divided into 5 sections and 35 Topics.

Section 1 COMPASS WORK
Topic 1.   Basic magnetism.
Topic 2.   Deviation and variation.
Topic 3.   Magnetic compass error.
Topic 3.   Gyro compass error.

Section 2 CHART WORK
Topic 5.   Information on Admiralty Charts.
Topic 6.   Chart projections; (Gnomonic, Mercator.)
Topic 7.   Position line, circle of position and transferred position lines.
Topic 8.   Ground and water track.
Topic 9.   Fix position by land and sea features.
Topic 10.   Voyage planning.
Topic 11.   Sources of information.

Section 3   CHART CORRECTING AND NOTICES TO MARINERS.
Topic 12.   Chart correction and use of N to M.
Section 4   TIDES AND TIDAL CALCULATIONS.
Topic 13.   Causes of tides
Topic 14   Standard and secondary port tidal calculations.
Section 5   KEEPING A SAFE NAVIGATIONAL WATCH
Topic 15.   The principles to be observed in keeping a safe navigational watch.

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Section 6 BUOYAGE SYSTEM.
Topic 16.   IALA system A & B.
Section 7   NAVIGATION AIDS.
Topic 17.   Satellite Navigation Systems (GNSS).
Topic 18   Terrestrial Navigation Systems.
Topic 19.   Echo Sounders.
Topic 20.   Speed Logs
Topic 21   Electronic Chart Display and Information Systems (ECDIS).
Section 8   RADAR
Topic 22.   Principles of Radar.
Topic 23.   Operation of Radar.
Topic 24.   Radar Plotting.
Section 9 ARPA
Topic 25   IMO Performance Standards for ARPA.
Topic 26   Factors affecting system performance and accuracy.
Topic 27   Tracking capabilities and limitations.
Topic 28   Processing delays.
Topic 29   Operational warnings.
Topic 30   Presentation of Vectors, target information and danger areas.
Topic 31.   Information on past positions of targets being tracked.
Topic 32.   Application of the International Regulations for Preventing
               Collision at Sea.
Section 10   AIS
Topic 33   Awareness of AIS and its uses.
Topic 34   Understands the elements of AIS data.
Topic 35.   AIS ship installations.
Topic 36.   Use of AIS at Sea.
Assessment.

The written examination will consist of a 2½-hour theory paper in two parts.
Part 1 will consist of 3 questions – 1 each on chartwork, tides and radar
plotting.

Part 2 will consist of 3 questions to test "under pinning knowledge".

Candidates must achieve a minimum of 70% in part A and 50% in part B.

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Section 1 COMPASS WORK.

Topic 1   Basic Magnetism;

a) Can state the difference between the magnetic and geographic poles;
b) Can define magnetic variation as the difference between magnetic and true north;
c) Can determine local magnetic variation from the chart;
d) Can define deviation of the magnetic compass;
e) Can state the causes of magnetic deviation.
f) Can explain how deviation of the magnetic compass changes with the ships head.

Topic 2   Deviation and Variation.

a) Can convert compass course to true and true to compass;
b) Can convert compass bearings to true bearings and true bearings to compass bearings.

Topic 3   Magnetic Compass Error.

a) Can calculate compass error using transits;
b) Can calculate the compass error by rising & setting bearings bearing of the sun using tables, given Declination and Latitude.
c) Can apply compass error correctly;
d) Can state when the compass error should be determined.

Topic 4   Gyro compass error.

a) Can calculate gyro error using transits;
b) Can calculate the gyro error by rising bearing of the sun using tables, given Declination and Latitude.
c) Can apply gyro error correctly;
d) Can state the need for latitude and speed correction.

Section 2 CHARTWORK.

Topic 5   Information on Admiralty Charts.

a) Can recognise chart symbols and abbreviations;
b) Can describe the significance of the notes, warnings and chart datum's.

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Topic 6   Chart projections; Gnomonic, Mercator.

    a) Can state the properties of a Mercator chart;
    b) Can state the properties of a gnomonic chart;

Topic 7   Position line, circle of position and transferred position lines.

    a) Can state the differences between a position, a position line and a position circle;
    b) Can state the definition of DR, EP and Fix;
    c) Can plot ship's dead reckoning (DR) position using compass and speed log;
    d) Can plot ship's estimated position (EP) allowing for set, drift and leeway;
    e) Can calculate a position by running fix with tide and leeway;
    f) Can find the course to steer allowing for set, drift and leeway.

