NTNU

MASTER OF SCIENCE IN ENGINEERING
MASTER OF SCIENCE IN NATURAL SCIENCES
MASTER OF PHILOSOPHY

DEGREE PROGRAMMES
2004 - 2005

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INTRODUCTION

This is a guide for students who are enrolled in one of the International Master's Degree Programmes at NTNU, and who are in the process of planning or completing their degree.
It contains complete and updated prospectuses for the degree programmes, with course descriptions for the individual International Master's Degrees.

As this catalogue is revised annually, only the latest edition is valid. This edition is valid until the end of the academic year 2004/2005.

Good luck with your studies,

Student and Academic Division
Office of International Relations

NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY (NTNU)

NTNU consists of 7 faculties. The University has over 18 000 students, and approximately 3 800 employees.

Although the University has a main profile in technological and the natural sciences it also has a full range of degrees in the social sciences, arts, humanities, medicine, and psychology. NTNU has a number of non-degree courses, such as those for practising musicians and teachers, as well as for artists in the visual arts.

NTNU is concerned with innovation and being a university where its students can meet the challenges of a new era. NTNU is concerned with interrelations at the macro- and micro-levels, and contributes to developing society that is in harmony with our natural resources in interplay with traditional and new knowledge.

GUIDE TO THE INTERNATIONAL MASTER´S DEGREE PROGRAMMES

TABLES
The tables show the courses in relation to the overall degree programme, number of lectures, credits, when the examination is held etc. The following gives a guide to the specific boxes:

Ex (Course year and time of examination)
This box states which course year and examination period this examination can be taken for the first time in each course. The examination period is marked a for the August examination, h for the autumn examination and v for the spring examination.

Course no.
The course number comprises 6 or 7 digits.

Course title
This box gives the course title in abbreviated form.

Note
This box includes any references to footnotes.

Weekly hours in summer, autumn and spring semesters
The boxes provide information about the weekly number of lessons each semester in each course and which semester the teaching is given.
These weekly hours are divided into:
F:Lecture hours per week
Ø:Exercise hours with instruction
S:Additional hours with self study

Cr (credits)
The credits give the weighting of each course in the degree programme.

Examination
The mark x shows whether the course has an examination or not.

DESCRIPTION OF COURSES FOR THE INTERNATIONAL MASTER´S DEGREE PROGRAMMES

The description of courses provides a survey of the topics covered in each course. This description also gives the following information:

Course title
The course titles in the course catalogue show:
Abbreviated course title (English)
Complete course title (English)
Complete course title (Norwegian)

Teacher(s)
This indicates the teacher(s) who is responsible for the teaching etc. and who is the contact person for students and others.

Weekly hours
This provides information about the weekly hours of each course per semester and the semester teaching is given in.

Time/venue
This provides information about when and where teaching will be given during the academic year.

Examination
This provides information about the examination date for the course in the academic year. (The examination date is only determined well in advance for courses that are also part of the Master i teknologi degree. Other courses will have the examination date decided after students have been registered for the examination.)

Examination support
Information about permitted examination support is given at each examination. The following codes are used:
A-All written and handwritten examination support materials are permitted.
All calculators* are permitted.

B-All written and handwritten examination support materials are permitted. Certain, specified calculator** is permitted.

C-Specified written and handwritten examination support materials are permitted. Certain, specified calculator** is permitted.

D-No written or handwritten examination support materials are permitted. Certain, specified calculator** is permitted.

Oral examination has code D unless stated otherwise.

* When "all calculators" are allowed, the following rules apply:
-No possibility of communication with other sources of data is allowed.
-Cannot be connected to mains electricity.
-Is not to make a noise.
-Is not to have any other equipment for reading data than a display.
-Is only to be one - 1 - unit.
-Is only to be pocket sized.
**"Certain, specified calculator" means a calculator with simple, numerical and trigonometrical functions such as +, -, sine, cosine etc. The type of calculator is to be easy for examination invigilators to recognize.
(The specified calculator is HP30S).

Exercises
This indicates if there are exercises in a course and whether the exercises are compulsory or voluntary. (More details about exercises are given in the Description of Courses). The following codes are used for exercises:
O -Compulsory exercises
F-Voluntary exercises
I-No exercises
Grades: All courses have grades based on the letter scale.

MSC PROGRAMME IN COASTAL AND MARINE CIVIL ENGINEERING

This Master of Science degree programme in Coastal and Marine Civil Engineering is an integrated, two year programme of study for Norwegian and international students. Thus the programme is designed according to the current framework for engineering graduate studies at NTNU.

Norwegian students can enrol in the entire MSc programme, or select individual courses from the programme in their study curriculum.

International students could be admitted through the Quota Programme, with participants from developing countries and from Central and Eastern Europe. Students with other sources of financing might also be admitted to the entire MSc programme.

Foreign exchange students can select individual courses from the programme, provided they have the necessary qualifications for the course.

The first year of the study consists of basic courses at graduate level. The second year provides a specialization in the following courses:

- Port Engineering
- Coastal Engineering
- Marine Civil Engineering
- Arctic Offshore Engineering
- Marine Geotechnics

In addition to the core engineering courses in the programme, the courses offered are included in two other Master´s degree programmes at NTNU:

- MSc in Urban Ecological Planning
- MPhil in Social Change

MSC PROGRAMME IN COASTAL AND MARINE CIVIL ENGINEERING
(MSCOASTMAR)

Term 1, 2, 3 and 4

Ex	Course no	Course title	Note	Autumn			Spring			Cr	Exam	Specialization				
				F	Ø	S	F	Ø	S			1	2	3	4	5
1h	TBA4265	MARINE PHYS ENV		3	2	7				7.5	x	o	o	o	o	o
1h	TBA4305	TRANSPORT SYSTEMS	1	3	3	6				7.5	x	v	v	v	v	v
1h	TBA5100	GEOTECH CALC METH		3	2	7				7.5	x	o	o	o	o	o
1h	TGB4235	SPREADING POLLUTION	1	3	2	7				7.5	x	v	v	v	v	v
1h	TKT5100	DUR/MAINT/REP CONCR		3	2	7				7.5	x	o	o	o	o	o
1v	-	EXP IN TEAM INT PROSJ						5	7	7.5	-	o	o	o	o	o
1v	TBA4115	GEOTECH STRUCTURES	2				3	3	6	7.5	x	v	v	v	v	o
1v	TBA4145	PORT/COAST FACILITY	2				3	2	7	7.5	x	v	o	v	v	v
1v	TBA4270	COASTAL ENGINEERING	2				3	2	7	7.5	x	o	v	v	v	v
1v	TBA4275	DYNAMIC RESPONSE	2				3	2	7	7.5	x	v	v	o	o	v
1v	TBA4310	TRANSPORT TECHNOLOGY					3	3	6	7.5	x	v	v	v	v	v
1v	AAR4230	PLAN IN DEV COUNTRY	3,4				3	1	8	7.5	x	v	v	v	-	v
		Total weighting compulsory course								37.5						
2h	TBA5700	COASTAL/MAR ENG SPEC	5			36				22.5	x	o	o	o	o	o
2h	-	ARCTIC OFFSHORE ENG	6							7.5	x	-	-	-	o	-
2h	GEOG3506	GEO HEALTH AND DEV	7	4	1	7				7.5	x	v	v	v	v	v
2h	AAR8300	RES METHODS FOR ARCH	7	2	3	7				7.5	-	v	v	v	v	v
2v		Master´s thesis	8							30.0						

o = Compulsory courses
v = Optional courses

Ex 1h = Term 1, Examination Autumn
Ex 1v = Term 2, Examination Spring
Ex 2h = Term 3, Examination Autumn
Ex 2v = Term 4, Master´s thesis Spring

1) Select one of the courses.
2) Select a minimum of two of the courses.
3) Select up to one course. Other available courses could be selected if approved by the Professor in charge.
4) Number of participants might be restricted.
5) Specialization project work (11.25 Credits) should preferably be taken in cooperation with partner institutions. For Arctic Offshore Engineering the project might be taken at UNIS, Svalbard. Select the theory part among the course offer in course TBA5700. Following approval by the Professor in charge, one of these might be replaced by another available theory part.
6) Course offer for students in Arctic Offshore Engineering taking the term at UNIS, Svalbard.
7) Select one course. Other available non-technical courses might be chosen provided approval by Professor in charge.
8) Master´s thesis should preferably be taken in cooperation with partner institutions. Students in Arctic Offshore Engineering might take the Master thesis at UNIS, Svalbard.

Specialization:
1 Coastal Engineering
2 Port Engineering
3 Marine Civil Engineering
4 Arctic Offshore Engineering
5 Marine Geotechnics

MSC PROGRAMME IN PETROLEUM ENGINEERING

Term 1, 2, 3 and 4

PETROLEUM ENGINEERING (MSG1)

Ex	Course no.	Course title	Note	Autumn F	Autumn Ø	Autumn S	Spring F	Spring Ø	Spring S	Cr	Exam	Specialization 1	2	3	4
1h	TPG4145	RESERVOIR FLUIDS		4	6	2				7.5	x	o	o	v	v
1h	TPG4150	RESERVOIR REC TECHN		4	4	4				7.5	x	o	o	o	o
1h	TPG4177	CARB RESERVOIR CHAR		4	2	6				7.5	x	v	v	v	v
1h	TPG4215	HIGH DEV DRILLING		4	1	7				7.5	x	v	v	o	v
1h	TPG5100	MATH/COMPUTER METHOD		2	8	2				7.5	-	o	o	o	o
1h	TPG5120	PETROPHYSICS BC	1	4	2	6				7.5	x	v	v	v	v
1v	TPG4160	RESERVOIR SIMULATION					4	4	4	7.5	x	o	v	v	v
1v	TPG4180	PETR PHYS INTERPR AC	1				4	2	6	7.5	x	v	v	v	o
1v	TPG4205	DRILL TECH PR CONTR					2	2	8	7.5	x	v	v	v	v
1v	TPG4220	DRILLING FLUID/HYDR					2	2	8	7.5	x	v	v	o	v
1v	TPG4225	FRACTURED RESERVOIR					3	2	7	7.5	x	v	v	v	v
1v	TPG4230	WELL TECHNOLOGY					3	2	7	7.5	x	o	o	o	o
1v	TPG5110	PETROLEUM ECONOMICS					3	2	7	7.5	x	v	v	v	v
		Total weighting compulsory courses	2							30.0/ 37.5					
2h	TPG4185	FORMATION MECHANICS		3	3	6				7.5	x	v	v	v	v
2h	TPG4700	FORM EV-ENG SPEC				36				22.5	x	-	-	-	o
2h	TPG4705	PETR PROD SPEC				36				22.5	x	-	o	-	-
2h	TPG4710	DRILLING SPEC				36				22.5	x	-	-	o	-
2h	TPG4715	RESERVOIR ENG SPEC				36				22.5	x	o	-	-	-
2h	TPG5200	PET ENG/GEO INT PROJ		1	3	8				7.5	-	v	v	v	v
		Total weighting compulsory courses	3							22.5					
2v		Master´s thesis								30					

o - compulsory courses
v - optional courses

Ex 1h = Term 1, Examination Autumn
Ex 1v = Term 2, Examination Spring
Ex 2h = Term 3, Examination Autumn
Ex 2V = Term 4, Master´s thesis Spring

1) TPG4180 requires TPG5120 or equivalent.
2) Two optional courses must be chosen in the autumn semester (1h) in specialization 4. In specialization 1, 2 and 3 one optional course must be chosen. Three optional courses must be chosen in the spring semester (1v) in specialization 2. Two courses must be chosen in specializations 1, 3 and 4.
3) One course must be chosen in the third semeser (2h). In addition to the course listed, students can also choose from first semester, Petroleum Engineering, Petroleum Geosciences ad PhD courses if taught in English.

