Indian Institute of Technology
Course Details Report

Course No: OE3036

Course Name: Manoeuvring and Control of Marine Vehicles

Course Type:

Theory

Description:

To enable the students to get basic knowledge on ship course keeping and course changing, control devices, ship manoeuvring experimental methods, sea trials and statutory requirements in ship manoeuvrability.

Course Content:

Controllability fundamentals of ships and submarines–Introduction- Kinematics of rotating frame, Nonlinear 6-DoF and 3-DoF rigid body equation of motion, nonlinear and linear hydrodynamic derivatives, linear equations of motion for ship, longitudinal and lateral models for submarines, stability indices; Stability and control in the horizontal and vertical planes; Munk moment Definitive manoeuvres – turning tests, overshoot and zigzag tests, spiral and pullout tests, accelerating, stopping and backing tests. Control surface hydrodynamics – rudder geometry, aspect ratio, influence of fixed structures; Control surface design - specification of requirements and constraints on rudder design, types of rudder, rudder stock; Influence of ship features on controls fixed stability. Experimental determination of hydrodynamic derivatives - straight line test, rotating arm technique, planar motion mechanism; Numerical methods used in ship manoeuvring problems, ship manoeuvring simulators; IMO Rules and Recommendations. Ship manoeuvring sea trials. Control fundamentals-introduction-(Linear and nonlinear control, PID) , Linear system representation, first and second order Nomoto Equation, State-space modelling, Converting State-space model to transfer function, PD & PID controllers, Tuning, PID controller with acceleration feedback

Practicals : 1. Calculation of free stream characteristics of rudder. 2. Rudder design – dimensions, form, structure and system

Experiments: 1. Straight line test in towing tank 2. PMM tests in the towing tank 3. Free running models tests in the basin

Text Books:

1. Lewis,E.U, Principles of Naval Architecture, SNAME, New Jersey, U.S.A, 2010.
2. Fossen, T.I, Guidance and Control of Marine Vehicles, John Wiley & Sons, 1999
3. Molland,A.F and Turnock, S.R., Marine Rudders and Control Surfaces, Elsevier, 2007
4. Lewandowski, E.M. The Dynamics of Marine Crafts – Seakeeping & Maneuvering, World Scientific, 2004

Reference Books:

1. Abkowitz,M.A.; Lectures on Ship Hydrodynamics – Steering and Manoeuvrability, Danish Technical Press, Copenhagen, Denmark, 1964
2. Lecture notes – Maneuvering and control of marine vehicles,Michael S. Triantafyllou, Franz S. Hover , Department of Ocean Engineering Massachusetts Institute of Technology Cambridge, Massachusetts USA
3. Khac Duc Do and Jie Pan, Control of Ships and Underwater Vehicles , Springer, 2009
4. Faltinsen, M.O. Hydrodynamics of High Speed Marine Vehicles, Cambridge University Press, 2009
5. Newman J.N; 'Marine Hydrodynamics', MIT Press, USA, 1977