Assignments

* The weekly submissions will be graded from 1-5. The weekly submissions will contribute up to 50% of the course grade. The remaining 50% of the grade is defined by the final exam. The weekly grading is based 50% on technical contents, 20% on using technical aids, 15% on reporting and 15% on reflection previous and future studies (individual 0.5-1 page learning diary with questions for the next week).

**Submission**

Each week report the work done; the template is given in (For Aalto Users –section). Show clearly the roles of the group members in the report (leader, algorithms, data, reporting) in table format – in case of problems this table is used to identify the source of problems.

**Week 1, Given Sept 8th 2020, Deadline Sept 14th 2020, 23:59 – 10% of the course grade**

The idea of the round is to create rough overview of the treatment of random process of your engineering project. This is based on open literature and data search.

Grade 1: Form the group of 3-5 students. Agree the meeting times. Define the roles of members for each week (tabular format). Make table of weekly grades (goal vs. realization). Select the topic for engineering problem to be solved during the course where random loads are present. Give 1-2 pages description of that.

Grade 3: Describe the random variable associated with your engineering problem (case, location) based on related and relevant journal or conference articles. Describe how you could define it (measurements/sensors, references/literature, simulations/method) and required engineering tools and in which courses you learn to use these.

Grade 5: Describe the expected probability distribution (both short and long term) and give reasoning for the selection. What are the probability distributions closely related? How is the selected case related to your former and future studies (learning diary)?

**Week 2, Given Sept 15th 2020, Deadline Sept 22nd 2020, 23:59 – 10% of the course grade**

The idea of the round is to get confidence that we can model random processes by trigonometric functions, and we learn to understand the factors that affect the results. We learn to process random event both in time and frequency domains and understand their meaning for design.

Grade 1: Create in Matlab a scrip that computes time signal for 1-DoF equation of motion with forced excitation and damping. Separate from there the transient and stationary parts. Extract from the stationary part the frequency and amplitude by Fast Fourier Transfrom (FFT) and assess the correctness of the result.

Grade 3: Create a script in MATLAB multiple sinusoidal signals in time domain and their sum. Present that in a plot. Perform Fast Fourier Transform (FFT) and assess the correctness of the result. Show both narrow and broad banded processes in time domain? Perform FFT on these and use some windowing technique to improve the results.

Grade 5: Create a freak event in time domain from the spectra by phase matching. Discuss in the report the likelihood of such event in practice based on open literature (journals and conferences). Also discuss the roles of time and frequency domain in the design process.

**Week 3, Given Sept 22nd 2020, Deadline Sept 28th 2020, 23:59 – 10% of the course grade**

The idea of the round is to learn to treat environmental loading with spectra and to understand the associated time spans and physics of stationary and developing stages. We learn to assess the response by using load spectra and RAO. We understand the difference between narrow and broad-banded processes.

Grade 1: Based on the 1st week report, describe the random variable formation from physical viewpoint (i.e. what causes the random nature, developing stage and stationary stage, time spans etc). Describe the ensemble (response that is related to the transfer function) you could have for your application case. Under what circumstances you can define the random load and response for your application case using stochastic methods? Describe what kind of information is needed to estimate the magnitude of loading (e.g. meteorological) for you engineering problem. What are the random and stationary parts of the load in your application case and associated time spans? Explain what happens if time spans are changed?

Grade 3: Describe the load spectrums you can use to assess the random response of your engineering problem. Justify the selection. Compute the response for random loading based on RAO from open literature. Is the response of your system narrow or broad-banded – how can you make it narrow-banded?

Grade 5: Describe the process to measure the random excitations and responses. What are the sensors needed? Find article related to your engineering problem that has discussed the extreme events relevant to your selected application case. The article must be recognized by Scopus.

**Week 4, Given Sept 29th 2020, Deadline Oct 5th 2020, 23:59 – 10% of the course grade**

This round we learn to understand how we can assess probabilities from the spectra numerically or by using spectral moments and various probability distributions.

Grade 1: Describe under what circumstances you can define the response for random load using the stochastic processes theory. Check these mathematical conditions for your project and discuss the validity of the assumptions. Present the load and response spectrum and RAO.

Grade 3: Create and test a Matlab script that numerically calculates the time average, standard deviation and autocorrelation function for random signal for load and response of your project. Estimate the probability distributions based on numerical methods, i.e. "slicing" for elevations and Rainflow-analysis for cycles.

Grade 5: Fit the continuous distributions over the data (e.g. normal, Rayleigh) and discuss the goodness of these fits. How does discretisation and length of time signal affect the results? Describe the associated probability distributions. Relate you results to those from open literature. Discuss, what are the reasons for agreement and disagreement?

**Week 5, Given Oct 6th 2020, Deadline Oct 12st 2020, 23:59 – 10% of the course grade**

We learn to compute cycles and both short and long term estimates for the loading and responses. We can do this by using numerical and/or direct spectral methods.

Grade 1: Make a short term estimation of maximum wave amplitude of load and response based on spectrum and directly by using numerical tools. Discuss the result.

Grade 3: Make a long term estimation of maximum wave amplitude of load and response based on spectrum and directly by using numerical tools. Discuss the result.

Grade 5: Discuss the associated connection between the short and long term estimates and reflect the findings to those from Round 1.