Specialization:
1 Reservoir Engineering
2 Petroleum Production
3 Drilling Technology
4 Formation Evaluation

MSC PROGRAMME IN PETROLEUM GEOSCIENCES

Term 1, 2, 3 and 4

PETROLEUM GEOSCIENCES (MSG2)

Ex	Course no.	Course title	Note	Autumn F	Autumn Ø	Autumn S	Spring F	Spring Ø	Spring S	Cr	Exam
1h	TGB4160	PETROLEUM GEOLOGY		3	2	7				7.5	x
1h	TPG4150	RESERVOIR REC TECHN		4	4	4				7.5	x
1h	TPG4177	CARB RESERVOIR CHAR		4	2	6				7.5	x
1h	TPG4185	FORMATION MECHANICS		3	3	6				7.5	x
1h	TPG4195	GRAVIMETR MAGNETOMET		4	1	7				7.5	x
1h	TPG5100	MATH/COMPUTER METHOD		2	8	2				7.5	-
1h	TPG5120	PETROPHYSICS BC	1	4	2	6				7.5	x
1v	TGB4135	BASIN ANALYSIS					2	3	7	7.5	x
1v	TGB4170	DIAGENESIS/RES QUAL					2	2	8	7.5	x
1v	TPG4130	SEISMIC INTERPRET					2	3	7	7.5	x
1v	TPG4170	RESERVOIR SEISMICS					4	1	7	7.5	x
1v	TPG4180	PETR PHYS INTERPR AC	1				4	2	6	7.5	x
1v	TPG5110	PETROLEUM ECONOMICS					3	2	7	7.5	x
		Total weighting compulsory courses	2							15.0	
2h	TGB4715	PETR GEOLOGY SPEC				36				22.5	x
2h	TPG4120	ENG/ENVIRONM GEOPHYS		2	2	8				7.5	x
2h	TPG4190	SEISMIC DATA		3	2	7				7.5	x
2h	TPG4720	PETR GEOSCIENCE SPEC				36				22.5	x
2h	TPG5200	PET ENG/GEO INT PROJ		1	3	8				7.5	-
		Total weighting compulsory courses	3							30.0/ 22.5	
2v		Master´s thesis								30	

o - compulsory courses
v - optional courses

Ex 1h = Term 1, Examination Autumn
Ex 1v = Term 2, Examination Spring
Ex 2h = Term 3, Examination Autumn
Ex 2V = Term 4, Master´s thesis Spring

1) TPG4180 requires TPG5120 or equivalent.
2) In the autumn semester (1h) TPG5100 is compulsory. In the spring semester (1v) TPG4130 is compulsory. Totally four courses must be chosen each semester, see note 3.
3) In addition to the courses (listed 2h), students can choose from 1h Petroleum Engineering, 1h Petroleum Geosciences and PhD courses taught in English.
   Specialization and compulsory courses within these:
   Seismics: TGB4160 Petroleum Geology (1h), TPG4130 Seismic Interpretation (1v), TPG4170 Reservoir Seismics (1v) and TPG4190 Seismic Data (2h).
   Reservoir Geology: TPG4180 Petrophysics, Interpretation of Well Data AC (1v), TGB4160 Petroleum Geology (1h), TGB4170 Diagenesis/Res.Qual. (1v) and TPG4190 Seismic Data (2h).
   Formation Evaluation: TPG4180 Petrophysics, Interpretation of Well Data AC (1v), TPG4130 Seismic Interpretation (1v) and TPG4185 Formation Mechanics (1h).

MSC PROGRAMME IN HYDROPOWER DEVELOPMENT
(MSB1)

Term 1, 2, 3 and 4

Ex	Course no.	Course title	Note	Autumn F	Autumn Ø	Autumn S	Spring F	Spring Ø	Spring S	Cr	Exam
1h	TVM5100	HYDROPOWER PLAN 1 BC		8	8	8				15	x
1h	TVM5110	HYDROPOWER PLAN 2 BC		8	8	8				15	x
1v	TVM5120	HYDROPOWER PLAN 3 BC					8	8	8	15	x
1v	TVM5130	HYDROPOWER PROJECT						12	12	15	-
		Total weighting			48			48		60	
2h	TGB5100	ROCK ENGINEERING AC		3	2	7				7.5	x
2h	TVM5150	RIVER SYSTEM ANAL AC		3	2	7				7.5	x
2h	TVM5160	HEADWORKS AND SED AC		3	2	7				7.5	x
2h	TVM5170	SOCIAL IMPACT ASS AC		3	2	7				7.5	x
		Total weighting			48					30	
2v		Master´s thesis	1							30	

Ex 1h = Term 1, Examination Autumn
Ex 1v = Term 2, Examination Spring
Ex 2h = Term 3, Examination Autumn
Ex 2v = Term 4, Master´s thesis Spring

1) The Master´s thesis is to be submitted in term 4 (spring term).

MSC PROGRAMME IN LIGHT METALS PRODUCTION
(MSLIMETAL)

Term 1, 2, 3 and 4

Ex	Course no.	Course title	Note	Autumn F	Autumn Ø	Autumn S	Spring F	Spring Ø	Spring S	Cr	Exam
1h	TMT4155	HETEROGEN EQUILIBRIA		4	2	6				7.5	x
1h	TMT4185	MATR SCIENCE/ENG		4	2	6				7.5	x
1h	TMT5141	APPLIED THERMODYN		3	2	7				7.5	x
1h	MT8301	CARBON MAT TECHN		2	2	8				7.5	x
1v	TMT4150	REFRACTORIES					4	2	6	7.5	x
1v	TMT4160	HIGH TEMP CHEM PROJ					2	4	6	7.5	-
1v	TMT4235	REFIN/RECYCL METALS					3	2	7	7.5	x
1v	MT8300	ELECTR LIGHT METAL 2					3	2	7	7.5	x
		Total weighting								60.0	
2h	TMT4295	ELECTROLYTIC PROCESS		3	2	7				7.5	x
2h	TMT5730	PROC MET/ELECTR SPEC		2	26	8				22.5	x
		Total weighting								30.0	
2v		Master´s thesis								30.0	

Ex 1h = Term 1, Examination Autumn
Ex 1v = Term 2, Examination Spring
Ex 2h = Term 3, Examination Autumn
Ex 2v = Term 4, Master´s thesis Spring

MSC PROGRAMME IN MARINE TECHNOLOGY (MSN1)

Term 1 (May-July 2005)*
Term 2 and 3 (Autumn 2005 and Spring 2006)*
Term 4 (Autumn 2004 to February 2005)

MARINE STRUCTURES

Ex	Course no.	Course title	Note	Autumn F	Autumn Ø	Autumn S	Spring F	Spring Ø	Spring S	Cr	Exam
		Compulsory courses:									
1a	TMR5140	MARINE STRUCT BC		3	6	3				7.5	x
1a	TMR5150	MARINE DYNAMICS BC		3	6	3				7.5	x
1a	TMR5190	MARINE HYDRODYN BC		4	6	2				7.5	x
		Weighting compulsory courses		10	18	8				22.5	
		Compulsory courses:									
2h	TMR4190	ELEM METHODS STRUCT		3	6	3				7.5	x
2h	TMR4215	SEA LOADS		3	6	3				7.5	x
2h	TPG5100	MATH/COMPUTER METHOD	1	2	8	2				7.5	-
		Weighting compulsory courses		8	20	8				22.5	
		Optional courses:									
2h	TMR4200	FATIGUE/FRACTURE	2	3	6	3				7.5	x
2h	TMR4235	STOCH THEORY SEALOAD	2	3	6	3				7.5	x
2v	TMR4195	DESIGN OFFSHOR STRUC	3				3	6	3	7.5	x
2v	TMR4205	BUCKLING/COLLAPS STR	3				3	6	3	7.5	x
2v	TMR4220	NAVAL HYDRODYNAMICS	3				3	6	3	7.5	x
2v	TMR4225	MARINE OPERATIONS	3				3	6	3	7.5	x
2v	TMR4230	OCEANOGRAPHY	3				3	6	3	7.5	x
2v	TMR5160	MARIN STRUCT PROJECT	4						12	7.5	-
2v	TMR5200	MARINE HYDRO PROJECT	4						12	2.5	-
3h	TMR5170	MAR STRUC SPEC SUBJ	5	4	4	4				7.5	x
3h	TMR5220	MAR HYDRO SPEC SUBJ	5	4	4	4				7.5	x
3h		Master´s thesis								30.0	

Ex 1a = Term 1, Examination August
Ex 2h = Term 2, Examination Autumn
Ex 2v = Term 3, Examination Spring
Ex 3h = Term 3, Examination Autumn, the Master´s thesis is to be submitted in February 2005.

*) MSc PROGRAMME IN MARINE TECHNOLOGY is offered every second year. Next time starting in May 2005, with preliminary application deadline 1 December 2004 (www.marin.ntnu.no/msc). E-mail for information: mscadm@ivt.ntu.no. The programme may be course to change.

1) Exercises with examples from marine technology topics.
2) Select 1 of the courses.
3) Select 3 of the courses.
4) Select 1 of the courses.
5) Select 1 of the courses, so that the total weighting of the programme contains 120 credits (Cr.).

MSC PROGRAMME IN MARINE TECHNOLOGY (MSN1)

Term 1 (May-July 2005)*
Term 2 and 3 (Autumn 2005 and Spring 2006)*
Term 4 (Autumn 2004 to February 2005)

MARINE SYSTEMS ENGINEERING

Ex	Course no.	Course title	Note	Autumn F	Autumn Ø	Autumn S	Spring F	Spring Ø	Spring S	Cr	Exam
		Compulsory courses:									
1a	TMR5100	MAR DESIG/MAR ENG BC		4	6	2				7.5	x
1a	TMR5190	MARINE HYDRODYN BC		4	6	2				7.5	x
1a	TMR5270	OPERATION TECHN BC		3	6	3				7.5	x
		Weighting compulsory courses		11	18	7				22.5	
		Compulsory courses:									
2h	TMR4115	DESIGN METHODS		3	6	3				7.5	x
2h	TMR4290	DIESEL-EL PROP SYST		3	6	3				7.5	x
2h	TMR5120	DESIGN MAR VEHICLES			12					7.5	-
2v	TMR4130	RISK ANALYSIS SAFETY					2	8	2	7.5	-
2v	TMR4280	INTERNAL COMB ENGINE					3	6	3	7.5	x
		Weighting compulsory courses		6	24	6	5	14	5	37.5	
		Optional courses:									
2h	TMR4275	MOD/SIM/AN DYN SYST	2	3	6	3				7.5	x
2h	TPG5100	MATH/COMPUTER METHOD	1,2	2	8	2				7.5	-
2v	TMR4125	BUILD SHIPS/PLATFORM	3				3	3	6	7.5	x
2v	TMR4220	NAVAL HYDRODYNAMICS	3				3	6	3	7.5	x
2v	TMR5110	MAR DESIGN PROJECT	4					12		7.5	-
2v	TMR5280	MAR ENGINEER PROJECT	4					12		7.5	-
2v	TMR5290	TECH OPERAT PROJECT	4					12		7.5	-
3h	TMR5130	MAR DESIGN SPEC SUBJ	5	4	4	4				7.5	x
3h	TMR5300	MAR ENG SPEC SUBJ	5	4	4	4				7.5	x
3h	TMR5310	TECH OP SPEC SUBJ	5	4	4	4				7.5	x
3h		Master´s thesis								30.0	

Ex 1a = Term 1, Examination August
Ex 2h = Term 2, Examination Autumn
Ex 2v = Term 3, Examination Spring
Ex 3h = Term 3, Examination Autumn, the Master´s thesis is to be submitted in February 2005.

*) MSc PROGRAMME IN MARINE TECHNOLOGY is offered every second year. Next time starting in May 2005, with preliminary application deadline 1 December 2004 (www.marin.ntnu.no/msc). E-mail for information: mscadm@ivt.ntu.no. The programme may be course to change.

1) Exercises with examples from marine technology topics.
2) Select 1 of the courses.
3) Select 1 of the courses.
4) Select 1 of the courses.
5) Select 1 of the courses, so that the total weighting of the programme contains 120 credits (Cr.).

MSC PROGRAMME IN MARINE TECHNOLOGY (MSN1)

Term 1 (May-July 2005)*
Term 2 and 3 (Autumn 2005 and Spring 2006)*
Term 4 (Autumn 2004 to February 2005)

MARINE CONTROL SYSTEMS (No students 2003-2005)

Ex	Course no.	Course title	Note	Autumn F	Autumn Ø	Autumn S	Spring F	Spring Ø	Spring S	Cr	Exam
		Compulsory courses:									
1a	TMR5140	MARINE STRUCT BC	1	3	6	3				7.5	x
1a	TMR5150	MARINE DYNAMICS BC		3	6	3				7.5	x
1a	TMR5190	MARINE HYDRODYN BC		4	6	2				7.5	x
		Weighting compulsory courses		10	18	8				22.5	
		Compulsory courses:									
2h	TMR4215	SEA LOADS		3	6	3				7.5	x
2h	TMR5180	CONTROL ENGINEERING		3	6	3				7.5	x
2h	TMR4240	MARINE CONTROL SYST					3	6	3	7.5	x
2v	TTK4130	MODELLING/SIMULATION					4	4	4	7.5	x
2v	TTK4190	GUIDANCE AND CONTROL					3	2	7	7.5	x
		Weighting compulsory courses		6	12	6	10	12	14	37.5	
		Optional courses:									
2h	TMR4190	ELEM METHODS STRUCT	2	3	6	3				7.5	x
2h	TMR4275	MOD/SIM/AN DYN SYST	2	3	6	3				7.5	x
2h	TTK4150	NONLINEAR CONTR SYST	2	3	2	7				7.5	x
2h	TTT4140	FUND OF NAVIGATION	2	4	2	6				7.5	x
2v	TMR4220	NAVAL HYDRODYNAMICS	3				3	6	3	7.5	x
2v	TMR4225	MARINE OPERATIONS	3				3	6	3	7.5	x
2v	TMR4230	OCEANOGRAPHY	3				3	6	3	7.5	x
2v	TTT4150	NAVIGATION SYSTEMS	3				4	2	6	7.5	x
3h	TMR5210	CONTR SYST SPEC SUBJ	4	4	4	4				7.5	x
3h	TTK5100	GUID/NAV SYST SPEC	4	4	4	4				7.5	x
3h		Master´s thesis								30.0	

Ex 1a = Term 1, Examination August
Ex 2h = Term 2, Examination Autumn
Ex 2v = Term 3, Examination Spring
Ex 3h = Term 3, Examination Autumn, the Master´s thesis is to be submitted in February 2005.

