INTERNATIONAL FEDERATION OF SURVEYORS

INTERNATIONAL HYDROGRAPHIC ORGANIZATION

INTERNATIONAL CARTOGRAPHIC ASSOCIATION

STANDARDS OF COMPETENCE for Hydrographic Surveyors

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Guidance and Syllabus for Educational and Training Programmes

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Comments arising from the experience gained in the application of the guidance and syllabus are welcome. They should be addressed to the Chairman of the International Board at the above address. This document is published periodically. Please check with IHB for the latest edition, including current amendments.
Please consult the companion IHO publication C-6 "Reference Texts for Training in Hydrography", available from the IHB.

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1. PREFACE

During the International Congress of Surveyors (FIG) at Wiesbaden in 1971, a Working Group was formed by Commission IV (Hydrography) to develop International Standards of Competence within the profession of surveying at sea. In 1972, the International Hydrographic Conference at Monte Carlo, the International Hydrographic Organization (IHO) set up a working group for the compilation of training programmes in hydrography conducted by Member States. In 1974, at the XIV FIG Congress in Washington, it was resolved that the FIG and IHO working groups combine to study and modify the Report of the FIG working group on Educational Standards.
The Report of the joint FIG-IHO WG was accepted by the two parent bodies at their respective conferences in 1977. In consequence of similar resolutions passed at these conferences an International Advisory Board on Standards of Competence for Hydrographic Surveyors (the Board) was formed.
Since then the Board has met annually and compiled and regularly updated "Standards of Competence for Hydrographic Surveyors" (the Standards). The intention of the Board in preparing these Standards is to provide guidance whereby individual surveyors may be trained and qualified in accordance with internationally accepted levels of competence. The Standards indicate the minimum degree of knowledge and experience considered necessary for hydrographic surveyors, and provide a set of programme outlines against which the Board may evaluate programmes submitted for recognition.

The fifth edition represented a significant change of approach in order to make the Standards more applicable to the different requirements for hydrographic surveyors in government and industry. They provided basic and essential subjects that are required for all hydrographic surveyors and a choice of three options for specialization in Nautical Charting Surveys, Surveys for Coastal Zone Management, or Industrial Offshore Surveys.

The sixth edition incorporated a change in format, to facilitate easier cross-referencing between syllabus topics and programmes which were submitted for recognition and also included minor changes in content to eliminate duplication of subject matter and to reflect the evolution of technology.

The seventh edition eliminated the distinction between Full/Academic recognition and increased the emphasis on developing techniques of GPS, multibeam sonar systems and ECDIS.

The eighth edition eliminated the Specialisms and re-structured the Syllabus in two different parts : the "Minimum Standards", including Basic and Essential Subjects and the "Optional Units".

The ninth edition (2001) provided a better definition of the three levels of knowledge identified in the syllabus. Nautical Science was moved to the Basic Subjects, and was modified to reflect the minimum knowledge required by a hydrographic surveyor. This edition contained a more detailed description of each subject, which were divided into Category A / Category B and Category A-only learning objectives. The ninth edition was amended in 2006 and 2007 to eliminate the first part of the Preamble (Vision and Mission and Terms of Reference) which become an IAB Document and to introduce other minor amendments.
The tenth edition makes changes to Section 3 "Submission of courses", introduces a new Appendix V "Annual Assessment Report" and also reflects the change of the Board's name which became "FIG/IHO/ICA International Board on Standards of Competence for Hydrographic Surveyors and Nautical Cartographers" as agreed during the 31st Meeting.

In 2009 the IHO restructured its publications and the M-5 Standard was renamed S-5. The Eleventh edition includes a new and expanded section relating to the recognition of Schemes that maintain the competency of Individuals beyond their formal training and education. S-5 introduces the requirement for a fee to be paid by submitting organizations.

2. DEFINITIONS

2.1 Categories of programmes and schemes

Categories of programmes and schemes for hydrographic personnel are defined with respect to the theoretical background and working knowledge of those who successfully graduate from such programmes. Only categories 2.1.1, 2.1.2 and 2.1.4 of programmes are considered suitable for international recognition.

2.1.1 **Category A Programme** - A programme which provides a comprehensive and broad-based knowledge in all aspects of the theory and practice of hydrography and allied disciplines for individuals who will practise analytical reasoning, decision making and development of solutions to non-routine problems.

2.1.2 **Category B Programme** - A programme which provides a practical comprehension of hydrographic surveying for individuals with the skill to carry out the various hydrographic surveying tasks.

2.1.3 **Unclassified Programmes** - Programmes of training for support personnel employed in hydrographic operations. Such programmes are defined according to local requirements and are not intended for international recognition.

2.1.4 **Scheme(s)** - The system of review, assessment and recognition of an Individual to ensure that he/she possess the relevant and up to date competencies to perform the role of a surveyor at the appropriate level.

2.2 Minimum Standards

2.2.1. **Basic Subjects** - These are the subjects underlying all aspects of hydrographic surveying. They contain the knowledge necessary for the reduction, assessment of accuracy and computation from observed data, and for an understanding of the principles and use of hydrographic instruments and vessels.

Where knowledge of some or all of these subjects to at least the minimum Standards is a pre-requisite of admission to a programme, exemption from the requirement for that programme to cover the relevant subjects may be sought. See section 3.2.j with respect to such exemptions.

2.2.2. **Essential subjects** - These subjects are considered essential for all hydrographic surveyors and, together with the basic subjects, form the nucleus of the academic syllabus within these Standards.

2.3 Optional Units

They provide guidance on complementary matters which may be offered by the different programmes. They allow organizations more flexibility in offering different training programmes. It is recommended, but not mandatory, that programmes offer one or more of the optional units.

2.3.1. **Option 1 - Nautical Charting** Hydrography - the collection, assimilation and presentation of data to support marine navigation.

2.3.2. **Option 2 - Hydrography to Support Port Management and Coastal Engineering -** hydrographic surveying in support of port management and coastal engineering.

2.3.3. **Option 3 - Offshore Seismic Surveys** - hydrographic surveying in support of resource exploration and development.

2.3.4. Option 4 - Offshore Construction Hydrography - hydrographic surveying in support of drilling, construction, pipeline and cable laying operations.

2.3.5. Option 5 - Remote Sensing - applications to hydrographic surveys and related activities.

2.3.6. Option 6 - Military Hydrography - hydrographic surveying in support of anti-submarine, mining and amphibious operations.

2.3.7. Option 7 - Inland Waters Hydrography - hydrographic surveying operations in relation with rivers and lakes.

2.4 Knowledge

Two aspects of knowledge are content and level. Three levels of knowledge are defined. For each level, a list of active verbs is provided, which characterize appropriate competencies for that level.

2.4.1 Fundamental - Basic knowledge of the subject, normally not permitting the candidate to apply it in actual hydrographic work, except in the simplest of cases or under close supervision. Active verbs (indicating, recall, recognition and comprehension of materials): define, identify, describe, explain, differentiate, predict.

2.4.2 Practical - Knowledge of the subject as far as theory and principles are concerned, sufficient to enable their application in practice in all common hydrographic tasks. Active verbs (indicating application and analysis): apply, use, calculate, solve, classify, analyze.

2.4.3 Detailed - Thorough knowledge of the subject in all its aspects to enable its application in all hydrographic activities including the most difficult areas. Active verbs (indicating synthesis and evaluation): evaluate, select, design, specify, plan, create.

The minimum knowledge levels for each subject for both Category A and Category B programmes are detailed in the Syllabus, Section 6 below. For some subjects the content requirements for Category A and Category B programmes also differ.

2.5. Practical Exercises and Field Training

Because hydrography is an applied discipline, every student attending Category A and B programmes is expected to be given hands-on experience by the instructors. This experience should form an important part of the student's assessment, and should be considered in two parts.

2.5.1. Practical Exercises - Both Category A and B programmes should contain practical hydrographic surveying exercises related to field operations. These should include, for example, experiments, exercises, laboratories and fieldwork designed to complement the theory component.

Appendix II provides Guidelines for practical experience and Appendix III Guidelines for Nautical Science, both with a checklist of tasks to be performed by each student.

2.5.2. Field Training Projects - Any qualifying programme should also include a minimum aggregate period of at least 4 weeks supervised and evaluated field training, including launch operations. These projects should reflect the level of knowledge outlined in the syllabus, and a full report should be compiled and evaluated. For students of a Category A programme, a complex multi-disciplinary project is envisaged.

2.6 Experience

The Board is of the strong opinion that hydrographic surveyors must possess both education and experience to carry out their work effectively. It stresses that an aggregate period of at least two years varied field experience in hydrographic surveying is necessary to reach the minimum level of competence and active participation in precise positioning, tidal measurements, bathymetric and sonar measurements, land surveys, and data management.

2.7 Recognition

2.7.1. Recognition of programmes. The Board provides recognition for programmes meeting internationally accepted standards. The Board will grant recognition to a programme (or appropriate combination of programmes) which satisfies the minimum Standards.

2.7.2. Recognition of individuals. The Board does not provide recognition to individuals. (see Section 4 for guidance).

3. PROCEDURES FOR SUBMISSION AND RECOGNITION OF PROGRAMMES AND SCHEMES

3.1 Procedure for Submission

3.1.1. Institutions, formal training, academic organizations and learned bodies offering hydrographic programmes are invited to submit their programmes for review by the Board.

3.1.2. The Board encourages joint submission from institutions which can collectively meet the minimum Standards for recognition but which on their own cannot meet all the requirements.

3.1.3. Institutions should inform the Secretariat of the Board, at the IHB address below, of their intention to submit programmes for review. The Secretariat, in turn, will provide the addresses of the Board members. It will then be the responsibility of the institution or organization concerned to dispatch a copy of its submission (as detailed in 3.2 below), in English and both as printed and digital copy to each Board member and the Secretariat.

The Secretariat of the FIG/IHO/ICA IBSC
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The submission deadline will normally be 31st December of the year prior to the next meeting. Should an institution miss the deadline it may be excluded from the review. If an extension to this deadline is requested the institution must contact the secretary at the earliest time in order that the Board may consider the request.
The Board cannot review and recognize courses and schemes that are submitted outside of the above periods.

3.1.4. Correspondence and documentation concerning the international recognition of programmes and schemes should be copied to a National Focal Point where appropriate. The National Focal Point in a country will normally be the Hydrographer in liaison with the national association representing the country in FIG or ICA. National Focal Points are expected to review a programme or scheme submission and comment upon its suitability for recognition prior to the submission. The submission may include a reference from the national focal point.

3.1.5 The Board will set fees for submissions. Payment must be received as instructed by the Secretariat and no later than the deadline. Payment is to be made to the "FIG/IHO/ICA International Standards Board" account held by FIG. The secretary will provide the account and banking details as well as the amount of any fees due. The fees paid will be recorded and included in the summary of the accounts that will from a part of the annual report of the FIG/IHO/ICA International Standards Board. The summary account report will also detail how any monies have been allocated to the work of the Board.

3.2. Documentation to be submitted

It is the experience of the Board that a good submission is one of clarity with detailed cross referencing to the syllabus and modules. A good syllabus that clearly describes its structure, form and references is ideal. What is also helpful is detail on what might have been left out or what has been added and the reasons behind that. This is particularly relevant if technology is being updated. Although it is not expected that a submission will keep to a standard format or template it is important that the submission is comprehensive and adequately documented but not simply a copy of the syllabus texts. In summary, the easiest submissions with which to review are those that are clear, completely cross-related to the syllabus, include some photographs where helpful and are submitted with explanations of any deviations.

The following information must be included in all submissions:

3.2.1. Information about the programme infrastructure. Each item in the following list should be described in the first Chapter of the submission.

a) Programme identification:
Name of the Programme:
Institution submitting the Programme for recognition:
Recognition sought: Specify Category A: or Category B:
Standard against which recognition is sought:
S5 Eleventh Edition [2010]
S5 Options offered: 1, 2, 3, 4, 5, 6, or 7
Language(s) in which the Course is given:

b) Aims of the programme:
The submission should, in this section, provide a clear narrative outline of the programme, with details of who it is for, how it is managed and where it fits in within the institution and national hydrographic environment. The section should describe the academic elements of the course and the objectives it has for each student and their general learning outcomes.

c) Entry requirements:
Qualifications required for entry:
Entry exemptions that may be given:
Alternative qualifications that may be acceptable for entry:

NOTE: For programmes seeking exemption of some or all the basic subjects, provide a clear indication of where students would previously have attained that knowledge, and a clear description of the formal procedures used to evaluate such exemptions. With regard to the pre-entry requirement for admission to any educational or training programme, the prospective student for a Category A programme should have a deeper theoretical ability in mathematics and applied physics than the candidate for a Category B programme.

d) Programme capacity:
Expected/actual number of students beginning the programme each year.
For multi-year programmes, the expected total number of students progressing through the programme.

e) Staff list:
For each instructor in the programme, provide a brief résumé, listing subjects in the programme for which they are responsible; Academic qualifications (degrees, etc.), Hydrographic experience, Authorships.

f) Facilities available to students:
Equipment: Provide a list of relevant equipment/systems
Software: List specific software (with emphasis on hydrographic and cartographic software packages)
Training aids:
Laboratories:
Training vessels:
Library. List:
- total number of volumes held,
- approximate number of hydrographically-relevant volumes,
- other media available (e.g. charts, maps, audio-visual resources)

g) Programme structure:
The programme may involve a series of modules and formal training sessions as well as additional practicals, tutorials and field experience. It is important that a submission is clearly described and sufficient detail is provided. It should as a minimum include:

a. Total duration of the Programme (in weeks or months or years).
b. Table of programme modules (individual courses). For each module, identify where in the sequence of module it is to be taken by students,
c. The duration (in weeks) of the module and
d. The total number of lecture hours, supervised practical exercise hours, and unsupervised practical exercise hours (individual or team project hours) expected from an average student for that module.

