

# Master 2 M2 Reliability based structural MAintenance for marine REnewable ENERgy (MAREENE)

Année universitaire 2021-2022

## Information générale

|  |   |
|--|---|
| <b>Objectifs</b>                         | This program aims to train structural reliability, monitoring and maintenance specialists in the field of Marine Renewable Energy (MRE). At the end of this program, students will be able to use and quantify the added value of non-destructive testing techniques and SHM methods applied to offshore structures.  |
| <b>Responsable(s)</b>                    | SCHOEFS FRANCK<br>CHEVREUIL PLESSIS MATHILDE  |
| <b>Mention(s) incluant ce parcours</b>   | master Mécanique  |
| <b>Lieu d'enseignement</b>               | The majority of the first semester courses are held on the campus of the Faculty of Sciences of Université de Nantes.<br>These courses are complemented by e-learning courses delivered by partner universities.<br>The second semester can be held at the University of Nantes or in one of the partner universities (attachment).<br>Courses can be taught at ENSM. Shared modules with the Ecole Centrale de Nantes can be offered on its campus, 2 km away.       |
| <b>Langues / mobilité internationale</b> | The programme is taught in English. In the case of this Master, students will be able to carry out internships or projects abroad, and especially in partner universities.  |
| <b>Stage / alternance</b>                | In the first semester of the Master 2 there is a group project that lasts about two months. It is a tutored project realized within the University.<br>The internship or project (in the second semester) lasts at least 4 months and maximum 6, in accordance with European rules. In accordance with French law, internships are therefore paid.  |
| <b>Poursuite d'études /débouchés</b>     | Sectors:<br><ul style="list-style-type: none"> <li>• Energy sector, Marine and Renewable Energy, electricity, gas, oil, nuclear</li> <li>• Higher education and research</li> </ul> Occupations:<br><ul style="list-style-type: none"> <li>· Higher education and academic research</li> <li>· Research and Development functions</li> <li>· Project Manager</li> <li>· Structural Health Monitoring (SHM) specialists</li> <li>· Researcher (after a PhD)</li> </ul> |
| <b>Autres renseignements</b>             | This course is one of those offered by the Master of Mechanics, co-accredited by the Faculty of Sciences of Université de Nantes and Centrale Nantes  |
| <b>Conditions d'obtention de l'année</b> | Graduation is subject to European rules (average over the year, compensation between the EU, except that there is no compensation between semesters, that is to say that the average (10/20) is required in both S1 and S2.   |

## Programme

| 1 <sup>er</sup> SEMESTRE                                     | Code         | ECTS | CM   | CI | TD   | TP | Distanciel | Total         |
|--|--------------|------|------|----|------|----|------------|---------------|
| <b>Groupe d'UE : Core teaching units (24 ECTS)</b>           |              |      |      |    |      |    |            |               |
| Monitoring strategy and monitoring system                    | X3PR010      | 3    | 16   | 0  | 12   | 0  | 4          | 32            |
| Numerical methods for uncertainty quantification             | X3PM060      | 3    | 16   | 0  | 12   | 0  | 4          | 32            |
| MRE structures : wind and ocean energy                       | X3PR020      | 2    | 14   | 0  | 0    | 0  | 4          | 18            |
| Risk based inspection and value of information               | X3PR030      | 3    | 11   | 0  | 12   | 0  | 10         | 33            |
| Risk and reliability in Engineering                          | X3PR040      | 5    | 0    | 0  | 24   | 0  | 24         | 48            |
| Design of offshore structures                                | X3PR050      | 4    | 20   | 0  | 0    | 14 | 0          | 34            |
| Technical Communication                                      | X3PR060      | 2    | 0    | 0  | 0    | 0  | 20         | 20            |
| Problem Based Learning and Project Management                | X3PR070      | 2    | 0    | 0  | 0    | 0  | 11         | 11            |
| <b>Groupe d'UE : Optional teaching units (6 ECTS)</b>        |              |      |      |    |      |    |            |               |
| Probabilistic modelling of degradations                      | X3PR080      | 3    | 16   | 0  | 12   | 0  | 0          | 28            |
| Windloads on structures                                      | X3PR090      | 3    | 0    | 0  | 0    | 0  | 22         | 22            |
| Stochastic theory of Sealoards                               | X3PR100      | 3    | 13.5 | 0  | 10.5 | 0  | 10         | 34            |
| <b>Groupe d'UE : Teaching units without credits (0 ECTS)</b> |              |      |      |    |      |    |            |               |
| Préparation au toeic   | X3LA010      | 0    | 0    | 0  | 0    | 0  | 0          | 0             |
| FLE (French as a Foreign Language)                           | X3PR110      | 0    | 0    | 0  | 0    | 0  | 0          | 0             |
| Fluid Dynamics   | X1PM060      | 0    | 20   | 0  | 16   | 12 | 4          | 52            |
|  | <b>Total</b> | 30   |      |    |      |    | 91.00      | <b>342.00</b> |

| 2 <sup>ème</sup> SEMESTRE  | Code         | ECTS | CM | CI | TD | TP | Distanciel | Total        |
|--|--------------|------|----|----|----|----|------------|--------------|
| <b>Groupe d'UE : Units for professional experience (30 ECTS)</b> |              |      |    |    |    |    |            |              |
| Internship or project and workshops                              | X4PR010      | 30   | 0  | 0  | 0  | 0  | 31         | 31           |
|  | <b>Total</b> | 30   |    |    |    |    | 31.00      | <b>31.00</b> |

## Modalités d'évaluation

Mention Master 2ème année Parcours : M2 Reliability based structural MAintenance for marine REnewable ENergy (MAREENE) Année universitaire 2021-2022