*) MSc PROGRAMME IN MARINE TECHNOLOGY is offered every second year. Next time starting in May 2005, with preliminary application deadline 1 December 2004 (www.marin.ntnu.no/msc). E-mail for information: mscadm@ivt.ntu.no. The programme may be course to change.

1) Can be replaced by the course Calculus 4.
2) Select 2 of the courses.
3) Select 1 of the courses.
4) Select 1 of the courses, so that the total weighting of the programme contains 120 credits (Cr.).

MSC PROGRAMME IN MARINE TECHNOLOGY (MSN1)

Term 1 (May-July 2005)*
Term 2 and 3 (Autumn 2005 and Spring 2006)*
Term 4 (Autumn 2004 to February 2005)

NAUTICAL SCIENCE

Ex	Course no.	Course title	Note	Autumn F	Autumn Ø	Autumn S	Spring F	Spring Ø	Spring S	Cr	Exam
		Compulsory courses:									
1a	TMA5100	CALCULUS 4		4	2	6				7.5	x
1a	TMR5150	MARINE DYNAMICS BC		3	6	3				7.5	x
1a	TMR5190	MARINE HYDRODYN BC		4	6	2				7.5	x
		Weighting compulsory courses		11	14	11				22.5	
		Compulsory courses:									
2h	TMR4215	SEA LOADS		3	6	3				7.5	x
2h	TMR5230	NAUTICAL SCIENCE BC		3	6	3				7.5	x
2h	TTT4140	FUND OF NAVIGATION		4	2	6				7.5	x
2v	TMR5240	NAUTICAL SCIENCE AC					3	6	3	7.5	x
2v	TMR5250	NAUTICAL SC PROJECT						12		7.5	-
2v	TTT4150	NAVIGATION SYSTEMS					4	2	6	7.5	x
		Weighting compulsory courses		10	14	12	7	20	9	45.0	
		Optional courses:									
2h	TMR4235	STOCH THEORY SEALOAD	1	3	6	3				7.5	x
2h	TMR5180	CONTROL ENGINEERING	1	3	6	3				7.5	x
2v	TMR4130	RISK ANALYSIS SAFETY	2				2	8	2	7.5	-
2v	TMR4220	NAVAL HYDRODYNAMICS	2				3	6	3	7.5	x
2v	TMR4225	MARINE OPERATIONS	2				3	6	3	7.5	x
2v	TMR4230	OCEANOGRAPHY	2				3	6	3	7.5	x
2v	TMR4240	MARINE CONTROL SYST	2				3	6	3	7.5	x
2v	TTK4190	GUIDANCE AND CONTROL	2				3	2	7	7.5	x
3h	TMR5260	NAUTIC SC SPEC SUBJ	3	4	4	4				7.5	x
3h		Master´s thesis								30.0	

Ex 1a = Term 1, Examination August
Ex 2h = Term 2, Examination Autumn
Ex 2v = Term 3, Examination Spring
Ex 3h = Term 3, Examination Autumn, the Master´s thesis is to be submitted in February 2005.

*) MSc PROGRAMME IN MARINE TECHNOLOGY is offered every second year. Next time starting in May 2005, with preliminary application deadline 1 December 2004 (www.marin.ntnu.no/msc). E-mail for information: mscadm@ivt.ntu.no. The programme may be course to change.

1) Select 1 of the courses..
2) Select 1 of the courses.
3) The course must be chosen so that the total weighting of the programme contains 120 credits (Cr.).

COURSES DESCRIPTIONS OF THE MASTER OF SCIENCE DEGREES IN ENGINEERING

Department of Civil and Transport Engineering

TBA4115 GEOTECH STRUCTURES
Geotechnics, Structures
Geoteknikk, konstruksjoner

Lecturers: Professor Steinar Nordal, Professor Corneliu Athanasiu
Coordinator: Professor Steinar Nordal
Weekly hours: Spring: 3F + 3Ø + 6S = 7.5Cr
Time: Spring:

F	tu	15-17	B2		Ø	mo	17-19	-
F	th	14-15	B2					

Examination: May 26 09.00 Examination support: C Exercises: Compulsory Grade: Letter grade

Learning outcomes: The course should give the students basic knowledge and practical skills in use of computer programmes for use on geotechnical related problems. At the same time hand calculations should be carried out and compared with the numerical results.
Recommended previous knowledge: BSc in Civil Engineering or equivalent. The course is based on TBA4100 Geotechnics and Geology, TBA4105 Geotechnics Design Methods and TBA4110 Geotechnics Material Properties or equivalent. These courses are not necessary, but recommended.
Academic content: Finite element method. Numerical analysis of stability, settlements, groundwater flow, tunnels etc. Mostly the exercises will be based on the use of PLAXIS.
Teaching methods and activities: Lectures, hand calculation and by the use of PLAXIS.
Course material: Information at the start of the semester. Lecture notes.
Evaluation form: Oral 67% + exercises 33%.

TBA4145 PORT/COAST FACILITY
Port and Coastal Facilities
Kyst og havnefasiliteter

Lecturer: Professor Eivind Bratteland
Weekly hours: Spring: 3F + 2Ø + 7S = 7.5Cr
Time: Spring:

F	mo	13-14	MA24		Ø	fr	13-15	MA24
	tu	08-10	MA24					

Examination: June 1 09.00 Examination support: C Exercises: Compulsory Grade: Letter grade

Learning outcomes: To provide applicable knowledge and background for planning, design, construction and operation of marine facilities with focus on concepts and principles involved.
Recommended previous knowledge: TBA4265 Marine Physical Environment.
Academic content: Guidelines and principles in marine civil engineering. Approach navigation channels, ports and harbours. Terminal facilities. Marine structures in port and coastal engineering; quays, including moorings and fenders, breakwaters, coastal defence works. Dredging, handling and deposition of clean and polluted materials.
Teaching methods and activities: Lectures and exercises.
Course material: Textbook, lecture notes and selected papers.
Evaluation form: Written 100%.

TBA4265 MARINE PHYS ENV
Marine Physical Environment
Marint fysisk miljø

Lecturer: Professor Sveinung Løset, Førsteamanuensis Øivind Asgeir Arntsen
Coordinator: Professor Sveinung Løset
Weekly hours: Autumn: 3F + 2Ø + 7S = 7.5Cr
Time: Autumn:

F	mo	08-10	R71		Ø	we	10-12	R71
F	fr	13-14	R71					

Examination: Dec 1 09.00 Examination support: C Exercises: Compulsory Grade: Letter grade

Learning outcomes: Knowledge and skills dealing with action and action effects from environmental processes as wind, currents, waves and ice in a marine environment.
Recommended previous knowledge:BSc in Civil Engineering or similar. Basic course in Fluid Mechanics.

Academic content: Marine physical processes. Description of waves, currents, wind and formation and mechanics of ice. Resulting consequences for marine activities. Fundamentals of statistical methods used in physical marine environment and an introduction to spreading processes. Special note: For students from developing countries, the ice topics are replaced by topics of particular interest for these students.
Teaching methods and activities: Lectures and exercises.
Course material: Information at the start of the semester. Textbook and lecture notes.
Evaluation form: Written 100%.

TBA4270 COASTAL ENGINEERING
Coastal Engineering
Kystteknikk

Lecturer: Førsteamanuensis Øivind Asgeir Arntsen, Professor Eivind Bratteland
Coordinator: Førsteamanuensis Øivind Asgeir Arntsen
Weekly hours: Spring: 3F + 2Ø + 7S = 7.5Cr
Time: Spring:

F	mo	15-17	MA23	Ø	th	16-18	MA23
F	fr	10-11	MA23				

Examination: June 8 09.00 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: To provide insight to coastal zone management and understanding and description of processes caused by waves, tides, or currents in the coastal zone, givind the student a good background for planning and working in the coastal zone.
Recommended previous knowledge: TBA4265 Marine physical environment, or similar.
Academic content: Use of the coastal zone, planning, environment, rules and guidslines. Description of the coastal zone physical environment; wave transformation, currents, wind, sand transport, errosion and accretion, scour and scour protection.
Teaching methods and activities: Lectures and exercises.
Course material: Compendium, selected papers.
Evaluation form: Written 100%.

TBA4275 DYNAMIC RESPONSE
Dynamic Response to Irregular Loadings
Dynamisk respons på uregelmessige laster

Lecturers: Professor Geir Moe, Førsteamanuensis Øivind Asgeir Arntsen
Coordinator: Professor Geir Moe
Weekly hours: Spring: 3F + 2Ø + 7S = 7.5Cr
Time: Spring:

F	mo	13-14	MA22	Ø	th	10-12	MA22
F	fr	12-14	MA22				

Examination: May 23 15.00 Examination support: D Exercises: None Grade: Letter grade

Learning outcomes: To familiarize the students with state-of-the-art methods to describe the environmental loads and responses to these, displacements of structures.
Recommended previous knowledge: TBA4265 Marine physical environment and some knowledge of structural dynamics.
Academic content: Environmental loadings (wind, waves, earthquakes) will be modelled as irregular time series, and considered as input to a system the produces environmental forces as output, and then in the next step the environmental forces will be considered as input and structural displacements may be found as output. This is done by means of transfer functions, which determine variance spectra of the output. Vital quantities such as the average numbers of peaks on various levels, average frequencies and expected extremes will be estimated from these spectra .
Teaching methods and activities: Lectures and exercises.
Course material: Textbook, lecture notes and selected papers.
Evaluation form: Written 100%.

TBA4305 TRANSPORT SYSTEMS
Transport Systems
Transportsystemet
Lecturer: Professor Tore Øivin Sager
Weekly hours: Autumn: 3F + 3Ø + 6S = 7.5Cr
Time: Autumn:
F we 10-12 B2 Ø fr 09-11 B2
F fr 08-09 B2
Examination: Dec 6 09.00 Examination support: C Exercises: Compulsory Grade: Letter grade

Learning outcomes: To provide knowledge and understanding of the freight transport systems and developments and the related logistics in the integrated transport chain.
Recommended previous knowledge: None. The course is tought in English. Exercises and the final test can be answered in Norwegian.
Academic content: Infrastructure and markets for all freight transport modes are characterized from the perspectives of logistics and transport economics. Key elements are market development, transport policy, competitive interfaces, organization, and the needs and strategies of the actors responsible for commercial transport functions. Terminals and special features of road, rail, sea, and air transport systems as part of the general logistics and supply chain are considered. Cost-benefit analysis and other methods of transport economics are introduced.
Teaching methods and activities: Lectures, seminars, and exercises.
Course material: Textbook, lecture notes, and selected papers.
Evaluation form: Written 100%.

TBA4310 TRANSPORT TECHNOLOGY
Transport Technology
Transportteknologi
Lecturer: Amanuensis Bjørn Magne Høsøien
Weekly hours: Spring: 3F + 3Ø + 6S = 7.5Cr
Time: Spring:
F mo 08-10 R57 Ø th 12-14 R57
F th 11-12 R57
Examination: June 7 09.00 Examination support: C Exercises: Compulsory Grade: Letter grade

Learning outcomes: Give an introduction to the transport modes, their physical characteristics and technology related to various cargo units and standards, intermodal transports and terminals.
Recommended previous knowledge: None.
Academic content: The course takes a technological approach, detailing the physical characteristics for the transportation modes and the terminals. Relationship between technical production solutions and transport technology is covered. Unit loads, intermodal solutions and the function and structure of the terminals are central issues. In addition are included courses related to physical distribution, transport informatics, dangerous cargo and risk assessments. Introduction to the theoretical basis for cargo transport models will be given, as will be data- and development demands for these.
Teaching methods and activities: Lectures, group works, seminars and excercises. The course is taught in English.
Course material: Lecture notes.
Evaluation form: Written 100%.