The section should allow the Board to relate the module or lectures to the cross–reference table and tabulated course description.

3.2.2. Information about each module (course) in the programme

It is strongly recommended that this section is made very clear and contains a full cross-referencing of the S-5 Syllabus against the Course modules and subjects. This aids greatly in the assessment and enables the institution to better describe the programme in relation to the Standards.

a. The programme being submitted should be described in more detail than the S-5 Syllabus (Section 6), with a tabulation of contact of hours devoted to S-5 Syllabus subjects. In the tabulation, a distinction should be made between lecture hours, guided exercise hours, and – if significant amounts of learning are expected to occur outside scheduled class hours – the estimated out-of-class hours. The S-5 Syllabus need not to be considered as the most appropriate structure for a particular programme.

b. Representative examination papers covering all subject areas from the previous two years, which are taken by students during the programme (i.e. not only the final examination), showing the marking scheme and pass marks. This should not be taken as precluding newly developed programmes not yet able to satisfy these items.

c. A list of texts and reference material used for each subject area, with an indication of the editorial house/publisher, and year of publication.

d. Details of Practical Exercises as detailed in 2.5.1.

e. Details of Field Training Projects as detailed in 2.5.2.

3.2.3. Cross-reference Table

This table is the most important information used by the Board to assess submitted courses. What this table contains is a map of the hours devoted to each topic in each course module described in 3.2.2, and classified according to which S-5 Syllabus topic they are related to. The description should ensure that all elements are covered and that each course module contains the necessary references to match the teaching module with this table.

3.2.4 Internal assessment

The methodology adopted by the institution for internal assessment will need to be furnished in detail. The summary of the recent assessment undertaken for the programme in question (under review) will also need to be included. This should not be taken as precluding newly developed programmes not yet able to satisfy these items.

The institutions which do not have an internal assessment are encouraged to have one. A recommended template for the same is given at Appendix V. The Board may, from time to time,

at its discretion seek the summary of internal assessment of the programmes under review or those already recognized.

3.3. Procedure for Recognition of Programmes

3.3.1. Board members will review the material submitted and discuss their findings at their annual meeting. Due to various factors the Board cannot undertake to review and recognize courses outwith the timescales described in section 3.1.3. Institutions representatives are strongly encouraged to attend the Board meeting, to present their programme, and offer clarifications that the Board may seek. The Board aims to inform the institution, or its representatives, of its decision at the Board meeting, but, may respond afterwards should it be necessary to do so.

3.3.2. The institution concerned should be prepared to allow an inspection party to visit, and meet staff and students involved. The members of the party are to be nominated by the Board.

3.3.3. The Board will advise the institution of its findings. If a programme is adjudged to meet the Standards, the Board will issue a certificate to the institution, detailing the category and options (if any) recognized.

3.4 Register of Recognized Programmes

Recognition is granted on the understanding that institutions undertake to update their programme content according to changes in technology as reflected in the latest edition of the Standards. The Board reserves the right to monitor programme syllabi in conformity with the current published Standards. The Board annually updates its Register of recognized programmes, which is published in the Board Annual Meeting report. Programmes that have been recognized within the previous six years are listed in this Register. To remain on the Register beyond six years, programmes will need to be resubmitted against the then-current Standards.

3.5 Certificate of programme completion

Institutions providing a programme which has been recognized as outlined in Sub-section 2.7.1, are encouraged to issue successful students with a certificate of programme completion. Such certificate may acknowledge that the programme has received the Board's recognition, specifying the category of that recognition, as in the following example:

"This programme has been recognized as meeting the requirements for FIG/IHO/ICA Standards of Competence for Hydrographic Surveyors, at the Category A/B level."

3.6 Certificate of field proficiency

Appropriate national organizations, or alternatively institutions providing a programme which has been recognized, are encouraged to provide a certificate of field proficiency for successful academic students. It is suggested that such certificates be awarded only to students who present log book records demonstrating completion of at least 24 months of supervised field experience in hydrographic surveying, at least 50 % of which was operational. A model log book is shown in Appendix I. Institutes may consider it desirable for students to submit a project report to support the log book.

The Board provides a mechanism for schemes of individual recognition and encourages the establishment of a national or regional scheme to replace the use of certificates of field proficiency.

4. GUIDELINES FOR RECOGNITION OF INDIVIDUALS

The Board does not provide recognition to individuals directly. It does however seek to recognise formal systems and Schemes that review and assess individuals' experience in order to provide them with recognition of their Competency. These Schemes offer to monitor and assess individuals at regular intervals and to register them in a formal system so that an individual may gain recognition at a level of Competency including Category A and Category B a defined level of competency which may include Category A and Category B.

4.1 Background, Board Philosophy and Processes concerning Schemes for Individual Recognition

The term "scheme" in this section means the system of review, assessment and recognition of an Individual to ensure an individual has the relevant and up to date competencies to perform the role of a surveyor at the Category A or Category B level at the specified level of competency. It is this system or scheme that the Board shall recognize on the basis of appropriate information to demonstrate a suitable level of competence is achieved and maintained.

4.1.1 In issuing the guidelines the Board fully recognizes and anticipates dialogue with national bodies seeking such recognition as the guidelines are developed to a level of maturity acceptable internationally. In this sense, the guidelines are issued in this version of the Standards without prejudice.

4.1.2 The underpinning philosophy of the work of the Board in issuing Standards of Competence is that Competence equals Knowledge plus Experience, and must be demonstrated. Thus, successful achievement by any individual of a Category A or B recognition a competency certification recognition within any scheme consists of BOTH successful completion of a course of study which addresses the topics within the relevant Standard AND a satisfactory period of relevant experience during which competence has been demonstrated. In addition, the Board notes that hydrographic and cartographic technology are constantly advancing, and that in order to maintain competence, an individual must pursue continuing professional training and education. Consequently national organisations and academic institutions may recognise individuals. Recognition for individuals should be based on completion of:

a) a programme as outlined in Sub-section 2.7.1, and

b) experience as outlined in Section 2.6.

c) a methodology to demonstrate and document competencies.

d) continuing professional education and training

4.1.3 Submissions to the Board must be written in the English Language and should demonstrate the ability to monitor and assess individuals at the Category A and/or Category B levelspecified competency level.

4.1.4 The Board shall approve the final wording on the Certificate awarded by the Scheme to individuals.

4.1.5 Validity by the Board to any scheme shall be for a maximum period of six years from the date of recognition.

4.1.6 The Board declares that in publishing these Guidelines it is not its intention to override or challenge any legal or procedural processes imposed upon the scheme by government or law.

4.2 Guidelines for National or Regional Schemes submitted for Board Recognition

The Board shall expect the following elements in a national or regional scheme submitted for recognition:

4.2.1 The Board shall normally recognise only one Scheme per country or identifiable region for S-5 and thus, a submission must clearly describe its authority and geographic area. It should include endorsements from the appropriate National Focal Point(s) which in turn should describe and authenticate with evidence (for example, approving and endorsing letters) the status of the scheme submitted. This shall include, where appropriate, the endorsement of academic institutions, government bodies and professional associations. The Board shall not arbitrate between competing schemes within one jurisdiction.

4.2.2 An individual classified by the submitting Scheme as having met the levels of Category A or B must have completed a Category A or B course. It is required that the submitted scheme shall describe in detail how the accrediting process functions. Where prior learning and experience are taken into account within a scheme the processes undertaken by the accrediting body must be fully described and justified.

4.2.3 The Board shall expect adherence to its currently issued Standard(s) and shall expect that a scheme will take into account the currency (or validity) of an individual's experience. Currency will be clearer if the individual has recently satisfied a Course recognised by the Board and has also satisfied the experience minima. Where the recognition process includes vocational training a full detailed description is required by the Board.

4.2.4 The scheme should clearly articulate processes and sub-schemes of Continuing Professional Development/Education (CPD) and show where and how these in turn build-up relevant units for recognition. Clear reference shall be made to the current S-5 syllabus to enable the Board to assess that the processes of CPD adopted provide relevant currency between Editions of the Standards for those individuals who originally qualified against earlier Editions of the Standards.

4.2.5 The process whereby an individual can enter the scheme should be described in detail. Processes for application should be detailed, including all examples of documentation used. The Board considers that a scheme should include a degree of examination for entry which might include all or some of the following: interview, oral or written examination with recording of the process being retained to ensure objectivity. Examples of the process using an individual's work and the records of the reviewers are to be submitted as part of the application process.

4.2.6 It is essential that an individual has recourse to an independent process of appeal to any decision taken by the Panel which administers the entry process into a scheme. This process of appeal will not be to the Board. Appeals must be resolved satisfactorily at the national or regional level in accordance with standards of due process and objectivity. The Board's interest is in assessing the efficacy of such a process. Thus, the Board will expect the submitting scheme to fully describe its adopted appeals process.

4.2.7 The Board shall expect to be able to assess from the documentation provided by a scheme that peer recognition forms part of its system supervision. It follows that a scheme shall be administered by a panel comprising members who represent the wider hydrographic surveying and nautical cartography communities including, but not necessarily limited to, members representing its constituent organisations (government, professional, academic, National Focal Point as well as Offshore Industry and Ports where appropriate).

4.2.8 The processes of the scheme shall include clear record-keeping that details all processes

adopted: records of decision, timing, appeals, reasoning, forms and register, follow up processes for assessing currency (validity) etc. These should be comprehensively detailed in the submission.

4.2.9 The scheme should advise the Board if there are other schemes within its area of jurisdiction and detail how its own status has been defined and agreed in regard to those schemes. It should also detail its communication processes with such schemes with particular detail on the method it adopts to communicate and share its findings and how any differences or ambiguities are resolved. In particular it should describe how it deals with individuals making multiple applications and whether there is a degree of harmonisation, standardization of processes and reciprocity.

4.2.10 The scheme should publish its Rules and Processes together with its critical dates. This shall be kept current and may be achieved by way of a website. Currency will ensure publication of relevant Rules and Processes before critical dates on which they impact.

4.2.11 A scheme can operate in the national language but see 4.1.3 above for the Board's language requirement for submission documentation.

4.2.12 The Board reserves the right to inspect specific scheme documents, such as the Register of Individuals, where it feels this is necessary to aid it in its own recognition assessment process.

4.2.13 A scheme might within its own processes distinguish different levels of competency. Where these exist they should be fully described and the Board will look for detailed cross-referencing to its own Standards and an explanation as to how such processes contribute to the overall system of accreditation and ongoing recognition of an individual's competence.

4.2.14 A scheme might include an overall set of competencies as well as subsets based on limits such as ports, bathymetry, shorelining etc. Where these exist they should be fully described and the Board will look for detailed cross-referencing to its own Standards and an explanation as to how such processes contribute to the overall system of accreditation.

4.2.15 Where a submission considers it cannot meet the guidelines of the Board due to government imposed procedures or legal requirements the Board will expect a fully detailed explanation sufficient for the Board to take them into account during its deliberations.

4.2.16 The Board shall look to the comprehensiveness of submitted Schemes and completeness of documentation including, where relevant, documents which authenticate claims made in the submission and reserves the right to seek any clarifying documentation or explanation it needs to assist in its process of review.

4.3 Statement to be included in the scheme's certificate

Schemes providing a programme, which has been recognised as outlined in Sub-section 4.1, shall be required to issue successful candidates with a certificate of the successful assessment of their competence in relation to the programme or recognition scheme. Such a certificate may acknowledge that the scheme has received the Board's recognition, specifying the level of that recognition. The certificate issued by the Board shall include text similar to the following example:

"This Assessment Scheme has been recognised as meeting the requirements for Recognition of Individuals in the FIG/IHO/ICA Standards of Competence for Hydrographic Surveyors".

