**DRAFT**

**IALA World Wide Academy**

**LEVEL 2 – Technician Training**

**Introduction to Radionavigation and Differential Global Navigation Satellite Systems**

**Module 9 Elements 9.1 to 9.5 (L2.9.1- 9.5)**

**Edition 1**

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DOCUMENT REVISIONS

Revisions to the IALA Document are to be noted in the table prior to the issue of a revised document.

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| **Date** | **Page / Section Revised** | **Requirement for Revision** |
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FOREWORD

The International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) recognises that training in all aspects of Aids to Navigation (AtoN) service delivery, from inception through installation and maintenance to replacement or removal at the end of a planned life-cycle, is critical to the consistent provision of that AtoN service.

Taking into account that under the SOLAS Convention, Chapter 5, Regulation 13, paragraph 2; Contracting Governments, mindful of their obligations published by the International Maritime Organisation, undertake to consider the international recommendations and guidelines when establishing aids to navigation, including recommendations on training and qualification of AtoN technicians, IALA has adopted Recommendation E-141 on Standards for Training and Certification of AtoN personnel.

IALA Committees working closely with the IALA World Wide Academy have developed a series of model courses for AtoN personnel having E-141 Level 2 technician functions. This model course which is an introduction to radionavigation and differential global navigation satellite systems should be read in conjunction with the Training Overview Document IALA WWA.L2.0 which contains standard guidance for the conduct of all Level 2 model courses

This model course is intended to provide national members and other appropriate authorities charged with the provision of AtoN services with specific guidance on the training of AtoN technicians in the principles of radionavigation and differential global navigation satellite systems. Assistance in implementing this and other model courses may be obtained from the IALA World Wide Academy at the following address:

The Dean

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# PART A - COURSE OVERVIEW

## Scope

This course is intended to provide technicians with the theoretical training necessary to have a basic understanding of radionavigation including Differential Global Navigation Satellite Systems (DGNSS).

This course is intended to be supported by further training modules on the practical operation and maintenance of radar beacons; Automatic Identification Systems; DGNSS transmission stations; aspects of power supplies; lightning protection and the maintenance of structures. Details of these supporting model courses can be found in the Level 2 Technician training overview document IALA WWA L2.0.

## Objective

Upon successful completion of this course, participants will have acquired sufficient theoretical knowledge and skill to undertake the practical elements of Module 9 (9.6 – 9.9) which will enable them to maintain DGNSS transmission stations whilst on the job within their organizations.

## Course Outline

This course is intended to cover the knowledge required for a technician to understand the principles of radionavigation systems including DGNSS and the importance of uninterrupted Position, Navigation and Timing (PNT). The complete course comprises 5 classroom modules and a site visit designed to consolidate theoretical knowledge. Each module begins by stating its scope and aims, and then provides a teaching syllabus.

## Table of Teaching Modules

|  |  |  |
| --- | --- | --- |
| **Module Title** | **Time in hours** | **Overview** |
| Introduction to radionavigation systems | 1.0 | This module describes the basic functions and types of radionavigation systems  **Note:**  Radar beacons are covered in Level 2 Module 7 and the Automatic Identification System (AIS) in L2 Module 8 |
| Position, Navigation and Timing (PNT) | 0.5 | This module describes the importance to safe navigation of the uninterrupted receipt of signals to provide PNT |
| Accuracy, integrity, continuity, availability and vulnerability | 1.0 | This module describes the factors that can affect the accuracy and uninterrupted receipt of radionavigation signals |
| Applications of GNSS on AtoN | 0.5 | This module describes which AtoN components rely on GNSS signals for their effective operation |
| Introduction to DGNSS and principles of operation | 1.0 | This module describes the principles of the transmission of differential signals from a DGNSS shore station or AIS base station |
| Site visit | 3.0 | This visit to an appropriate DGNSS transmission station is designed to consolidate theoretical knowledge gained in Modules 9.1 – 9.5 |
| Evaluation | 1.0 | Written test |
| **Total Hours:** | **8.0** | One day course |