TBA5100 GEOTECH CALC METH
Geotechnical Engineering, Calculation Methods
Geoteknikk, beregningsmetoder
Lecturer: Førsteamanuensis Arnfinn Emdal
Weekly hours: Autumn: 3F + 2Ø + 7S = 7.5Cr
Time: Autumn: As agreed
Examination: Not decided Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: The course is designed to develop basic skill in geotechnical design methods for slope stability, earth pressure, bearing capacity of foundations and piles as well as assessments of settlements and displacements.
Recommended previous knowledge:BSc degree in Civil Engineering or equivalent. Basic courses in geology and geotechnics.
Academic content: Relevant stress fields based on the theory of plasticity, basic elements and combinations. Principles and recipes for performing short-hand calculations of settlements, slope stability, earth pressure and

bearning capacity of foundations and piles. The course aims at creating basic understanding through classical analytic tools and hand calculations as well as demonstrations of real design cases.
Teaching methods and activities: Lectures, calculation and laboratory exercises and a minor project work.
Course material: Information at the start of the semester, lecture notes.
Evaluation form: Written 100%.

TBA5700 COASTAL/MAR ENG SPEC
Coastal and Marine Civil Engineering, Specialization
Marin byggteknikk, fordypning
Lecturer: Programme staff and external supervisors
Coord.: Professor Eivind Bratteland
Weekly hours: Autumn: 36S = 22.5Cr
Time: Autumn: As agreed
Examination: Nov 30 Examination support: D Exercises: None Grade: Letter grade

Learning outcomes: The specialization will give the student an in-depth theoretical knowledge and competence within a selected course area of the field. It will improve the student ability to do independent engineering/research work, and provide training in planning of projects, systematic processing of information and report writing.
Recommended previous knowledge: Passed examinations in the required basic courses necessary for the chosen specialization courses.
Academic content: The specialization in Coastal and Marine Civil Engineering is divided into 5 course areas: Coastal Engineering, Port Engineering, Marine Civil Engineering, Arctic Offshore Engineering and Marine Geotechnics. The specialization consists of a project equivalent to 11.25 Cr and normally three selected specialization courses listed below summing up to 11.25 Cr. For each course area one of the specialization courses is compulsory. The specialization courses are:
Coastal Engineering II (3,75Cr, compulsory for Coastal Engineering, (Professor Øivind A. Arntsen)
Port Engineering (3,75Cr, compulsory for Port Engineering, (Professor Eivind Bratteland)
Flow-Induced Vibrations (3,75Cr, compulsory for Marine Civil Engineering, (Professor Geir Moe)
Marine Geotechnics (3,75Cr, compulsory for Marine Geotechnics, (Professor Lars Grande)
Safety and Reliability (3,75Cr, (Professor Arvid Næss)
For Arctic offshore engineering there are two options:
1. Study at NTNU with the following course as compulsory: Structures in Ice-Infested Waters (3,75Cr, (Professor Sveinung Løset)
2. Study at UNIS, Svalbard with the following course as compulsory: Arctic Offshore Engineering (7.5Cr, (Professor Sveinung Løset).
Apart form the compulsory course given, the specialization normally requires at least one of the other courses listed to be included. The Professor in charge of the project work will inform about this. If the Professor in charge approves it, the student could choose one course given by others. The project work should include problems related to research and development within the chosen course areas. Whenever possible the project should be linked to local problems and challenges and preferably have a local supervisor. The project may comprise theoretical, numerical, experimental or field studies. If possible, fieldwork should be included. The specialization project will normally be a starting point for the thesis work in the spring term. The student can work individually or in a team.
Teaching methods and activities: Supervised project work. Depending on the number of participants the specialization courses may be lectured, given as seminars or taken as a self-study.
Course material: Lectures, selected texts from textbooks, papers etc.
Evaluation form: Project report and its oral presentation (50%) and oral examination in the specialization courses (50%).

Department of Mathematical Sciences

TMA5100 CALCULUS 4K
Calculus 4K
Matematikk 4K
Lecturer: NN
Weekly hours: Summer: 4F + 2Ø + 6S = 7.5Cr
Time: Summer: Not given in 2004/05
Examination: Not decided Examination support: C Exercises: Compulsory Grade: Letter grade

Learning outcomes: To introduce the students to the theory of functions of a complex variable and the theory of Fourier series and integral transforms, and to make the students able to use these techniques to solve ordinary and partial differential equations.

Recommended previous knowledge: Mathematical courses equivalent to 21 credits from engineering colleges or similar.
Academic content: Laplace transform and solving ordinary differential equations and integral equations. Fourier series, Fourier transform and solving partial differential equations, complex functions, complex integration, series expansions and residue calculus.
Teaching methods and activities: Lectures and exercises.
Course material: E. Kreyszig: Advanced Engineering Mathematics, 8th. ed., Wiley.
Evaluation form: Written 100%
Department of Geology and Mineral Resources Engineering

TGB4135 BASIN ANALYSIS
Basin Analysis
Bassenganalyse
Lecturer: Professor Stephen Lippard
Weekly hours: Spring: 2F + 3Ø + 7S = 7.5Cr
Time: Spring: As agreed
Examination: June 9 09.00 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: To give an overview of the formation and development of sedimentary basins.
Recommended previous knowledge: Knowledge equivalent to Structural Geology and Sedimentology and Stratigraphy.
Academic content: Classification of sedimentary basins according to tectonic environment; Mechanism of basin origin and controlling factors of sedimentary filling. Subsidence and thermal history of basins.
Teaching methods and activities: Exercises.
Course material: P.A. Allen & J.R. Allen: Basin Analysis, Principles and Applications, Blackwell Scientific Publications.
Evaluation form: Oral 100%.

TGB4160 PETROLEUM GEOLOGY
Petroleum Geology
Petroleumsgeologi
Lecturers: Professor Stephen Lippard, Professor Mai Britt Mørk, Førsteamanuensis Sverre Ola Johnsen
Coordinator: Førsteamanuensis Sverre Ola Johnsen
Weekly hours: Autumn: 3F + 2Ø + 7S = 7.5Cr
Time: Autumn:
F mo 12-14 G1 Ø tu 10-12 G21
F th 13-14 G1
Examination: Dec 6 09.00 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: The course aims at making the students comfortable with the processes leading to formation and accumulation of hydrocarbons in the earths crust, and to show how these processes can be modelled. Further, to give the students an overview of the geological development and geological conditions on the Norwegian continental shelf and in other important petroleum provinces.
Recommended previous knowledge: BSc in geosciences.
Academic content: Composition and classification of petroleum. Conditions controlling primary production and accumulation of organic matter to petroleum. Primary and secondary migration of petroleum. Porosity and permeability in rocks. The role of depositional environment as a controlling factor for reservoir rock quality. Classification and formation of petroleum traps. Basin types and their petroleum potential. Principles of basin analysis. The geological development of the Norwegian continental shelf. Examples of Norwegian oil and gas fields. Geological conditions in some selected petroleum provinces in other parts of the world. The exercises include construction of burial graphs, maturation calculations, construction and interpretation of structure maps, thin section microscopy of potential reservoir rocks and a comprehensive exercise where the petroleum potential within a given area should be evaluated.
Teaching methods and activities: Lectures and exercises.
Course material: J. Gluyas & R.E. Swarbrick: Petroleum Geoscience, Blackwell Publishing.
Evaluation form: Written 100%.

TGB4170 DIAGENESIS/RES QUAL
Diagenesis/Reservoir Quality
Diagenese/reservoarkvalitet

Lecturer: Professor Mai Britt Mørk
Weekly hours: Spring: 2F + 2Ø + 8S = 7.5Cr
Time: Spring:
F th 08-10 B3 Ø tu 12-14 B3
Examination: June 2 15.00 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: Processes determining reservoir rock quality like porosity, permeability, pressure and kerogenity.
Recommended previous knowledge: Knowledge equivalent to TGB4165 Sedimentology and Stratigraphy.
Academic content: Physical and chemical changes in deep burried sediments. Main emphasis is put on processes leading to preservation and destruction of porosity, and formation of secondary porosity in potential reservoir rocks for hydrocarbons. Silicates. Carbonates. Interpretation of "Cases".
Teaching methods and activities: Lectures and exercises.
Course material: Articles and compendium.
Evaluation form: Written 75% + midterm 25%.

TGB4235 SPREADING POLLUTION
Spreading of Pollution
Spredning av forurensning

Lecturer: Professor Sveinung Løset, Professor Knut Lyng Sandvik
Coordinator: Professor Knut Lyng Sandvik
Weekly hours: Autumn: 3F + 2Ø + 7S = 7.5Cr
Time: Autumn:
F tu 14-17 B3 Ø mo 16-18 B3
Examination: Dec 11 09.00 Examination support: C Exercises: Compulsory Grade: Letter grade

Learning outcomes: The course aims to give students an introduction to mechanisms for dispersion and transport of pollution in various recipients (water, soil and air).
Recommended previous knowledge: Elementary knowledge in hydro-dynamics and hydro-geology.
Academic content: Ocean dispersion: Tidal currents, air driven currents, coastal currents. An overview of principles for calculation of currents in oceans and coastal waters. Dispersion in the atmosphere: Geostrophic wind, vertical wind profile, topographic influence. Mixed processes: Spreading by shear, turbulent diffusion, density driven diffusion (in plumes). Statistical methods and modelling. Degradation processes (oil): Evaporation, emulsion formation, dispersion, solubility in water, biological and photo-chemical degradation. Airborne dust: Spreading and retention times.
Teaching methods and activities: Lectures/colloquiums, exercises and laboratory demonstrations.
Course material: Lecture notes and selected papers. To be announced at start of course.
Evaluation form: Written 100%.

TGB4715 PETR GEOLOGY SPEC
Petroleum Geology, Specialization
Petroleumsgeologi, fordypning

Lecturers: Professor Stephen Lippard, Professor Mai Britt Mørk, Professor II Atle Mørk, Førsteamanuensis Sverre Ola Johnsen
Coordinator: Førsteamanuensis Sverre Ola Johnsen
Weekly hours: Autumn: 36S = 22.5Cr
Time: As agreed
Examination: Nov 30 Examination support: D Exercises: None Grade: Letter grade

Learning outcomes: The specialization course aims to deepen knowledge in selected geological fields through project work combined with back up topics. In addition, the specialization course will form a preparation to the diploma work in that the student will become familiar with scientific working methodology.
Recommended previous knowledge: It is supposed that the student has completed a study which permits the selection of a specialization course in petroleum geology. The study can be in accordance with the requirements given in the study plan or exceptionally a study plan that is approved by the teacher.
Academic content: Petroleum geology includes the development and application of all geological methods and application of geophysical methods of significance for exploration of petroleum, mapping and description of the petroleum reservoir, as well as all measurements made in a well. Specialization can be carried out within:

Basin Modelling/Sedimentology/Structural Geology/Diagenesis/Reservoir Geology/Maturity and Migration of Petroleum.
The most relevant topics for specialization are:
Geoscientific field course on Svalbard (Tjåland)
Petroleum Geology – sedimentology (Johnsen)
Petroleum Geology – tectonics (Lippard)
Reservoir Geology/Diagenesis (Mørk)
Plate tectonics and basin formation (Torsvik)
Seismic imaging of sedimentary sequences, field course (Landrø/Johnsen)
Teaching methods and activities: The course is divided into two; project work equivalent to 15 stp and a course study equivalnt to 7.5 stp. Project topics should be chosen in cooperation with a teacher. The final grade is determined as a combination of the examination (1/3) and project work (2/3). .
Course material: Given at the start of the semester.
Evaluation form: Oral 33% + exercises (project work) 67%.

TGB5100 ROCK ENGINEERING AC
Rock Engineering, Advanced Course
Anvendt ingeniørgeologi, videregående kurs
Lecturer: Professor Einar Broch, Professor Bjørn Nilsen
Coordinator: Professor Einar Broch
Weekly hours: Autumn: 3F + 2Ø + 7S = 7.5Cr
Examination: Autumn 2004 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: The course is offered in English to the students in the second year in the MSc programme "Hydropower Development" or to Master i teknologi/siv.ing. students in the programme of study "teknisk geologi" and "bygg- og miljøteknikk". The course objective is extended applied knowledge in rock engineering
Recommended previous knowledge: The course assumes completion of the basic course TVM5100 Hydropower Planning 1 in the first year of the MSc programme or TGB4185 Engineering Geology, basic course
Academic content: Ocean dispersion: Tidal currents, air driven currents, coastal currents. An overview of principles for calculation of currents in oceans and coastal waters. Dispersion in the atmosphere: Geostrophic wind, vertical wind profile, topographic influence. Mixed processes: Spreading by shear, turbulent diffusion, density driven diffusion (in plumes). Statistical methods and modelling. Degradation processes (oil): Evaporation, emulsion formation, dispersion, solubility in water, biological and photo-chemical degradation. Airborne dust: Spreading and retention times.
Teaching methods and activities: Lectures, workshops, field studies, literature survey (English).
Course material: Bjørn Nilsen and Alf Thidemann: Rock Engineering, supplementary articles, cases, reports (English).
Evaluation form: Oral 100%.