The submitted scheme should include examples of its certificates for all levels awarded by the scheme. An

example of the type of text used by a scheme on its certificate to an individual follows:

Having completed a Category A Program recognized by the IBSC against the 11th edition of the Standards of Competence for Hydrographic Surveyors and having been successfully assessed by the procedures recognized by the IBSC, the … institution …… grants Mr. ……the Hydrographer Category A/B certificate of competency "

5. SYLLABUS OUTLINE

BASIC SUBJECTS

B1 Mathematics and Statistics

B1.1 Functions
B1.2(a) Differential calculus
B1.2(b) Integral calculus
B1.3 Series
B1.4 Matrix algebra
B1.5 Complex variables
B1.6 Co-ordinate geometry (2 and 3 dimensional)
B1.7 Spherical trigonometry
B1.8 Theory of errors

B2 Information and communication technology

B2.1 Computer fundamentals
B2.2 System and application software
B2.3 Programming
B2.4 Communication tools and Internet
B2.5 Database and information systems

B3 Physics

B3.1 Units of measure
B3.2 Mechanics
B3.3(a) Signal modulation
B3.3(b) Measurement of time
B3.4 Theory of oscillations
B3.5(a) Electrostatics
B3.5(b) Direct current
B3.5(c) Electromagnetics
B3.5(d) Electromagnetic waves
B3.5(e) Alternating current
B3.6(a) Optical Principles
B3.6(b) Optical equipment
B3.6(c) Lasers
B3.7(a) Electronic signals
B3.7(b) Electronic systems
B3.8 Transducers
B3.9 Pressure

B4 Nautical Science

B4.1 Navigation and Charting
B4.1(a) Rule of the Road
B4.1(b) Conventional Aids to Navigation
B4.1(c) Warnings
B4.1(d) Nautical Charts
B4.1(e) Electronic Charts
B4.1(f) Navigation Publications
B4.1(g) Methods of communication at sea
B4.1(h) Compasses
B4.2 Safety and Seamanship
B4.2(a) Safety
B4.2(b) Safe practice
B4.2(c) Ropes and wires

B4.2(d) Ship behaviour
B4.2(e) Anchoring
B4.3 Pilotage
B4.4 Small boats

ESSENTIAL SUBJECTS

E1 Bathymetry

E1.1(a) Acoustic fundamentals
E1.1(b) Generation of Acoustic Waves
E1.1(c) Transmission of acoustic waves
E1.1(d) Sound speed and refraction
E1.1(e) Reflection and scattering of acoustic waves
E1.1(f) Acoustic noise and the directivity index
E1.1(g) Reception of acoustic waves and system performance
E1.1(h) Acoustic devices
E1.2(a) Transducers
E1.2(b) Data recording
E1.2(c) Sounder calibration
E1.2(d) Sounding reduction
E1.2(e) Sounding accuracy
E1.2(f) Acoustic sweeps
E1.2(g) System selection
E1.3(a) Side Scan systems
E1.3(b) Side scan data interpretation
E1.4(a) Multibeam echo sounding systems
E1.4(b) Multibeam transducers and signal processing
E1.4(c) Coverage and accuracy
E1.4(d) Object detection
E1.4(e) Backscatter
E1.4(f) Integration and calibration
E1.4(g) Reference surface
E1.5(a) Phase differencing systems
E1.5(b) Deployment and mounting
E1.6(a) Laser bathymetry
E1.6(b) Other remote sensing bathymetry
E1.6(c) Mechanical techniques
E1.6(d) Inspection techniques

E2 Water levels and flow

E2.1 Tidal fundamentals
E2.2 Tidal measurements
E2.3 Tidal streams and currents
E2.4 Tidal analysis and prediction
E2.5 Tidal information
E2.5(a) Use of tide tables
E2.5(b) Cotidal charts
E2.5(c) Use of numerical tidal models
E2.6 Non-tidal water level variations

E3 Positioning

E3.1(a) Introduction to Geodesy
E3.1(b) Coordinate systems for positioning
E3.1(c) Satellite positioning
E3.1(d) Map projections

E3.1(e) Geodetic computations

E3.1(f) Approximation and estimation
E3.2(a) Horizontal positioning fundamentals
E3.2(b) Angular measurements
E3.2(c) Distance measurement
E3.2(d) Electromagnetic positioning
E3.2(e) Satellite positioning
E3.2(f) Acoustic positioning concepts
E3.2(g) Sources of error
E3.2(h) Deployment
E3.3(a) Vertical positioning fundamentals
E3.3(b) Datums
E3.3(c) Elevation measurements & computations
E3.3(d) Heave
E3.4 Orientation

E4 Hydrographic practice

E4.1 Types of hydrographic surveys
E4.1(a) Nautical charting surveys
E4.1(b) Surveys in support of port management and coastal engineering
E4.1(c) Offshore industrial surveys
E4.2 Hydrographic specifications
E4.2(a) Instrumentation
E4.2(b) Operations
E4.2(c) Products
E4.3 Routing
E4.3a Siting of Aids
E4.3b Line Keeping
E4.4 Data telemetry links
E4.5 Digital signal processing

E5 Hydrographic data management

E5.1 Data acquisition and control
E5.2 Data capture
E5.3 Data management, processing and analysis
E5.3(a) Approximation and estimation
E5.3(b) Spatial data processing & analysis
E5.3(c) Marine GIS
E5.4 Data presentation
E5.4(a) Visualization and presentation
E5.4(b) Marine Cartography
E5.4(c) Electronic chart
E5.5 Hydrography for Nautical Charting
E5.5(a) Chart compilation
E5.5(b) Correction of Charts
E5.5(c) Electronic Charts

E6 Environmental Science

E6.1 Meteorology
E6.1(a) The atmosphere
E6.1(b) Meteorological elements
E6.1(c) Winds
E6.1(d) Climatology

E6.1(e) Weather systems
E6.1(f) Weather observing and recording
E6.1(g) Weather forecasting
E6.1(h) IMMSS
E6.2 Oceanography
E6.2(a) Physical properties of sea water
E6.2(b) Marine circulation dynamics
E6.2(c) General circulation of the oceans
E6.2(d) Wind-waves and swell
E6.2(e) Wave propagation
E6.2(f) Oceanographic measurements
E6.2(g) Oceanographic instruments
E6.3 Marine geology and geophysics
E6.3(a) Marine geology
E6.3(b) Geomorphology
E6.3(c) Earth's magnetic field
E6.3(d) Earth's internal structure
E6.3(e) Seismic profiling
E6.3(g) Geotechnical sampling
E6.3(h) Deposition and erosion
E6.4 Environmental impact

E7 Legal Aspects

E7.1 Product Liability
E7.2 Contracts
E7.3 Law of the Sea
E7.3(a) Development
E7.3(b) Delimitation zones
E7.3(c) Marine Law

OPTIONAL UNITS

O1 Nautical Charting Hydrography

O1.1 Coastal topography
O1.2 Siting of aids
O1.3 Publications
O1.4 Chart Reproduction
O1.5 Correction of charts
O1.6 Chart Compilation
O1.7 Geographic Information Systems
O1.8 ENC – ECDIS Concepts
O1.9 International Standards
O1.10 ENC Production

O2 Hydrography to support Port Management and Coastal Engineering

O2.1 Surveys for Dredging Operations
O2.2 Hydraulic surveys
O2.3 Surveys for pollution monitoring
O2.4 Channel Marking
O2.5 Controlling sedimentation
O2.6 Remote Sensing in the Coastal Zone

O2.7 GIS
O2.8 Warnings

O3 Offshore Seismic Surveying

O3.1 Geomagnetic surveys
O3.2 Gravity surveys
O3.3 Digital seismic techniques
O3.4 Digital seismic data acquisition
O3.5 Digital seismic data processing
O3.6 Analogue equipment
O3.7 Analogue Applications
O3.8 Deep Water Surveys

O4 Offshore Construction Hydrography

O4.1 Drilling terminology
O4.2 Mobile rig positioning
O4.3 Fixed offshore platforms
O4.4 Structure emplacement
O4.5 Pipeline operations
O4.6 Cable operations
O4.7 ROV operations
O4.8 ROV positioning
O4.9 ROV equipment
O4.10 ROV Surveying

O5 Remote sensing

O5.1 Coastline delineation
O5.2 Ice mapping
05.3 Water surface mapping
O5.4 Bathymetric remote sensing
O5.5 Water column properties

O6 Military Hydrography

O6.1 Anti-submarine
O6.2 Mine Countermeasures
O6.3 Amphibious Operations
O6.3(a) Beach reconnaissance
O6.3(b) Obstructions
O6.3(c) Surveying in the surf zone
O6.3(d) Vertical datum
O6.3(e) Horizontal positioning
O6.3(f) Depth measurement
O6.3(g) Products
O6.4 Rapid Environmental Assessment (REA)
O6.5 Electronic Chart – Military aspect

O7 Inland Waters hydrography

O7.1 Hydraulic engineering
O7.2 Elevation models
O7.3 Flood plane mapping
O7.4 Erosion and sedimentation

6. DETAILED SYLLABUS

FIG/IHO INTERNATIONAL BOARD SYLLABUS – 11th EDITION				Course Cross-reference	
Item and Title	**Level A B**	**Both Category B and A**	**Only for Category A**	*Hours*	**Volume & Page**
Basic 1: Mathematics and Statistics					
B1.1 Functions	P-		Describe and recognise various types of function such as: linear, monotonic, periodic, and continuous. Explain limits of functions, implicit and inverse functions. Solve problems using appropriate functions		
B1.2 Calculus					
(a) Differential Calculus	PP	Calculate gradients of simple functions.	Explain the meaning of higher order derivatives, partial differentiation and use of local minima and maxima. Apply differential calculus to problem solving.		
(b) Integral Calculus	P-		Integrate simple functions and combinations of them using integration by parts and substitution. Calculate the area under a curve.		
B1.3 Series	P-		Describe both finite and infinite forms of the binomial expansion. Classify series as divergent or convergent by the application of tests. Apply Newton's approximation method to find the roots of equations. Use Taylor and Mac Laurin series to evaluate functions.		
B1.4 Matrix Algebra	PP	Describe types of matrices and perform basic matrix operations such as: addition, multiplication, transposition and inversion. Solve simultaneous equations.	Calculate determinants and eigen values.		

B1.5 Complex Variables	P-		Describe complex numbers in both Cartesian and polar formats and the use of the Argand diagram. Calculate products, quotients, powers and roots of complex numbers.		
B1.6 Co-ordinate Geometry	PF	Explain co-ordinate systems, Cartesian and polar co-ordinates. Identify linear and quadratic functions. Describe equations of lines and planes, the angle between lines and planes, the intersection between lines and planes and the distance from a point to a plane.	Describe conic sections, direction cosines and the parametric equations of curves and surfaces. Calculate the equations of lines and planes, the angle between lines and planes, the intersection between lines and planes and the distance from a point to a plane.		
B1.7 Spherical Trigonometry	PF	Describe the sphere, great circles, spherical angles, spherical triangles and spherical excess.	Use the sine, cosine and 4 part formulae to solve spherical triangles. Use Napier's rules to solve right angled and quadrantal triangles.		
B1.8 Theory of Errors	PP	Classify errors. Describe the treatment of systematic and random errors in measurements. Describe the basic ideas of probability theory: mean, standard deviation, variance, co-variance, correlation, residuals and minimising the sum of the squared residuals.	Calculate errors and apply appropriate statistical tests. Describe hypothesis testing and Fourier transformations. Estimate standard errors and weights. Conduct numerical analysis and approximation. Use Filtering and Smoothing techniques. Formulate Stochastic Models.		

FIG/IHO INTERNATIONAL BOARD SYLLABUS – 11th EDITION				Course Cross-reference	
Item and Title	**Level A B**	**Both Category B and A**	**Only for Category A**	*Hours* **Volume & Page**	
Basic 2. Information and Communication Technology					
B2.1 Computer Fundamentals	PF	Explain how the following components interact to form a computer system: central processor unit, storage devices, storage media, input and output ports and devices. Describe the input and output devices particularly useful in Geomatics (hydrographic) computer systems.	List appropriate criteria for selecting computer systems for hydrographic data acquisition, processing, and management. Explain the interfacing standards for peripheral devices: RS-232, USB, Ethernet, Bluetooth, IEEE 1394 (Firewire, iLink), IEEE802. 11(WLAN, Wi-Fi) etc.		
B2.2 System and Application Software	PP	Describe the architecture of operating system software, such as Windows, UNIX and Linux. List the functions and operations provided by an operating system. Operate common application software systems such as spreadsheet, word processor, graphics software, and internet browser.			
B2.3 Programming	PF	Describe software development procedures: statement of requirements, interface design, algorithm development, flowcharts and pseudo code. Define syntax, data types and structures, control structures, arrays, pointers, functions, and file processing procedures for a modern programming language, such as Visual Basic, Visual C++, or Java.	Write computer programs using a modern programming language, to solve practical problems.		
B2.4 Communication Tools and Internet	PP	Explain the networking concepts underlying Internet and intranet communications. Describe the features, resources and security issues of the Internet. Conduct searches for specialized information using Internet tools.	Explain the different Internet access modes, and their bandwidths. Upload hydrographic information to a web page.		

B2.5 **Database and Information Systems**	FF	Define different types of database management systems, and explain the architecture, functions and operations provided by each.	Describe the development of an information system, built upon database management software. Explain the special requirements of geospatial information systems		

FIG/IHO INTERNATIONAL BOARD SYLLABUS – 11th EDITION				Course Cross-reference	
Item and Title	**Level A B**	**Both Category B and A**	**Only for Category A**	*Hours* **Volume & Page**	
Basic 3: Physics					
B3.1 Units of Measure	PP	Describe System International (SI), Imperial and other systems of units in common use. Classify fundamental and derived units.			
B3.2 Mechanics	PF	Define velocity, acceleration, and rate of change. Describe vectors including fundamental operations and triple products. Define force, mass, units of force and general dynamics. Explain angular velocity equations and differentiate between centrifugal and Coriolis effects. Describe Newton's Laws, gravitational fields, energy, potential fields, static levers, couples and moments.	Calculate linear and angular velocities, accelerations, rate of change and use the velocity equation.		
B3.3 Signals					
a) Signal Modulation	FF	Explain and give examples of amplitude, frequency, phase and pulsed methods of signalling.	Describe coding and multiplexing techniques.		
b) Measurement of time	FF	Describe different types of frequency standards. Differentiate various types of clocks. Describe low frequency oscillators.	Describe the relationship between time and other physical measurements.		

B3.4 Theory of Oscillation	FF	Describe harmonics, modulation techniques and the composition of sinusoidal movements, pulsations, damped oscillations, forced oscillations, oscillatory and wave systems. Explain simple harmonic motions and vibrations including pendulums. Describe various properties of propagation.	Describe wave functions, interference, stationary waves, factors influencing propagation.		
B3.5 Electricity and Magnetism					
a) Electrostatics	FF	Describe electric fields and potential. Explain the use of conductors, capacitors and insulators.			
b) Direct Current	FF	Explain voltage, current and Ohm's Law. Describe circuit resistance and conductance, power and energy. Explain the principles of electromagnetic fields and thermoelectricity.			
c) Electromagnetics	FF	Explain current induced magnetic fields, field forces, magnetic circuits and magnetic characteristics of bodies. Describe the principles of the production of a magnetic field and electromagnetic waves.			
d) Electromagnetic Waves	FF	Describe the propagation of electromagnetic waves. Describe various aspects of propagation media, the propagation equation, the effects of ducting ground and space waves and reflection and refraction characteristics. Define direct and indirect wave propagation and propagation over the horizon. Identify and describe various antennas.	Explain Maxwell Equations.		
e) Alternating Current	FF	Describe Ohm's Law, impedance, phase difference and resonance. Explain power and energy and polyphased systems.			

