



Advanced Drilling Engineering (Module I)

1.0 Course Faculty Information

Name: Prof. Dr. M. Enamul Hossain
NSRIC Chair Professor in Sustainable Energy
NSRIC Inc.
London, Ontario, Canada

2.0 Course Information

Course Code and Title	ENG-A-C00109
Class Days	Saturday and Sunday
Class Time	9:00 am – 10:30 am EST (Self-study)
Course Credit Hours	1 (7 Hrs.)
Class Location	NSRIC online platform
Prerequisites and/or co-requisites	Horizontal and Multilateral Drilling
Level /A, E, H, I, K12, M, P, S, T, U, V, W	Professional and High-level courses: P/H

Note: The below classification of courses is related any areas of knowledge:

A: Advanced level academic level courses; **E:** Executive courses; **H:** Higher-level courses (i.e., graduate courses); **I:** Intermediate courses (i.e., university preparatory courses – Grade XII+); **K12:** Foundational, and lower-level courses; **M:** Mid-level courses (i.e., undergraduate courses); **P:** Professional courses; **S:** Short/seminar courses; **T:** Training courses; **U:** Tutorial Courses; **V:** Vocational training courses; and **W:** Workshop courses.
ENG – Engineering
PET – Petroleum

3.0 Professor Information

Name	Prof. Dr. M. Enamul Hossain
Title	NSRIC Chair Professor in Sustainable Energy
Contact Information	enamulh@nsric.ca ; dr.mehossain@gmail.com
Office Location	NSRIC online platform
Office Hours	08:30 am – 09:30 am EST (Monday) by email appointment only

Our Specializations:

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4.0 Course Description

This course is designed for audiences and students who are interested to learn about the advanced and in-depth of drilling related to drilling engineering during oil and gas operations. The course content is designed for students who are enrolled in undergraduate senior level, graduate program(s), early career professionals, professionals and interested in learning advanced drilling operations. This course content is aimed to present in five modules (Module I to V) and each module comprises with six to eight lectures. The modules cover rig side preparation, managed pressure drilling (MPD), dual gradient drilling (DGD), underbalanced drilling (UBD), surge and swab, identifying various factors affecting drilling operations, wellbore stability, situational problems, basic concept and advances of hole stability, rate of penetration (ROP) and its optimization, basic concept of optimization of drilling operations, techniques to optimize drilling operations, advances in optimization of drilling operations etc.

Module I mainly covers managed pressure drilling (MPD). In addition, it also covers tasks and steps needed to consider before drilling, choosing the site, seismic exploration, geological surveys, logging, and sources of data etc. The steps include preparing the rig site, drilling, cementing, and testing, well completion, fracking, production, and fracking fluid recycling, well abandonment and land restoration. The module offers an illustration on MPD such as an introduction of managed pressure drilling (MPD), definition, IADC definitions, advantages, disadvantages, drilling window, categories of MPD, proactive and reactive MPD, types of MPD, constant bottom hole pressure drilling (CBHPD), friction management method, continuous circulation method, mud cap drilling (MCD), pressurized mud cap drilling (PMCD), controlled mud cap drilling (CMCD), dual gradient drilling (DGD), annulus injection method, riserless dual gradient method, return flow control (RFC) or HSE method, MPD problems and MPD pressure calculations. Further, an extensive discussion is added related to key tools for most techniques of MPD such as rotating control device (RCD) on floating rigs, external riser RCD, subsea RCD, internal riser RCD (IRRCD), rotating control device (RCD) on fixed rigs, active and passive annular seal design “land” models, marine diverter converter RCD, bell nipple insert RCD, marine diverter or surface annular, non-return valves, choke options and other tools for MPD. Module I contains eight lectures. Students are strongly advised to complete the courses titled “Basics of Drilling Engineering I”, “Drilling Engineering II”, “Horizontal and Multilateral Drilling” and “Coiled-tubing drilling and Fishing Operations” by Prof. M. Enamul Hossain at NSRIC Platform to understand more about the course content.