Department of Structural Engineering

TKT5100 DUR/MAINT/REP CONCR
Durability, Maintenance and Repair of Concrete Structures
Bestandighet, vedlikehold og reparasjoner av betongkonstruksjoner
Lecturers: Professor Øystein Vennesland, Postdoktor Roar Myrdal
Coordinator: Professor Øystein Vennesland
Weekly hours: Autumn: 3F + 2Ø + 7S = 7.5Cr
Time: Autumn: As agreed
Examination: Not decided Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: To provide an understanding of degradation mechanism and general principles and methods for maintenance and repair.
Recommended previous knowledge:BSc degree in Civil Engineering or equivalent.
Academic content: A short description of the main construction materials and mechanisms of degradation - with special emphasis on degradation mechanisms of steel and concrete structures. Methods for structural assessment, both in field and in laboratory. Planning and execution of structural assessment. Maintenance and repair of steel and concrete structures, including electrochemical techniques.
Teaching methods and activities: Lectures, exercises and laboratory.
Course material: Textbook, lecture notes and selected papers.
Evaluation form: Written 100%.

Department of Marine Technology

TMR4115 DESIGN METHODS
Design Methods
Prosjekteringsmetoder
Lecturer: Professor Torbjørn Digernes
Weekly hours: Autumn: 3F + 6Ø + 3S = 7.5Cr
Time: Autumn: Not decided for 2005/06
Examination: Not decided Examination support: C Exercises: Compulsory Grade: Letter grade

Learning outcomes: Teach the students to use operation research and methods in designing ships and other marine systems with focus on functional conditions and modelling as tools in the design process.
Recommended previous knowledge: Course Marine Design and Marine Engineering, Basic course.
Academic content: Design process as conversion of users requirements to the system solution. Identification of the key problems in design. Design models and methods of modelling. Operation research. Linear programmeming.
Teaching methods and activities: Lectures and exercises.

Course material: Hiller & Liberman: Introduction to Operation Research.
Evaluation form: Written 60%, exercises 40%.

TMR4125 BUILD SHIPS/PLATFORM
Building of Ships and Platforms
Bygging av marine konstruksjoner
Lecturer: Professor II Chris M. Braathen
Weekly hours: Spring: 3F + 6Ø + 3S = 7.5Cr
Time: Spring: Not decided for 2005/06
Examination: Not decided Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: Provide the general knowledge which most of the marine engineering students ought to have about the building of ships and platforms.
Recommended previous knowledge: Course Marine Design and Marine Engineering, Basic course.
Academic content: Introduction to building of ships and platforms from the very first beginning of the building project to competition. Both management of the activities and the technical accomplishment are included.
Teaching methods and activities: Lectures and exercises.
Course material: Lecture notes.
Evaluation form: Written 50% + exercises 50%.

TMR4130 RISK ANALYSIS SAFETY
Risk Analysis and Safety Management of Maritime Transport
Risikoanalyse og sikkerhetsledelse i maritim transport
Lecturer: Professor Svein Kristiansen
Weekly hours: Spring: 2F + 8Ø + 2S = 7.5Cr
Time: Spring: Not decided for 2005/06
Examination: - Examination support: - Exercises: None Grade: Letter grade

Learning outcomes: Present the basic issues relating to the improvement of safety at sea. Give the theoretical and practical basis for risk analysis of maritime systems. Discuss central ideas on how safety can be improved through organization and management control.
Recommended previous knowledge: Course Marine Design and Machine Knowledge, Basic Course, or equivalent.
Academic content: The risk concept. What is an accident? Risk picture. Accident statistics. Preventive and ameliorating measures. Safety management - monitoring of the risk level. Risk objectives and data. Statistical analysis of safety oriented decision alternatives. Maritime traffic models. Probability of grounding and collision. Risk analysis methods: Hazard analysis, FTA, ETA, FMECA, HazOp. Formal safety assessment (FSA). Cost-benefit analysis of safety measures. Analysis and modelling of ship casualties. Cost-benefit analysis of controls. Analysis and modelling of ship accidents. Human reliability and error mechanisms. Catastrophe behaviour, evacuation and rescue. Training, drills and human-machine simulation. Regulation and official control of maritime safety. National and international control authorities. Safety and quality management. ISO standards. Auditing. Safety Case.
Teaching methods and activities: Lectures and 4 assignments.
Course material: S. Kristiansen: Risk analysis and safety management of maritime transport. Lecture notes.
Evaluation form: Exercises 100%.

TMR4190 ELEM METHODS STRUCT
Finite Element Methods in Structural Analysis
Elementmetoden anvendt i konstruksjonsanalyse
Lecturer: Professor Torgeir Moan
Weekly hours: Autumn: 3F + 6Ø + 3S = 7.5Cr
Time: Autumn: Not decided for 2005/06
Examination: Not decided Examination support: C Exercises: Compulsory Grade: Letter grade

Learning outcomes: The objective of the course is to provide an introduction in the theoretical basis of the finite element method and how the method can be used to model and analyse marine structures and how computational results can be evaluated.
Recommended previous knowledge: Course Marine Structures, BC and course Marine Hydrodynamics, BC or similar.
Academic content: Energy principles and their application in the derivation of stiffness and load properties of elements. Beam, membrane and plate elements as well as superelement and substructure techniques are covered. The application to typical components in marine structures and numerical problems associated with practical use of the method are discussed. Exercises covering theoretical issues as well as the practical use of computer programmes are given.
Teaching methods and activities: Lectures and compulsory exercises.
Course material: Various textbooks in English (further information in the first lecture).
Evaluation form: Written 70% + exercises 30%.

TMR4195 DESIGN OFFSHOR STRUC
Design of Offshore Structures
Havkonstruksjoner
Lecturer: Professor Torgeir Moan
Weekly hours: Spring: 3F + 6Ø + 3S = 7.5Cr
Time: Spring: Not decided for 2005/06
Examination: Not decided Examination support: C Exercises: Compulsory Grade: Letter grade

Learning outcomes: The objectives of the course are to give students instruction in the conceptual design of structures used in exploiting hydrocarbons and other resources offshore; as well as to determine scantlings and inspection plans for such structures.
Recommended previous knowledge: Course Marine Structures, BC or equivalent.
Academic content: Overview of structural concepts. Serviceability and safety requirements, especially accidental collapse limit state. Fabrication and installation requirements. Inspection planning. Review of loads, load effects and (system) strength analysis and dimensioning. Load carrying behaviour of alternative structural layouts. Use of steel, aluminium and other materials. Selection of system layout (hull, positioning and riser system). Service vessels.
Teaching methods and activities: Lectures, exercises. Some of the exercises count 40% in the grading.
Course material: Lecture notes, papers.
Evaluation form: Written 60% + exercises 40%.

TMR4200 FATIGUE/FRACTURE
Fatigue and Fracture of Marine Structures
Utmatting og brudd i marine konstruksjoner
Lecturer: Professor Stig Berge
Weekly hours: Autumn: 3F + 6Ø + 3S = 7.5Cr
Time: Autumn: Not decided for 2005/06
Examination: Not decided Examination support: C Exercises: Compulsory Grade: Letter grade

Learning outcomes: The students are to learn theory and methods for design to prevent fatigue and fracture of ships, platforms and other structures, methods for operation and maintenance of load carrying structures.
Recommended previous knowledge: Basic materials science and strength of materials.
Academic content: Linear elastic and elastic plastic fracture mechanics, materials characterization, methods for assessment of defects and cracks in structure, failure assessment diagram. Cyclic loading and fatigue of metals, fracture mechanics analysis of fatigue, cumulative damage, stress corrosion cracking, corrosion fatigue, design rules and practices. Materials for marine structures: Steel, aluminium, titanium, composite, polymer. Strength properties with emphasis on fracture mechanics properties. The course is directed towards marine structures. However, the theory and methods which are taught are used also for design of other types of dynamically loaded structures, like bridges, cranes, pressure vessels, pipelines, aircraft, rotating machinery.
Teaching methods and activities: Lectures, exercises, laboratory demonstrations. 70 % of the exercises must be completed for admission to the examination. The course is taught in English, and is a joint course for master i teknologi/siv.ing.students and MSc students. Midterm test will count 50% of the grade.

Course material: Compendia, exercises.
Evaluation form: Written 70% + midterm 30%.

TMR4205 BUCKLING/COLLAPS STR
Buckling and Collapse of Marine Structures in Steel and Aluminium
Knekking og sammenbrudd av marine konstruksjoner i stål og aluminium
Lecturer: Professor Jørgen Amdahl
Weekly hours: Spring: 3F + 6Ø + 3S = 7.5Cr
Time: Spring: Not decided for 2005/06
Examination: Not decided Examination support: C Exercises: Compulsory Grade: Letter grade

Learning outcomes: Give an understanding of the physical principles and basic theory of buckling and plastic collapse of structures. Provide methods for analysis and design of marine structures to prevent such failures.
Recommended previous knowledge: Basic knowledge in Mechanics (Statics and Strength of Materials), Materials Technology and Structural Analysis at BSc/BEng-level or similar.
Academic content: Design principles for limit state of ultimate collapse, codes and quidelines (Eurocode, API, Veritas ship rule, DnV RPC2011, Effect of initial distortions, welding residual stresses and "soft" (HAZ) zones on buckling capacity, Yield hinge theory and mechanisme analysis of beams and frames. Incremental plastic analysis. Bending moment axial force interaction stiffness matrix for beams with axial force computer programme (USFOS) for advanced buckling and collapse analysis of trussworks, frames and stiffened plates. Buckling of columns, beam-column and frames. Buckling of stiffened plates in steel and aluminium under uni-axial or multiple loads. Plate girders in post-critical range. Buckling of stiffened cylindrical shells.
Teaching methods and activities: Lectures, compulsory exercises, hand calculation, computer analysis, laboratory demonstrations.
Course material: Compendia, lecture notes and T.H. Søreide: Ultimate Load Analysis of Marine Structures, Tapir, 1981.
Evaluation form: Written 50%, exercises 25% + midterm 25%.

TMR4215 SEA LOADS
Sea Loads
Sjøbelastninger
Lecturer: Professor Odd Faltinsen
Weekly hours: Autumn: 3F + 6Ø + 3S = 7.5Cr
Time: Autumn: Not decided for 2005/06
Examination: Not decided Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: To generate physical understanding and to make use of simple methods for an early design stage, for marine operation planning or for checking practical computer results or model experiments.
Recommended previous knowledge: Course Marine Hydrodynamics, BC or similar.
Academic content: Motions, accelerations and wave loads on high-speed vessels. Mean and slowly varying motions of moored structures in waves, wind and current. Slamming.
Teaching methods and activities: Lectures and compulsory exercises.
Course material: O.M.Faltinsen: Sea Loads on Ships and Offshore Structures, Cambridge University Press, 1990.
Evaluation form: Written 75% + exercises 25%.

TMR4220 NAVAL HYDRODYNAMICS
Naval Hydrodynamics
Skipshydrodynamikk
Lecturer: Professor Knut Minsaas
Weekly hours: Spring: 3F + 6Ø + 3S = 7.5Cr
Time: Spring: Not decided for 2005/06
Examination: Not decided Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: To make the students familiar with procedures for calculations of resistance, propulsion and evalution of manoeuvring and steering ability of high speed craft and conventional ships. To make the students familiar with selection and design of proper propulsion and manoeuvring systems.
Recommended previous knowledge: Course Marine Hydrodynamics, BC or corresponding knowledge.
Academic content: Application of lifting line and lifting surface theory in the design of propulsors, rudders, foils etc. Application of theory and experimental methods in calculation of resistance and in calculation of hydrodynamical characteristics of waterjets, tunnel thrusters and rotatable thrusters. Propeller induced vibration and noise. Influence of fouling, wind and waves on resistance and propulsion. Horizontal stability and maneuverability characteristics of conventional ships.
Teaching methods and activities: Lectures and voluntary exercises.

Course material: Knut Minsaas: Compendium Naval Hydrodynamics.
Evaluation form: Oral 70% + midterm 30%.