Responsable(s) : SCHOEFS FRANCK, CHEVREUIL PLESSIS MATHILDE

### REGIME ORDINAIRE

|  |          |  |   |             | PREMIERE SESSION |       |      |        |       |      |       | DEUXIEME SESSION |       |      |        |       |      |              | TOTAL  |      |
|--|----------|--|---|-------------|------------------|-------|------|--------|-------|------|-------|------------------|-------|------|--------|-------|------|--------------|--------|------|
|  |          |  |   |             | Contrôle continu |       |      | Examen |       |      |       | Contrôle continu |       |      | Examen |       |      |              | Coeff. | ECTS |
| CODE UE  | INTITULE | UE non dipl.                                     |   |             | écrit            | prat. | oral | écrit  | prat. | oral | durée | écrit            | prat. | oral | écrit  | prat. | oral | durée        |        |      |
| <b>Groupe d'UE : Core teaching units</b>               |          |  |   |             |                  |       |      |        |       |      |       |                  |       |      |        |       |      |              |        |      |
| 3  | X3PR010  | Monitoring strategy and monitoring system        | N | obligatoire | 1                | 1     | 1    |        |       |      |       | 0.5              | 1     |      |        |       | 1.5  |              | 3      | 3    |
| 3  | X3PM060  | Numerical methods for uncertainty quantification | N | obligatoire |                  | 1.5   | 1.5  |        |       |      |       |                  | 1.5   |      |        |       | 1.5  |              | 3      | 3    |
| 3  | X3PR020  | MRE structures : wind and ocean energy           | N | obligatoire | 2                |       |      |        |       |      |       | 0.5              |       |      | 1.5    |       |      |              | 2      | 2    |
| 3  | X3PR030  | Risk based inspection and value of information   | N | obligatoire |                  | 2     | 1    |        |       |      |       |                  | 2     |      |        |       | 1    |              | 3      | 3    |
| 3  | X3PR040  | Risk and reliability in Engineering              | N | obligatoire | 3                | 2     |      |        |       |      |       | 1                | 2     |      | 2      |       |      |              | 5      | 5    |
| 3  | X3PR050  | Design of offshore structures                    | N | obligatoire |                  | 4     |      |        |       |      |       |                  | 2     |      |        |       | 2    |              | 4      | 4    |
| 3  | X3PR060  | Technical Communication                          | N | obligatoire | 0.4              |       | 1.6  |        |       |      |       | 0.4              |       |      |        |       | 1.6  |              | 2      | 2    |
| 3  | X3PR070  | Problem Based Learning and Project Management    | N | obligatoire | 1                |       | 1    |        |       |      |       | 1                |       |      |        |       | 1    |              | 2      | 2    |
| <b>Groupe d'UE : Optional teaching units</b>           |          |  |   |             |                  |       |      |        |       |      |       |                  |       |      |        |       |      |              |        |      |
| 3  | X3PR080  | Probabilistic modelling of degradations          | N | optionnelle | 2                | 1     |      |        |       |      |       |                  | 1     |      | 2      |       |      |              | 3      | 3    |
| 3  | X3PR090  | Windloads on structures                          | N | optionnelle | 1.5              |       | 1.5  |        |       |      |       | 1.5              |       |      |        |       | 1.5  |              | 3      | 3    |
| 3  | X3PR100  | Stochastic theory of Sealoads                    | N | optionnelle | 3                |       |      |        |       |      |       | 1                |       |      | 2      |       |      |              | 3      | 3    |
| <b>Groupe d'UE : Teaching units without credits</b>    |          |  |   |             |                  |       |      |        |       |      |       |                  |       |      |        |       |      |              |        |      |
| 3  | X3LA010  | Préparation au toEIC                             | O | optionnelle |                  |       |      |        |       |      |       |                  |       |      |        |       |      |              | 0      | 0    |
| 3  | X3PR110  | FLE (French as a Foreign Language)               | O | optionnelle |                  |       |      |        |       |      |       |                  |       |      |        |       |      |              | 0      | 0    |
| 1  | X1PM060  | Fluid Dynamics                                   | O | optionnelle |                  |       |      |        |       |      |       |                  |       |      |        |       |      |              | 0      | 0    |
| <b>Groupe d'UE : Units for professional experience</b> |          |  |   |             |                  |       |      |        |       |      |       |                  |       |      |        |       |      |              |        |      |
| 4  | X4PR010  | Internship or project and workshops              | N | obligatoire | 10               | 10    | 10   |        |       |      |       |                  |       |      | 10     | 10    | 10   |              | 30     | 30   |
|  |          |  |   |             |                  |       |      |        |       |      |       |                  |       |      |        |       |      | <b>TOTAL</b> | 60     | 60   |

A la seconde session, les notes de contrôle continu correspondent à un report des notes de CC de la première session.

## DISPENSE D'ASSIDUITE

|  |          |  |   | PREMIERE SESSION |       |      |        |       |      |       |       | DEUXIEME SESSION |      |       |        |      |              |    |    | TOTAL  |      |
|--|----------|--|---|------------------|-------|------|--------|-------|------|-------|-------|------------------|------|-------|--------|------|--------------|----|----|--------|------|
|  |          |  |   | Contrôle continu |       |      | Examen |       |      |       |       | Contrôle continu |      |       | Examen |      |              |    |    | Coeff. | ECTS |
| CODE UE  | INTITULE | UE non dipl.                                     |   | écrit            | prat. | oral | écrit  | prat. | oral | durée | écrit | prat.            | oral | écrit | prat.  | oral | durée        |    |    |        |      |
| <b>Groupe d'UE : Core teaching units</b>               |          |  |   |                  |       |      |        |       |      |       |       |                  |      |       |        |      |              |    |    |        |      |
| 3  | X3PR010  | Monitoring strategy and monitoring system        | N | obligatoire      |       |      |        | 1.5   |      | 1.5   |       |                  |      |       | 1.5    |      | 1.5          |    | 3  | 3      |      |
| 3  | X3PM060  | Numerical methods for uncertainty quantification | N | obligatoire      |       |      |        |       | 1.5  | 1.5   |       |                  |      |       |        | 1.5  | 1.5          |    | 3  | 3      |      |
| 3  | X3PR020  | MRE structures : wind and ocean energy           | N | obligatoire      |       |      |        | 2     |      |       |       |                  |      |       | 2      |      |              |    | 2  | 2      |      |
| 3  | X3PR030  | Risk based inspection and value of information   | N | obligatoire      |       |      |        |       | 2    | 1     |       |                  |      |       |        | 2    | 1            |    | 3  | 3      |      |
| 3  | X3PR040  | Risk and reliability in Engineering              | N | obligatoire      |       |      |        | 3     | 2    |       |       |                  |      |       | 3      | 2    |              |    | 5  | 5      |      |
| 3  | X3PR050  | Design of offshore structures                    | N | obligatoire      |       |      |        |       | 4    |       |       |                  |      |       |        | 4    |              |    | 4  | 4      |      |
| 3  | X3PR060  | Technical Communication                          | N | obligatoire      |       |      |        | 0.4   |      | 1.6   |       |                  |      |       | 0.4    |      | 1.6          |    | 2  | 2      |      |
| 3  | X3PR070  | Problem Based Learning and Project Management    | N | obligatoire      |       |      |        | 1     |      | 1     |       |                  |      |       | 1      |      | 1            |    | 2  | 2      |      |
| <b>Groupe d'UE : Optional teaching units</b>           |          |  |   |                  |       |      |        |       |      |       |       |                  |      |       |        |      |              |    |    |        |      |
| 3  | X3PR080  | Probabilistic modelling of degradations          | N | optionnelle      |       |      |        | 2     | 1    |       |       |                  |      |       | 2      | 1    |              |    | 3  | 3      |      |
| 3  | X3PR090  | Windloads on structures                          | N | optionnelle      |       |      |        | 1.5   |      | 1.5   |       |                  |      |       | 1.5    |      | 1.5          |    | 3  | 3      |      |
| 3  | X3PR100  | Stochastic theory of Sealoads                    | N | optionnelle      |       |      |        | 3     |      |       |       |                  |      |       | 3      |      |              |    | 3  | 3      |      |
| <b>Groupe d'UE : Teaching units without credits</b>    |          |  |   |                  |       |      |        |       |      |       |       |                  |      |       |        |      |              |    |    |        |      |
| 3  | X3LA010  | Préparation au toEIC                             | O | optionnelle      |       |      |        |       |      |       |       |                  |      |       |        |      |              |    | 0  | 0      |      |
| 3  | X3PR110  | FLE (French as a Foreign Language)               | O | optionnelle      |       |      |        |       |      |       |       |                  |      |       |        |      |              |    | 0  | 0      |      |
| 1  | X1PM060  | Fluid Dynamics                                   | O | optionnelle      |       |      |        |       |      |       |       |                  |      |       |        |      |              |    | 0  | 0      |      |
| <b>Groupe d'UE : Units for professional experience</b> |          |  |   |                  |       |      |        |       |      |       |       |                  |      |       |        |      |              |    |    |        |      |
| 4  | X4PR010  | Internship or project and workshops              | N | obligatoire      |       |      |        | 10    | 10   | 10    |       |                  |      |       | 10     | 10   | 10           |    | 30 | 30     |      |
|  |          |  |   |                  |       |      |        |       |      |       |       |                  |      |       |        |      | <b>TOTAL</b> | 60 | 60 |        |      |