B3.6 Optics					
a) Optical principles	FF	Explain radiation, emission and absorption. Describe natural light, the propagation of light its dispersion and absorption. Differentiate reflection, refraction and diffraction.			
b) Optical Equipment	PP	Explain the functions of mirrors, prisms, lenses and filters. Describe telescopic optics and magnification. Calculate field of view and resolving power of optics. Describe aberrations.			
c) Lasers	FF	Describe the operation, unique properties, and applications of stimulated sources of emission.			
B3.7 Electronics					
a) Electronic Signals	F-		Describe Fourier series and analysis. Explain the relationships between data and frequencies. Describe noise and its effects. Differentiate various signal spectra.		
b) Electronic Systems	F-		Describe various components, tubes and semi-conductors. Explain the principles of amplifiers, filters, generators, oscillators, modulators and demodulators. Identify and differentiate logic circuits and integrated circuits.		
B3.8 Transducers	FF	Describe various types of transducers for acoustic, thermal, electromagnetic optical and magnetic functionality.			
B3.9 Pressure	FF	Explain the principles of various pressure sensors. Describe Bourdon, piezoelectric and vibrating string sensors.			

FIG/IHO INTERNATIONAL BOARD SYLLABUS – 11th EDITION				Course Cross-reference	
Item and Title	**Level A B**	**Both Category B and A**	**Only for Category A**	*Hours*	**Volume & Page**
Basic 4: Nautical Science					
B4.1 Navigation and Charting					
(a) Rule of the road	FF	Recognize which vessel should keep clear of the other vessel, in a variety of meeting, crossing, and overtaking situations. Recognize the lights and day shapes displayed by common vessel types. Describe the sound signals required when operating in reduced visibility. Explain the responsibilities of a vessel operating in reduced visibility. Explain the basic principles of radar operation, and describe the capabilities and limitations of radar.			
(b) Conventional aids to navigation	FF	Describe the principal types of buoys and beacons, and their roles as aids to navigation. Explain the function of radio and radar beacons. Describe how vessel traffic services (VTS) and automatic identification systems (AIS) operate. Describe the use of traffic separation schemes.			
(c) Warnings	PP	Describe the means by which navigational warnings are provided to ships at sea using Global Marine Distress and Safety System. Explain the relationship of Notice to Mariners to nautical charts and publications, and describe the mariner's responsibility to provide information for inclusion in Notice to Mariners. Interpret navigational warnings and Notice to Mariners. Apply Notice to Mariners chart corrections to a nautical chart.			

d) Nautical Charts	PP	Explain the different uses of the nautical chart. Classify nautical charts according to scale, objectives, edition, and form (paper - digital). Describe the content of a nautical chart. Differentiate special purpose nautical charts. Use nautical chart for various applications. Recognize common charting symbols. Explain the following components of a nautical chart: datum, projection, scale.	Layout a route on a nautical chart. Plot fixes, identify navigational hazards, revise navigational plan as required. Describe the uncertainty indicators associated with nautical charts (e.g. source diagram, reliability diagram, zone of confidence, notes), and the nature of position and depth uncertainties that may exist.		
e) Electronic Charts	PF	Describe the ENC and ECDIS standards, as well as raster nautical chart standards. Describe other Electronic Chart Systems (ECS) and formats. Explain the differences between these electronic charting products. Describe the ENC production process.	Use software to convert hydrographic data to S57 format.		
f) Navigation Publications	PF	Describe the source and content of sailing directions, light and radio lists, and tide and current tables.	Analyze information from sailing directions and light lists for use in planning vessel operations. Compute the height of tide for a given location and time. Compute speed and direction of current for a given location and time.		
g) Methods of communicating at sea	PF	Explain the relative advantages of VHF, SSB, wireless telephone and satellite communications. List the important VHF channels and their uses for vessels.	Use appropriate reference materials to determine the proper frequency for reception of GMDSS information in a project locality.		
h) Compasses	PP	Describe the capabilities and limitations of magnetic and gyro compasses. Explain the sources of magnetic and gyro compass error. Determine and apply corrections for magnetic and gyro compass error.			

B4.2 Safety and Seamanship					
(a) Safety	PP	Demonstrate the proper operation, and the appropriate use of different types of fire extinguishers. Explain the safety procedures for using fixed CO2 fire extinguishing systems. Demonstrate proper use of life preservers and cold water survival suits. Describe procedures for launching and entering life rafts. Explain the operation of distress flares and Emergency Position-Indicating Radio-Beacons (EPIRB). Explain shipboard procedures for man-overboard, fire, and abandoning ship.			
(b) Safe practice	FF	Describe safety procedures for working with suspended loads, entering closed spaces, working aloft, working on deck, and working with equipment over the side. Explain safety procedures for making repairs to electronic and electrical equipment.			
(c) Ropes and wires	PP	Recognize different types of wire, natural, and synthetic rope. Tie a square knot, clove hitch, and bowline. Give examples where each might be used on a boat or aboard ship. Describe the purpose and use of block and tackle. Explain the purpose of derricks, davits, A-frames, cranes, winches and capstans. Describe methods for securing equipment for heavy weather.	Use proper reference sources to determine the breaking strength and safe working load of common ropes and wires.		

d) Ship Behaviour	PF	Describe the manoeuvring capabilities of single and twin screw ships, as well as ships with bow-thrusters and omni directional drive systems. Recognize the terminology for locations on a vessel, vessel construction components, and major equipment systems. Explain how tows will handle at varying speeds and with varying amounts of tow line. List the primary factors that affect ship stability.	Explain the relationship between metacentric height, stability, and vessel rolling characteristics. Explain how flooding affects the stability of a vessel. Prepare a list of all the information necessary to compute the effect on stability of the placement on board and the launch/recovery of a ROV.		
e) Anchoring	PF	Describe the component parts of shipboard ground tackle (anchor, chain, windlass, stoppers, etc.). Describe how multiple anchors can be used to position a vessel over a fixed location. Explain how the final position of the vessel can be adjusted.	Prepare a plan for laying an anchor spread, accounting for current, bottom type, and depth.		
B4.3 Pilotage	FF	Explain the role of harbour pilots for ships entering port. Describe the responsibilities of the pilot and the vessel master when a pilot is aboard	Describe how the sailing directions can be used to obtain the information necessary to arrange port services and pilotage.		
B4.4 Small Boats	PF	Demonstrate the ability to manoeuvre a small boat. List the minimum necessary safety equipment for responsible operation of small boats. Draw a diagram showing how an anchor should be rigged on a small boat.	Use a chart and compass to plan and to make a small boat transit.		

FIG/IHO INTERNATIONAL BOARD SYLLABUS – 11th EDITION				Course Cross-reference	
Item and Title	**Level A B**	**Both Category B and A**	**Only for Category A**	*Hours* **Volume & Page**	
Essential 1: Bathymetry					
E1.1 Underwater acoustics					
(a) Acoustic Fundamentals	F F	Distinguish between plane and spherical waves. Distinguish between sound speed and particle velocity. Describe the Active Sonar Equation. Define acoustic units, intensities and sound levels			
(b) Generation of Acoustic Waves	P F	Describe how acoustic waves are generated, define source level. Define frequency, wavelength, amplitude, pulse duration (pulse length), and pulse repetition rate.	Determine source level from typically available sonar specifications.		
(c) Transmission of Acoustic Waves	P F	Explain the causes of propagation loss and list the differences in water properties that affect propagation loss.	Explain how the acoustic medium affects the propagation of acoustic waves. Calculate propagation loss in practical situations, using water property observations and available tables.		
(d) Sound Speed and Refraction	P P	Describe effects of the physical properties of water on sound speed. Calculate sound speed from measurements of temperature, pressure (depth), and salinity (conductivity). Using available software tools, create a sound speed profile of the water column. Describe the effects of variation of sound speed in the water column on the path of sound rays through the water.	Explain the concept of a harmonic mean sound speed and determine the harmonic mean sound speed from water column observations. Describe the principles of refraction and ray path development and analysis. Determine the horizontal offset and travel distance for sound rays refracted through the water column.		
(e) Reflection and Scattering of Acoustic Waves	P F	Describe the characteristics of the seafloor and seafloor targets that affect the reflection of acoustic waves.	Define the characteristic impedance of an acoustic medium. Assess the effects of varying seafloor composition, texture, and slope on echo strength.		
(f) Acoustic Noise and the Directivity Index	P F	Identify the sources of noise in the environment and describe the effect of noise on echo sounding. Define the directivity index.	Calculate the effect on sonar range of a variety of noise conditions and sonar directivity circumstances.		

(g) Reception of Acoustic Waves and System Performance	P F	Define beam width, bandwidth, gain, detection threshold, range resolution and spatial resolution.	Analyze the performance (range, coverage, target detection, resolution, bottom penetration) of echo-sounders, sonars, acoustic beacons and seismic profilers, using specific values for pertinent system parameters.		
(h) Acoustic Devices	P F	Describe the purpose and operation of acoustic devices such as: transponders, pingers, acoustic releases, and sound speed meters. Operate such acoustic devices.	Select appropriate acoustic devices for particular applications. Analyze and apply the data provided by transponders and sound speed meters.		
E1.2 Single-beam echo-sounders					
(a) Transducers	D P	Discriminate between narrow beam and wide beam transducers, and list the transducer characteristics that affect beam width. Describe the piezo-electric principle and explain its application to transducers. Describe the arrangement of single element and multi-element array transducers. Explain methods of mounting transducers: hull, towed, over the side, and boom.	Describe the design and use of multi-frequency, wide-bandwidth and parametric transducers. Differentiate between chirp and CW transmission, and characterize their relative performance. Explain transducer Q values. Detail the advantages and drawbacks of different transducer installation and mounting approaches. Evaluate and select appropriate transducers and their method of mounting for specific applications.		
(b) Data Recording	D P	Differentiate between analogue and digital recording systems and media. Select appropriate range, scale, and pulse repetition rate for specific applications. Interpret echo-sounder records.	Explain the concept of recording full echo envelope data and apply the full echo envelope data in complex echo sounding environments. Explain the principles of dynamic range, clipping, and saturation.		
(c) Sounder calibration	D P	Calibrate an echo-sounder by bar check, lead line, sound speed profile measurements and CTD measurements.	Evaluate and select appropriate echo-sounder calibration methods and equipment for specific applications.		
(d) Sounding reduction	D P	Explain and apply the reductions to measured depths due to water level variations, draft, dynamic draft (settlement, sink age, squat, fuel depletion, and buoyancy changes), and sound speed.	Evaluate and apply all appropriate factors affecting depth reductions, for specific applications.		
(e) Sounding Accuracy	D P	Using available uncertainty values for individual sensors calculate and assess the uncertainty in soundings due to errors in the positioning system, echo-sounder, water level measurement, vessel motion and sound speed.	Assess the uncertainty of echo sounders and other contributors, including seabed topography and character, to the total uncertainty of soundings, and evaluate and select appropriate methods for controlling sounding uncertainty.		

(f) Acoustic Sweeps	P P	Explain the design of boom systems and the effect of transducer spacing and survey speed on full insonification.	Specify the transducer spacing and survey speed for a boom system, to ensure full sonar coverage, for specific applications.		
(g) System selection	D P	List the primary system characteristics that affect range resolution, spatial resolution, depth capability, and bottom penetration, and describe the effect of changes in those characteristics.	Specify appropriate echo-sounder characteristics (e.g., beam width, frequency, bandwidth, source levels), for specific applications.		
E1.3 Side scan sonar					
(a) Side scan systems	D P	Describe the principles, geometry, and deployment of side scan sonar. Explain the effect on side scan sonar performance (range, resolution, target detection) of frequency, beam angle, range scale, gain, towing speed, towing height, and deployment (deep tow, shallow tow, pole mount). Set up, deploy and operate side scan sonar, for specific applications.	Evaluate and select appropriate side scan frequency, operational settings and deployment for specific applications.		
(b) Side scan data interpretation.	D P	Using available software tools, plot and position sonar contacts and create side scan mosaics. Determine height and size of obstructions from sonar records. Describe sources of side scan image distortion. Explain sonar signatures of such items as debris from wrecks, pipelines, gas, fish and fresh water.	Oversee image enhancement and the creation of sonar backscatter mosaics. Assess differences in seafloor composition, topography, and texture. Evaluate sonar targets for further investigation. Describe the effects of stratification of the water column and develop mitigating strategies for surveying in a variety of environmental conditions.		
E1.4 Multibeam and swath echo sounders					
(a) Multibeam Echo Sounding Systems	F	Describe the principles and geometry of multibeam echo sounding			
(b) Multibeam transducers and signal processing.	P F	Describe the combination of transducer elements into transmit and receive arrays. Explain the basic principles of multibeam sonar transmit and receive beam forming and beam steering.	Explain the effect of aperture size and element spacing on array performance. Describe the techniques and relative advantages and disadvantages of weighted mean-time and split aperture differential phase methods of bottom detection.		
(c) Coverage and accuracy.	D P	Explain the dependence of depth coverage and uncertainty on bandwidth, beam-width, swath width, beam elevation angle, grazing and incident angles, depth, pulse repetition rate.	Estimate seafloor coverage and the contribution of these factors into depth and position uncertainty.		

