



Faculty of Engineering

**School of Minerals and Energy Resources Engineering**

Postgraduate Course Outline

PTRL6027

Casing Design & Cementing

Dr Zhixi Chen

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## 1 INFORMATION ABOUT THE COURSE

Course Code:	PTRL6027	Term:	T1, 2020	Level:	PG	Units/Credits	6 UOC
Course Name:	<b>Casing Design &amp; Cementing</b>						

Course Convenor:	<b>Dr Zhixi Chen</b>		
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		Phone:	+61 2 9385 5182
Contact times	<b>Distance Delivery</b>		

### 1.1 Course Description

The course covers:

**Casing Design** - API properties of casing and casing couplings; performance properties of casing under load conditions; principles of casing design for vertical, deviated and horizontal wells; preparation of casing programs for different well types; optimisation of casing program.

**Cementing** – Cement manufacture, composition and standardization; measuring and controlling cement properties; cement additives; cement slurry design; Cementing calculations - Primary cementing, plug balancing, and squeeze cementing; rheology and types of flow; mechanism of mud removal by cement; cementing equipment; planning, conducting and monitoring primary and secondary cementing jobs; post-job considerations and evaluation.

### 1.2 Course Completion

Course completion requires submission of all assessment items; failure to submit all assessment items can result in the award of an Unsatisfactory Failure (UF) grade for the Course.

### 1.3 Assumed Knowledge

Prerequisite: N/A

### 1.4 Attendance

This course is delivered in distance mode.

## 2 AIMS, LEARNING OUTCOMES AND GRADUATE ATTRIBUTES

### 2.1 Course Aims

This course will enable students to acquire fundamental knowledge of casing design and cementing operations and to apply the theory to the design, evaluation and optimization of casing program and cementing operations.

### 2.2 Learning Outcomes

At the conclusion of this course, students should be able to:

1. Design and evaluate casing program for specific well conditions.
2. Design and evaluate cementing operations for specific well conditions.
3. Prepare and test cementing slurry and set cement according to API standards.

### 2.3 Graduate Attributes

Students please view the link to the [UNSW Graduate Attributes](#).

## 3 REFERENCE RESOURCES

### 3.1 Reference Materials

Support material for this course including, whenever available, copies of lecture notes, recommended readings, etc. can be found on Moodle.

The lecture note may be viewed and downloaded from the UNSW-Moodle <http://moodle.telt.unsw.edu.au/>.

### 3.2 Recommended Materials

Followings are the recommended books for **Casing Design**:

- Rahman S.S. and Chilingarian G.V.: **Casing Design Theory and Practice**. Elsevier Science B.V., Amsterdam, The Netherlands, 1995.
- Bourgoyne A.T. Jr., Millheim K.K., Chenevert M.E. and Young F.S. Jr.: **Applied Drilling Engineering**, SPE Textbook Series, Vol. 2, Richardson, TX, USA, 1991.

The textbook for **Cementing** is:

Nelson, E.B. and Guillot D., **Well Cementing** (Second Edition), Schlumberger, 2006.

It is important that you have a copy of the above textbook as there is no separate course manual for Cementing. The book can be available from the following links:

<https://www.amazon.com/Well-Cementing-Erik-Nelson/dp/0978853008>

### 3.3 Other Resources

Links to websites etc.

The University and the Faculty provide a wide range of support services for students, including:

- UNSW Learning Centre (<http://www.lc.unsw.edu.au>)
- Counselling support - <http://www.counselling.unsw.edu.au>
- Library training and support services - <http://www.library.unsw.edu.au/>
- OnePetro – (<http://www.onepetro.org>)

### 3.4 Online Resources

There are numerous articles / information sources on reservoir engineering on the web. Many of them are sound, but many are either very lightweight or contain errors. Be very careful in your choice of web sources. Remember, UNSW librarians are usually happy to help you locate articles or make suggestions regarding possible material to help you in your academic work. You can also access basic online help at <http://www.library.unsw.edu.au/>

### 3.5 Report Writing Guide

The School has a report writing guide (RWG) available. A copy of this is available on the course Moodle site.

