Indian Institute of Technology
Course Details Report

Course No: OE5055

Course Name: Ship Dynamic Positioning Systems

Course Type:

Theory

Description:

The ship positioning systems are employed for different marine operations for e.g. drilling operations, weather vaning, pipe laying, tracking etc. This course focuses on the basic mathematical modeling of the control systems that are generally used for ship positioning systems. This mainly includes the study about the dynamic positioning systems, thruster assisted anchoring of vessels and the actuators of position systems which generally include propellers, thrusters, rudder etc.

Course Content:

Introduction- Kinematics – Reference frames, Euler angle transformation, Hydrostatics, Vesseldynamics-Linear wave frequency models, nonlinear low frequency vessel model, time domain model-Cummins solution, Linear and Nonlinear time domain models, static analysis of cable segments- catenaryequation and hydrodynamic drag loads.Environment loads acting on ship – waves, winds and currents- linear, nonlinear and drift forces. Seastate description, RAOs, State-space model for wave responses. 2D and 3D ocean current models.Propulsion and thruster control – Propellers and thrusters, Propeller characteristics, Propeller andthruster losses, thruster control in normal and extreme conditions. Steerable and non-steerable thrusters,Basics of rudder and fin design.Mathematical modelling of positioning control systems- Basics of linear system theory, Laplacetransform , Fourier transform, Observer design for DP- Extended Kalman Filter Design, Nonlinearobserver design, adaptive observer design, controller design for DP-control plant model, PID control andacceleration feedback, horizontal plane controller, Horizontal plane controller with roll and pitch damping,thrust allocation, advanced motions control systems (Linear quadratic optimal control, Integrator backstepping) weather optimal positioning.

Text Books:

1. Hubert Fay, Dynamic Positioning Systems, Principles, Designs and Applications. Technip,1990
2. Fossen Thor, Handbook of Marine Craft Hydrodynamics and Motion Control, Wiley publications, 2011
3. Capt. David Bray FNI, DP Operator’s Handbook, A practical guide, The nautical institute 2008

Reference Books:

1. Asgeir J. Sørensen- Lecture Notes- Marine Control Systems. Propulsion and Motion Control of Ships and Ocean Structures, Department of Marine Technology,Norwegian University of Science and Technology, Report UK-13-76 5.
2. Morgan, M.J. “Dynamic Positioning of Offshore Vessels”, PPC Book Division, Petroleum Pub. Co., 1978