Topic 8   Ground and water track.

    a) Can define Ground Track and Water Track.
    b) Can state the difference between ground track, water track and ships heading;
    c) Can state which mode should be used for collision avoidance when using true motion radar, ECDIS and AIS.

Topic 9   Fixing a position by land and sea features.

    a) Can fix position by compass bearings;
    b) Can fix position by ranges and bearings;
    c) Can fix position by horizontal angle;
    d) Can calculate distance off by vertical angle;
    e) Can use a line of soundings combined with range or bearing to fix position.
    f) Can calculate the distance off by rising/dipping distance of charted object.

Topic 10   Voyage Planning.

    a) Can describe the appraisal process;
    b) Can describe the planning process;
    c) Can describe the execution process;
    d) Can describe the monitoring process.

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Topic 11   Sources of information

a) Can detail the information available on a navigational charts (including ECDIS and RCDS);
b) Can describe the use of sailing directions;
c) Can describe the use of light lists,
d) Can describe the use of tide tables and the tidal atlas.
e) Can describe the use of Ocean routing Charts.
f) Can describe the use of radio navigational warnings and ship routing information;
g) Can describe the use of the ALRS.

Section 3   CHART CORRECTING AND NOTICES TO MARINERS.

Topic 12   Chart correction.

a) Can state how to determine that both a paper and electronic chart is up to date;
b) Can state the importance of Marine Safety Information (MSI) from NAVTEX and radio information before and during voyage;
c) Can state the purpose, use and value of T's & P's;
d) Can describe the contents of the 'Annual Summary of N to Mariners';
e) Can state the information contained in the 'Cumulative list'
f) Can state the information contained in the 'Weekly Notices to Mariners";
g) Can demonstrate the accurate manual correction of charts;
h) Can correct other Admiralty publications included in the weekly notices. (ALL, ALRS, Sailing Directions etc.,)

Section 4   TIDES AND TIDAL CALCULATIONS.

Topic 13   Causes of Tides.

a) Can describe the causes of tides;
b) Can differentiate between spring and neap tides;
c) Can state the relationship between chart datum, LAT, MHWS, MLWS and HAT;
d) Can state the information contained in the Admiralty Tide Tables;

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e)   Can calculate height and range of tide for standard and secondary European ports using the method in ATT;

f)   Can calculate the height of tide for a given time at standard and secondary European ports using the method in the ATT;

g)   Can calculate the time for a given height of tide at standard and secondary European ports using the method in ATT.

h)   Can calculate the set and rate of tide using tidal diamonds on the chart.

i)   Can state that some Pacific ports may only have one HW/LW daily.

Section 5   KEEPING A SAFE NAVIGATIONAL WATCH

Topic 15   The principles to be observed in keeping a safe navigational watch

a)   Can show a full understanding of the International Regulations for Preventing Collisions at Sea;

b)   Can state the requirement for crew to be well rested before standing a navigational watch;

c)   Can state and explain the requirement to keep a proper lookout;

d)   Can describe the handover procedure when taking over a navigational watch;

e)   Can state the bridge log book entries that should be made;

f)   Can state the circumstances when the Master should be called;

g)   Can describe the actions to be taken when a vessel is operating in or near an area of restricted visibility;

h)   Can describe the need for keeping a watch on a vessel at anchor;

i)   Can state the duties and responsibility of the pilot when advising the master on the navigation of a vessel. (as defined in the Bridge Procedures Guide)

j)   Can state the responsibilities of the Officer of the Watch and the Master when navigation with a pilot on the bridge. (as defined in the Bridge Procedures Guide)

Section 6 BUOYAGE SYSTEM.

Topic 16   IALA system A & B.

a) Can recognise and state the meaning of both the IALA 'A' and 'B' buoyage systems when displayed either on a paper chart or an ECDIS.

Section 7   NAVIGATION AIDS.