## 4 COURSE CONTENT AND LEARNING ACTIVITIES

### 4.1 Course content

- 1) Casing types and casing physical properties
- 2) Casing performance under load conditions
- 3) Principles of casing design
- 4) Chemistry and characterization of Portland cement
- 5) Cement calculations and cement properties
- 6) Mud removal, cement – formation interaction and annular fluid migration
- 7) Cementing equipment and techniques
- 8) Cement job evaluation

### 4.2 Learning Activities Summary

UNSW Wk	Activity	Content
1	Distance delivery	<ul style="list-style-type: none"> <li>• Casing Notes Ch-1: Casing types</li> <li>• Casing Notes Ch-2: Casing physical properties</li> </ul>
2	Distance delivery	<ul style="list-style-type: none"> <li>• Casing Notes Ch-3: Performance Properties of Casing Under Load Conditions</li> </ul>
3	Distance delivery	<ul style="list-style-type: none"> <li>• Casing Notes Ch-3: Performance Properties of Casing Under Load Conditions</li> <li>• Casing Notes Ch-4: Principles of Casing Design</li> </ul>
4	Distance delivery	<ul style="list-style-type: none"> <li>• Casing Notes Ch-4: Principles of Casing Design</li> </ul>
5	Distance delivery	<ul style="list-style-type: none"> <li>• Casing Notes Ch-4: Principles of Casing Design</li> </ul>
6	<b>Midterm Break</b>	<b>Midterm Break</b>
7	Distance delivery	<ul style="list-style-type: none"> <li>• <b>Well Cementing</b> Ch-2: Chemistry and Characterization of Portland Cement</li> <li>• <b>Well Cementing</b> Appendix C: Cementing Calculations</li> <li>• <b>Well Cementing</b> Ch-4: Rheology and Flow of Well Cement Slurries</li> </ul>
9	Distance delivery	<ul style="list-style-type: none"> <li>• <b>Well Cementing</b> Ch-5: Mud removal</li> <li>• <b>Well Cementing</b> Ch-6: Cement – Formation Interactions</li> <li>• <b>Well Cementing</b> Ch-8: Mechanical Properties of Well Cements</li> <li>• <b>Well Cementing</b> Ch-9: Annular Formation Fluid Migration</li> </ul>
10	Distance delivery	<ul style="list-style-type: none"> <li>• <b>Well Cementing</b> Ch-11: Cementing Equipment and Casing Hardware</li> <li>• <b>Well Cementing</b> Ch-13: Primary Cementing Techniques</li> </ul>

Study Period 29 Apr – 1 May 2020

Exam Period 2 May – 16 May 2020

Other UNSW Key dates: <https://student.unsw.edu.au/new-calendar-dates>

## 5 COURSE ASSESSMENT

### 5.1 Assessment Summary

Assessment task	Due date / week	Weight	Assessment	Learning outcomes assessed
1	15 March	10%	<b>Assignment 1</b> Topic: casing properties and load calculation	1
2	12 April	15%	<b>Assignment 2</b> Topic: casing design	1
3	16 April	5%	<b>Online Quiz/Discussion</b>	1, 2, 3
4	28 April	10%	<b>Assignment 3</b> Topic: Cementing calculations	2, 3
6	2 May – 15 May	60%	<b>Final Exam</b>	1, 2, 3

Assignments related details/submission-box will be available online through Moodle. Access to the Moodle site is via the Moodle icon on the MyUNSW homepage.

## 6 ASSESSMENT CRITERIA

The assessment criteria provides a framework for you to assess your own work before formally submitting major assignments to your course convenor. Your course convenor will be using this framework to assess your work and as a way to assess whether you have met the listed learning outcomes and the graduate attributes for your program. We ask that you don't use the assessment criteria guidelines as a checklist, but as a tool to assess the quality of your work. Your course convenor will also be looking at the quality, creativity and the presentation of your written assignment as they review the framework. Rubrics, wherever applicable, will be provided at the time of the assignment release.