TMR4225 MARINE OPERATIONS
Marine Operations
Marine operasjoner
Lecturer: Professor II Finn Gunnar Nielsen
Weekly hours: Spring: 3F + 6Ø + 3S = 7.5Cr
Time: Spring: Not decided for 2005/06
Examination: Not decided Examination support: C Exercises: Compulsory Grade: Letter grade

Learning outcomes: Provide insight into how marine operations are executed and how motions, loads and regularity of operations can be calculated. Emphasis is given to description of how waves and current influence the operations.
Recommended previous knowledge: Courses Marine Structures, BC and Stochastic Theory of Sealoads or similar.
Academic content: Marine- and subsea operations related to installation and operation of offshore oil and gas fields are operations, oil recovery and regularity will be towing of structures. Further, issues related to design and operations of subsea vehicles are discussed. Main focus is on dynamic and hydrodynamic problems. Methods for estimating loads and responses in waves and current are discussed.
Teaching methods and activities: Lectures and exercises.
Course material: F.G. Nielsen: Lecture Notes. Marine Operations 2002. T.E. Berg: Lecture Notes on Under Water Vehicles. O.M. Faltinsen: Sea Loads on Ships and Offshore Structures, Cambridge University Press.
Evaluation form: Written 70 % and excercises 30 %.

TMR4230 OCEANOGRAPHY
Oceanography
Oseanografi
Lecturer: Professor Dag Myrhaug
Weekly hours: Spring: 3F + 6Ø + 3S = 7.5Cr
Time: Spring: Not decided for 2005/06
Examination: Not decided Examination support: D Exercises: None Grade: Letter grade

Learning outcomes: The emphasis will be on the physical understanding of phenomena contributing to the interaction between the atmosphere and ocean, and which also contribute to the motions in the ocean.
Recommended previous knowledge: Course Marine Hydrodynamics.
Academic content: Properties of seawater. Conservation equations. Equations of motion. Coriolos effect. Geostrophic current. Inential current. Planetary boundary layer flow. Wind-induced current. Bottom currents. Circulation. Tides. Global and local wind description. Mean wind. Wind gust. Wave forecast. Surface waves. Wave refraction. Non-linear waves. Breaking waves. Wave-current interaction.
Teaching methods and activities: Lectures and exercises.
Course material: Myrhaug, D: Lecture notes on wind and waves. Mellor, G.B.: Introduction to Physical Oceanography, American Institute of Physics, 1996.
Evaluation form: Oral 70% + midterm 30%.

TMR4235 STOCH THEORY SEALOAD
Stochastic Theory of Sealoads
Sjøbelastningsstatistikk
Lecturer: Professor Dag Myrhaug
Weekly hours: Autumn: 3F + 6Ø + 3S = 7.5Cr
Time: Autumn: Not decided for 2005/06
Examination: Not decided Examination support: D Exercises: None Grade: Letter grade

Learning outcomes: The principles and methods which are used to describe stochastic processes will be explained. The emphasis will be on the applications to sealoads and motions of marine systems, and to make the students able to use such principles and methods.
Recommended previous knowledge: Basic knowledge in statistics on BSc/BEng-level. Courses Marine Hydrodynamics, BC and Marine Dynamics, BC.
Academic content: Transformation of random variables. Monte Carlo simulation. Probability distributions for response. Parameter-estimation. Extreme-value statistics. Stochastic processes. Auto- and cross-correlation functions. Spectra and cross-spectra. Differentiation of stochastic processes. Excitation-response of stochastic processes. Equivalent linearization. Response-statistics.
Teaching methods and activities: Lectures and exercises.

Course material: D.E. Newland: An introduction to random vibrations, spectral and wavelet analysis, 3rd edition, 1993. D. Myrhaug: Lecture notes. B. Leira: Probabilistic Modelling and Estimation, Lecture notes.
Evaluation form: Oral 70% + midterm 30%.

TMR4240 MARINE CONTROL SYST
Marine Control Systems
Marine reguleringssystemer
Lecturer: Professor Asgeir Sørensen
Weekly hours: Spring: 3F + 6Ø + 3S = 7.5Cr
Time: Spring: Not decided for 2005/06
Examination: Not decided Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: Marine control systems will give an introduction to design and development of control systems for positioning, marine automation and electrical power generation and distribution in diesel-electrical systems for ships and floating marine structures.
Recommended previous knowledge: Courses Control Engineeering and Electric Circuits, Control Engineering, or similar. It is recommended to study this course together with course Guidance Navigation and Control.
Academic content: Mathematical modelling, analysis and control of marine operations, ship motions, machinery systems and propulsion systems for ships and marine structures. This involves dynamically positioning, thruster assisted position mooring, marine auxiliary systems, loading systems, machinery systems, propellers, rudders and electrical power generation and distribution in diesel electrical systems. Typical application areas will be found in the fields of offshore oil and gas exploration and exploitation, shipping, and fishery and aquaculture. Introduction to design of linear SISO and multivariable (MIMO) control methods based on conventional ID control, LQG etc. will be emphasised. Furthermore, observers for state estimation such as Kalman filtering will also be presented. New research results from nonlinear control theory whereof nonlinear recursive Lyapunov analysis including adaptive methods will be treated. Industrial design principles for realization of stand-alone and integrated systems will also be discussed from a performance and safety point of view.
Teaching methods and activities: Lectures. Project (compulsory) will count 25% in the grading.
Course material: Lecture notes. Marine Cybernetics: Modelling and Control, 3rd. ed., Department of Marine Technology.
Evaluation form: Written 50%, exercises 30% + midterm 20%.

TMR4275 MOD/SIM/AN DYN SYST
Modelling, Simulation and Analysis of Dynamics Systems
Modellering, simulering og analyse av dynamiske system
Lecturer: Førsteamanuensis Eilif Pedersen
Weekly hours: Autumn: 3F + 6Ø + 3S = 7.5Cr
Time: Autumn: Not decided for 2005/06
Examination: Not decided Examination support: C Exercises: Compulsory Grade: Letter grade

Learning outcomes: Give the student knowledge of how to formulate mathematical models for quantitative analysis of physical systems, and how to carry out analysis of dynamic systems.
Recommended previous knowledge: Course Marine Design and Marine Engineering, Basic Course, or similar.
Academic content: Models in the basic tool for an engineer. All computations he/she performs are based on a model of the real world. All decisions he/she makes are based on a representation of the real world through some kind of model. This is a course about learning mathematical modelling of physical systems by using a graphical systematic and unified method. Based on a generalized set of variables, a set of basic elements is developed, which will be used for modelling of mechanical, hydraulic, thermal and electrical systems. The developed models will be state models, which are useful for numerical solution by computer. Extensive use of numerical analysis and simulation by computer will be performed on an number of different systems.
Teaching methods and activities: Lecture and compulsory exercises. (Calculation, data and laboratory exercises), midterm test and project carried out in groups.
Course material: Lecture notes.
Evaluation form: Written 50%, exercises 25% + midterm 25%.

TMR4280 INTERNAL COMB ENGINE
Internal Combustion Engines
Forbrenningsmotorer
Lecturer: Professor Harald Valland
Weekly hours: Spring: 3F + 6Ø + 3S = 7.5Cr
Time: Spring: Not decided for 2005/06
Examination: Not decided Examination support: D Exercises: Compulsory Grade: Letter grade
Midterm: C

Learning outcomes: Provide knowledge about characteristics of internal combustion engines, operation and emissions.
Recommended previous knowledge: Course Marine Design and Marine Engineering, Basic Course.
Academic content: Survey of heat engines and internal combustion engines. Characteristics of piston engines. Working cycles for Otto- and diesel engines: Combustion, rate of heat release and fuel supply. Gas exchange, turbocharging. Fuel requirements. Emission and emission control. Mechanical and thermal load on main engine components. Wear and maintenance.
Teaching methods and activities: Lectures and calculation exercises, project and laboratory exercises.
Course material: Lecture notes.
Evaluation form: Written 50%, exercises 25% + midterm 25%.

TMR4290 DIESEL-EL PROP SYST
Diesel-Electric Propulsion Systems
Dieselelektriske framdriftssystemer
Lecturer: Professor Lars Norum
Coord.: Professor Harald Valland
Weekly hours: Autumn: 3F + 6Ø + 3S = 7.5Cr
Time: Autumn: Not decided for 2005/06
Examination: Not decided Examination support: A Exercises: None Grade: Letter grade

Learning outcomes: Give the students an introduction to electrical engineering of importance for design and analysis of electrical systems on ships and platforms.
Recommended previous knowledge: Course Marine Design and Marine Engineering, Basic Course.
Academic content: Module 1: Introduction to electrical engineering: Characteristics of electrical systems, power generation, distribution and voltage levels on maritime systems, moment and power characteristics of electrical motors etc. Module 2: Electrical propulsion systems: Criteria for system design and optimal dimensioning of system and components, optimal operation. Introduction to basic methods for technical and economical analysis and evaluation of electrical systems. Safety requirements.
Teaching methods and activities: Lecture, exercises (calculation and data exercises) and midterm test.
Course material: Lecture notes.
Evaluation form: Written 70% + midterm 30%.

TMR5100 MAR DESIG/MAR ENG BC
Marine Design and Marine Engineering, Basic Course
Marin prosjektering og maskinerikunnskap
Lecturer: Professor Harald Valland and amanuensis Bjørn Sillerud
Coord.: Professor Harald Valland
Weekly hours: Summer: 4F + 6Ø + 2S = 7.5Cr
Time: Summer: Not decided
Examination: August 2005 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: Provide the basic knowledge in marine design and marine engineering which is necessary for studies in the MSc programme.
Recommended previous knowledge: Basic knowledge in Thermodynamics at BSc/BEng.-level.
Academic content: Hydrostatics and stability. System based design. Machinery propulsion and auxiliary systems.
Teaching methods and activities: Lectures and exercises.
Course material: Lecture notes.
Evaluation form: Written 100%.

TMR5110 MAR DESIGN PROJECT
Marine Design, Project
Marin prosjektering, prosjekt
Lecturer: Professor Torbjørn Digernes, Professor Anders Endal
Coord.: Professor Anders Endal
Weekly hours: Spring: 12Ø = 7.5Cr
Time: Spring: Not decided for 2005/06
Examination: - Examination support: - Exercises: None Grade: Letter grade

Learning outcomes: Introductory and preparatory studies for the thesis work within the area of marine design.
Recommended previous knowledge: Various courses within the area of marine system engineering, dependent of the topic of the thesis.
Academic content: Search study of relevant literature references, reporting of a state-of-art prestudy, including a work plan for the thesis work.
Teaching methods and activities: Supervised project.
Course material: Not decided.
Evaluation form: Exercises (Project report) 100%.

TMR5120 DESIGN MAR VEHICLES
Design of Marine Vehicles
Fartøyprosjektering
Lecturer: Professor Anders Endal
Weekly hours: Autumn: 12Ø = 7.5Cr
Time: Autumn: Not decided for 2005/06
Examination: - Examination support: - Exercises: None Grade: Letter grade

Learning outcomes: Provide practice in design of a complete marine vehicle, with subsystems.
Recommended previous knowledge: Course Marine Design and Marine Engineering, Basic course, and course Marine Hydrodynamics, Basic Course.
Academic content: Participate in and co-ordinate detailed design of a marine vehicle specified by the supervisor. The design should include drawings and specification of the complete vehicle as well as its subsystems.
Teaching methods and activities: The students are supposed to work in teams of 2-4 participants, with supervision in colloquim.
Course material: Specification of the vehicle and a programme for the design process.
Evaluation form: Exercises 100%.

TMR5130 MAR DESIGN SPEC SUBJ
Marine Design, Specialization Course
Marin prosjektering, spesialiseringsemne
Lecturer: Professor Anders Endal
Weekly hours: Autumn: 4F + 4Ø + 4S = 7.5Cr
Time: Autumn: As agreed
Examination: Dec 2004 Examination support: D Exercises: None Grade: Letter grade

Learning outcomes: Supporting topics within the area of the thesis work.
Recommended previous knowledge: Compulsory courses in the MSc programme in Marine Systems Engineering.
Academic content: Two topics selected from a list presented for the students in connection with the project work.
Teaching methods and activities: Lectures and voluntary exercises.
Course material: Lecture notes.
Evaluation form: Oral 100%.

TMR5140 MARINE STRUCT BC
Marine Structures, Basic Course
Marine konstruksjoner, grunnkurs
Lecturer: Professor Jørgen Amdahl
Weekly hours: Summer: 3F + 6Ø + 3S = 7.5Cr
Time: Not decided
Examination: August 2005 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: The course gives the students the basic knowledge in marine structures which is necessary for studies in the MSc programme in marine technology.