A la seconde session, les notes de contrôle continu correspondent à un report des notes de CC de la première session.

## Description des UE

| <b>X3PR010</b>                        | <b>Monitoring strategy and monitoring system</b>   |
|---------------------------------------|--|
| Lieu d'enseignement                   | Université de Nantes   |
| Niveau                                | Master   |
| Semestre                              | 3  |
| Responsable de l'UE                   | LUPI CYRIL<br>LEDUC DOMINIQUE<br>LECIEUX YANN  |
| Volume horaire total                  | <b>TOTAL : 32h Répartition : CM : 16h TD : 12h CI : 0h TP : 0h EAD : 4h</b>  |
| <b>Place de l'enseignement</b>        |  |
| UE pré-requis(s)                      |  |
| Parcours d'études comprenant l'UE     | M2 Reliability based structural MAintenance for marine REnewable ENergy (MAREENE)  |
| <b>Evaluation</b>                     |  |
| Pondération pour chaque matière       | Monitoring strategy and monitoring system <b>100%</b>  |
| Obtention de l'UE                     |  |
| <b>Programme</b>                      |  |
| Objectifs (résultats d'apprentissage) | At the end of the teaching unit, the student is able to: <ul style="list-style-type: none"> <li>• Describe the major families of sensors, their uses and the means of acquisition available.</li> <li>• Prescribe the performance of measurement, transmission and storage systems according to a specific use</li> <li>• Describe the simple physical principles of large families of sensors</li> </ul>  |
| Contenu                               | <ul style="list-style-type: none"> <li>• Introduction: from measured physics to mechanical size</li> <li>• Sensor technologies and acquisition devices available</li> <li>• Qualification and quantification of the performance of measurement systems: sensitivity, reliability, lifetime</li> <li>• Case of optical fibers</li> <li>• Case of resistivity and impedance</li> <li>• Selection strategy, positioning, redundancy according to use (alert / update)</li> <li>• Optimization of sensor positioning</li> <li>• Transmission, spécifications, storage and management of databases</li> <li>• Application to the PBL (Problem Based learning) of the industrial project semester 4</li> </ul> |
| Méthodes d'enseignement               | On campus  |
| Langue d'enseignement                 | Anglais  |
| Bibliographie                         |  |

| <b>X3PM060</b>                    | <b>Numerical methods for uncertainty quantification</b>   |
|-----------------------------------|---|
| Lieu d'enseignement               | Fac de Nantes et Ecole Centrale de Nantes   |
| Niveau                            | Master  |
| Semestre                          | 3   |
| Responsable de l'UE               | CHEVREUIL PLESSIS MATHILDE  |
| Volume horaire total              | <b>TOTAL : 32h Répartition : CM : 16h TD : 12h CI : 0h TP : 0h EAD : 4h</b>   |
| <b>Place de l'enseignement</b>    |   |
| UE pré-requis(s)                  |   |
| Parcours d'études comprenant l'UE | M2 Mécanique et Fiabilité des Structures, M2 CMI-ICM, M2 Reliability based structural MAintenance for marine REnewable ENergy (MAREENE) |

| <b>Evaluation</b>                     |  |
|---------------------------------------|--|
| Pondération pour chaque matière       | Numerical methods for uncertainty quantification <b>100%</b>   |
| Obtention de l'UE                     |  |
| <b>Programme</b>                      |  |
| Objectifs (résultats d'apprentissage) | At the end of the teaching unit, the student is able to: <ul style="list-style-type: none"> <li>• model the inputs of a physical model according to the data of the problem,</li> <li>• estimate by simulation a quantity of post-processed interest of the output of the physical model (average, variance, probability of exceeding the threshold, sensitivity index),</li> <li>• construct a meta-model of a variable of interest based on observations from this one,</li> <li>• estimate the error of the meta-model,</li> <li>• use the meta-model or models for the estimation of statistical quantities.</li> </ul>  |
| Contenu                               | - Modelling of random variables: parametric and non-parametric modeling, discretization of a random variable (sampling, polynomial approximation), identification of a random variable, error and bias estimation<br>- Simulation: Monte Carlo simulation and variance reduction techniques for Monte Carlo methods (importance sampling, control variates, antithetic variables, low discrepancy sequences ...)<br>- Meta-models: projection methods, statistical learning methods (Krigging, Kernel methods, least squares methods, cross validation)<br>- Sensitivity analysis<br>Practical sessions and projects on Matlab (using a dedicated Approximation toolbox), OpenTurns and 'R'. |
| Méthodes d'enseignement               | Cours/TD<br>TP numériques (Matlab, OpenTurns, R)<br>Etude du comportement des méthodes numérique + Etude de cas<br>Projets : présentation orale façon cours, évaluation par les pairs et par l'équipe pédagogique  |
| Langue d'enseignement                 | Anglais  |
| Bibliographie                         | T Hastie, R Tibshirani and J Friedman, "The elements of Statistical Learning. Data mining, inference, and prediction". Springer, second edition, 2001  |