### 6.1 Assignments

The specifications and marking rubrics will be provided at the time of the assignment release.

### 6.2 Online Quizzes

Online quizzes will test the understanding of the material of the covered topics till date. General format of both the quizzes will be a combination of multiple-choice questions and short response questions required to be submitted in a pre-defined duration.

### 6.3 Final Exam

A two hours closed book exam will be hold within the exam period. Guidelines for helping the preparation for the final exam will be released prior to the exam.

## 7 STUDYING AN UG COURSE IN UNSW MINERALS AND ENERGY RESOURCES ENGINEERING

### 7.1 How We Contact You

At times, the School or your course convenors may need to contact you about your course or your



enrolment. Your course convenors will use the email function within Moodle or we will contact you on your @student.unsw.edu.au email address.

We understand that you may have an existing email account and would prefer for your UNSW emails to be redirected to your preferred account. Please see these instructions on how to redirect your UNSW emails: <https://www.it.unsw.edu.au/students/email/index.html>

## 7.2 How You Can Contact Us

We are always ready to assist you with your inquiries. To ensure your question is directed to the correct person, please use the email address below for:

Enrolment or other admin questions regarding your program:  
<https://unswinsight.microsoftcrmportals.com/web-forms/>

Course inquiries: these should be directed to the Course Convenor.

## 7.3 Computing Resources and Internet Access Requirements

UNSW Minerals and Energy Resources Engineering provides blended learning using the on-line Moodle LMS (Learning Management System).

It is essential that you have access to a PC or notebook computer. Mobile devices such as smart phones and tablets may compliment learning, but access to a PC or notebook computer is also required. Note that some specialist engineering software is not available for Mac computers.

Mining Engineering Students: OMB G48/49

Petroleum Engineering Students: TETB

It is recommended that you have regular internet access to participate in forum discussion and group work. To run Moodle most effectively, you should have:

- broadband connection (256 kbit/sec or faster)
- ability to view streaming video (high or low definition UNSW TV options)

More information about system requirements is available at [www.student.unsw.edu.au/moodle-system-requirements](http://www.student.unsw.edu.au/moodle-system-requirements)

## 7.4 Accessing Course Materials Through Moodle

Course outlines, support materials are uploaded to Moodle, the university standard Learning Management System (LMS). In addition, on-line assignment submissions are made using the assignment dropbox facility provided in Moodle. All enrolled students are automatically included in Moodle for each course. To access these documents and other course resources, please visit: [www.moodle.telt.unsw.edu.au](http://www.moodle.telt.unsw.edu.au)

## 7.5 Assignment Submissions

The School has developed a guideline to help you when submitting a course assignment.

We encourage you to retain a copy of every assignment submitted for assessment for your own record either in hardcopy or electronic form.

All assessments must have an assessment cover sheet attached.

## 7.6 Late Submission of an Assignment

Full marks for an assignment are only possible when an assignment is received by the due date.

We understand that at times you may not be able to submit an assignment on time, and the School will accommodate any fair and reasonable extension. We would recommend you review the UNSW Special Consideration guidelines – see following section.

Penalty marks will be applied at the following rate if submitted after the due date: five (5) percentile points of the maximum possible mark for each day.

For example, if a student submitted the Project Progress Report five days after the due date and the unadjusted mark was 68% then the final adjustment mark for the assignment would be 43%; that is the raw mark of 68% less 25 percentile points (5 days @ 5 percentile points per day).

## 7.7 Special Consideration

You can apply for special consideration through [UNSW Student Central](#) when illness or other circumstances interfere with your assessment performance. Sickness, misadventure or other circumstances beyond your control may:

- Prevent you from completing a course requirement,
- Keep you from attending an assessable activity,
- Stop you submitting assessable work for a course,
- Significantly affect your performance in assessable work, be it a formal end-of-semester examination, a class test, a laboratory test, a seminar presentation or any other form of assessment.