(d) Object Detection	D P	Predict the nominal sounding density on the seafloor using available information for depth, vessel speed, beam dimensions, and total swath angle.	Determine the beam footprint size and sounding spacing across the swath and assess the limitations and likelihood of detecting objects on the seafloor under varying surveying conditions.		
(e) Backscatter	P F	Describe the generation of backscatter data and the various modes of backscatter recording (e.g., beam average, side scan time series, beam time series)	Explain the concept of angle dependence and describe the signal processing steps required to obtain corrected backscatter data for seafloor characterization.		
(f) Integration and Calibration.	D P	Explain the effects on depth and position uncertainty of uncertainty in sensor locations, system latency, and alignments within the vessel reference frame. Define the "patch test".	Establish the vessel reference frame and sensor offsets and alignments. Select test area and lines to be run for "patch test". Calibrate the latency and misalignments between transducer and motion sensor. Assess the contribution to position and depth uncertainty of the residual uncertainty in reference frame, latency, attitude, and alignment.		
(g) Reference Surface	F	Explain the concept and process of establishing a reference surface and assessing the performance of an integrated survey system			
E1.5 Phase Differencing Bathymetry (Interferometry)					
(a) Phase Differencing Systems	P F	Explain the principles and geometry of interferometry and phase differencing bathymetric sonars and the arrangement of transducer arrays	Explain the benefits and effect of incorporating multiple array pairs in the sonar transducer of a phase differencing system.		
(b) Deployment and mounting	P F	Describe the options for deployment and mounting of phase differencing systems.	Assess the relative merits of multibeam and phase differencing systems for specific mapping applications in water depths from very shallow to full ocean depths.		
E1.6 Non-acoustic bathymetric techniques					
(a) Laser Bathymetry	P F	Explain the principles, capabilities, and limitations of bathymetric lidar. Describe the environmental and operational environments in which bathymetric lidar surveys are complementary to echo sounder surveys. Define a Secchi Depth and list which environmental factors affect it	Explain the difference between topographic lidar and bathymetric lidar (wavelength, pulse repetition rate, footprint, and water penetration). Describe the Jerlov Curves and identify the ideal wavelength for maximum water penetration in typical ocean cases. Explain how variations in seafloor		

			reflectance, turbidity, and sea state affect the performance of bathymetric lidar, and select areas suitable for airborne lidar bathymetry.		
(b) Other Remote Sensing Bathymetry	F F	Describe the techniques of passive remote sensing for bathymetry. Describe other airborne, shore-based, and satellite active remote sensing techniques for bathymetry.	Explain the limitations and advantages of passive remote sensing relative to active remote sensing.		
(c) Mechanical techniques.	F F	Describe wire and bar sweeps.			
(d) Inspection techniques.	F F	Explain the use of the camera, diver and ROV in the inspection of sea floor contacts.			

FIG/IHO INTERNATIONAL BOARD SYLLABUS – 11th EDITION				Course Cross-reference	
Item and Title	**Level A B**	**Both Category B and A**	**Only for Category A**	*Hours*	**Volume & Page**
Essential 2 - Water levels and flow					
E2.1 Tidal fundamentals	P F	Describe tide generating forces and the static and dynamic tidal theories. Describe the major harmonic constituents. Identify and recognise the different types of tide. Explain the concept of amphidromic points and co-tidal charts. Define different tidal levels.	Classify tidal regimes.		
E2.2 Tidal measurements	D P	Explain the principles of various types of water level gauges and poles. Describe characteristics of river, coastal and offshore water level gauges. Install and operate water level gauges and poles.	Evaluate and select appropriate instruments and sites for water level monitoring. Calibrate analogue and digital recording water level gauges. Evaluate sources of error. Apply appropriate corrections.		
E2.3 Tidal streams and currents	DF	Describe the relation between streams and tides. Define rectilinear and rotary tidal streams and related elements. Describe methods for measuring tidal streams and currents, including log ship, pole and current meters.	Select depth at which to observe a tidal stream or current. Measure tidal streams and currents using appropriate methods. Analyze tidal stream measurements.		
E2.4 Tidal analysis and prediction	P_		Determine a preliminary sounding datum from observed water levels.		
E2.5 Tidal information					
(a) Use of tide tables	PP	Predict water levels for main and secondary ports, using tide tables. Calculate water level at a particular time, and/or calculate the time at which a specific height will occur.			

(b) Co-tidal charts	P F	Apply co-tidal chart information.	Construct co-tidal charts		
(c) Use of numerical tidal models	PP	Compute tidal predictions using numerical models.			
E2.6 Non-tidal water level variations	DF	Describe the temporal and spatial effects on water level caused by: atmospheric pressure, wind, seiches, and precipitation. Identify water level variations occurring in rivers and lakes and due to dam operations.	Evaluate and select appropriate locations for water level gauges in rivers, lakes, and near dams, for specific applications.		

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Essential 3: Positioning					
E3.1 Geodesy					
(a) Introduction to Geodesy	F F	Describe the shape of the Earth and explain the ellipsoid of revolution and its relationship to the Geoid. Describe the principles of gravity models.	Describe the nature of the gravity field, how it is measured, monitored and modelled, together with associated uncertainties. Explain the role of the gravity field in hydrography and in particular in obtaining predicted bathymetry from satellite altimetry.		
(b) Co-ordinate Systems for Positioning	P F	Define the celestial sphere and other astronomical terms including sidereal and solar time. Describe geodetic, astronomic, orbital and geocentric systems. Describe the Conventional Terrestrial System and some of its practical realizations, such as GRS80, WGS84 etc.	Calculate transformations between co-ordinate reference systems. Define various realizations of solar time, such as UTC TAI, GPS time etc.		
(c) Satellite Positioning	D P	Describe different satellite positioning systems and explain for each, their role (primary positioning system or overlay) and orbit geometry (e.g. inclination, ellipticity, altitude). Define satellite observables. Calculate satellite coverage and availability.	Specify and evaluate satellite positioning systems for positioning, navigation and altimetry.		
(d) Geodetic Computations	P P	Differentiate between plane and geodetic computations. Calculate forward and inverse computations on the ellipsoid using appropriate software.	Apply computations to the determination of boundaries..		
(e) Approximation and Estimation	D P	Describe methods for estimating and approximating static and dynamic survey measurements. Apply and analyze filtering and cleaning functions using appropriate software.	Evaluate and select the best filtering and /or cleaning procedure, for specific applications.		

(f) Map Projections	D P	Distinguish between conformal and non-conformal projections. Classify the properties of cylindrical, azimuthal and conical projections. Describe grids and graticules on projections. Transform between geographic and grid coordinates, compute convergence, scale factors and arc to chord corrections, using appropriate software.	Verify computed values for a number of parameters including scale factor, convergence and arc to chord corrections. Select an appropriate projection for a specific application.		
E3.2 Horizontal Positioning					
(a) Horizontal Positioning Fundamentals	D P	Specify and plan horizontal control surveys. Describe horizontal positioning procedures (e.g. intersection, resection, polar and traverse). Specify appropriate instruments. Understand economic and logistical aspects of providing control.	Plan the number and quality of observations required.		
(b) Angular Measurements	D P	Describe the principles of sextants and theodolites as used for horizontal positioning. Use sextants and theodolites and evaluate errors.	Select appropriate sextant and theodolite shore locations for specific applications.		
(c) Distance Measurement	D P	Describe the principles of stadia, microwave, infrared and laser systems, as used for measuring distances and distance LOPs. Use distance measurement equipment.	Evaluate and select appropriate distance measurement systems, shore locations and survey coverage areas, for specific applications.		
(d) Electromagnetic positioning	D P	Describe the principles of pulsed, differencing (phase and time) and range and bearing systems, utilizing both radio and optical frequencies. Operate appropriate systems.	Evaluate and select appropriate electromagnetic positioning systems, shore locations, deployment methods, and coverage areas, for specific applications.		

(e) Satellite positioning	D P	Explain the GNSS concept and principles. Describe the characteristics of various public and private DGNSS services (single baseline, network, state space). Define pseudo ranging and carrier phase based modes of satellite positioning. Evaluate the performance of code vs. carrier; differential vs. autonomous modes; dual vs. single frequency; fixed vs. float ambiguity resolution. Operate GNSS and DGNSS equipment.	Determine which methods are capable of limiting positioning uncertainties to appropriate levels. Evaluate and select appropriate equipment, shore locations, and coverage areas, for specific applications..		
(f) Acoustic positioning concepts	F F	Describe the principles of long, short and super-short baseline acoustic positioning system modes. Describe the deployment and calibration, signal structure, sources of error, and expected uncertainties for each mode.	Specify the deployment and calibration method, Predict and evaluate sources of error and expected uncertainties for each system and appropriate application (towed bodies, autonomous underwater vehicles, remotely operated vehicles).		
(g) Sources of error	D P	Catalogue sources and magnitudes of errors for each positioning method and system. Explain problems due to multipath, interference, re-radiation, geometry, time-sharing, and power supplies. Verify performance of each system to be used. Monitor system performance by analyzing results of least squares adjustments of measurements, where appropriate. Assess repeatability, relative and absolute accuracies.	Analyze the uncertainties expected for each positioning technique (e.g. static and kinematic, and code and phase GNSS techniques). Select appropriate systems, for specific applications. Describe the errors and effects arising from inadequate calibrations.		
(h) Deployment	P P	Establish, mark and describe hydrographic control stations.			
E3.3 Vertical positioning					
(a) Vertical positioning fundamentals	D P	Explain and describe the characteristics of height systems (e.g. dynamic, orthometric and normal heights). Differentiate between gravity-related and ellipsoidal heights.			

(b) Datums	D F	Describe the role of, and methods of establishing, the various vertical datums used in hydrographic operations (e.g. Chart, Sounding, MSL, LAT, LW, and HW datums).	Select, establish, interpolate and transfer datums in oceans, coastal waters, estuaries, rivers, and lakes for soundings and elevations.		
(c) Elevation measurements and computations	D P	Describe methods for determining differences in elevation (e.g. by spirit level, vertical angle, and GNSS). Compute elevations from observed data. Correct for effects of curvature and refraction, where appropriate. Describe the principles of satellite altimetry..	Compare and evaluate the observing methods and procedures for the determination of elevation (e.g. by spirit level, theodolite, and satellite systems). Select an appropriate system for specific applications. Describe how bathymetry can be predicted from satellite altimetry.		
(d) Heave	D P	Describe the principles and limitations of heave compensation systems. Determine heave using such a system. Describe the role of filtering in making heave measurements.	Evaluate and select appropriate heave compensation systems for specific applications.		
E3.4 Orientation	D P	Describe the operation of heading sensors (e.g. flux-gate and other magnetic, fibre-optic and gyro compasses). Explain the principles of inertial roll and pitch sensors. Describe the principles and limitations of GNSS attitude sensors.	Evaluate and select appropriate heading, roll and pitch sensors, for specific applications. Describe field alignment checking procedures. Install, calibrate and analyze the data quality of the selected sensors.		
E 3.5 Three-dimensional Geodesy	DP	Describe the mathematical model for 3D geodesy, integrating satellite and terrestrial observations.	Evaluate a typical hybrid network, using commercial software. Describe application of 3D Geodesy to hydrographic survey control and 3D positioning of survey vessels.		

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Essential 4: Hydrographic practice					
E4.1 Types of hydrographic surveys					
(a) Nautical charting surveys	F F	Describe the purposes of nautical charting surveys - all essential data to ensure safety of navigation. Define the components of a nautical charting survey (general depths, wrecks and obstructions, shorelines, navigation aids, etc.). Explain IHO survey specifications.			
(b) Surveys in support of port management and coastal engineering.	F F	Describe and distinguish between surveys for dredging, environmental monitoring and hydraulics, including surveys at a large scale. Describe the methods and instruments used (e.g. geotechnical, magnetic, diving, and cameras).			
(c) Offshore industrial surveys	F F	Explain the principles and conduct of seismic, gravity, geomagnetic, pipeline route selection, pipeline installation and submarine cable route surveys. Describe the role of ROV's in such surveys. Define terms used to describe offshore hydrocarbon structures and drill rig equipment.			
E4.2 Hydrographic specifications					

(a) Instrumentation	DF	Compare specifications of bathymetric systems (single beam echo-sounders, multibeam echo-sounders, interferometric side scan sonar, and Lidar). Describe oceanographic, geophysical (seismic, magnetometer, and gravimetric) and geotechnical equipment. Explain the importance of the correct installation and determination of the attitude and position of each sensor.	Specify the appropriate bathymetric, oceanographic, geophysical and geotechnical equipment required, for specific applications. Specify and evaluate appropriate location of sensors.		
(b) Operations	DF	Describe the roles of the following survey parameters: scale, positional accuracy, survey speed, line orientation, interlines, cross lines, fix interval, data coverage. Explain methods for quality control of survey data, and the quality assurance of surveys. Describe cost estimating, and project scheduling. Interpret survey specifications.	Create specifications for specific surveys, including appropriate requirements for scale, positional accuracy, survey speed, line orientation, interlines, cross lines, fix interval, and data coverage. Specify methods to be used for quality control of survey data, and the quality assurance of surveys. Estimate survey costs. Schedule survey operations.		
(c) Products	DP	Describe tender documentation. Describe and prepare grid sheets, track charts, alignment sheets, textural presentation, contours and contour intervals, fair sheets, digital elevation models, sonar mosaics, electronic data formats, and survey reports.	Create tender documents. Specify the characteristics and preparation methods for grid sheets, track charts, alignment sheets, textural presentation, contours and contour intervals, fair sheets, digital terrain models, sonar mosaics, electronic data formats, and survey reports.		
E4.3 Routing					
(a) Siting of Aids	P F	Describe how fixed and floating aids to navigation are used to delineate channels, fairways, and safe water. Explain how the position of a buoy can vary with the strength and direction of the current and the stage of tide.	Identify appropriate locations within a surveyed area for leading lines, fixed lights, and buoys, considering the draft of vessels, the bathymetry, the coastal topography, the tide and current regime, and the location of wrecks and dangers. Explain the location of navigation aids for a surveyed area in relation to their wider regional system of navigation aids.		

