

## UNDER WATER COMMUNICATIONS

**22ECMC2T5B**

**Lecture: 4 periods/week**

**Credits: 4**

**Internal assessment: 40 marks**

**Semester end examination: 60 marks**

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**Prerequisites:** Digital Signal Processing, Digital Communications

### **Course Outcomes:**

At the end of the course Student will be able to

- Examine underwater acoustics
- Understand the characteristics of Sonar Systems
- Outline the importance of underwater acoustic Modems
- Analyze the performance of underwater sensor networks

### **UNIT I**

**Fundamentals of Underwater Acoustics:** The Ocean acoustic environment, measuring Sound level, Sources and receivers, Sound velocity in sea water, typical vertical profiles of sound velocity, Sound propagation in the Ocean, Deep water and Shallow water, Range dependent environment. Sound attenuation in sea water, Bottom Loss, Surface bottom and volume scattering, Snells law for range Dependent Ocean

### **UNIT II**

**Types of sonar systems:** Active and Passive Sonar equations, Propagation characteristics of the medium, Transmission loss and Spreading effects, Beam forming and Steering, Detection Threshold, Target Angle Estimation, Array Shading

**Ambient noise:** Sources of ambient noise, Shallow water ambient noise, Effect of depth, Directional characteristics of deep water ambient noise, Electrical noise, Machinery noise, Flow noise, Propeller noise, Self-noise and Radiated noise

### **UNIT III**

**Acoustic Modem:** Underwater Wireless Modem, Sweep spread carrier signal, transmission characteristics in shallow water channel, separation of time varying multipath arrivals, Typical acoustics modems, characteristics and specifications, Applications, Acoustic Releases, Real time wireless current monitoring system

### **UNIT IV**

**Underwater Sensor Network:** Underwater Networking, Ocean Sampling Networks, Pollution Monitoring, Environmental Monitoring and Tactical surveillance systems, Major challenges in design of Underwater Sensor Networks, Factors that affect the UWSN, Sensor Node Architecture- GIBS, VRAP, DABSRAPT

### Learning Resources

#### Text Books

1. Marco Lanzagorta, Underwater Communications, Morgan & Claypool Publishers, 2012
2. A.D. Waite John, SONAR for Practicing Engineers, Wiley & Sons, Ltd
3. Robert J Urick, Principles of Underwater Sound, 3<sup>rd</sup> Ed., Penninsula Publishers

#### References

1. Lufen Xu Tianzeng Xu, Digital Underwater Acoustic Communications, 1<sup>st</sup> Ed, Elsevier
2. L. M. Brekhovskikh and Yu. P. Lysanov Fundamental of ocean acoustics, Modern Acoustics and signal processing

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