We ask that you please contact the Course Convenor immediately once you have completed the special consideration application, no later than one week from submission.

More details on special consideration can be found at: [www.student.unsw.edu.au/special-consideration](http://www.student.unsw.edu.au/special-consideration)

## 7.8 Course Results

For details on UNSW assessment policy, please visit: [www.student.unsw.edu.au/assessment](http://www.student.unsw.edu.au/assessment)

In some instances your final course result may be withheld and not released on the UNSW planned date. This is indicated by a course grade result of either:

- WD – which usually indicates you have not completed one or more items of assessment or there is an issue with one or more assignment; or
- WC – which indicates you have applied for Special Consideration due to illness or misadventure and the course results have not been finalised.

In either event it would be your responsibility to contact the Course Convener as soon as practicable but no later than five (5) days after release of the course result. If you don't contact the convener on time, you may be required to re-submit an assignment or re-sit the final exam and may result in you failing the course. You would also have a NC (course not completed) mark on your transcript and would need to re-enroll in the course.

## 7.9 Students Needing Additional Support

The Student Equity and Disabilities Unit (SEADU) aims to provide all students with support and professional advice when circumstances may prevent students from achieving a successful university education. Take a look at their webpage: [www.studentequity.unsw.edu.au/](http://www.studentequity.unsw.edu.au/)

## 7.10 Academic Honesty and Plagiarism

Your lecturer and the University will expect your submitted assignments are truly your own work. UNSW has very clear guidelines on what plagiarism is and how to avoid it. Plagiarism is using the words or ideas of others and presenting them as your own. Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. The University has adopted an educative approach to plagiarism and has developed a range of resources to support students. All the details on plagiarism, including some useful resources, can be found at [www.student.unsw.edu.au/plagiarism](http://www.student.unsw.edu.au/plagiarism).

All Mining Engineering students are required to complete a student declaration for academic integrity which is outlined in the assignment cover sheets. By signing this declaration, you agree that your work is your own original work.

If you need some additional support with your writing skills, please contact the Learning Centre or view some of the resources on their website: [www.lc.unsw.edu.au/](http://www.lc.unsw.edu.au/). The Learning Centre is designed to help you improve your academic writing and communication skills. Some students use the Centre services because they are finding their assignments a challenge, others because they want to improve an already successful academic performance.

## 7.11 Continual Course Improvement

At the end of each course, all students will have the opportunity to complete a course evaluation form. These anonymous surveys help us understand your views of the course, your lecturers and the course materials. We are continuously improving our courses based on student feedback, and your perspective is valuable.

Feedback is given via <https://student.unsw.edu.au/myexperience> and you will be notified when this is available for you to complete.

We also encourage all students to share any feedback they have any time during the course – if you have a concern, please contact us immediately.



# School of Minerals and Energy Resources Engineering Assessment Cover Sheet

Course Convenor: \_\_\_\_\_  
 Course Code: \_\_\_\_\_ Course Title: \_\_\_\_\_  
 Assignment: \_\_\_\_\_  
 Due Date: \_\_\_\_\_  
 Student Name: \_\_\_\_\_ Student ID: \_\_\_\_\_

## ACADEMIC REQUIREMENTS

Before submitting this assignment, the student is advised to review:

- the assessment requirements contained in the briefing document for the assignment;
- the various matters related to assessment in the relevant Course Outline; and
- the *Plagiarism and Academic Integrity* website at < <http://www.lc.unsw.edu.au/plagiarism/pintro.html> > to ensure they are familiar with the requirements to provide appropriate acknowledgement of source materials.

If after reviewing this material there is any doubt about assessment requirements, then in the first instance the student should consult with the Course Convenor and then if necessary with the Director – Undergraduate Studies.