(b) Line keeping	D P	Explain and apply position fixing for route guidance (e.g. compass courses, transits, optical route following techniques, and computer assisted track and route guidance). Explain the dependence on survey route of overlap and quality control for various data collection systems.	Evaluate and select the appropriate route guidance system, for specific applications.		
E4.4 Data Telemetry Links					
(a) Radio data telemetry links	P F	Explain the differences in telemetry range and data capacity of various carrier frequencies and operational parameters (e.g. signal strength, water column, terrestrial or satellite path, modulation technique used). Describe data telemetry for emergency use (GMDSS), telemetry of survey data (water level gauges, calibration and position data). Describe "in field" data telemetry applications and methods, and ship to shore data telemetry applications and methods.	Install and operate appropriate data telemetry links for specific applications.		
(b) Acoustic data telemetry links	F_		Explain and describe the Burst, Pulsed and Spread spectrum signal structure.		
E4.5 Digital signal processing	F _		Describe basic digital signal and image processing concepts		

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Essential 5: Hydrographic data management					
E5.1 Real-time data acquisition and control	DP	Collect hydrographic data manually and automatically. Describe and operate integrated navigation systems and data logging systems. Explain the significance and effect of the use of various data logging rates. Describe the process of on-line data sampling, validation and selection techniques. Explain the effects of using various gating and filtering parameters.	Evaluate and specify, for specific applications, methods to be used for hydrographic data collection, integrated navigation, data logging, on-line data sampling, data validation and selection, and data gating and filtering.		
E5.2 Analogue data capture	DP	Explain the manual input of alphanumeric data, raster scanning processes and vector digitisation. Describe digitising systems and scanners. Describe digital data formats. Carry out digital data transfer.	Evaluate and select digital data capture equipment, formats and strategies, for specific applications.		
E5.3 Data management, processing and analysis.					
(a) Approximation and estimation	D P	Apply approximation and estimation procedures to survey measurements.	Evaluate and select the best filtering and / or cleaning procedure, for specific applications.		
(b) Spatial data processing & analysis	DF	Describe the properties of spatial databases and Database Management Systems (DBMS). Explain the concepts of raster and vector data. Explain the concepts of Geographical Information Systems (GIS) and Spatial data Infrastructures (SDI). Recognize algorithms used for spatial data selection, filtering, smoothing, approximation, estimation, correlation and analysis. Describe Digital Elevation Models (DEMs).	Evaluate and select the best filtering and / or cleaning procedure and processing algorithm, for specific applications. Evaluate and select appropriate DEM types (e.g. gridded, triangular, etc.) for specific applications. Carry out data conversion and editing. Merge multiple data sets.		

(c) Marine GIS	PF	Explain the use of Geographical Information Systems (GIS) within the marine environment. Describe their use in areas such as coastal zone management, graphic presentation of data from marine data bases, data and metadata management and nautical charting. Explain the electronic charting concept as a special form of GIS.	Apply Geographical Information Systems to a marine environmental issue requiring solution.		
E5.4 Data presentation					
(a) Visualisation and presentation	DP	Explain and perform manual and automatic plotting and contouring of hydrographic data. Describe the use of vector and raster digitising and plotting systems. Describe the hydrographic applications of 3D modelling and visualisation.	Evaluate and select the best 3D modelling and visualization methods for specific applications. Use vector and raster digitising and plotting systems.		
(b) Marine cartography	FF	Describe the chart compilation and composition process and flow line. Describe the characteristics of the General Bathymetric Chart of the Oceans (GEBCO).			
E5.5 Hydrography for Nautical Charting					
(a) Chart Compilation	DF	Outline the process involved in selecting soundings and features for the nautical chart from a hydrographic survey or other sources.	Select soundings, contours, and features from a hydrographic survey or other sources, for compilation of the affected nautical charts.		

(b) Correction of Charts	F	Explain the importance of updating nautical charts, and the dissemination of chart corrections. Identify the responsibilities of each element in the sequence from surveyor to mariner. Explain how to ensure the latest information can be obtained and how it is certain this has been applied.			
(c) Electronic Charts	P	Describe Electronic Navigational Charts (ENC), and Electronic Chart Display and Information Systems (ECDIS) (concepts, components, impact on hydrography).			

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Essential 6 - Environmental science					
E6.1 Meteorology					
(a) The atmosphere	F F	Describe the vertical structure of the atmosphere.			
(b) Meteorological elements:	F F	Define the following parameters, explain how they are measured/classified and describe their effect on hydrographic operations: temperature, humidity, dew-point, frost-point, atmospheric pressure, clouds and precipitation, rain, snow, visibility, advection fog and radiation fog.			
(c) Winds:	F F	Explain the relation between atmospheric pressure and winds, the origin of geostrophic winds and Buys Ballot's law. Describe wind circulation around pressure systems and the effect of friction.			
(d) Climatology:	F _		Describe the general circulation of the atmosphere and the global distribution of pressure systems, air and sea surface temperatures, winds and precipitation over the oceans, local circulation and land and sea breezes.		
(e) Weather systems:	F _		Describe the elements of a weather system and their evolution (e.g. air masses, extra-tropical cyclones, anticyclones and associated weather; fronts, clouds and weather at different stages of fronts; intertropical convergence zone, tropical revolving storms and associated weather).		

(f) Weather observing and recording:	PP	Operate instruments and sensors used to register temperatures, pressure, direction and intensity of wind. Identify characteristics of weather by simple observation of the sea and the sky. Record these parameters according to internationally accepted standards.			
(g) Weather forecasting:	P _		Interpret a synoptic chart. Produce an on-board short range forecast based on meteorological information, weather bulletins and facsimile charts.		
(h) International Marine Meteorological Service System:	F _		Describe the international collection and distribution of standardised meteorological information.		
E6.2 Oceanography					
(a) Physical properties of sea water:	PF	Define the following terms, including units and normal ranges: salinity, conductivity, temperature, pressure, density and colour. Describe the relationship between temperature and salinity in relation to depth	Explain the effects of solar radiation. Describe the optical properties of sea water. Explain temperature and salinity distribution and variation. Prepare TS diagrams. Recognise water masses and types.		
(b) Marine circulation dynamics:	F _		Define types of circulation (e.g. geostrophic, wind-driven, Ekman spiral, slope currents, coastal and thermohaline). Explain the effect of friction.		
(c) General circulation of the oceans:	F _		Define the general characteristics of climatic mean ocean currents. Explain the western intensification of ocean currents and the vertical circulation, along with their driving mechanisms.		
(d) Wind-waves and swell:	PP	Define wave parameters. Explain the elements involved in the wave growth process including typical fetches. Classify sea state according to Beaufort Scale.	Explain the relationship between winds, waves, swell, sea state (Beaufort scale), and icing conditions.		

(e) Wave propagation:	F F	Define, giving practical examples: refraction, diffraction and reflection. Explain breaking waves, and long-shore and rip current processes.			
(f) Oceanographic measurements:	FF	Describe oceanographic sampling, and methods for measuring common oceanographic parameters.			
(g) Oceanographic instruments:	DP	Use oceanographic sensors (e.g. for temperature, conductivity, and sound speed, as well as current meters and wave sensors).	Describe principles of oceanographic sensors. Select equipment for specific applications.		
E6.3 Marine geology and geophysics					
(a) Marine geology:	FF	Describe seabed samplers such as grabs, corers and dredges.	Define rock types and describe the structure of the earth.		
(b) Geomorphology:	F_		Describe geomorphological structures and processes. Explain their effects on seabed topography, with special reference to the continental shelf.		
(c) Earth's magnetic field:	FF	Define magnetic field terms. Explain the objective of geomagnetic surveys and the use of magnetometers.	Explain the need to correct measurements by using observatory records. Define polar reversals and anomalies.		
(d) Earth's internal structure:	FF	Define gravity survey terms. Explain the objective of gravity surveys.	Describe the use of gravimeters and the application of Eötvos correction.		
(f) Seismic profiling	FF	Define the objective of continuous reflection/refraction seismic profiling, and the equipment needed to conduct it. Describe typical sound sources, receivers and recorders.			
(g) Geotechnical sampling:	FF	Define the objective of geotechnical sampling.	Describe geotechnical sampling equipment. Explain how samples are obtained, stored, and analysed.		

(h) Deposition and erosion:	FF	Identify types of seabed material.	Describe the processes of sediment transport and deposition, as well as the normal fluvial process and formation of bars and other focal points of deposition. Describe the methods of spoil dispersal and selection of spoil grounds.		
E6.4 Environmental impact	FF	Outline the basic concepts of environmental impact studies. List applications (e.g. to water quality, sedimentation, coastal development, shipping, living and non living resource development, etc.).			

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Essential 7: Legal Aspects					
E7.1 Product Liability	FF	Explain the legal liability of the Hydrographer and surveyor for their products (e.g. charts, Notices to Mariners, survey reports).			
E7.2 Contracts	P _		Incorporate contractual considerations, in planning and specifying hydrographic products and services.		
E7.3 Law of the sea					
(a) Development	P F	Describe the historical development of the Law of the Sea. Explain its influence on hydrographic surveying, marine scientific investigations, and environmental impact.	Incorporate provisions of the Law of the Sea, in planning and specifying hydrographic surveys.		
(b) Delimitation zones	DF	Describe the nature, characteristics, and delimitation of: baselines, Interior waters, Territorial Sea, Contiguous zone, Exclusive Economic Zone, Continental Shelf, High Seas, and boundaries between States with opposite or adjacent coasts.	Design and specify surveys to establish baselines, 2500 m isobath, foot of the continental slope, the sedimentary thickness beyond the foot, and the outer limits of the continental shelf (reference the Scientific and Technical Guidelines of the UN Commission on Limits of the Continental Shelf).		
(c) Marine Law	F _		Describe the basic process of marine accident investigations and court cases, in relation to hydrographic issues.		

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Option 1: Nautical charting hydrography					
O1.1 Coastal Topography	PP	Use GNSS-based and ground survey techniques to delineate coastline and attached cultural features. Describe how a coastline map can be created with aerial photographs. List uses of ground photography in the depiction of coastline topography. Explain how tidal datums and charted shorelines are related.	Explain the differences between and uses of color, black and white, color infrared, and black and white infrared film in coastline delineation from aerial photographs. Describe the process of ortho-rectification of aerial photographs. Describe the digital photogrammetric process. Explain the photogrammetric principles that allow the determination of topography from aerial photographs. Describe how LIDAR is used for shoreline mapping.		
O1.2 Siting of Aids	PF	Describe how fixed and floating aids to navigation are used to delineate channels, fairways, and safe water. Explain how the position of a buoy can vary with the strength and direction of the current and the stage of tide.	Identify appropriate locations within a surveyed area for leading lines, fixed lights, and buoys, considering the draft of vessels, the bathymetry, the coastal topography, the tide and current regime, and the location of wrecks and dangers.		
O1.3 Publications	PF	Describe the hydrographic data that are required for the navigational publications including tide tables, sailing directions, light lists, radio aids to navigation, port guides, and Notice to Mariners.	Prepare a narrative describing a surveyed area for the sailing directions and/or the port guide. Compile the information necessary to update the light list in a surveyed area. Draft the text for a Notice to Mariners reporting the discovery of a danger to navigation, including instructions for updating the applicable nautical chart.		
O1.4 Chart Re-Production	FF	Outline the process of creating chart plates from graphic products and from digital files. Describe how multiple plates are combined to produce the chart.	Explain the differences between offset printing and plotter-based print-on-demand technology.		

O1.5 Correction of Charts	FF		Describe the graphic or digital procedures by which charting databases are updated and maintained.		
O1.6 Chart Compilation	DF	Describe how data quality is maintained throughout the compilation process.	Use manual and digital cartographic methods to prepare a chart drawing. Reconcile any apparent discrepancies between the hydrographic survey data and other sources of charting data, using good cartographic practice.		
O1.7 GIS	PF	Explain the use of Geographical Information Systems in data management and nautical charting.	Apply Geographical Information Systems in data management and nautical charting		
O1.8 ENC – ECDIS Concepts	FF	Define the Electronic Navigational Chart. Explain constraints in electronic chart production. Describe ENC as a product.	Explain the concept and purpose of Marine Information Objects (MIO), and list some potential data types. Explain the Additional Military Layer (AML) concept.		

O1.9 International Standards	PF	Identify the content of international digital chart standards, such as IHO S-52, S-57, -S61, S-65. Interpret and make use of information provided by such standards.	Use appropriate software to demonstrate the display of ENC data in ECDIS utilising symbols of the presentation library.		
O1.10 ENC Production	DP	Describe ENC Production Requirements. Apply processes to ensure synergy between paper and ENC production techniques.	Specify ENC Production Requirement.		

