Programme: M. Sc. (Marine Sciences)
Course Code: MSC 467 Title of the Course: Physical and Inorganic Chemistry of Seawater
Number of Credits: 04
Effective from AY: June2018-19

Prerequisites for the course:	Should have undergone the course Marine Chemistry (MSC 162).	
Objective:	This course develops concepts in understanding the detailed nature of the structure and physical chemistry of liquid water and aqueous electrolytic solutions that are central to marine chemistry. Also, this course develops a theoretical basis of chemical reactions and processes – acid-base reactions, oxidation-reduction reactions, complex formation, and precipitation and dissolution reactions – that occur in natural waters.	
Content:	The structure of liquid water – Theories of water structure, colligative properties of seawater with the thermodynamic derivations of expressions for boiling point elevation and freezing point depression, electrostriction – The Thermodynamics of seawater – Ideal and real solutions. Equation of state for pure water and seawater, thermodynamics of PVT changes in seawater, activities, activity coefficients; Debye - Huckel theory and the Debye - Huckel limiting law; heats of solution, dilution, and mixing. Acids and bases – basic concepts, proton condition and the electroneutrality of solutions; pH as a master variable – log C – pH diagram for monoprotic and diprotic acid – base system; buffer pH, buffer intensity – Oxidation and Reduction Reactions – Redox equilibria, electron activity and pE – Peters-Nernst equation; pE-pH diagram for the aqueous chlorine system, pE – pc diagram for Fe (II) - Fe (III) system, Kinetics of redox processes (Oxidation of Fe (II) and Mn (II) only). Metal Ions in Aqueous solutions – hydrolysis of metal ions, formulation of stability constants, the stability of hydrolysis species, chelates and the chelate effect; Precipitation and dissolution – Heterogeneous equilibria, solubility product and saturation; the solubility of oxides and hydroxides – carbonate system closed to atmosphere and in equilibrium with $CO_2(g)$; the stability of hydroxides and carbonates; crystal formation – The initiation and production of the solid phase – Solubility of silicates, gibbsite and iron (oxy) hydroxides.	12 hours 12 hours 12 hours 12 hours
Pedagogy:	Lectures/ tutorials/ assignments/ self-study	
References/ Readings	1. Marine Chemistry, 1969 – Horne, R.A., Wiley – Interscience, London. 2. Aquatic Chemistry, 1981, 1996 – Stumm, W. and Morgan, J.J., Wiley-Interscience, New York. 3. Water Chemistry, 1980 – Snoeyink, V.L. and Jenkins, D., John Wiley & Sons, New York. 4. Principles of Aquatic Chemistry, 1983 – Moral, E.M.M., Wiley Interscience 5. Chemical Kinetics and Process Dynamics in Aquatic Systems, 1994 – Brezonik, P.L., Lewis Publ., London. 6. Aquatic Chemistry, 1995 – Huang, C.P., O'Melia, C.R. and Morgan, J.J. American Chemical Society, Washington, DC. 7. Aquatic Surface Chemistry, 1987 – Stumm, W., Wiley Interscience, New York. 8. Chemical Oceanography (vol. 1), 1975 – Riley, J.P. and Chester R., Academic Press. 9. Text Book of Physical Chemistry, 1981 - Glasstone, S., Macmillan Indian Press. 10. The Geochemistry of Natural Waters, 1982, 2002 - Drever, J.I., Prentice Hall. 11. Introduction to Geochemistry, 1995 – Krauskopf, K.B. and Bird, Mc.Graw Hill. 12. Water Chemistry – An Introduction to the Chemistry of Natural and Engineered Aquatic Systems, 2011 – P. L. Brezonik and W. A. Arnold, Oxford University Press.	
Learning Outcomes	1. Provide a comprehensive understanding of the seawater as an aqueous electrolytic solution. 2. Illustrate numerical applications of PVT relationships for seawater and the changes in thermodynamic properties of seawater. 3. Explain the key reactions and processes occurring in aquatic environment. 4. Apply the general concepts to aquatic systems of interest such as ocean waters, estuaries, rivers, lakes, ground waters, and soil water systems, as well as in water technology.	