| <b>X3PR020</b>                        | <b>MRE structures : wind and ocean energy</b>   |
|---------------------------------------|---|
| Lieu d'enseignement                   | Université de Nantes  |
| Niveau                                | Master  |
| Semestre                              | 3   |
| Responsable de l'UE                   | SCHOEFS FRANCK  |
| Volume horaire total                  | <b>TOTAL : 18h Répartition : CM : 14h TD : 0h CI : 0h TP : 0h EAD : 4h</b>  |
| <b>Place de l'enseignement</b>        |   |
| UE pré-requis(s)                      |   |
| Parcours d'études comprenant l'UE     | M2 Reliability based structural MAintenance for marine REnewable ENergy (MAREENE)   |
| <b>Evaluation</b>                     |   |
| Pondération pour chaque matière       | MRE structures : wind and ocean energy <b>100%</b>  |
| Obtention de l'UE                     |   |
| <b>Programme</b>                      |   |
| Objectifs (résultats d'apprentissage) | At the end of the teaching unit, the student is able to: <ul style="list-style-type: none"> <li>• Define and understand the diversity of offshore technologies</li> <li>• Briefly describe the relationship between technological maturity and the severity of environmental conditions in case studies.</li> </ul> |

|                         |   |
|-------------------------|---|
| Contenu                 | <ul style="list-style-type: none"> <li>• MREs which resource for which technology: Site conditions in the world and in particular in France conditioning the selection of technological concepts (2h)</li> <li>• Approach of the offshore oil sector and its specificities according to the sites (1h) <ul style="list-style-type: none"> <li>- Structures laid (1h)</li> <li>- Floating structures (1h)</li> </ul> </li> <li>• The specific challenge of MREs and major families of solutions for: <ul style="list-style-type: none"> <li>- Offshore wind power (2h)</li> <li>- Floating offshore wind (3h)</li> <li>- tidal stream (2h)</li> <li>- the wave energy (1h)</li> </ul> </li> </ul> <p>* the thermal energy of the seas (1h)</p> |
| Méthodes d'enseignement | On campus then 30% by e-learning on offshore technology (UN-e-SEA Master TP2M database).<br>E- Learning : As part of the Problem based Learning, a specific study will be proposed in connection with the industrial project.   |
| Langue d'enseignement   | Anglais   |
| Bibliographie           | Websites EWEA / WEAMEC  |

|                                       |   |
|---------------------------------------|---|
| <b>X3PR030</b>                        | <b>Risk based inspection and value of information</b>   |
| Lieu d'enseignement                   | Université de Nantes  |
| Niveau                                | Master  |
| Semestre                              | 3   |
| Responsable de l'UE                   | SCHOEFS FRANCK<br>SORENSEN John   |
| Volume horaire total                  | <b>TOTAL : 33h Répartition : CM : 11h TD : 12h CI : 0h TP : 0h EAD : 10h</b>  |
| <b>Place de l'enseignement</b>        |   |
| UE pré-requis(s)                      |   |
| Parcours d'études comprenant l'UE     | M2 Reliability based structural MAintenance for marine REnewable ENergy (MAREENE)   |
| <b>Evaluation</b>                     |   |
| Pondération pour chaque matière       | Risk based inspection and value of information <b>100%</b>  |
| Obtention de l'UE                     |   |
| <b>Programme</b>                      |   |
| Objectifs (résultats d'apprentissage) | At the end of the teaching unit, the student is able to: <ul style="list-style-type: none"> <li>• Mathematically formulate the cost function of a Risk Based Inspection Problem</li> <li>• Write constraint optimization problem from inspections or monitoring</li> <li>• Digitally implement and calculate the added value of a monitoring system on a component of an EMR system.</li> </ul> |
| Contenu                               |   |
| Méthodes d'enseignement               | On campus and e-learning<br>Lectures, supplemented with project work  |
| Langue d'enseignement                 | Anglais   |
| Bibliographie                         |   |

|                     |  |
|---------------------|--|
| <b>X3PR040</b>      | <b>Risk and reliability in Engineering</b> |
| Lieu d'enseignement | Université de Nantes                       |
| Niveau              | Master                                     |
| Semestre            | 3  |

|                                       |   |
|---------------------------------------|---|
| Responsable de l'UE                   | SCHOEFS FRANCK<br>SORENSEN John   |
| Volume horaire total                  | <b>TOTAL</b> : 48h Répartition : <b>CM</b> : 0h <b>TD</b> : 24h <b>CI</b> : 0h <b>TP</b> : 0h <b>EAD</b> : 24h  |
| <b>Place de l'enseignement</b>        |   |
| UE pré-requis(s)                      |   |
| Parcours d'études comprenant l'UE     | M2 Reliability based structural MAintenance for marine REnewable ENergy (MAREENE)   |
| <b>Evaluation</b>                     |   |
| Pondération pour chaque matière       | Risk and reliability in Engineering <b>100%</b>   |
| Obtention de l'UE                     |   |
| <b>Programme</b>                      |   |
| Objectifs (résultats d'apprentissage) | <p><b>Objectives</b><br/>Students who complete the module:</p> <p><b>Knowledges</b></p> <ul style="list-style-type: none"> <li>• Understand the concepts risk, uncertainty, reliability and safety.</li> <li>• Know statistical methods for modeling physical, model, statistical and measurement uncertainties.</li> <li>• Know methods for assessment of reliability of structural systems using probabilistic methods.</li> <li>• Know methods for systems reliability for non-structural components and its applications in engineering.</li> </ul> <p><b>Skills</b></p> <ul style="list-style-type: none"> <li>• Be able to model physical, statistical, model and measurement uncertainties.</li> <li>• Be able to use failure rates and hazard functions to model failures in systems reliability for non-structural components.</li> <li>• Be able to model uncertainties for loads and strengths.</li> <li>• Be able to estimate the reliability by FORM/SORM methods (reliability index method) and by simulation.</li> <li>• Be able to model system behavior and estimate the reliability of series and parallel systems.</li> <li>• Understand basic concepts of stochastic processes and time-variant reliability methods.</li> <li>• Be able to estimate characteristic and design values for strength parameters and load bearing capacities, and for environmental loads and load effects using test data and measurements.</li> <li>• Be able to calibrate partial safety factors and load combination factors.</li> <li>• Be able to apply Bayesian statistical methods.</li> <li>• Be able to apply risk and reliability methods for probabilistic design of engineering structures such as buildings, bridges, offshore structures, costal structures, wind turbines etc.</li> <li>• Use correct professional terminology.</li> </ul> <p><b>Competencies</b></p> <ul style="list-style-type: none"> <li>• Be able to participate in a dialog on modelling of uncertainties, risk analysis and assessment of reliability of structural and non-structural components and systems.</li> <li>• Be able to model, calculate and communicate risk analysis, modelling of uncertainties and assessment of reliabilities for engineering problems.</li> </ul> |
| Contenu                               |   |
| Méthodes d'enseignement               | On campus and e-learning<br>Lectures, etc. supplemented with project work, workshops, presentation seminars, lab tests  |
| Langue d'enseignement                 | Anglais   |
| Bibliographie                         | COST TU1402 guidelines  |