While students are generally encouraged to work with other students to enhance learning, all assignments submitted for assessment must be their entire own work and duly acknowledge the use of other person's work or material. The student may be required to explain any or all parts of the assignment to the Course Convenor or other authorised persons. *Plagiarism* is using the work of others in whole or part without appropriate acknowledgement within the assignment in the required form. *Collusion* is where another person(s) assists in the preparation of a student's assignment without the consent or knowledge of the Course Convenor.

*Plagiarism* and *Collusion* are considered as Academic Misconduct and will be dealt with according to University Policy.

## STUDENT DECLARATION OF ACADEMIC INTEGRITY

I declare that:

- This assessment item is entirely my own original work, except where I have acknowledged use of source material [such as books, journal articles, other published material, the Internet, and the work of other student/s or any other person/s].
- This assessment item has not been submitted for assessment for academic credit in this, or any other course, at UNSW or elsewhere.

I understand that:

- The assessor of this assessment item may, for the purpose of assessing this item, reproduce this assessment item and provide a copy to another member of the University.
- The assessor may communicate a copy of this assessment item to a plagiarism checking service (which may then retain a copy of the assessment item on its database for the purpose of future plagiarism checking).

Student Signature: \_\_\_\_\_

Date: \_\_\_\_\_

**Students are advised to retain a copy of this assessment for their records and submission should be made in accordance to the assessment details available on the course Moodle site.**

## 9 STUDY GUIDELINE FOR CEMENTING

### 9.1 Textbook

Nelson, E.B. and Guillot D., *Well Cementing* (Second Edition), [Schlumberger](#), 2006.

#### 9.1.1 Chapter 2 Chemistry and Characterization of Portland Cement Required Readings

Reading Requirements (0.75 week):

- 2-1 Introduction, pp. 23;
- 2-2 Chemical notation, pp. 23;
- 2-3 Portland cement manufacture, pp. 23 – 30;
- 2-4 Hydration of the clinker phases, pp. 30 – 36;
- 2-5 Hydration of Portland cements – The multicomponent system, pp. 36 – 40;
- 2-7 Classification of Portland cements, pp. 44 – 48.

#### 9.1.2 Chapter 2 - Review Questions

1. What are the raw materials used for producing Portland cement clinker?
2. Describe the dry and wet processes of preparing the raw blends.
3. What are the names of the four crystalline compounds in the clinker? How do they contribute to the strength of set cement?
4. Name the five hydration stages of C3S.
5. What is the main purpose of adding gypsum to cement clinker?
6. What is flash set? How to prevent flash set?
7. How does temperature affect the hydration process of cement?
8. List the API designations of cement classes and types. Which class of cement can be used from 6,000 - 10,000 ft depth, under conditions of moderately high temperatures and pressures?

### 9.1.3 Chapter 3 Cement Additives and Mechanisms of Action Reading Requirements

Reading Requirements (0.75 weeks):

- 3-1 Introduction, pp. 49;
- 3-2 Variability of additive response, pp. 49 – 50;
- 3-3 Accelerators, pp. 50 – 54;
- 3-4 Retarders, pp. 54 – 58;
- 3-5 Extenders, pp. 58 – 69;
- 3-6 Weighting agents, pp. 69 – 71;
- 3-7 Dispersants, pp. 71 – 80;
- 3-8 Fluid-loss control agents, pp. 80 – 88;
- 3-9 Lost-circulation prevention agents, pp.88 – 89; 3-11 Summary, 90-91.

### 9.1.4 Chapter 3 - Review Questions:

1. List the main purposes of using additives in cement.
2. List the major categories of cement additives.
3. List the commonly used accelerators. Which one of those is the most widely used? What are the mechanisms of action?
4. List the commonly used retarders.
5. List the commonly used lightweight additives.
6. How would usage of high percentages of bentonite in cement affect the cement properties?
7. What are microspheres? What is the major limitation of microspheres?
8. What properties should a good weighting material have?
9. Describe functions of filtration controllers (low-fluid-loss additives).
10. What are the major problems during cementing which are caused by high fluid loss?
11. What are the common additives used to control lost circulation?
12. How does free water form from the cement slurry? How to prevent the free water?
13. What is slurry sedimentation? How does it affect the quality of set cement?

