Syllabus for: MSL 622: Tides –their Nature and Impacts

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Class meeting times: TBA
Location: TBA
Office hours: By appointment

Course Description.
It will provide students in marine sciences with in-depth knowledge on tides and the role of tides in the physical, biological, chemical and geological processes in the oceans. We will investigate importance of tides for the coastal regions of the Bering Sea and North Pacific. We will also cover associated aspects such as tidal currents and their role in transport of sediments, zooplankton and fish larvae, harnessing the tidal power for the generation of electricity and impact of tides on climate.
The tidal currents will be the main topic considered throughout this course. As strong coastal tidal currents are obvious factors in marine processes, the open ocean vertical mixing, nutrients transport, sedimentation and thermal balance are also linked to the tidal currents. Along with the above 'standard' oceanographic topics the course will aim to introduce the current issues including climate change and tidal energy sources. We will explore the well known 18.6-yr lunar tide period and show how it generates the cyclic changes in marine biological productivity. We will demonstrate that tides are a potential natural source of energy for the generation of electricity and also we will discuss an environmental impact of tidal power development.
Students will gain the knowledge on tides through the lectures and books. The practical knowledge will be gained through the series of numerical exercises on tidal analysis and prediction. Students will be evaluated through the exams and based on their solution of the numerical assignments.

Course Goals and Learning Objectives:
1. The goal of this course is to provide students with expertise in their professional careers to understand and address the influence of tides on practical issues related to physics, geology and biology of oceans. They will also acquire suitable quantitative tools to continue their own research.
2. Student will learn the physics of tide-generating forces and the main periodicities related to tides.
3. Students will become familiar with the basic laws of tide propagation and will be able to explain primary features of the observed tides.
4. Through the series of simple numerical exercises the students will acquire the quantitative skill, which will allow to solve problems related to tides such as estimation of the influence of the tides on transport processes in the ocean (sediments, pollutants, fish larvae and zooplankton), or estimation sources and sinks of the tidal energy for the tidal power development.

Course Policies and Requirements:

Check your e-mail regularly, and be sure I have your current contact information throughout the semester. Class information, updates, readings, and changes to the schedule will be distributed via e-mail.

Class participation and home assignments are expected from ALL students. Points for class participation will be applied toward the final grade, as indicated below.
One **midterm** and one **final** exam will be given during the course. These exams will be written, closed-book. The final exam will include material presented throughout the semester.

Home assignments will play the major role in this educational process. A series of the short practical projects will be made for the real hands–on experience in applying numerical methods for exploring the role of tides in the oceans.

Course Readings:
The hard copies of the following text books will be available in Dr. Kowalik's office to borrow and/or at the UAF Bio-Science Library,

1. Waves, tides and shallow-water processes. 1993, Open Univ. Course Team, Pergamon Press.
2. Massel S. R. 1999. Fluid mechanics for marine ecologists. Springer.
3. Mann, K. H. and J. R. N. Lazier, 1991. Dynamics of Marine Ecosystems. Blackwell Scientific Pub.

The electronic copies of the following text books will be available

1. Tides, Surges and Mean Sea-Level by D. T. Pugh. (pdf file of the book)
2. Coastal Engineering Manual (six chapters) available from the Website of US Army Corps of Engineer.
3. Lecture notes prepared by Z. Kowalik

Handouts of the important journal publications will be provided as appropriate.

Student Presentations: An assignment for a presentation will be made in the first month of the course. The topics related to tides and student field of interest will be chosen so the students will be able to apply the new expertise to their specific fields. Instructor will be strongly involved into preparation of presentation by suggesting proper tools required for the solving problems. The presentation will be scheduled in the second part of the semester and usually will be given for one hour. The presentation will be graded as fail or pass. After and during presentation the **group discussion** will be encouraged.

A note about plagiarism: Plagiarism will not be tolerated in any way during this course. All student presentations are expected to consist of students' original ideas and/or

information from properly cited published sources. Every case of plagiarism will be carefully scrutinized and the range of consequences will be from failing assignment to failing the entire course.

Grading:

Grades will be determined based on the absolute points awarded for the following requirements.