|                      |  |
|----------------------|--|
| <b>X3PR050</b>       | <b>Design of offshore structures</b>   |
| Lieu d'enseignement  | Université de Nantes   |
| Niveau               | Master   |
| Semestre             | 3  |
| Responsable de l'UE  | SCHOEFS FRANCK<br>AMDAHL Jorgen<br>ZHEN Gao  |
| Volume horaire total | <b>TOTAL</b> : 34h Répartition : <b>CM</b> : 20h <b>TD</b> : 0h <b>CI</b> : 0h <b>TP</b> : 14h <b>EAD</b> : 0h |



| <b>Place de l'enseignement</b>        |   |
|---------------------------------------|---|
| UE pré-requise(s)                     |   |
| Parcours d'études comprenant l'UE     | M2 Reliability based structural MAintenance for marine REnewable ENergy (MAREENE)   |
| <b>Evaluation</b>                     |   |
| Pondération pour chaque matière       | Design of offshore structures <b>100%</b>   |
| Obtention de l'UE                     |   |
| <b>Programme</b>                      |   |
| Objectifs (résultats d'apprentissage) | Provide the candidate with the knowledge and skills to carry out basic tasks regarding structural design and dimensioning of marine structures.   |
| Contenu                               | <ul style="list-style-type: none"> <li>• The extent of the various subjects lectured may vary from one year to the other, but will typically comprise:</li> <li>• Serviceability and safety design criteria, including requirements to overall stability and strength as well as evacuation and escape.</li> <li>• Design rules for offshore structures including offshore wind turbines.</li> <li>• Overview of functional, environmental and accidental loads for marine structures, with emphasis on wind - and wave induced loads.</li> <li>• Methods for calculating characteristic natural loads with emphasis on use of statistical methods.</li> <li>• Stochastic response analysis, long term response analysis, environmental contour method.</li> <li>• Nonlinear, time domain simulation of offshore structures and wind turbines subjected to extreme environmental actions.</li> <li>• Limit state design checks.</li> <li>• Structural resistance against accidental actions-; fires, explosions, ship collision.</li> <li>• Materials for marine structures.</li> <li>• Alternative designs of facilities for the offshore oil and gas industry.</li> </ul> |
| Méthodes d'enseignement               | On campus and e-learning<br>Lectures, tutorials, projects   |
| Langue d'enseignement                 | Anglais   |
| Bibliographie                         |   |

| <b>X3PR060</b>                        | <b>Technical Communication</b>   |
|---------------------------------------|--|
| Lieu d'enseignement                   | Université de Nantes   |
| Niveau                                | Master   |
| Semestre                              | 3  |
| Responsable de l'UE                   | BROPHY Barry   |
| Volume horaire total                  | <b>TOTAL : 20h Répartition : CM : 0h TD : 0h CI : 0h TP : 0h EAD : 20h</b>   |
| <b>Place de l'enseignement</b>        |  |
| UE pré-requise(s)                     |  |
| Parcours d'études comprenant l'UE     | M2 Reliability based structural MAintenance for marine REnewable ENergy (MAREENE)  |
| <b>Evaluation</b>                     |  |
| Pondération pour chaque matière       | Technical Communication <b>100%</b>  |
| Obtention de l'UE                     |  |
| <b>Programme</b>                      |  |
| Objectifs (résultats d'apprentissage) | <p>On successful completion of this module students will be able to:</p> <ul style="list-style-type: none"> <li>• Adapt your personal conversational style to the task of presenting.</li> <li>• Analyse your presentation task and set realistic goals.</li> <li>• Learn design principles of effective visual aids.</li> <li>• Use of communication tools - examples, analogies, stories, demo's.</li> </ul> |

|                         |   |
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| Contenu                 | <ul style="list-style-type: none"> <li>• This module focuses on making presentations. To do this an understanding of the entire communication chain is required (eg. handouts, questions, follow-up meetings etc.) It works off the assumption that you already have the skills necessary to make a presentation – your conversational skills.</li> <li>• The challenge is to set out your material in an audience-friendly so that you can deliver it with the same style, and as easily, as if you were talking to a friend.</li> </ul>   |
| Méthodes d'enseignement | <p>The module will include:</p> <ul style="list-style-type: none"> <li>• Extensive set of videos demonstrating best practice and conversational techniques.</li> <li>• Themed podcasts edited from interviews with people who present as part of their jobs.</li> <li>• Small-group work for preparing for each presentation task.</li> </ul> <p>Discussion boards and several scheduled live group/class discussions.</p> <ul style="list-style-type: none"> <li>• Two sessions, one online and one at the Université de Nantes campus, during the term to deliver group presentations (assessment)</li> <li>• Online feedback sessions on presentations.</li> </ul> |
| Langue d'enseignement   | Anglais   |
| Bibliographie           |   |

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|---------------------------------------|--|
| <b>X3PR070</b>                        | <b>Problem Based Learning and Project Management</b>   |
| Lieu d'enseignement                   | Université de Nantes   |
| Niveau                                | Master   |
| Semestre                              | 3  |
| Responsable de l'UE                   | SCHOEFS FRANCK<br>SORENSEN John<br>GUERRA Aida<br>PAKRASHI Vikram<br>LEIRA Bernt   |
| Volume horaire total                  | <b>TOTAL : 11h Répartition : CM : 0h TD : 0h CI : 0h TP : 0h EAD : 11h</b>   |
| <b>Place de l'enseignement</b>        |  |
| UE pré-requise(s)                     |  |
| Parcours d'études comprenant l'UE     | M2 Reliability based structural MAintenance for marine REnewable ENERgy (MAREENE)  |
| <b>Evaluation</b>                     |  |
| Pondération pour chaque matière       | Problem Based Learning and Project Management <b>100%</b>  |
| Obtention de l'UE                     |  |
| <b>Programme</b>                      |  |
| Objectifs (résultats d'apprentissage) | <p>Enter the learning environment by problem and manage study projects in close collaboration with peers (introduction) :</p> <ul style="list-style-type: none"> <li>• Describe and discuss the Aalborg PBL model based on the three key words: group work, Project work, problem orientation.</li> <li>• Identify an initial individual challenge when using a PBL approach.</li> <li>• Develop and practice peer feedback skills.</li> <li>• Practice collaborative learning in a group.</li> <li>• Design an action plan to deal with an initial individual challenge or curiosity.</li> <li>• Practice presentation skills.</li> <li>• Practice critical skills by giving feedback to peers.</li> <li>• Reflect on one's own and peers' competencies in relation to the practice exam PBL</li> <li>• Solves in a group a research or industrial problem in Mechanics.</li> <li>• Prepares for the internship in a company.</li> <li>• Write a report.</li> <li>• Present his work orally.</li> </ul> |
| Contenu                               |  |