### 9.1.5 Appendix C Cementing Calculations

Reading Requirements (0.75 week):

- C-1 Introduction, pp. 659;
- C-2 Cement-slurry properties, pp. 659 – 664;
- C-3 Primary cementing calculations, pp. 664 – 668;
- C-4 Plug balancing, pp. 668 – 670;
- C-5 Squeeze cementing, pp. 670 – 672.

### 9.1.6 Review Questions:

1. Calculate the slurry density and yield, given:

Water content = 40 % (BWOC) One sack cement = 1 cu ft = 94 lb

Absolute volume of cement = 0.0380 gal/lbm

Density of water = 8.34 lb/gal

2. Given well and cementing data as follows:

3

**Well data:** Upper casing of 13 8'' (54.50 lb/ft) set to 2000 ft  
12¼'' open hole to TD at 5800 ft  
Mud weight 14.5 lb/gal

5

**Cementing data:** 9 8'' casing (36 lb/ft) to TD  
Float collar 42 ft above shoe  
Cement required to fill 350 ft into upper casing Slurry: Class G (35% excess) +  
0.8% CMHEC 25 bbl Spacer 1000 ahead of cement Displacement rate: 9 BPM  
Slurry yield = 1.14 cu ft/sk and mix water = 4.97 gal/sk

#### Calculate:

- (1) Total water required
- (2) Job time
- (3) Displacement time
- (4) Total time (assuming time to drop plug = 13 minutes)

3. Design a plug-balancing job with the following data:

- A 150-ft plug is required in an 8½'' open hole.
- The bottom of the plug is to be set at 5500 ft.
- The cement is a neat Class G.
- To spot the plug, a 4½'', 16.6 lb/ft drillpipe will be used and 5 bbl of water will be pumped ahead of the cement slurry.
- 25% excess cement is believed necessary to allow for hole enlargement

### 9.1.7 Chapter 4 Rheology and Flow of Well Cement Slurries Required Readings

Reading Requirements (0.5 weeks):

4-1 Introduction, pp. 93;

4-2 Basic rheological principles and calculations, pp. 93 – 104;

4-6 Friction pressure calculations for all flow regimes, pp. 130 – 141.

### 9.1.8 Chapter 4 - Review Questions:

1. List the reasons why an adequate rheological characterization of cement slurries is necessary?
2. Distinguish between plug flow, laminar flow and turbulent flow.
3. Define the following terms: rheology, rheological models and thixotropy.
4. Draw the rheograms for Newtonian, power-law and Bingham plastic models.
5. Write down the equation for the power-law model. Explain the major difference between a power-law fluid and a Newtonian fluid.
6. Define Bingham yield stress and plastic viscosity.
7. Sketch velocity profiles (i.e., plug, laminar and turbulent flows) for a non-Newtonian fluid in an annulus.
8. Assuming the flow regime remains laminar, what effect does lowering of 'n' of a power-law fluid has on its velocity profile?
9. Define Reynolds number and what is the critical Reynolds number where flow becomes turbulent?
10. What is the major effect of eccentricity on the velocity profile?
11. Derive an expression of average flow rate in pipe in field unit.
12. Derive an expression of average flow rate in annulus in field unit.



### 9.1.9 Chapter 5 Mud Removal Required Readings

Reading Requirements (0.5 weeks):

- 5-1 Introduction, pp. 143 – 145;
- 5-2 Well preparation, pp. 145 – 163;
- 5-3 Mud displacement, pp. 163 - 168; 174 – 183;
- 5-4 Drilling fluids, spacers and washes, pp. 183 – 186;
- 5-5 Cleaning-fluid sequence – current practices, pp. 187;
- 5-7 Qualitative recommendations, pp.188-189.