5.0 Course Captions/Keywords

Rig site, fixed rigs, drilling, cementing and testing, well completion, fracking, production and fracking fluid recycling, well abandonment, land restoration, managed pressure drilling

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(MPD), definition, IADC definitions, advantages and disadvantages of MPD, drilling window, categories of MPD, proactive and reactive MPD, types of MPD, constant bottom hole pressure drilling (CBHPD), friction management method, continuous circulation method, mud cap drilling (MCD), pressurized mud cap drilling (PMCD), controlled mud cap drilling (CMCD), dual gradient drilling (DGD), annulus injection method, riserless dual gradient method, return flow control (RFC), HSE method, MPD problems, MPD pressure calculations, key tools for MPD, rotating control device (RCD), floating rigs, external riser RCD, subsea RCD, internal riser RCD (IRRCD), active and passive annular seal design land models, marine diverter converter RCD, bell nipple insert RCD, marine diverter or surface annular, non-return valves, choke options, other tools for MPD, choosing the site, seismic exploration, sources of data, geological surveys, seismic exploration, offshore seismology, logging, standard logging, electric logging, data interpretation, direct detection, computer assisted exploration (CAEX), interactive 3-D seismic, 3-D seismic imaging, porosity, permeability, geologist and geophysicist.

6.0 Course Learning Outcomes (CLO)

Upon successful completion of this course, students will be able to:

- CLO1: Become familiar with advanced drilling technology for oil and gas industry.
- CLO2: Understand and follow the different steps and tasks needed to be completed before drilling.
- CLO3: Become familiar with the basics of managed pressure drilling (MPD).
- CLO4: Ability to understand the applications, advantages, and disadvantages of MPD.
- CLO5: Ability to understand the key parameters related to MPD.
- CLO6: Become familiar and an in-depth understanding of the different types and categories of MPD.
- CLO7: Become familiar with the basics of MPD equipment, tools and related drilling devices and parts.
- CL08: Ability to map the MPD through a case study.
- CL09: Ability to design a system, component, or process to meet the desired needs within realistic constraints such as economic, environmental and safety.
- CL10: Ability to use techniques, skills, and modern engineering tools necessary for engineering practices.

7.0 Course Materials

Online course materials

- Online PowerPoint presentation slides in pdf form.

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- Audio/visual recording of lectures (Optional).
- Online tutoring session(s) and meeting(s) with students upon request and needs.
- Assignments and quizzes in the MLS system.
- Reading materials if any in pdf form.

Textbook and resources (If any)

- 1) Islam, M.R. and **Hossain, M.E.** (2020). Drilling Engineering: Towards Achieving Total Sustainability, ISBN-10: 0128201932 (ISBN-13: 978-0128201930), Gulf Professional Publishing, 1st Edition, pp. 800.
- 2) **Hossain, M.E.** and Al-Majed, A.A. (2015). Fundamentals of Sustainable Drilling Engineering. ISBN 978-0-470878-17-0, John Wiley & Sons, Inc. Hoboken, New Jersey, and Scrivener Publishing LLC, Salem, Massachusetts, USA, pp. 786.

8.0 Target Audiences

- Diploma and vocational training students
- University undergraduate and graduate level students
- Any students who are interested in advanced drilling engineering, managed pressure drilling and steps and tasks before drilling.
- Students who have completed the Basics of Drilling Engineering I (Module 1 – 4), Drilling Engineering II (Module 1 – 4), Horizontal and Multilateral Drilling and Coiled-tubing Drilling and Fishing operations offered by Prof. M. Enamul Hossain are highly recommended.

9.0 Requirements/Instructions

Students are advised to register all drilling engineering modules and course(s) for becoming the master in the subject area offered by Prof. Dr. M. Enamul Hossain.

10.0 Course Topics

Module I

- An introduction of advanced drilling engineering.
- Steps and tasks before attempting drilling.
- Managed pressure drilling (MPD).
- Equipment and tools related to MPD.

Module II – V

- Dual gradient drilling (DGD).

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- Underbalanced drilling (UBD).
- Mud cup drilling (MCD).
- Situational problems.
- Wellbore stability.
- Basic concept of optimization of drilling operations.
- Optimization of drilling operations.
- Advances in optimization of drilling operations.
- Surge and swab.
- Identify various factors affecting drilling operations.
- Factors affecting rate of penetration (ROP).
- Technique to optimize drilling operations.