|                         |   |
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| Méthodes d'enseignement | On campus and e-learning<br>Workshops focused on the individual student working with a challenge or individual focus on the PBL approach.<br>Peer learning is also a feature, as students discuss and reflect on their individual challenges / interests in a peer learning group.<br>Tutored group project |
| Langue d'enseignement   | Anglais   |
| Bibliographie           |   |

| <b>X3PR080</b>                        | <b>Probabilistic modelling of degradations</b>  |
|---------------------------------------|---|
| Lieu d'enseignement                   | Université de Nantes  |
| Niveau                                | Master  |
| Semestre                              | 3   |
| Responsable de l'UE                   | BASTIDAS ARTEAGA EDGAR EMILIO<br>JACQUEMIN Frédéric<br>SCHOEFS FRANCK   |
| Volume horaire total                  | <b>TOTAL : 28h Répartition : CM : 16h TD : 12h CI : 0h TP : 0h EAD : 0h</b>   |
| <b>Place de l'enseignement</b>        |   |
| UE pré-requis(s)                      |   |
| Parcours d'études comprenant l'UE     | M2 Reliability based structural MAintenance for marine REnewable ENergy (MAREENE)   |
| <b>Evaluation</b>                     |   |
| Pondération pour chaque matière       | Probabilistic modelling of degradations <b>100%</b>   |
| Obtention de l'UE                     |   |
| <b>Programme</b>                      |   |
| Objectifs (résultats d'apprentissage) | At the end of the teaching unit, the student must be able to: <ul style="list-style-type: none"> <li>• Select a modeling strategy based on a failure mechanism.</li> <li>• Program a model according to time.</li> <li>• Know the parameters to measure in input and / or output.</li> <li>• Calculate reliability according to time.</li> </ul>  |
| Contenu                               | <ul style="list-style-type: none"> <li>• Stochastic modeling of degradation models</li> <li>• Applications to steel: corrosion / fatigue</li> <li>• Application to reinforced concrete: corrosion / fatigue</li> <li>• Application to other composites: specific degradations</li> <li>• Time Dependent Reliability</li> <li>• Application to the problem of the industrial project of semester 4 (PBL).</li> </ul> |
| Méthodes d'enseignement               | On campus and e-learning  |
| Langue d'enseignement                 | Anglais   |
| Bibliographie                         |   |

| <b>X3PR090</b>       | <b>Windloads on structures</b>   |
|----------------------|--|
| Lieu d'enseignement  | Université de Nantes   |
| Niveau               | Master   |
| Semestre             | 3  |
| Responsable de l'UE  | SORENSEN John  |
| Volume horaire total | <b>TOTAL : 22h Répartition : CM : 0h TD : 0h CI : 0h TP : 0h EAD : 22h</b> |

| <b>Place de l'enseignement</b>        |  |
|---------------------------------------|--|
| UE pré-requis(s)                      |  |
| Parcours d'études comprenant l'UE     | M2 Reliability based structural MAintenance for marine REnewable ENergy (MAREENE)  |
| <b>Evaluation</b>                     |  |
| Pondération pour chaque matière       | Windloads on structures <b>100%</b>  |
| Obtention de l'UE                     |  |
| <b>Programme</b>                      |  |
| Objectifs (résultats d'apprentissage) | <p>Knowledge</p> <ul style="list-style-type: none"> <li>• Understand the nature of wind: wind profile, mean wind, extreme wind, turbulence, turbulence field - for applications for structures such as buildings, bridges and wind turbines.</li> <li>• Understand modelling and calculation of wind loads on civil engineering structures</li> <li>• Be able to calculate static and dynamic wind loads on buildings.</li> <li>• Be able to assess cross-wind load actions such as rhythmic vortex shedding and galloping.</li> <li>• Be able to assess structures exposed to wind load in ULS and SLS (comfort).</li> <li>• Be able to apply rules for wind actions in design codes.</li> <li>• Use correct professional terminology.</li> </ul> <p>Competencies</p> <ul style="list-style-type: none"> <li>• Be able to model, calculate and communicate wind loads on civil engineering structures.</li> </ul> |
| Contenu                               | Introduction to wind loads on structures/ Static wind loads/ Dynamic wind loads (along wind)/ Dynamic wind loads (across wind)/ Windloads on complex structures  |
| Méthodes d'enseignement               | e-learning<br>Lectures, etc. supplemented with project work, workshops, presentation seminars, lab tests   |
| Langue d'enseignement                 | Anglais  |
| Bibliographie                         |  |

| <b>X3PR100</b>                        | <b>Stochastic theory of Sealoads</b>   |
|---------------------------------------|--|
| Lieu d'enseignement                   | Université de Nantes   |
| Niveau                                | Master   |
| Semestre                              | 3  |
| Responsable de l'UE                   | LEIRA Bernt  |
| Volume horaire total                  | <b>TOTAL : 34h Répartition : CM : 13.5h TD : 10.5h CI : 0h TP : 0h EAD : 10h</b>   |
| <b>Place de l'enseignement</b>        |  |
| UE pré-requis(s)                      |  |
| Parcours d'études comprenant l'UE     | M2 Reliability based structural MAintenance for marine REnewable ENergy (MAREENE)  |
| <b>Evaluation</b>                     |  |
| Pondération pour chaque matière       | Stochastic theory of Sealoads <b>100%</b>  |
| Obtention de l'UE                     |  |
| <b>Programme</b>                      |  |
| Objectifs (résultats d'apprentissage) | <ul style="list-style-type: none"> <li>• To have detailed knowledge of statistical methods and of the basis for description of stochastic processes. This includes detailed knowledge of the topics given in the academic content.</li> <li>• To be able to make simple calculations of stochastic loads on and responses of marine structures.</li> <li>• To master the concepts and terminology which are used in statistical methods and in the description of stochastic processes and how this is applied in marine technology.</li> <li>• To have detailed knowledge of the basic principles and methods which are used to describe stochastic processes with the emphasis on the applications to sealoads and motions of marine systems.</li> </ul> |

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|-------------------------|--|
| Contenu                 | <ul style="list-style-type: none"> <li>• Transformation of random variables.</li> <li>• Monte Carlo simulation.</li> <li>• Probability distributions for response.</li> <li>• Parameter-estimation.</li> <li>• Extreme-value statistics.</li> <li>• Stochastic processes.</li> <li>• Auto- and cross-correlation functions. Spectra and cross-spectra.</li> <li>• Differentiation of stochastic processes.</li> <li>• Excitation-response of stochastic processes. Response-statistics.</li> </ul> |
| Méthodes d'enseignement | E-learning<br>Virtual classes/videos, online exercices   |
| Langue d'enseignement   | Anglais  |
| Bibliographie           | D.E. Newland: An introduction to random vibrations, spectral and wavelet analysis, 3rd edition, 1993. D. Myrhaug: Lecture notes. B. Leira: Lecture notes.  |