### 9.1.10 Chapter 5 - Review Questions:

1. What would be the optimum wellbore preparation for successful cementing?
2. What would be the ideal mud for the purposes of efficient displacement during primary cementing?
3. Why do you use centralizers when running casing?
4. What effect would the contamination of a cement slurry by mud have on the cement property?
5. What is “viscous fingering” effect in the mud displacement process? How to minimize this effect?
6. How would you improve mud displacement efficiency in eccentric annuli?
7. How do casing movements improve the quality of cement jobs?
8. Why should we use spacers and flushes (washes) in primary cementing?
9. What is the difference between spacers and flushes (washes)?

### 9.1.11 Chapter 6 Cement – Formation Interactions Required Readings

Reading Requirements (0.25 weeks):

6-1 Introduction, pp. 191;

6-2 Fluid loss, pp. 191 – 202;

6-3 Lost circulation, pp. 202 – 204.

### 9.1.12 Chapter 6 - Review Questions:

1. Define static filtration and dynamic filtration.
2. The equation (6-2) below is normally used in filtration tests, explain the meaning of each term in the equation.

$$V = A \sqrt{\frac{2k_{fc} \Delta p t}{\mu_{filt} \times K_{dep}}} \quad (6-2)$$

3. How does fluid loss affect the primary cementing job?
4. how to control fluid loss in primary cementing?
5. How to classify lost circulation?
6. How to control lost circulation during cementing?

### **9.1.13 Chapter 8 Mechanical Properties of Well Cements Required Readings**

Reading Requirements (0.25 weeks):

8-1 Introduction, pp. 269;

8-4 Mechanical behaviour of a cement cased wellbore, pp. 280 – 287; 8-5 Guidelines for cement design, pp. 287.

### **9.1.14 Chapter 8 - Review Questions:**

1. How does the change in wellbore pressure/temperature affect the cement cased wellbore?
2. How do tectonics, subsidence and formation creep affect the cement cased wellbore?
3. What are the general procedures for cement design?

### **9.1.15 Chapter 9 Annular Formation Fluid Migration Reading Requirements**

Reading Requirements (0.5 weeks):

9-1 Introduction, pp. 289;

9-2 Practical consequences of gas migration, pp. 289 – 290; 9-3 Physical process of gas migration, pp. 290 – 299;

9-6 Practical solutions for combating gas migration, pp.305 – 310.

### **9.1.16 Chapter 9 - Review Questions:**

1. What are the causes of short-term and long term gas migration?
2. What are the factors affecting gas migration?
3. How to prevent short term gas migration?
4. How to predict and combat gas migration?

### 9.1.17 Chapter 11 Cementing Equipment and Casing Hardware Reading Requirements

Reading Requirements (0.5 weeks):

11-1 Cementing materials, pp. 343 – 344;

11-2 Basic equipment, pp. 344 – 358;

11-3 Cementing units, pp. 359 – 362;

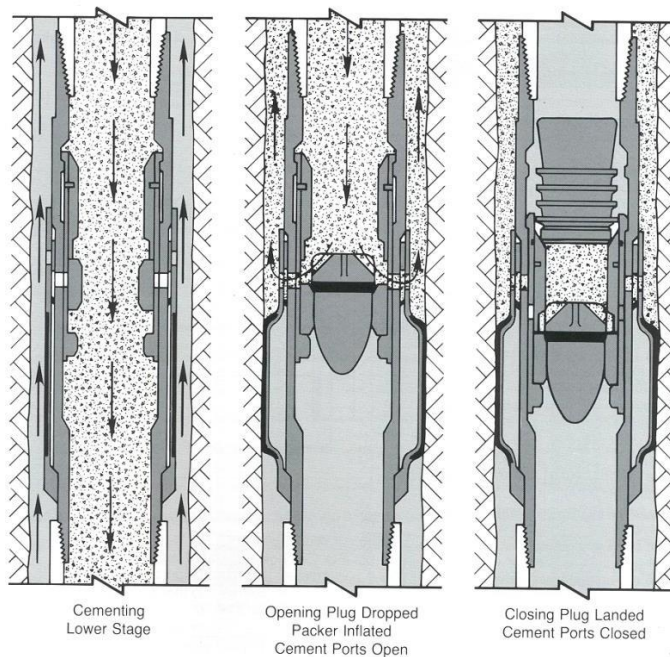
11-4 Introduction to casing hardware, pp.362; 11-5 Casing hardware, pp. 362 – 397;

