| Section | Length | Led by |
|---|---|---|
| **Course Introduction** | 5 min | Yi-Hsiang |
| **Fundamentals of wave energy conversion and hybrid systems (e.g., wind-wave)**<br>• **WEC archetypes**<br>• **Hybrid systems (e.g., wind-wave, current-wave)**<br>• **Power take-off Systems**<br>  o **Hydraulic PTO model**<br>  o **Direct Drive PTO model**<br>• **End-use applications (e.g., utility power, water, PBE)** | 1 hr | Yi-Hsiang |
| **Coffee Break** | 15 min | |
| **Wave mechanics and hydrodynamic fundamentals**<br>• **Ocean Waves (30mins)**<br>  o **Operational and survival wave conditions (JPD, spectra, time-series, etc.)**<br>• **Numerical Methods**<br>  o **Introduction to numerical modeling (30mins)**<br>  ▪ **Potential flow**<br>  ▪ **Cummins' formulation and Pseudo -Spectral Methods**<br>  ▪ **CFD (high-fidelity models and trade-off with design codes)**<br>  ▪ **Spectral models**<br>  ▪ **Experimental methods (System identification and experimental testing of WECs)**<br>  o **Frequency-Domain linear wave theory, potential flow and boundary element models (BEM) (30mins)**<br>  ▪ **Basic potential flow problem formulation**<br>  ▪ **Key assumptions**<br>  ▪ **Impedance Models**<br>  ▪ **BEM solution approach & numerical methods**<br>  • **BEM codes – approach and comparison**<br>  • **1st order vs higher-order panels**<br>  • **Meshing**<br>  • **Irregular frequencies**<br>  o **Time-domain Cummins' radiation/diffraction formulation (30min)**<br>  ▪ **PTO systems for WECs**<br>  ▪ **Modeling friction**<br>  ▪ **Kinematic formulations (i.e., multi-body dynamics versus generalized modes)**<br>  ▪ **Pseudo -Spectral Methods**<br>  ▪ **Capytaine or WAMIT to get linear hydrodynamics (will walk through the** | 2 hr | Jessica & Yi-Hsiang |

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| **process, but students will not perform this, BEM results will be provided to students)**<br>▪ **Frequency domain analysis for operational performance estimate** | | |
| **Lunch** | 1.5 hr | |
| o **CFD Simulation**<br>▪ **Meshing**<br>▪ **Numerical Wave Tank**<br>▪ **OpenFOAM Fluid-structure Interaction Examples** | 1 hr | Jessica |
| **Model WECs from wave to wire (with introduction to WEC-Sim)**<br>• **Analysis/post-processing**<br>o **FRF/RAO**<br>o **Bandwidth (compare incident wave conditions to device response)**<br>o **Power matrix and RCW?**<br>• **Mooring and Cable Dynamics Modeling**<br>• **WEC-PTO Modeling and**<br>• **WEC control co-design and implementation** | 1 hr | Yi-Hsiang |
| **Breakout groups, focused on student needs** | 1 hr | |