## Specific Course Related Teaching Aids

1. This course involves both classroom instruction and a visit to a DGNSS transmission station. Classrooms should be equipped with blackboards, whiteboards, and overhead projectors to enable presentation of the subject matter.
2. A large scale general arrangement diagram of the DGNSS transmission station should be available to each participant.
3. Hand-held satnav receiver(s)

## References

In addition to any specific references required by the Competent Authority, the following material is relevant to this course:

* IALA NAVGUIDE
* IALA Recommendations A-124/16; R-115; R-121; R-129; R-135
* IALA Guidelines 1060
* Technical documentation from DGNSS equipment manufacturers

# PART B - TEACHING MODULES

## Module 1 – Introduction to Radionavigation Systems

### Scope

This module describes the basic functions and types of radionavigation systems not covered in other Modules.

### Learning Objective

To gain a **basic** understanding of the function and types of both terrestrial and satellite radionavigation systems

### Syllabus

Lesson 1 Terrestrial radionavigation systems

1. Review of racons and AIS
2. Hyperbolic radionavigation systems - Loran-C
3. e-Loran

Lesson 2 Satellite radionavigation systems

1. History of Global Navigation Satellite Systems
2. Operational and planned GNSS
3. Military and civilian GNSS signals
4. Position from satellites
5. Satellite datum (WGS84)
6. Obtaining a position from a hand-held satnav
7. Grid and Geographical positions

## Module 2 – Position, Navigation and Timing

### Scope

This module describes the importance to safe navigation of the uninterrupted receipt of signals to provide PNT.

### Learning Objective

To gain a **basic** understanding of PNT and augmentation systems and their vital importance to safe navigation

### Syllabus

Lesson 1 Position Navigation and Timing

1. Concept of location and time
2. PNT services from satellite
3. Uses and users of PNT services
4. Accurate time (UTC)
5. Alternative sources of time

Lesson 2 – Satellite and Ground Based Augmentation Systems

1. Introduction to Satellite Based Augmentation Systems
2. Introduction to Ground Based Augmentation Systems

## Module 3 – Accuracy, integrity, continuity, availability and vulnerability

### Scope

### This module describes the factors that can affect the accuracy and uninterrupted receipt of radionavigation signals.

### Learning Objective

To gain a **basic** understanding of errors inherent in GNSS and its potential vulnerability

### Syllabus

Lesson 1 GNSS Errors

1. Signal, clock and ephemeris errors
2. Geometric Dilution of Position
3. Multipath errors
4. Selective Availability

Lesson 2 Physical and Intentional Interference

1. GNSS signal strength
2. Coronel Mass Ejections and their effect on GNSS signals
3. HP microwave signals
4. Jamming and spoofing

Lesson 3 Integrity and Continuity

1. Principles of RAIM
2. Introduction to IALA WWRNP

## Module 4 – Applications of GNSS on AtoN

### Scope

This module describes which AtoN components rely on GNSS signals for their effective operation.

### Learning Objective

To gain a **basic** understanding of which AtoN are dependent on uninterrupted PNT

### Syllabus

Lesson 1 Review of radionavigation componets fitted to AtoN Stations

1. Racons; RTEs and AIS
2. AtoN dependent on PNT

## Module 5 – Introduction to DGNSS and principles of operation

### Scope

This module describes the principles of the transmission of differential signals from a DGNSS shore station or AIS base station.

### Learning Objective

To gain a **basic** understanding of the principles of differential corrections to GNSS with theoretical training consolidated through a site visit

### Syllabus

Lesson 1 – Introduction to DGNSS

1. Principles of differential corrections to pseudoranges
2. ITU standard formats
3. Geostationary satellite corrections to portable systems
4. IALA MF DGNSS beacons and coverage
5. Basic components of a DGNSS transmission station
6. Introduction to integrity and reference modules
7. AIS Message 17

Lesson 2 – DGNSS Site Visit

1. Visit DGNSS site (or AIS base station)
2. Identify key components and their functions