Recommended previous knowledge: Basic knowledge in statics and strength of materials at BSc/BEng-level or similar.
Academic content: The precourse deals with structural design and methods of analysis for ships and other types of marine structures. The following main topics are covered: Stress analysis of plates. Buckling of beams and plates. Stochastic analysis. Design and analysis of ships, semisubmersibles and compliant platforms. Design philosophy and criteria. Rules and regulations.
Teaching methods and activities: Lectures and compulsory exercises.
Course material: Lecture notes.
Evaluation form: Written 100%.

TMR5150 MARINE DYNAMICS BC
Marine Dynamics, Basic Course
Marin dynamikk, grunnkurs
Lecturer: Professor Carl Martin Larsen, Professor Bernt Leira
Coord.: Professor Bernt Leira
Weekly hours: Summer: 3F + 6Ø + 3S = 7.5Cr
Time: Not decided
Examination: August 2005 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: The principles and methods relevant to dynamic response of marine structures will be explained.
Recommended previous knowledge: Basic knowledge in dynamics at BSc/BEng-level or similar.
Academic content: One degree of freedom systems and modelling of continous systems using generalized co-ordinates. Eigenfrequency-calculation of beams using the differential equation energy method. Calculation of forced response in time and frequency domain modal superposition. Response in ship-hill and motion of typical floating structures e.g. floaters, and tension leg plattforms. Irregular waves and wave spectra, short-time and long-time statistics of waves. Transfer functions and response statistics. Separation of vertices. Anchor lines.
Teaching methods and activities: Lectures and exercises.
Course material: Lecture notes.
Evaluation form: Written 100%.

TMR5160 MARIN STRUCT PROJECT
Marine Structures, Project
Marin konstruksjonsteknikk, prosjekt
Lecturer: Professor Bernt Leira
Weekly hours: Spring: 12Ø = 7.5Cr
Time: Not decided for 2005/06
Examination: - Examination support: - Exercises: None Grade: Letter grade

Learning outcomes: Introductory and preparatory studies for thesis work within the area of marine structures.
Recommended previous knowledge: Various courses within the area of marine structures and marine hydrodynamics, dependent of the topic of the thesis.
Academic content: Literature search, study of relevant literature references, reporting of a state-of-art pre-study including a work plan for the thesis work.
Teaching methods and activities: Supervised project.
Course material: -
Evaluation form: Exercises (Pre-project report) 100%.

TMR5170 MAR STRUC SPEC SUBJ
Marine Structures, Specialization Course
Marin konstruksjonsteknikk, spesialiseringsemne
Lecturer: Professor Bernt Leira
Weekly hours: Autumn: 4F + 4Ø + 4S = 7.5Cr
Time: As agreed
Examination: Dec 2004 Examination support: D Exercises: None Grade: Letter grade

Learning outcomes: Supporting topics within the area of the thesis work.
Recommended previous knowledge: Compulsory courses in the MSc programme in Marine Structures.
Academic content: Two topics selected from a list presented for the students in connection with the project work.
Teaching methods and activities: Lectures and voluntary exercises.
Course material: Lecture notes.
Evaluation form: Oral 100%.

TMR5180 CONTROL ENGINEERING
Control Engineering and Linear System Theory
Reguleringsteknikk med lineær systemteori
Lecturer: NN
Weekly hours: Autumn: 3F + 6Ø + 3S = 7.5Cr
Time: Not decided for 2005/06
Examination: Not decided Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: Introduction to basics in control engineering.
Recommended previous knowledge: Mathematics: Laplace, Fourier.
Academic content: Linear system theory, frequency analysis, stability analysis, PID controller design, observer design based on Kalman filter, design of multivariable controllers like LQG, LTR, H^{inf} and H^2.
Teaching methods and activities: Lectures and compulsory exercises. Midterm test.
Course material: International textbook (tbd).
Evaluation form: Written 45%, exercises (project) 25% + midterm 30%.

TMR5190 MARINE HYDRODYN BC
Marine Hydrodynamics, Basic Course
Marin hydrodynamikk, grunnkurs
Lecturer: NN
Weekly hours: Summer: 4F + 6Ø + 2S = 7.5Cr
Time: Not decided
Examination: August 2005 Examination support: C Exercises: Compulsory Grade: Letter grade

Learning outcomes: Give the basic knowledge in marine hydrodynamics and ocean environment whichis necessaary for studies in the MSc programme in marine technology.
Recommended previous knowledge: Basic knowledge in fluid mechanics on BSc/BEng-level or similar.
Academic content: Review of important parts of fluid dynamics. Introduction to marine hydrodynamics. Potential flow. Linear waves. Wave induced forces on fixed and floating bodies. Motion of floating bodies.
Teaching methods and activities: Lectures and compulsory exercises.
Course material: Lecture notes.
Evaluation form: Oral 100%.

TMR5200 MARINE HYDRO PROJECT
Marine Hydrodynamics, Project
Marin hydrodynamikk, prosjekt
Lecturer: Professor Dag Myrhaug
Weekly hours: Spring: 12Ø = 7.5Cr
Time: Not decided for 2005/06
Examination: - Examination support: - Exercises: None Grade: Letter grade

Learning outcomes: Introductory and preparatory studies for thesis work within the area of marine hydrodynamics.
Recommended previous knowledge: Various courses within the area of marine hydrodynamics, dependent on the topic of the thesis.
Academic content: Studying necessary literature references and working out a plan of progress for the thesis work.
Teaching methods and activities: Supervised project.
Course material: -
Evaluation form: Exercises 100%.

TMR5210 CONTR SYST SPEC SUBJ
Marine Control Systems, Specialization Course
Marine reguleringssystemer, spesialiseringsemne
Lecturer: Professor Asgeir Sørensen
Weekly hours: Autumn: 4F + 4Ø + 4S = 7.5Cr
Time: As agreed
Examination: Dec 2004 Examination support: D Exercises: None Grade: Letter grade

Learning outcomes: Supporting topics within the area of the thesis work.
Recommended previous knowledge: Compulsory courses in the MSc programme in Marine Control Systems.
Academic content: Two topics selected from a list presented for the students in connection with the project work.
Teaching methods and activities: Lectures and voluntary exercises.
Course material: Lecture notes
Evaluation form: Oral 100%.

TMR5220 MAR HYDRO SPEC SUBJ
Marine Hydrodynamics, Specialization Course
Marin hydrodynamikk, spesialiseringsemne
Lecturer: Professor Dag Myrhaug
Weekly hours: Autumn: 4F + 4Ø + 4S = 7.5Cr
Time: As agreed
Examination: Dec 2004 Examination support: D Exercises: None Grade: Letter grade

Learning outcomes: Supporting topics within the area of the thesis work.
Recommended previous knowledge: Compulsory courses in the MSc programme in Marine Structures.
Academic content: Two topics selected from a list presented for the students in connection with the project work.
Teaching methods and activities: Lectures and voluntary exercises.
Course material: Lecture notes
Evaluation form: Oral 100%.

TMR5230 NAUTICAL SCIENCE BC
Nautical Science, Basic Course
Nautisk vitenskap, grunnkurs
Lecturer: Førsteamanuensis Egil Pedersen
Weekly hours: Autumn: 3F + 6Ø + 3S = 7.5Cr
Time: Not decided for 2005/06
Examination: Not decided Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: To provide a basic knowledge in maritime technology with emphasis on navigational safety at sea, operational efficiency of nautical operations and the importance of a link between developers and end-users of nautical systems.
Recommended previous knowledge: None.
Academic content: Dimensional analysis with nautical applications. Theory and applications of collision and grounding avoidance at sea. Shipboard weather routing. Astronomic navigation without dead reckoning or GMT. Basic quality control in marine navigation. Cable mechanics with nautical applications. Evaluation of various nautical operations (vessel transit, anchoring/mooring, marine geophysical exploration, minesweeping, cable laying, sub-sea etc.) and nautical systems (ARPA, DP, ENC/ECDIS, AIS, integrated positioning etc.).
Teaching methods and activities: Lectures and compulsory exercises. Case studies. A project exercise will count 1/3 in the grading. Ship handling simulator exercises to demonstrate and evaluate nautical operations and systems. (Simulator exercises to be carried out at the full-mission ship handling simulator center at Ålesund College).
Course material: Compendium, lecture notes, technical/scientific papers.
Evaluation form: Oral 70% + exercises (project) 30%.

TMR5240 NAUTICAL SCIENCE AC
Nautical Science, Advanced Course
Nautisk vitenskap, videregående kurs
Lecturer: Professor II Tor Einar Berg, Førsteamanuensis Egil Pedersen
Coord.: Professor II Tor Einar Berg
Weekly hours: Spring: 3F + 6Ø + 3S = 7.5Cr
Time: Not decided for 2005/06
Examination: Not decided Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: Utilize approximations and simplified methods for critical assessment of navigational safety at sea and evaluation of operational efficiency of nautical operations.
Recommended previous knowledge: MSN1585 Maritime Technology, Basic Course.
Academic content: Modelling and analysis of the plotting performance due to errors in the pointing targets in ARPA systems. Theory and applications of a radar plot and display technique for time-efficient and precise anti-collision assessment of multiple targets. Environmental stress model for evaluation of ship handling difficulty in restricted manoeuvring area and traffic congestion. Advanced collision and grounding avoidance system that emphasizes the human ability in processing critical information as supplied by radar, ECDIS and AIS. Advanced shipboard weather routing. Interaction effects in towed marine seismic multiple cable operations. Ship handling and manoeuvrability in open and restricted waters. Advanced position and quality control methods in offshore operations.
Teaching methods and activities: Lectures and compulsory exercises. Case studies. A project exercise will count 1/3 in the grading. PC based ship handling simulator training.
Course material: Compendium, lecture notes, technical/scientific papers.
Evaluation form: Oral 70% + exercises (project) 30%.

TMR5250 NAUTICAL SC PROJECT
Nautical Science, Project
Nautisk vitenskap, prosjekt
Lecturer: Professor II Tor Einar Berg, Førsteamanuensis Egil Pedersen
Coord.: Professor II Tor Einar Berg
Weekly hours: Spring: 12Ø = 7.5Cr
Time: Not decided for 2005/06
Examination: - Examination support: - Exercises: None Grade: Letter grade

Learning outcomes: Introductory and preparatory studies for thesis work within the area of maritime technology.
Recommended previous knowledge: Various courses within the area of maritime technology, dependent on the topic of the thesis.
Academic content: Studying necessary literature references and working out a plan of progress for the project work.
Teaching methods and activities: Supervised project.
Course material: Not decided.
Evaluation form: Exercises (project work) 100%.

TMR5260 NAUTIC SC SPEC SUBJ
Nautical Science, Specialization Course
Nautisk vitenskap, spesialiseringsemne
Lecturer: Professor II Tor Einar Berg
Weekly hours: Autumn: 4F + 4Ø + 4S = 7.5Cr
Time: As agreed
Examination: Dec 2004 Examination support: D Exercises: None Grade: Letter grade

Learning outcomes: Supporting topics within the area of the thesis work.
Recommended previous knowledge: Compulsory courses in the MSc programme in Nautical Science.
Academic content: Two topics selected from a list presented for the students in connection with the project work.
Teaching methods and activities: Lectures and voluntary exercises.
Course material: Lecture notes
Evaluation form: Oral 100%.

TMR5270 OPERATION TECHN BC
Operation Technology, Basic Course
Driftsteknikk, grunnkurs
Lecturer: Professor Magnus Rasmussen
Weekly hours: Summer: 3F + 6Ø + 3S = 7.5Cr
Time: As agreed
Examination: August 2005 Examination support: A Exercises: Compulsory Grade: Letter grade

Learning outcomes: Provide the basic knowledge in operation technology which is necessary for studies in the MSc programme.
Recommended previous knowledge: BSc/BEng in marine technology related areas or in mechanical engineering.
Academic content: Overview of organization and management systems. Failure- and degradation mechanisms and their effect on performance, cost, safety and environment. Methods for condition monitoring and inspection. The maintenance function. The concept for Reliability Centered Maintenance (RCM). Risk and safety analysis.
Teaching methods and activities: Lectures and project work.
Course material: Lecture notes.
Evaluation form: Written 60% + exercises (project) 40%.

TMR5280 MAR ENGINEER PROJECT
Marine Engineering, Project
Marint maskineri, prosjekt
Lecturer: Professor Harald Valland
Weekly hours: Spring: 12Ø = 7.5Cr
Time: Not decided for 2005/06
Examination: - Examination support: - Exercises: None Grade: Letter grade

Learning outcomes: Introductory and preparatory studies for the thesis work within the area of marine engineering.
Recommended previous knowledge: Various courses within the area of marine system engineering, dependent of the topic of the thesis.