Topic 17   Satellite Navigation Systems. (GNSS)

a) Can describe the use and function of satellite navigation systems;
b) Can state the errors in GNSS and their causes;
c) Can define the term Dilution of Precision and the meaning of the values;
d) Can state the problems associated with datum shifts;
e) Can describe the principle of GNSS Augmentation Systems (GBAS, SBAS, WAAS, and LAAS etc.)
f) Can describe the principles of Differential GNSS;

Topic 18   Terrestrial Navigation Systems

a) Can describe the principle of terrestrial navigation systems such as eLORAN.
b) Can outline the errors in a terrestrial navigation system.
     i.   Atmospheric attenuation.
     ii. Effect of the Ionosphere
     iii. Land effect.

Topic 19   Echo Sounders.

a) Can define the echo ranging principles;
b) Can describe the operation of a simple echo sounder;
c) Can describe the setting up procedure with regard to range, alarms, gain and datum (depth below keel);
d) Can define the errors of echo sounders including the effect of; water density, shallow water, aeration, cavitation and multiple returns and second trace returns.

Topic 20   Speed Logs

a) Can describe how speed and distance are measured through the water.
b) Can describe the use of Doppler logs including;

- Doppler shift principle.
- Method used in Doppler log to measure ship speed.
- The errors of a Doppler log system.
- The dangers associated with Doppler logs for speed input into true motion radar and ARPA.
- Janus configuration

c) Can describe the use of electromagnetic and impeller logs including;

- Knowledge of the principles of operation,
- Understand these logs read speed through the water, and understands the errors of these logs.

Topic 21   Electronic Chart Display and Information Systems (ECDIS).

a) Can state the difference between ECS & ECDIS;

b) Can describe the principal types of electronic charts available;
   a) Raster charts,
   b) Vector charts,

c) Can state the purpose of the S-52 & S-57 IHO performance standards;

d) Can define ENCs and their use with ECDIS;

e) Can define the difference between Base, Standard and Full functions and settings;

f) Can describe the specific functions of route monitoring;

g) Can describe the use and dangers of Radar, ARPA and AIS overlays;

h) Can state the meaning of ECDIS chart symbols and their paper chart equivalent; (As provided in the UKHO 'Admiralty quick Guide to ENC symbols')

i) Can list the required status indicators and alarms; (as listed in IMO Resolution 232(82))

j) Can describe the purpose of integrity monitoring;

k) Can state the risk of over reliance on the data and information displayed by an ECDIS;

l) Can state the need for updating and correcting ECDIS charts;

m) Can state the requirements for a back up systems in event of ECDIS failure.

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Topic 22.   Principles of Radar.

a) Can state the echo ranging principle;
b) Can describe the main characteristics of the radar beam;
c) Can describe the function of the radar antenna (scanner) and associated aerial system;
d) Can describe how bearing is determined by the azimuth of scanner;
e) Can describe the effect that beam width has on bearing discrimination;
f) Can describe the formation of spurious returns including
    i. side lobes
    ii. multiple echoes;
    iii. false echoes
g) Can describe the importance and purpose of vertical beam width;
h) Can state the factors affecting minimum range and discrimination such as;
    i. Pulse length;
    ii. Vertical beam width;
    i. Height of Scanner;
a) Can describe the factors affecting target size and quality such as;
    i. Aspect of target;
    ii. Material;
b) Can describe the errors and interference on a radar display such as;
    i. Multiple echoes;
    ii. Side lobes;
    iii. Shadow and Blind sectors;
    iv. Second trace echoes;
    v. Meteorological effects.

Topic 23.   Operation of Radar.

a) Can state correct setting up procedure;
b) Can state the action of each of the following controls;
    i. Brilliance,
    ii. Gain,
    iii. Tuning,
    iv. Pulse length,
    v. Range;
    vi. Sea and rain Clutter and Auto clutter controls;
c) Can state the difference between X & S band and the effect on clutter, resolution and range.
d) Can state the purpose of the heading marker and can explain;

    i.   The dangers of incorrectly aligned heading marker,
    ii. The methods used to check the alignment of the heading marker.
    iii. The use of the heading marker switch,
e) Can define the need to check the accuracy of range rings, electronic bearing line (EBL) and variable range markers.
f) Can state the sources of errors in range and bearing;
g) Can state the use of the offset electronic range and bearing line (ERBL);
h) Can describe the purpose and use of parallel indexing;
i) Can describe the use of index lines when monitoring the vessels progress using parallel indexing;
j) Can state why it is important to set up index lines correctly;
k) Can define the information provided by relative and true tracks.