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|---------------------------------------|---|
| <b>X3LA010</b>                        | <b>Préparation au toEIC</b>   |
| Lieu d'enseignement                   | FST-Lombarderie   |
| Niveau                                | Master  |
| Semestre                              | 3   |
| Responsable de l'UE                   | KERVISION SYLVIE  |
| Volume horaire total                  | <b>TOTAL : 0h Répartition : CM : 0h TD : 0h CI : 0h TP : 0h EAD : 0h</b>  |
| <b>Place de l'enseignement</b>        |   |
| UE pré-requise(s)                     |   |
| Parcours d'études comprenant l'UE     | M2 Chimie Moléculaire et Thérapeutique (CMT),M2 Mathématiques Fondamentales et Appliquées - Algèbre et Géométrie (MFA-AG),M2 Ingénierie Statistique (IS),M2 CMI-IS,M2 Modélisation, Analyse numérique et Calcul Scientifique (MACS),M2 Ingénierie des Systèmes d'Information (ISI),M2 Mécanique et Fiabilité des Structures,M2 Sciences et techniques aux époques moderne et contemporaine,M2 Génétique, Génomique & Biologie des Systèmes (GGBS),M2 Biologie, Biotechnologie & Recherche Thérapeutique (BBRT),M2 Recherche Clinique,M2 Capteurs Intelligents et Qualité des Systèmes Electroniques,M2 Pilotage des Systèmes d'Information (PSI),M2 Génétique, Génomique & Biologie des Systèmes (GGBS),M2 CMI-ICM,M2 Gestion des Risques, Santé, Sécurité, Environnement (GRiSSE),M2 Modélisation en Pharmacologie Clinique et Epidémiologie (MPCE),M2 Biologie, Biotechnologie & Recherche Thérapeutique (BBRT),M2 Rayonnements Ionisants et Applications médicales (RIA),M2 Démantèlement et Modélisation Nucléaires (DMN),M2 Recherche en Physique Subatomique (RPS),M2 CMI-INA,M2 Préparation Supérieure à l'Enseignement (PSE),M2 Mathématiques Fondamentales et Appliquées - Analyse et Probabilités (MFA-AP),M2 Nanosciences, Nanomatériaux, Nanotechnologies (CNano),M2 Energies Nouvelles et Renouvelables (ENR) - option Gestion de l'énergie,M2 Energies Nouvelles et Renouvelables (ENR) - option Dispositifs pour l'énergie,M2 Analyse, Molécules, Matériaux, Médicaments (A3M) ,M2 Conception et Réalisation des Bâtiments,M2 Travaux Publics et Maintenance,M2 Travaux publics et Maritimes,M2 Chimie Moléculaire et Thérapeutique (CMT) par alternance,M2 Reliability based structural MAintenance for marine REnewable ENergy (MAREENE) |
| <b>Evaluation</b>                     |   |
| Pondération pour chaque matière       | Préparation au toEIC <b>100%</b>  |
| Obtention de l'UE                     |   |
| <b>Programme</b>                      |   |
| Objectifs (résultats d'apprentissage) | <p>A l'issue de cet enseignement, les étudiants seront capables de :</p> <ul style="list-style-type: none"> <li>• Reconnaître et anticiper les formats de certifications en anglais.</li> <li>• Compléter les réponses exigées par les tests de certifications.</li> <li>• Pouvoir optimiser leurs résultats aux certifications grâce à une méthodologie de travail appliquée lors des séances d'entraînement.</li> </ul> <p>At the end of this course, students will be able to:</p> <ul style="list-style-type: none"> <li>• Recognize and anticipate certification formats in English.</li> <li>• Complete the answers required by the certification tests.</li> <li>• To be able to optimize their results to certifications thanks to an applied work methodology during training sessions.</li> </ul>   |

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| Contenu                 | <p><i>Se préparer pour obtenir une certification en anglais (objectif B2 et +)</i></p> <ul style="list-style-type: none"> <li>• Présentation des formats</li> <li>• Exercices d'entraînement</li> <li>• Conseils pour optimiser son score</li> </ul> <p><i>Prepare to obtain certification in English (objective B2 and +)</i></p> <ul style="list-style-type: none"> <li>• Presentation of formats</li> <li>• Training exercises</li> <li>• Tips to optimize your score</li> </ul> |
| Méthodes d'enseignement | Distanciel  |
| Langue d'enseignement   | Français  |
| Bibliographie           | <ul style="list-style-type: none"> <li>• 200% TOEIC 2017 Listening &amp; Reading (2 août 2016, de Michael Byrne et Michelle Dickinson)</li> <li>• TOEIC® La Méthode Réussite (20 janvier 2011, de David Mayer et Serena Murdoch Stern)</li> <li>• Tactics for TOEIC® Listening and Reading Test (13 septembre 2007, de Grant Trew)</li> <li>• Cambridge Grammar and Vocabulary for the TOEIC Test (11 novembre 2010, de Jolene Gear et Robert Gear)</li> </ul>                      |

| <b>X3PR110</b>                        | <b>FLE (French as a Foreign Language)</b>   |
|---------------------------------------|---|
| Lieu d'enseignement                   | Université de Nantes  |
| Niveau                                | Master  |
| Semestre                              | 3   |
| Responsable de l'UE                   |   |
| Volume horaire total                  | <b>TOTAL : 0h Répartition : CM : 0h TD : 0h CI : 0h TP : 0h EAD : 0h</b>          |
| <b>Place de l'enseignement</b>        |   |
| UE pré-requis(s)                      |   |
| Parcours d'études comprenant l'UE     | M2 Reliability based structural MAintenance for marine REnewable ENERGY (MAREENE) |
| <b>Evaluation</b>                     |   |
| Pondération pour chaque matière       | FLE (French as a Foreign Language) <b>100%</b>                                    |
| Obtention de l'UE                     |   |
| <b>Programme</b>                      |   |
| Objectifs (résultats d'apprentissage) |   |
| Contenu                               |   |
| Méthodes d'enseignement               |   |
| Langue d'enseignement                 | Français  |
| Bibliographie                         |   |

| <b>X1PM060</b>                 | <b>Fluid Dynamics</b>  |
|--------------------------------|--|
| Lieu d'enseignement            | Faculté des Sciences de Nantes   |
| Niveau                         | Master   |
| Semestre                       | 1  |
| Responsable de l'UE            | CARPY SABRINA  |
| Volume horaire total           | <b>TOTAL : 52h Répartition : CM : 20h TD : 16h CI : 0h TP : 12h EAD : 4h</b> |
| <b>Place de l'enseignement</b> |  |