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Option 2: Hydrography to Support Port Management and Coastal Engineering					
O2.1 Surveys for Dredging Operations	D P	Select appropriate sites for, and establish, dredging control marks. Describe pre-dredging geotechnical surveys. Set up water level gauges for dredging contracts. Identify dredger types, dredging control, and electronic control systems.	Determine dredging volumes		
O2.2 Hydraulic Surveys	F F	Identify field instruments for tide, flow, and sediment transport	Describe survey methods for hydraulic modelling, discharge and influx.		
O2.3 Surveys for Pollution Monitoring	PP	Describe methods for tracking pollutants, sewage and industrial effluents. Explain trace and dye methods for tracking pollutants. Acquire and present temperature, salinity, pH, suspended solids, and dissolved oxygen data.	Plot pollutant distribution patterns over a period of time. Assess the impact on water quality of land-based activities (e.g. nutrient and pesticide run-off, radioactive discharge)		
O2.4 Channel Marking	PF	Describe and apply various methods for monitoring navigation channel location and depth, using advanced position fixing systems and bathymetric surveying techniques	Select sites for and position buoys, beacons and other aids to navigation. Define leading lines. Establish them in ports, harbours and approaches. Establish correct width and depth of channel.		
O2.5 Controlling Sedimentation	F-		Describe methods for improvement of channels and fairways. Explain how training walls, groynes, dredging and sediment traps are used for sedimentation control. Describe modelling techniques for predicting sedimentation.		

O2.6 Remote Sensing in the Coastal Zone	F-		Explain how bathymetric and coastline information can be obtained from aerial photography, synthetic aperture radar, hypersprectal scanning, electromagnetic induction, and LIDAR. Describe how sun angle, solar radiation, cloud cover, surface waves and optical seawater properties affect the quality of remotely sensed data.		
O2.7 GIS	PF	Explain the use of Geographical Information Systems in port management and coastal engineering	Apply Geographical Information Systems in port management and coastal engineering		
O2.8 Warnings	FF	Explain the need for local Notices to Mariners and warnings.	Identify, acquire and present data for Local Notices to Mariners. Describe the mechanics behind, and effects of abnormal water levels (e.g. Tsunamis, seiches, surges, bores)		

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Option 3: Offshore geophysical surveying					
O3.1 Geomagnetic surveys	PF	Describe geomagnetic surveys principles and distinguish different aerial survey techniques and applications.	Use magnetometer.		
O3.2 Gravity surveys	PF	Explain the concepts of gravity surveys and describe gravity survey operations, both offshore and onshore. Describe the fundamentals of a gravimeter.	Use gravimeter		
O3.3 Digital seismic techniques	DF	Describe Reflection, refraction, multiple fold profiling, 2D, 3D, high resolution shallow seismic and surveys to establish maritime boundaries. Identify the elements of navigation processing for 3D seismic, integrated seismic network solutions, Kalman filtering.	Specify and Plan Seismic Surveys. Identify data deliverables and describe the appropriate data formats.		
O3.4 Digital seismic data acquisition	DF	Describe acoustic sources, streamers, resolution, penetration, depth of tow, tail buoys and equipment tests for specific applications.	Specify appropriate equipment for seismic data acquisition. Identify tracking methods for the in-water equipment and describe Quality Control methods and parameters.		
O3.5 Digital seismic data processing	F-		Explain basic techniques, stacking, migration, normal move out, interpretation (conventional and computer-assisted) techniques to identify anomalies.		
O3.6 Analogue equipment	DF	Describe Profilers including boomers, sparkers and chirp systems. Describe the influence of frequency and wavelength on resolution and penetration. Explain equipment configuration for towing, launch and recovery.	Evaluate coverage and penetration of systems and select equipment for appropriate applications		

O3.7 Analogue Applications	DF	Describe the analogue applications and the different data deliverables. Explain the methods to acquire, record, process and interpret the data	Specify analogue systems for different applications. Explain how the systems may be operated in each case. (Pipeline or hazard detection, seabed sediment identification for mapping, shallow sedimentary channels etc),		
O3.8 Deep Water Surveys	P F	Differentiate between the methods for positioning towed systems, AUVs and ROVs. Describe the influence of the deep water survey on the accuracy, stability and progress of a survey.	Identify the elements of the data acquisition process and how they are impacted by the deepwater survey methods		

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Option 4: Offshore construction hydrography					
O4.1 Drilling terminology	FF	Differentiate between drill rig types. Explain jack-up rig positioning - towing procedures, pre-loading. Explain anchored rig positioning - anchor types, patterns, deployment and tensioning. Explain dynamically positioned rigs - dynamic positioning systems; taut wire, acoustics.			
O4.2 Mobile rig positioning	FF	Describe GNSS positioning techniques, data telemetry and associated marine operations. Differentiate between types of rig positioning operations (e.g. re-entry, wildcat)			
O4.3 Fixed Offshore Platforms	FF	Describe gravity-based, pile-driven, guyed, floating, and tension-leg platforms.			
O4.4 Structure emplacement	DF	Describe the positioning operations for the emplacement of fixed structures. Explain the use of drilling templates	Plan and specify the positioning for emplacement of fixed structures		
O4.5 Pipeline Operations	FF	Explain the route survey and as-laid survey requirements. Describe general pipeline laying operations. Explain positioning requirements e.g. laydown, layback, flop forward calculations, setting out curves. Describe general Inspection procedures e.g. leak detection, damage, scouring. Explain the use of trenching and ploughing equipment for appropriate operations.			

O4.6 Cable Operations	DF	Explain the route survey and as-laid survey requirements. Describe general cable laying operations. Explain positioning requirements e.g. cable lay, tension monitoring burial etc. Explain the use of trenching and ploughing equipment for appropriate operations.	Select appropriate acoustic, imagery and profiling systems for all aspects of submarine cable route selection surveys. Evaluate and plan the data collection, processing and interpretation of the data. Describe survey techniques for cable routes relating to full ocean depths.		
O4.7 ROV Operations	FF	Identify different classes of ROV. Describe the main components of a complete ROV system. Differentiate between various ROV survey and inspection applications.			
O4.8 ROV positioning	DF	Describe the use of Ultrashort Baselines (USBL), Supershort Baselines (SSBL) acoustic positioning systems, their calibration and integration with other navigation and engineering sensor logging systems.	Select appropriate acoustic positioning equipment and associated positioning units involving Doppler, Inertial and Orientation techniques		
O4.9 ROV equipment	F-		Identify the various types of survey sensors and tools fitted on ROV's for appropriate survey and inspection tasks.		
O4.10 ROV Surveying	D F	Explain the reasons for selecting an ROV as a survey platform and describe how the collection of the data and the processing may differ from surface borne surveys.	Plan an ROV based survey, identifying appropriate sensor packages and systems for hydrographic, engineering, as-built and visual surveys.		

FIG/IHO INTERNATIONAL BOARD SYLLABUS – 11th EDITION				Course Cross-reference	
Item and Title	**Level A B**	**Both Category B and A**	**Only for Category A**	*Hours*	**Volume & Page**
Option 5: Remote sensing					
O5.1 Coastline delineation	PF	Describe geometrical principles of imaging and how to use images (air photos, satellite images) to define the coastline.	Apply photogrammetric methods and image processing to coastline delineation.		
O5.2 Ice mapping	PF	Characterize river, lake and sea ice and icebergs, using optical reflectance, thermal emission, imaging radar and microwave emission.	Estimate sea ice motion.		
O5.3 Water surface mapping	P-		Describe water surface mapping using laser & radar altimeter. Describe imaging radar for wave climatology. Describe microwave radiometer estimation of wind speed. Use thermal emissions to estimate sea surface temperature. Describe the use of remote sensing in search & rescue operations, and for oil spill mapping.		
O5.4 Bathymetric remote sensing	PF	Describe LIDAR, radar altimetry, electromagnetic induction, photogrammetric and synthetic aperture radar (SAR) methods to determine bathymetry. List applications of close-range underwater Photogrammetry.	Process remotely sensed data to determine bathymetry.		
O5.5 Water column properties	FF	Explain optical reflectance to define water quality, turbidity, "gelbstoff" and phytoplankton concentration. Describe upwelling detection from Sea Surface Temperature (SST).			

FIG/IHO INTERNATIONAL BOARD SYLLABUS – 11th EDITION				Course Cross-reference	
Item and Title	**Level A B**	**Both Category B and A**	**Only for Category A**	*Hours*	**Volume & Page**
Option 6: Military hydrography					
O6.1 Anti-submarine	PF	Identify oceanographic parameters affecting anti-submarine operations. Explain the effects of sound speed profiles and the use of ray tracing in the prediction of sonar performance.	Use ray tracing to predict sonar performance and identify shadow zones.		
O6.2 Mine countermeasures	DF	Define the principles of route-survey and describe the requirements for seabed texture information, object detection and mine burial information. Explain the principles of precise navigation applied to lead through techniques. Explain the requirements for Route Survey Databases (establishment, composition and maintenance).	Classify seabed textural information for use in Route Survey Databases. Select lead through routes.		
O6.3 Amphibious operations					
(a) Beach reconnaissance	DP	Explain the differing requirements for surveys of the sea approaches, channels, beach and back of beach. Describe beach profile/ gradient diagrams. Conduct beach surveys.	Plan and report on beach surveys.		
(b) Obstructions	DF	Identify obstructions to boat operations and traficability on the beach and back of beach.	Select suitable areas for amphibious operations.		
(c) Surveying in the surf zone	PF	Describe issues pertinent to surveying in the surf zone	Apply survey techniques in the surf zone.		
(d) Vertical datum	DP	Establish land and marine vertical datums in the beach area.	Evaluate the relationship between land and marine datums in use.		

(e) Horizontal positioning	DF	Describe positioning systems (e.g. sextant, leading lines, total stations, GNSS). Differentiate between overt and covert techniques.	Select and establish positioning systems.		
(f) Depth measurement	DF	Describe methods of depth measurement (e.g. swimmer, levelling, total station, single beam echo-sounder, multi-beam echo-sounder, airborne laser).	Specify appropriate methods of depth measurement.		
(g) Products	DF	Describe products (e.g. beach profiles, gradient diagrams, special charts, reports)	Specify data and formats for required products.		
O6.4 Rapid Environmental Assessment (REA)	DF	Describe the processes involved in conducting REA (e.g. data collection, data fusion, data dissemination)	Use appropriate software to perform REA. Specify requirements for REA.		
O6.5 Electronic Chart – Military Aspects	FF	Describe electronic chart concepts as applied to military operations (e.g. additional military layers, Warship ECDIS). Differentiate between civilian and military layers.	Create military electronic chart products.		

FIG/IHO INTERNATIONAL BOARD SYLLABUS – 11th EDITION				Course Cross-reference	
Item and Title	**Level A B**	**Both Category B and A**	**Only for Category A**	*Hours*	**Volume & Page**
Option 7: Inland waters hydrography					
O7.1 Hydraulic Engineering	PF	Describe the hydrological phenomena that produce seasonal variations in inland waters. Explain the transportation of solids in flows.	Measure river flows and water levels. Compare measurements with models.		
O7.2 Elevation models	FF	Explain methods and techniques for acquisition, processing and depiction of elevation data, as applied to hydrological and hydraulic applications.			
O7.3 Flood Plane Mapping	FF	Explain the forecasting of floods and low waters in rivers draining a large basin.	Describe methods of mapping flood planes. Explain how surveying is done under flood conditions.		
O7.4 Erosion and Sedimentation	FF	Describe the factors which affect erosion and deposition. List methods of remediating erosion and deposition.	Explain how erosion and deposition rates can be measured and mapped.		
O7.5 Vertical References	PF	Describe how vertical reference levels in rivers and lakes are defined, and determined in practice.	Determine requirements for a network of water level stations.		
O7.6 Buoyage	PF	Explain the purposes for fluvial buoyage. List the criteria for placing a buoy.	Determine the positions of fixed and floating aids in a river.		

APPENDIX I

MODEL LOG BOOK FOR FIELD PROFICIENCY AND EXPERIENCE

Candidate : _____

DATES		TOTAL	DESCRIPTION WORK	LOCATION	SUPERVISOR TITLE
FROM	TO	WEEKS		LAND? SEA?	& SIGNATURE
89-08-07	89-09-29	8.0	Field training in using echo sounders and microwave positioning systems, and in producing reports of survey to company internal standards. Office training with 5 one-day launches sessions.	Houston	Training chief HydroTeam Inc.
89-10-09	89-12-01	8.0	Operation of control survey instruments as member of survey crew establishing hydrographic survey horizontal control. Contract survey, Dhahran, Saudi Arabia.	Dhahran	Party chief HydroTeam Inc.
90-01-15 90-05-07 90-08-27	90-04-06 90-07-27 90-11-16	12.0 12.0 12.0	Responsible for operation of hydrographic survey launch equipped with Raytheon 719 sounder and Microfix positioning system, reducing depth and position data, and plotting boat boards and field sheets. Contract survey of Jakarta Bay, Indonesia.	S/L Intrepid	Party chief HydroTeam Inc.
91-01-07	91-06-14	23.0	Design and development of software to merge Fansweep swath data and GPS positions, to produce input into standard gridding, contouring and plotting package.	Hamburg	Software Manager SwatheMap Surveys
91-08-05 91-10-28	91-09-27 91-12.20	8.0 8.0	Responsible for operating Krupp Atlas Fansweep swath mapping system. SeePipe project in North Sea.	MV Heron	Chief Hydrographer SwatheMap Surveys
92-02-03 92-04-27	92-03-27 92-06-19	8.0 8.0	Responsible for dredging surveys and volume calculations for Ejsberg harbour channel maintenance surveys, and approaches to Lübeck harbour.	MV Heron	Chief Hydrographer SwatheMap Surveys
Total sea time Total field experience		68.0 107.0			

APPENDIX II

GUIDELINES FOR PRACTICAL EXPERIENCE

1. The (educational) purpose of the field experience period is to give every student experience in performing as many hydrographic tasks as possible, involved in a small, shore-based hydrographic survey. For example, a wharf could be surveyed, along with other inshore work (channel, harbour, shore lining, etc..).