Requirements	Points	% of total
Class participation (attendance, preparedness)	10	10
Homework assignments	40	40
Midterm exam	10	10
Presentation	10	10
Final exam	30	30
Total	100pts	100%

Semester Grades will be assigned according to the following scale:

100-90 A
89-80 B
79-70 C
69-60 D
Below 59 F

Lecture Schedule (subject to change):

Week	Lecture Topic	Assignments/Readings
1 and 2	Tide-generating forces. Enumerate and discuss all forces and periodicities related to tides.	Readings: Ch.I (Tidal Forces) , pdf file, prepared by Z. Kowalik and Waves, tides and shallow-water processes. 1993, Open Univ. Course Team, Pergamon Press. Home assignment No1: 1a. Calculate magnitude of the tidal force as a function of latitude. 1b. Perform calculation and make graphics of linear and nonlinear superposition of the two tide periods.
3 and 4	Analysis and prediction of tides and tidal currents. This lecture will describe the	Readings: Ch.VI (Harmonic Analysis and Prediction), pdf file, prepared by Z. Kowalik and Coastal Engineering Manual available from

	methods to analyze sea level and currents by classic harmonic analysis and by selected modern tools related to energy spectra.	the Website of US Army Corps of Engineer. Home assignment No2: Out of measured tidal currents construct tidal ellipse. Explain a sense of rotation. Home assignment No3: For a monthly series of the sea level data perform tidal analysis. Explain periods and origin of the main tidal constituents
5 and 6	Structure of the tidal currents. Discuss the effects of intense turbulence generated by tides which erases vertical stratification and forms the tidal fronts in shallow water domains. Bering Sea and Gulf of Alaska tides.	Home assignment No4: Starting with equation of motion and continuity introduce energy equation and explain all terms. Home assignment No5: Calculate potential energy of the M2 tide in the Cook Inlet. Evaluate power which can be generated by this energy during one tidal period.
MIDTERM EXAM		
7 and 8	Tidal dynamics. Using Kelvin and Sverdrup waves to explain primary features of the observed tides.	Home assignment No6: Calculate and discuss critical latitudes for the major tidal waves
9 and 10	Introduction to numerical solutions of the tidal equations. Initially, simple problems will be addressed related to a simple geometry of a channel or rectangle.	Readings: Tides, Surges and Mean Sea-Level by D. T. Pugh. (pdf file of the book)
11	Internal tidal waves. Propagation of tides in the density-stratified fluid will be considered. The generation of large internal tides is especially important at the shelf break. The impact of these large waves and currents will be considered on transport of nutrients from the deep waters into the surface layers.	Home assignment No7: Based on the typical distribution of the water density in the Gulf of Alaska calculate the Vaisala-Brunt period of oscillations. Explain this periodicity.
12 and 13	Tidal power. Basic laws of tidal energy generation,	Readings: Ch.IV (Tide Distribution and Tidal Power), pdf file, prepared

	transport and dissipation will be discussed. Harnessing the power of tides for the generation of electricity will be explained. The methods for evaluation environmental impact of a tidal power development will be given.	by Z. Kowalik Home assignment No8: Describe five regions in the World Ocean of extreme tidal ranges. Explain physics of the high tide generation.
14 and 15 FINAL EXAM	Impact of tides on climate. Tidal forces display many long periods (e.g., 2000-yr, 18.6-yrs) but the sea level change at these periods is miniscule. This lecture will discuss the mechanisms that induce these periodicities into the climate change and into bio productivity	Readings: 1. Massel S. R. 1999. Fluid mechanics for marine ecologists. Springer. 2. Mann, K. H. and J. R. N. Lazier, 1991. Dynamics of Marine Ecosystems. Blackwell Scientific Pub. 3. Charles D. Keeling and Timothy P. Whorf . Possible forcing of global temperature by the oceanic tides (pdf file)

Support and Disability Services:

The Office of Disability Services (208 WHIT; 474-5655; mcmatthew@alaska.edu) implements the Americans with Disabilities Act and insures that UAF students have equal access to the campus and course materials. Students with physical or learning disabilities should contact this office, or the instructor, as soon as possible so that suitable arrangements can be made to accommodate specialized needs. Instructor will work with the office of disabilities to provide reasonable accommodation to students with disabilities.