|                                       |  |
|---------------------------------------|--|
| UE pré-requise(s)                     | Mécaniques des fluides   |
| Parcours d'études comprenant l'UE     | M1 Mécanique et Fiabilité des Structures, M1 CMI-ICM, M2 Reliability based structural MAintenance for marine REnewable ENergy (MAREENE), M2 International Master in Planetary Geosciences  |
| <b>Evaluation</b>                     |  |
| Pondération pour chaque matière       | Fluid Dynamics <b>100%</b>   |
| Obtention de l'UE                     | Les notes de pratique à la deuxième session correspondent à un report des notes de pratiques de la première session.<br>The practice notes for the second session are a carry-over from the practice notes of the first session.   |
| <b>Programme</b>                      |  |
| Objectifs (résultats d'apprentissage) | <p>A l'issue de cette U.E., L'étudiant :</p> <ul style="list-style-type: none"> <li>• schématise et modélise un écoulement réel grâce à la méthode des fonctions potentiels et fonctions de courant de l'aérodynamique</li> <li>• met en équation un problème de dynamique des fluides</li> <li>• simplifie le problème à l'aide des hypothèses du problème et si besoin, grâce à une analyse dimensionnelle</li> <li>• détermine les solutions à l'aide des conditions aux limites et des conditions initiales</li> <li>• est capable d'appréhender les différences entre un fluide parfait et réel, laminaire et turbulent, stationnaire et instationnaire et de faire le lien entre la théorie et la pratique lors des séances de travaux pratiques</li> <li>• rédige un rapport détaillé sur les expériences réalisées en travaux pratiques dans un document synthétique avec des outils scientifiques adaptés (réalisation de schéma, écriture des équations,...) par groupe de deux ou trois</li> </ul> <p><b>Learning outcomes :</b></p> <ul style="list-style-type: none"> <li>- model a fluid dynamics problem</li> <li>- simplify the problem using the hypotheses of the problem and, if necessary, through a dimensional analysis</li> <li>- determine solutions using boundary conditions and initial conditions</li> <li>- understand the differences between a perfect and real fluid, laminar and turbulent, stationary and unsteady</li> <li>- schematize and models a real flow using the method of potential and current functions of aerodynamics</li> <li>- write a transport equation for temperature or concentration</li> <li>- write a detailed report on the experiments carried out in practical work in a synthetic document with adapted scientific tools (making a diagram, writing equations, etc.) in groups of two or three students</li> </ul> |
| Contenu                               | <p>-Fondamentaux de la mécanique des fluides (propriétés d'un fluide, cinématique des fluides, équation de Bernoulli, vorticit , fluide visqueux,...)</p> <p>-Solution des probl mes d' coulement des fluides mod lis s par des  quations diff rentielles ( quation d'onde,  quation de diffusion,  quation de Laplace)</p> <p>-Application aux  coulements   surface libre et aux couches limites</p> <p>-Travaux pratiques :  coulement laminaire dans une conduite,  coulement turbulent dans une conduite,  coulement autour d'un cylindre, mesures exp rimentales de forces a rodynamiques sur des profils d'ailes.</p> <p><b>Programme's content :</b></p> <p>-Fundamentals of fluid mechanics (properties of a fluid, kinematics of fluids, Bernoulli's equation, vorticity, viscous fluid)</p> <p>-Solution of fluid-flow problems that are modelled by differential equations (wave equation, diffusion equation, Laplace's equation)</p> <p>-Application to Water waves and Boundary layers</p> <p>-Practical work: laminar flow in a pipe, turbulent flow in a pipe, flow around a cylinder in a wind tunnel, experimental measurements of aerodynamic forces on wing profiles.</p>   |
| M thodes d'enseignement               | Lectures, tutorials, practical work, distance learning, project mode   |
| Langue d'enseignement                 | Anglais  |
| Bibliographie                         | M canique des fluides,  l ments d'un premier parcours, Chassaing, C padu s  ditions ; Hydrodynamique Physique, Guyon, Hulin et Petit, CNRS  ditions.   |

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|---------------------|--|
| <b>X4PR010</b>      | <b>Internship or project and workshops</b> |
| Lieu d'enseignement |  |
| Niveau              | Master                                     |

|                                       |  |
|---------------------------------------|--|
| Semestre                              | 4  |
| Responsable de l'UE                   | CHEVREUIL PLESSIS MATHILDE   |
| Volume horaire total                  | <b>TOTAL</b> : 31h Répartition : <b>CM</b> : 0h <b>TD</b> : 0h <b>CI</b> : 0h <b>TP</b> : 0h <b>EAD</b> : 31h  |
| <b>Place de l'enseignement</b>        |  |
| UE pré-requis(s)                      | Problem Based learning   |
| Parcours d'études comprenant l'UE     | M2 Reliability based structural MAintenance for marine REnewable ENergy (MAREENE)  |
| <b>Evaluation</b>                     |  |
| Pondération pour chaque matière       | Internship or project and workshops <b>100%</b>  |
| Obtention de l'UE                     |  |
| <b>Programme</b>                      |  |
| Objectifs (résultats d'apprentissage) | <p>At the end of this teaching unit, the student:</p> <ul style="list-style-type: none"> <li>• Solves a problem of industrial mechanics or research within a team</li> <li>• Identifies the methods necessary for solving</li> <li>• Models the problem posed and justifies the assumptions made</li> <li>• Produce a bibliography on the subject</li> <li>• Solve the problem and comment on the validity of its results</li> <li>• Complies with the requirements (rules, standards, means, communication) of the company or laboratory</li> <li>• Produces an internship report</li> <li>• Present his work orally</li> </ul> <p>Workshops:</p> <ul style="list-style-type: none"> <li>• Develop and practice peer feedback skills</li> <li>• Practice collaborative learning in a group</li> <li>• Design an action plan to deal with an initial individual challenge or curiosity</li> <li>• Practice presentation skills</li> <li>• Practice critical skills by giving feedback to peers</li> <li>• Reflect on hisr own skills and those of peers</li> </ul> |
| Contenu                               | <ul style="list-style-type: none"> <li>• The internship lasts between 4 and 6 months. It takes place either in a company or in a laboratory. In accordance with the French law the internship is paid.</li> <li>• The student is in charge of finding his internship. Proposals are addressed throughout the first semester but he can also find the internship by himself.</li> <li>• The choice of an internship must be validated by the training manager in order to verify the suitability of its content with training.</li> </ul>   |
| Méthodes d'enseignement               | <p>Internship or project in company or laboratory with follow-up by the supervisor and an academic tutor.</p> <p>Writing and defense of a thesis</p> <p>Collaborative online activities / seminars</p>   |
| Langue d'enseignement                 | Anglais  |
| Bibliographie                         |  |

Dernière modification par ISABELLE BEAUDET, le 2020-05-29 18:56:21