2. The field training period should occur near the end of the training program, so that knowledge gained in earlier work can be put into practice, and the practical limitations involved in field operations experienced by the student.

3. Planning and design reference material should be available to students, including an archive of case study material, and equipment and costing brochures and information.

4. Actual fieldwork should be preceded by exercises in planning and design. This should begin with presentations by the instructor(s) on the principles of planning a hydrographic survey (e.g. specification, evaluation, decisions, scheduling, and costing); and on the preparation of hydrographic survey field reports (the legal and hydrographic implications of completeness of the report; guidelines for report preparation). Following this, students should be required to prepare a written assignment on a hydrographic survey planning case study, selected from the course archives (or any other case study approved by the instructor). The planning case study could be presented in the form of a competitive bid for the survey work involved.

5. Consideration should be given to involving experienced hydrographers, and equipment provided by outside agencies in the field experience period, in order to supplement the resources of the training institution.

6. The class should be divided into teams. Each team should develop the specifications for the survey work to be done during the field camp, and then apply the planning structure to planning the field camp. This may involve a competition among the teams for the best design (to be judged by the instructors, or invited outside experts). Each student in a team should be assigned responsibility for some aspect of the preparation (control, logistics, vessels, equipment, transportation, communications, scheduling, cost estimating, etc.).

7. Students should prepare a complete field report on the results of the field camp survey. Each field report should contain a separately inked sample boat board and field sheet for a small area of the survey. Field reports should form part of the performance assessment for students during the field experience period.

8. A checklist of tasks to be performed by each student during the field experience period should be prepared, and provided to the students well in advance.

EXAMPLE CHECKLIST OF TASKS TO BE PERFORMED BY EACH STUDENT

TIDE GAUGE

LEVELING

- check existing Bench Marks (three wire level)
- establish new Bench Marks (three wire leveling)
- reduce three wire leveling notes
- Bench Marks to tide staff

INSTALLATION

- install tide staff
- install transducer
- install tide gauge
- set time and height on gauge

OPERATION

- check gauge daily
- record tides for each day

HORIZONTAL CONTROL (fieldwork)

EXISTING

- locate geodetic monuments
- build stations

OBSERVATIONS

- angles with theodolite
- distances with Electronic Distance Measuring equipment
- vertical angles for elevations
- DGPS control observations

RECORDING

- station descriptions
- reduce notes (mean angle)
- check notes

HORIZONTAL CONTROL (office work)

REDUCTIONS

- distances to horizontal

COMPUTATIONS

- inverses
- traverses
- geographical to UTM
- UTM to geographical

ADJUSTMENT

- using GEOLAB or equivalent
- DGPS control processing

FILE COMPUTATIONS

MANUALLY PLOT CONTROL ON FIELD SHEET

AUTOMATICALLY PLOT CONTROL USING CARIS

LARGE SCALE SURVEY (1:1000)

MANUAL SHORE LINING

- instrument man (angle, distance)
- rod/reflector man
- note keeper

SHORE LINING FROM PHOTOGRAPHY

- digitize shoreline using CARIS

OFFICE WORK

- manually draft shoreline plan
- automatically plot digitized shoreline on field sheet
- draft sounding plan

LARGE SCALE SOUNDING FIELD WORK

- set up baseline
- operate sounder (incl. bar check)
- note keeping
- check sextant calibration
- set sextant angle
- measure sextant/subtense distance
- subtense/range pole man on wharf

HARBOUR/RIVER SURVEY (1:10000)

HORIZONTAL POSITIONING (USING MICROWAVE SYSTEM)

- select transponder sites
- build stations
- calibrate transponders (against EDM)
- set up transponders (with 24 volt batteries)

HORIZONTAL POSITIONING (USING RANGE/BEARING)

- select shores sites
- calibrate Microfix 100C (against EDM), or
- calibrate Polarfix (against known baseline)
- set up shore transponder & theodolite, or
- set up Polarfix shore station
- operate range/bearing system

HORIZONTAL POSITIONING (USING DGPS)

- select monitor site
- set up monitor and remote receivers
- test operation (while alongside wharf)

PREPARE BOAT BOARDS

- manually draft lattice (concentric circles)
- automatically plot lattices using computer evaluate error lobes
- draft sounding plan
- plot shoreline on boat boards

SOUNDING OPERATIONS

- set up positioning system
- set up ISAH
- daily position system calibration

CHECK AGAINST EDM MEASURED RANGES

CHECK AGAINST SEXTANT FIX

- operate sounder (including bar check)
- check sounder digitizer (if used)
- manual note keeping
- manually plot positions on boat board
- operate ISAH
- act as coxswain - steer launch on line

MANUAL OFFICE WORK

DIVIDE SOUNDING ROLLS

- on boat board find # divisions (2 soundings/inch)
- note # divisions on sounding roll & notes
- divide sounding roll (prop. dividers, Gerber scale)

SCALE SOUNDING ROLLS

- include bar check correction
- record in sounding notes
- reduce for tides

TRANSFER DAILY BOAT BOARD TO MASTER BOAT BOARD (TRACK PLOT)

- use daily colour
- mark divisions

INK SOUNDINGS ON FIELD SHEET

CONTOUR FIELD SHEET

COMPUTER ASSISTED OFFICE WORK

LOAD ISAH DATA INTO GT FILES ON SPARCSTATION

PROCESS POSITIONS USING QT SOFTWARE TOOLS

- remove LOP spikes
- remove position spikes
- analyze fix uncertainties

TRANSFER DATA TO HIPP FILES ON µVAX

PROCESS SOUNDING DATA

- keep track of draft correction
- include bar check correction
- reduce for tides

PLOT SOUNDINGS, USING OVERPLOT REMOVAL

EXAMINE FIELD SHEET FOR POSSIBLE SHOAL EXAMINATIONS

PLOT DATA IN OTHER FORMS (CONTOUR PLOTS, WIRE FRAME, ETC..)

SHORELINING

POSITIONS AND ELEVATIONS OF ROCKS

CHOOSE POINTS FOR PHOTO CONTROL

POSITION POINTS FROM PHOTOGRAPHY

DIGITIZE FEATURES USING CARIS

NOTE KEEPING

- in note book
- on photo overlay

SHOAL EXAMINATIONS

SELECT FROM FIELD SHEET

LOCATE

DROP BUOY

EXAMINATION SURVEY

- star pattern
- grid pattern

FIND LEAST DEPTH & ITS POSITION

LEAD LINE CONFIRMATION

BOTTOM SAMPLES

PLAN SAMPLING GRID

SAMPLING

- use lead line with paraffin insert
- use bottom grab
- interpret sample
- record position and sample type

PLOT CORRECT SYMBOL AT SAMPLING POSITIONS

OTHER OBSERVATIONS

CURRENTS

- observe positions of drift pole
- compute current speed, direction, position
- plot

NAVAIDS

- check ranges
- check buoy positions and types

SAILING DIRECTIONS

- check narrative

MULTIBEAM SURVEYING

PLANNING MULTIBEAM SURVEY LINES

CALIBRATION PROCEDURES ("PATCH TEST")

LINE RUNNING PROCEDURES

DATA CLEANING

INSPECTION OF CLEANED MULTIBEAM DATA FOR ARTIFACTS

APPENDIX III

GUIDELINES FOR NAUTICAL SCIENCE

1.- The student should be exposed to a Radar in operation. He should be instructed on the spot, on the way a radar works and on the interpretation of the screen. It should also be allowed to make measurements, make scale changes, etc. The objective is to have the student with a practical feeling of what a radar is and what he can expect from it, in a practical way.

2.- Through different hypothetical situations given by the instructor, the student should be able to practice the Rules of the Road.

3.- The student should be given a nautical chart and make him identify the symbols used and become familiar with the "reading" of the chart. Special mention should be made on aids to navigation and warnings. The student should practice the positioning of symbols, on co-ordinates being provided.

4.- The student should be given a set of nautical publication to examine and identify clearly its content. Afterwards, he should practice finding information requested by the instructor and relate that information with the appropriate nautical chart.

5.- The student should be exposed to different communication equipment and relevant communication procedures. A hands-on equipment to make the student familiar with different components is envisaged.

6.- The student should be exposed to magnetic compass and gyro compass. It is envisaged that students will have the opportunity to see these instruments working, being able to understand corrections that might be necessary to applied before using data.

7.- It will be desirable to expose the students to drill fire combat exercise, using normal extinguishing systems. This might me complemented with the exhibition of special training videos or movies.

8.- As a task, the student should be requested to prepare a list of actions and control before any dangerous activity is initiated. Different scenarios should be given by the instructor.

9.- Be exposed to participate in weight lifting operations, using different elements and facilities.

10.- Using ship drawings, provide terminology of main elements.

11.- Be exposed to the harbour pilot work as an observer.

12.- Prepare a boat to sail and operate a rubber boat in normal conditions.

APPENDIX IV

CERTIFICATE MODELS

A) Model Certificate of the FIG/IHO/ICA International Board to recognized Courses

B) Model Certificate to individuals issued by National Institutions

N°

FIG - IHO - ICA International Advisory Board on Standards of Competence for Hydrographic Surveyors

CERTIFICATE OF RECOGNITION

The FIG-IHO International Advisory Board on Standards of Competence for Hydrographic Surveyors, having reviewed the course programme
submitted by

against the "Standards of Competence"
edition, and being satisfied that it meets the requirements prescribed for a category course,
pertaining to

hereby awards this certificate of recognition.

Signed at Monaco

Chairman of the Board
This day the of

UNIVERSITY OF X

SCIENCES FACULTY

This is to certify that

Mr. ……

was admitted to the degree of bachelor of Surveying Science (Hydrographic Survey) with class 1 honours on

…….. of …… 20xx

This course is recognized by the FIG/IHO/ICA Board on Standards of Competence for Hydrographic Surveyors and Nautical Cartographers as meeting the requirements prescribed for a Category …….. course with Options……

Signed at ……..

Dated at ……..

APPENDIX V

Annual Assessment Report
Program:……

Academic Year: 20xx-20xx
Due to IBSC secretariat by December 31st 20xx

Name of Program: _____
Name of Contact Person: _____
Names of Assessment Committee Members: _____

A. Identify the goal/outcome assessed this academic year.

B. Identify and/or describe the assessment and the student group(s) assessed

C. What did you learn from the assessment?

D. Based on what you learned, what actions did-or will-you take or consider?

E. Are follow-up studies planned?

F. What can the School do to help? What can the University do?

G. What actions, if any, did you take based on *last year's* assessment findings?

STATISTICAL PROCESSING

a. per module
b. per programme

1. Total number of evaluation sheets
2. Number of valid evaluation sheets
3. Mean
4. Median
5. Standard deviation
6. Minimum
7. Maximum

At the end of each module, the students are asked to fill in an anonymous questionnaire
form that constitutes a significant tool for the internal assessment of the course. Internal assessment is the appraisal process performed by the institution responsible for the programme.

Note: A negative assessment must be accompanied by additional comments or remarks justifying the assessment.

Course module assessment template

MODULE: _____(one for each module)
General assessment of the module;
[range 1(unsatisfactory) to 5 (fully satisfactory)]
Contribution of the module to the programme as a whole
[range 1(none) to 5 (very important)]
Overlapping of topics in different modules
[range 1(seldom) to 5 (often)]
Completeness of topics within the module
[range 1 (incomplete) to 5 (complete)]
Course organization vs. exam preparation
[range 1(unsatisfactory) to 5 (fully satisfactory)]

Quality of course materials
[range 1(unsatisfactory) to 5 (fully satisfactory)]
Sufficient number of lecture hours
[range 1(insuffient) to 5 (absolutely sufficient)]
Sufficient number of lab/field/exercise hours
[range 1(insuffient) to 5 (absolutely sufficient)]
Contribution of the assigments/lab/field work to the understanding and assimilation of the module content
[range 1(negligible) to 5 (important)]

Student characteristics

Difficulty in following the course
[range 1(negligible) to 5 (high)]
Sufficient prerequisite knowledge
[range 1(negligible) to 5 (high)]
Own effort – participation in the course
[range 1(negligible) to 5 (high)]
Percentage of lectures attended
[range 1(under 50%) to 5 (100%)]

Comments:

Instructor's assessment template

Instructor's Name:
Module:

Teaching methods
[range 1(unsatisfactory) to 5 (fully satisfactory)]
Knowledge of the subject
[range 1(unsatisfactory) to 5 (fully satisfactory)]
Instructor was well prepared for class
[range 1(unsatisfactory) to 5 (fully satisfactory)]
Instructor presented objectives/material of course clearly/effectively
[range 1(unsatisfactory) to 5 (fully satisfactory)]
Instructor provided sufficient reference material
[range 1(insufficient) to 5 (sufficient)]
Instructor encouraged discussion and/or questions
[range 1(unsatisfactory) to 5 (fully satisfactory)]
Instructor answered questions effectively
[range 1(ineffectively) to 5 (very effectively)]
Instructor showed respect for students
[range 1(unsatisfactory) to 5 (fully satisfactory)]
Instructor's availability for consultation out of class
[range 1(unsatisfactory) to 5 (fully satisfactory)]
Relationship with the instructor
[range 1(unsatisfactory) to 5 (fully satisfactory)]
Coordination with the other instructors
[range 1(unsatisfactory) to 5 (fully satisfactory)]