11.0 Course Contents and Schedule

Lec. No.	Module	Topics	Remarks
Advanced Drilling Engineering (Module I)			
01	Introduction	Course overview and introduction to advanced drilling – 1	
02	Tasks and steps	Tasks before start drilling and steps to drilling a well – 1	
03	MPD	Managed Pressure Drilling (MPD) – 1	Quiz 1
04	MPD	Managed Pressure Drilling (MPD) – 2	Assignment 1
05	MPD Equipment	MPD Equipment and Tools - 1	
06	MPD Equipment	MPD Equipment and Tools - 2	
07	MPD Equipment	MPD Equipment and Tools - 3	Quiz 2
08	Case study on MPD	Summary of MPD and a case study on MPD – 1	Assignment 2

12.0 Academic Integrity

Students are encouraged to have a look at the NSRIC’s statement of academic integrity at NSRIC website. It is noted that by signing this syllabus, you will acknowledge that you have understood that any detected plagiarism should be reported.

13. Assessment for Grade

This course contains assignment and quizzes for assessment. Student will receive a “Certificate of completion” after successful completion of the course.

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Important Note:

- i) The below classified courses (i.e., academic courses) will only be evaluated based on the grade system shown in Table 2. A grade and certificate will be issued for the student(s) and participant(s).
A: Advanced level academic level courses; **H:** Higher-level courses (i.e., graduate courses); **I:** Intermediate courses (i.e., university preparatory courses – Grade XII+); **K12:** Foundational, and lower-level courses; **M:** Mid-level courses (i.e., undergraduate courses).
- ii) The below classified courses will **not** be evaluated based on the grade system shown in Table 2. A certificate will be issued for the student(s) and participant(s).
E: Executive courses; **P:** Professional courses; **S:** Short/seminar courses; **T:** Training courses; **U:** Tutorial Courses; **V:** Vocational training courses; and **W:** Workshop courses.

Participation/Engagement/Performance

Your participation in every aspect of the course is important for the learning process. Your engagement in every discussion in the course, due delivery of all assignments, quizzes, and research projects will be fruitful. These efforts from your side will reflect your performance in the course delivery and your commitments. This performance is the reflection of your dream grade!!

Assignments

You will be given **two assignments** during the course delivery. The due dates for assignments are specified in the course content and schedule section. The assignments will be given time to time to solve/answer during the term. Assignments will be posted through NSRIC online platform at least one week before they are due. Due dates are given in course schedule (tentative schedule). However, in case of any special circumstance, the date will be posted beforehand or announced in class.

Quizzes

A Maximum of two quizzes (maximum of **ten MCQ @ 10 minute**) will be taken based on class lectures and performance. The quiz will be taken in the beginning of the lecture through NSRIC online platform. If you miss the quiz without any valid official excuse, you will receive for the non-attended quiz. If any student fails to attend the quiz, he/she must submit a valid reason to the instructor. In such case, he/she should appear another quiz or may be averaged on the quizzes that he/she attended. It will depend on the situation and instructor.

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14.0 Advice and additional requirements

I advise you to:

- Please contact me if you need any help.
- Students are expected to attend all scheduled online lecture classes.
- Students are expected to study from the course materials and/or textbooks which will help to easily read and understand.
- Students are encouraged to write their own notes during lectures/presentations (pdf PowerPoint presentations, and additional materials if any).
- Students are encouraged to attend online platform classes on time because late attendee disrupts the flow of the class for both the instructor and the other students.

Additional information (During Online Course offering Period)

- The PowerPoint course materials, and video lectures will be available at the NSRIC Platform.
- There will be scheduled discussion/tutorial sessions on a set scheduled time. All students should attend this session (Need student request).
- There will be an office hour for students on Monday – Friday from 08:30 am – 09:30 am EST (Toronto, Canada time). **Students need to send an email request so that a zoom meeting can be arranged.** In addition, any time student can set up an online appointment (i.e., phone, zoom, and/or other mode of communications) based on availability of the course instructor. However, student should send an email request for setting up this type of meeting.

Prepared by Prof. Dr. Mohammed Enamul Hossain, NSRIC Chair Professor in Sustainable Energy, Dept. of Petroleum Engineering, OE Division, NSRIC Inc., London, ON, Canada.

Subtitle: Learn about the advanced and in-depth of drilling engineering during oil and gas operations, specifically the tasks before starting drilling and the steps to drill a well, managed pressure drilling and its equipment.

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