11-6 Liners, pp. 397 – 419;

11-7 Remedial cementing tools, pp. 421 -429.

### 9.1.18 Chapter 11 - Review Questions:

1. How does a single-plug cement work?
2. When do you use stage collars for cementing?
3. What are the functions of wiper plug in cementing?
4. Draw schematics of four basic liner systems.
5. Use the figure shown below to explain how multiple-stage packer collar work.



### **9.1.19 Chapter 13 Primary Cementing Techniques Reading Requirements**

Reading Requirements (0.5 weeks):

- 13-1 Introduction, pp. 459;
- 13-2 Classification of casing strings, pp. 459 – 466;
- 13-3 Cement placement procedures, pp. 466 - 474;
- 13-4 Liners, pp. 475 – 484.
- 13-7 Operational considerations, pp. 495 – 500.

### **9.1.20 Chapter 13 - Review Questions:**

1. Describe the single-stage-cementing operations.
2. Describe the continuous two-stage cementing technique.
3. What are the common industry misconceptions about liner reciprocation and/or rotations?
4. When do we normally run tieback liners?
5. What are operational considerations that should be taken into account during the planning stage of primary cementing?

### **9.1.21 Chapter 14 Remedial Cementing Reading Requirements**

Reading Requirements (0.5 weeks):

14-1 Introduction, pp. 503;

14-2 Problem identification – Well problems cured by remedial cementing, pp. 505 -512;

14-3 Plug cementing – Tools and techniques, pp. 512 – 515;

14-4 Plug cementing – Placement, pp. 515 – 520;

14-5 Plug cementing – Cement –slurry design, pp. 520 – 521;

14-6 Cement –plug evaluation, pp. 521;

14-7 Squeeze cementing – Introduction, pp. 521;

14-9 Squeeze cementing tools and techniques, pp. 525 – 532;

14-13 Basic squeeze-job procedures, pp. 538 – 540.

14-14 Monitoring squeeze jobs, pp. 540;

14-15 Cleanup after a squeeze job, pp. 540 – 541;

14-16 Squeeze job evaluation, pp. 541 – 532;

14-17 Reasons for squeeze cementing failures, pp. 542 - 543.

### **9.1.22 Chapter 14 - Review Questions:**

1. What are the purposes of remedial cementing?
2. List the reasons of why or when squeeze cementing is necessary.
3. Describe the basic procedures of packer-squeeze technique.
4. List the reasons for setting cement plugs.
5. What are advantages and disadvantages of dump bailer method of setting plug?
6. In designing cement plugs, what are the key factors that need to be considered?
7. What are the most common causes of failure in plug setting operations? How to prevent them?

### **9.1.23 Chapter 15 Cement Job Evaluation Reading Requirements**

Required Readings (0.25 weeks):

15-1 Introduction, pp. 549;

15-2 Hydraulic testing, pp. 549 – 551;

15-3 Temperature, nuclear and noise-logging measurements, pp. 551 – 555;

15-4 Acoustic logging measurements, pp. 555; 561 - 565.

### **9.1.24 Chapter 15 - Review Questions:**

1. What is the purpose of pressure integrity test (PIT)?
2. Detail the procedures of pressure integrity test.
3. How to determine the cement top?
4. What are the principles of using acoustic logs for the evaluation of cement job?
5. Describe the basic structure of a CBL tool.
6. What does the CBL bond index stand for?