15. MO18-5302 Advanced Fatigue & Fracture Mechanics

Module name	Advanced Fatigue & Fracture Mechanics
Module level, if applicable	Master
Code, if applicable	MO18-5302
Subtitle, if applicable	-
Course, if applicable	Advanced Fatigue & Fracture Mechanics
Semester	3rd Semester
Person responsible for the module	Prof. Ir. Eko Budi Djatmiko, M.Sc., Ph.D. Nur Syahroni, S.T., M.T.,Ph.D
Lecturer	Prof. Ir. Eko Budi Djatmiko, M.Sc., Ph.D. Nur Syahroni, S.T., M.T.,Ph.D
Language	Indonesian
Relation to curriculum	Elective course for master degree program in Ocean Engineering
Type of teaching, contact hours	Lecture, <50 students 150 minutes x 16 weeks per semester
Workload	1. Class, 3 × 50’ = 150 minutes per week 2. Independent Study, 3 × 60’ = 180 minutes per week 3. Structured Activities, 3 × 60’ = 180 minutes per week
Credit points	3 CREDITS ~ 4.8 ECTS CREDITS × 1.6 ECTS
Requirements according to the examination regulations	A student must have attended at least 80% of the lectures to sit in the exams.
Recommended prerequisites	-

Learning outcomes **and their corresponding PLOs**	CLO.1. Able to understand and explain the basic principles of structural damage mechanism (sea) due to fatigue. CLO.2. Able to understand the procedure and can calculate the fatigue life of the structure by applying the method of deterministic wave load and random (spectral) random loads based on Palmgren-Miner law. CLO.3. Able to understand and explain the basic principles of structural damage mechanism in the form of fracture. CLO.4. Able to understand the procedure and can calculate the period of crack propagation and structure breakdown by applying constant amplitude load method and variable based on Paris-Erdogan law.	LO.8. Able to identify, formulize and solved the science and technology problems related to ocean engineering through the accurate and innovative theoretical, experimental, or computational approach

Content	This course begins with the introduction of structural damage mechanisms due to fatigue, fatigue case on steel structure of marine facilities, fatigue experiment, S-N curve, stress concentration, crack initiation. Then followed by a discussion of the accumulation of structural damage due to fatigue with the Palmgren-Miner hypothesis, the calculation of stress distribution and fatigue with deterministic approach, calculation of stress distribution and fatigue with spectral method, and calculation of fatigue failure with the application of closed form fatigue equation. The next section was introduced on the foundations of fracture mechanics, crack propagation, stress intensity factors, Paris-Erdogan law, final damage by applying constant and variable amplitude load methods, tubular fatigue, and summary calculations of fatigue life of marine structures. This course contains of following materials: ▪ Load cycles as a source of excitation of fatigue and breakdown of marine structures. ▪ S-N curves and their equations for plate and tubular structures. ▪ Nominal stress, hot spot stress and Stress Concentration Factor (SCF); ▪ Calculation of sea structure fatigue by deterministic method; ▪ Calculation of sea structure fatigue by spectral method; ▪ Closed-form fatigue equation; ▪ Factors that affect structural breakdown; ▪ Determination of Stress Intensity Factor (SIF) and its equations; ▪ Paris-Erdogan equations and crack propagation curves; ▪ Fractional calculation of marine structures by the method of accumulation of deterministic wave load cycles; ▪ Fractional calculation of marine structures by method of accumulation of random wave load cycle.
Study and examination requirements and forms of examination	16. In-class exercise 17. Assignment 18. Mid-term exam 19. Final exam
Media employed	Offline: LCD, whiteboard, PowerPoint presentation Online: websites (myITS Classroom), Zoom, Microsoft Teams, PowerPoint presentation.

Reading list	1. Knott, J.F., "Fundamental of Fracture Mechanics", Butterworth & Co. Publ. Ltd., 1973 2. Broek, D., "Elementary Engineering Fracture Mechanics", Noordhoff Int. Publ., 1974. 3. Rolfe, N.E. and Barson, J.M., "Fracture and Fatigue Control in Structures", Prentice-Hall Inc., 1977. 4. Fuchs, H.O. and Stephens, R.I., "Metal Fatigue in Engineering", Jon Wiley & Sons, Inc., 1980 5. Hellan, K. 1984, *Introduction to Fracture Mechanics*, McGraw-Hill, New York, 1984 6. Almar-Næss, A. (Ed), "Fatigue Handbook: Offshore Steel Structure", Tapir, Trondheim, 1985. 7. Dover, W.D. and Glinka, G., *Fatigue of Offshore Structures*, EMASBOOKS: Offshore Structures Series, London, UK, 1988 8. DNV-RP-C203, *Fatigue Design of Offshore Structures*, Norway, 1988 9. API-RP2A LRFD, *Recommended Practice for Planning, Designing & Constructing Fixed Offshore Platforms – Load & Resistance Factor Design*, 1st Ed, USA, 1993 10. ASM Handbook Volume 19: *Fatigue and Fracture*, USA, 1996 11. Etube, L., *Fatigue and Fracture of Offshore Structures*, Gulf Publishing Company, USA, 2001 12. API-RP2A WSD, Recommended Practice for Planning, Designing & Constructing Fixed Offshore Platforms – Working Stress Design, 21st Ed, USA, 2001 13. Anderson, T.L, "Fracture Mechanics, Fundamental and Applications 3rd Ed.", Taylor & Francis, 2005 14. DNV-RP-C206, Fatigue Methodology for Offshore Ships of Offshore Structures, Norway, 2007