Topic 24.   Radar Plotting.

a) Can construct on a radar plotting sheet the AOW triangle using own vessels course and speed;
b) Can find plotted targets CPA, TCPA, course, speed and aspect;
c) Can find the result of an alteration of course or speed by own vessel on plotted targets with particular regard to CPA and TCPA;
d) Can find the set and rate of drift of own vessel using a fixed plotted target.
e) Can interpret plotted information correctly and take appropriate action with regard to IRCPS both in clear and restricted viability;

Section 9 ARPA

Topic 25.   IMO Performance Standards for ARPA

a)   Can list the performance standards, in particular the standards relating to accuracy.

Topic 26.   Factors affecting system performance and accuracy

a)   Can state the function of the ARPA sensor inputs, speed and compass, and explain the effect on the accuracy of ARPA information of the loss of a sensor or of false sensor data;
b)   Can describe the limitations of radar range and bearing discrimination and errors on the accuracy of ARPA data;
c)   Can describe the limitations of compass and speed input errors on the accuracy of ARPA data;

    d)   Can state the factors which influence vector accuracy.

Topic 27.   Tracking capabilities and limitations

a) Can state:
  i. The criteria for the selection of targets by automatic acquisition.
  ii. The factors leading to the correct choice of targets for manual acquisition.
  iii. The effects on tracking of lost targets and target fading
  iv. The circumstances causing 'target swap' and its effects on displayed data.
  v. The limits imposed on both types of acquisition in multi-target scenarios.

Topic 28.   Processing delays.

    a)   Can describe the effect of processing delays on the display of ARPA information.

Topic 29.   Operational warnings.

    a)   Can state the benefits and limitations of ARPA operational warnings and their correct setting;
    b)   Can state how to avoid spurious alarms.

Topic 30.   Presentation of Vectors, target information and danger areas.

a) Can describe the use of true and relative vectors and the derivation of targets' courses and speeds, including:
  i. Threat assessment, derivation of predicted closest point of approach and predicted time to closest point of approach from forward extrapolation of vectors;
  ii. The use of graphic representation of danger areas;
  iii. The effects of alteration of course and/or speed of own ship and/or targets on predicted closest point of approach and predicted time to closest point of approach and danger areas;
  iv. The effects of incorrect vectors and danger areas.
  v. The benefits of switching between true and relative vectors.

Topic 31.   Information on past positions of targets being tracked

    a)   Can demonstrate an understanding of the derivation of past positions of targets being tracked;

b)   Can describe the use of historic data as a means of indicating recent maneuvering of targets and as a method of checking the validity of the ARPA tracking.

Topic 32.   Application of the International Regulations for Preventing Collision at Sea.

a)   Can analyse potential collision situations from given data and determine the action necessary to avoid close quarters situations in accordance with the International Regulations for Preventing Collision at Sea.

Section 10   AIS

Topic 33.   AIS and its uses.
a)   Can state the objectives of AIS;
b)   Can outline the concept of Self Organising Time Division Multiple Access (SOTDMA) with reference to the AIS transmission.
c)   Can state the difference between AIS A and AIS B.

Topic 34.   Understands the elements of AIS data.
a)   Can state the information included in static data.
b)   Can state the information included in dynamic data;
c)   Can state the information included in voyage related data;
d)   Can state the associated transmission intervals for each group of data;
e)   Can describe the use of safety and security related messages;
f)   Can describe the use of AIS as aids to navigation.

Topic 35.   AIS ship installations.
a)   Can state the carriage requirements;
b)   Can state the Minimum Keyboard Display (MKD) configuration;
c)   Can explain the radar/ECDIS configuration.

Topic 36.   Use of AIS at Sea.

a)   Can explain the need for checking of own ship input data;
b)   Can explain the use of AIS data on a radar or ECDIS display;
c)   Can state the need for caution when making decisions based on AIS target data;
d)   Can state the advantages and disadvantages of AIS compared with radar.