Academic content: Search study of relevant literature references, reporting of a state-of-art prestudy, including a work plan for the thesis work.
Teaching methods and activities: Supervised project.
Course material: Not decided.
Evaluation form: Exercises (project report) 100%.

TMR5290 TECH OPERAT PROJECT
Technical Operations of Marine Systems, Project
Driftsteknikk, prosjekt
Lecturer: Professor Magnus Rasmussen
Weekly hours: Spring: 12Ø = 7.5Cr
Time: Not decided for 2005/06
Examination: - Examination support: - Exercises: None Grade: Letter grade

Learning outcomes: Introductory and preparatory studies for the thesis work within the area of technical operations of marine systems.
Recommended previous knowledge: Various courses within the area of marine system engineering, dependent of the topic of the thesis.
Academic content: Search study of relevant literature references, reporting of a state-of-art prestudy, including a work plan for the thesis work.
Teaching methods and activities: Supervised project.
Course material: Not decided.
Evaluation form: Exercises (project report) 100%.

TMR5300 MAR ENG SPEC SUBJ
Marine Engineering, Specialization Course
Marint maskineri, spesialiseringemne
Lecturer: Professor Harald Valland
Weekly hours: Autumn: 4F + 4Ø + 4S = 7.5Cr
Time: As agreed
Examination: Dec 2004 Examination support: D Exercises: None Grade: Letter grade

Learning outcomes: Supporting topics within the area of the thesis work.
Recommended previous knowledge: Compulsory courses in the MSc programme in Marine Systems Engineering.
Academic content: Two topics selected from a list presented for the students in connection with the project work.
Teaching methods and activities: Lectures and voluntary exercises.
Course material: Lecture notes
Evaluation form: Oral 100%.

TMR5310 TECH OP SPEC SUBJ
Technical Operations, Specialization Course
Driftsteknikk, spesialiseringemne
Lecturer: NN
Weekly hours: Autumn: 4F + 4Ø + 4S = 7.5Cr
Time: As agreed
Examination: Dec 2004 Examination support: D Exercises: None Grade: Letter grade

Learning outcomes: Supporting topics within the area of the thesis work.
Recommended previous knowledge: Compulsory courses in the MSc programme in Marine Systems Engineering.
Academic content: Two topics selected from a list presented for the students in connection with the project work.
Teaching methods and activities: Lectures and voluntary exercises.
Course material: Lecture notes
Evaluation form: Oral 100%.

Department of Materials Technology

TMT4150 REFRACTORIES
Refractories
Ildfaste materialer

Lecturer: Førsteamanuensis Kjell Wiik
Weekly hours: Spring: 4F + 2Ø + 6S = 7.5Cr
Time: Spring:

F	th	08-10	K23		Ø	tu	18-19	K23
F	fr	08-10	K23					

Examination: May 24 09.00 Examination support: C Exercises: Compulsory Grade: Letter grade

Learning outcomes: Establish a basic tool for the choice of refractory materials for a given process.
Recommended previous knowledge: Knowledge of chemical thermodynamics and phase diagrams are an advantage.
Academic content: Methods for manufacturing refractory bricks, refractory masses and carbon based materials. Thermal, and thermomechanical properties. Structure, chemical composition and mineral composition for the most common and important refractory materials. Thermal-insulating refractories. Chemical attack on refractory materials. Thermal shock resistance.
Teaching methods and activities: Lectures and written exercises. Final grade in the course is based on portfolio assessment. The portfolio includes written final examination (75%) and a project work (25%). The project work will be combined with an excursion.
The evaluation of the different parts is given in percentages while the final grade for the whole portfolio is given by a Letter grade. For examination in August a written final examination can be replaced by an oral examination.
Course material: "Refractories Handbook.", Published by The Technical Association of Refractories, Japan, (June 1998). Various articles and exercises.
Evaluation form: Written 75% + exercises 25%.

TMT4155 HETEROGEN EQUILIBRIA
Heterogeneous Equilibria and Phase Diagrams
Heterogene likevekter og fasediagram

Lecturer: Professor Tor Grande
Weekly hours: Autumn: 4F + 2Ø + 6S = 7.5Cr
Time: Autumn:

F	mo	12-14	R50		Ø	th	14-15	R50
F	we	08-10	R50					

Examination: Dec 16 09.00 Examination support: C Exercises: None Grade: Letter grade

Learning outcomes: The course aims to give the students an introduction to chemical thermodynamics applied on heterogeneous phase equilibria. The chemical systems in focus will be important high temperature systems relevant for metallurgy and material science and engineering. Thermodynamic models used for calculation of phase diagrams are also included.
Recommended previous knowledge: Knowledge in physical chemistry and chemical thermodynamics is an advantage.
Academic content: Gibbs Phase law applied to liquid/solid, gas/solid and solid/solid phase equilibria. Phase diagrams for 1, 2, 3 and multi component systems with emphasis on systems of relevance for important metallurgical systems and inorganic materials. Principles for thermodynamic solution models for condensed phases and the application of commercial thermodynamic computer programmes.
Teaching methods and activities: Lectures including written exercises, some which includes the use of commercial thermodynamic software. Voluntary examinations during the semester will be given.
Course material: Bergeron and Risbud: Intoduction to Phase Equilibria in Ceramics, American Ceramic Society, Columbus,Ohio 1984. Lecture notes and exercises.
Evaluation form: Written 100%.

TMT4160 HIGH TEMP CHEM PROJ
High Temperature Chemistry, Project Work
Høytemperaturkjemi, prosjektarbeid

Lecturer: Førsteamanuensis Dagfinn Bratland
Weekly hours: Spring: 2F + 4Ø + 6S = 7.5Cr
Time: Spring:

F	tu	12-14	R8		Ø	fr	15-17	R8

Examination: - Examination support: - Exercises: None Grade: Pass/Fail

Learning outcomes: The aim is to give the students a basic introduction to the experimental techniques in high temperature chemistry and related topics, including synthesis of inorganic materials.
Recommended previous knowledge: None.
Academic content: Measurement and control of temperature. Refractories in the laboratory. Laboratory furnaces. Vacuum technique, work in inert atmosphere. Synthesis of inorganic materials. Experimental work with ceramic materials. Thermal analysis, study of phase equilibria. X-ray diffraction. Electron microscopy and optical microscopy, microanalysis. FTIR spectroscopy.
Teaching methods and activities: The students are guided through a number of experimental methods and techniques, essential for the reasearch activites in the department. A 7-week assignment will be carried out by the students at the end of the semester.
Course material: In-house collection of description of the various techniques.
Evaluation form: Exercises 100 %.

TMT4185 MATR SCIENCE/ENG
Materials Science and Engineering
Materialteknologi
Lecturer: Førsteamanuensis Børre Børresen
Weekly hours: Autumn: 4F + 2Ø + 6S = 7.5Cr
Time: Autumn:

F	tu	10-12	R10		Ø	mo	08-09	R3
F	we	10-12	K5					

Examination: Dec 14 0900 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: The main objective with this course is to give a short introduction of the behaviour of various types of materials (metals, ceramics, polymers) and discuss this in terms of their fundamental physical/chemical properties. Mechanical strength, toughness and corrosion are some key issues.
Recommended previous knowledge: Basic knowledge in chemistry.
Academic content: Structures, defects and dislocations in solids. Transport properties (diffusion), mechanical properties (elasticity, deformation, strength), phase equilibria (phase diagrams), phase transformations, electrical properties. Basic principles of corrosion are discussed. Various materials are discussed, like iron/iron alloys, ceramics, polymers and composites.
Teaching methods and activities: Lectures and compulsory exercises.
Course material: William D. Callister Jr.: Materials Science and Engineering, An Introduction, 6th. ed., John Wiley and Sons Inc, 2002.
Evaluation form: Written 100%.

TMT4235 REFIN/RECYCL METALS
Refining and Recycling of Metals
Raffineringsmetallurgi og resirkulering
Lecturer: Professor Thorvald A. Engh
Weekly hours: Spring: 3F + 2Ø + 7S = 7.5Cr
Time: Spring:

F	we	08-09	B23		Ø	tu	11-13	B23
F	fr	09-11	B23					

Examination: June 9 0900 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: To provide a theoretical treatment of the field of treatment of molten metals, bridging extractive metallurgy and casting. To connect mechanical properties to the treatment of melts and emphasize the importance of recycling.
Recommended previous knowledge: Basic chemistry and mathematics.
Academic content: The course gives an overview of the origin of impurities and particles in primary and recycled metal and an overview of the dependence of mechanical properties on dissolved elements and inclusions. An introduction to basic thermodynamic, kinetic and technological aspects of metal refining is presented. Aluminium and magnesium recycling are treated. A survey of separation methods for recycled raw materials is given. An excursion to a relevant production facility is arranged.
Teaching methods and activities: Lectures, exercises and laboratory work. The laboratory work corresponds to 1 hour per week.
Course material: Engh, T. A., “Principles of Metal Refining”, Oxford University Press, 1992.
Evaluation form: Written 100%.

TMT4295 ELECTROLYTIC PROCESS
Electrolytic Processes
Elektrolyseprosesser
Lecturer: Professor Geir Martin Haarberg
Weekly hours: Autumn: 3F + 2Ø + 7S = 7.5Cr
Time: Autumn:
F mo 15-17 R4 Ø fr 14-16 R4
F th 15-16 R10
Examination: Dec 14 15.00 Examination support: D Exercises: None Grade: Letter grade

Learning outcomes: The contents of the course should give a basic understanding of the industrial electrolyses processes in Norway.
Recommended previous knowledge: TMT4250 "Electrochemistry, Basic Course" or equivalent knowledge.
Academic content: Basic theory and background for industrial electrolysis; including heat balance, cell design, electrode reactions, overvoltage and electrode materials. Comprehensive treatment of molten salts as electrolytes, including emf cells and metal solubility. Special treatment of industrial processes of importance for Norway;
- chlor-alkali and chlorate
- zinc
- nickel, copper, cobalt
- electroplating
- aluminium and magnesium
- refining of aluminium

Teaching methods and activities: Lectures and problem solving.
Course material: Lecture notes.
Evaluation form: Written 100%.

TMT5141 APPLIED THERMODYN
Applied Thermodynamics
Anvendt termodynamikk
Lecturer: Professor Terje Østvold
Weekly hours: Autumn: 3F + 2Ø + 7S = 7.5Cr
Time: Autumn: As agreed
Examination: Not decided Examination support: C Exercises: Compulsory Grade: Letter grade

Learning outcomes: (Not reported).
Recommended previous knowledge: (Not reported).
Academic content: Equations of state and thermodynamic data from equations of state. Stability, activity, fugacity. Calculation of phase equilibria (vapour - liquid, liquid - liquid, liquid - solid) based on ideal models for activity and fugacity coefficients. The phase law and its applications. Calculation of homogeneous and heterogeneous equilibria. Sources of thermodynamic data. Application of thermodynamic models and calculations.
Teaching methods and activities: Lectures and problem solving.
Course material: T. Østvold: Applied Thermodynamics I, Tapir 2001. D.R. Gaskell: Introduction to the Thermodynamics of Materials, 3rd.ed, Taylor and Francis, 1995.
Evaluation form: Written 50% +midterm 25% + midterm 25%.

TMT5730 PROC MET/ELECTR SPEC
Process Metallurgy and Electrolysis, Specialization
Prosessmetallurgi og elektrolyse, fordypningsemne
Coordinator: Professor Trygve Foosnæs
Lecturers: Scieentific Institute personnel
Weekly hours: Autumn: 2F + 26Ø + 8S = 22.5Cr
Time: Autumn: As agreed
Examination: Nov 30 09.00 Examination support: D Exercises: None Grade: Letter grade

Learning outcomes: To provide specialization in selected parts of the students field and to provide training in oral and written communication.
Recommended previous knowledge: The course is part of the programme for chemistry students with specialization in Inorganic Chemistry.
Academic content: Project work (15Cr) and a supporting course module (7.5Cr). The project work will in general be experimental but may also be of a more theoretical character. The project work will be part of the Section´s ongoing research work. Systematic work within a field is emphasized as well as work to acquire detailed knowledge through literature studies and practical work. Course modules are chosen from the following.
Thermodynamics of Molten Salts (7.5Cr)

Electrolysis of Light Metals (7.5Cr).
Possible course combinations depends on the students other choices. In principle courses may be chosen from other lines of specialization at the Faculty. The experimental/theoretical work is reported in a formal report which will be evaluated.
Teaching methods and activities: The project module is carried out under the supervision of one of the Professors at the Department. The teaching in the course module is lectures or colloquia, seminars and literature studies with active student participation. The project work weighs 2/3 in the final grade.
Industry Seminars: In order to supplement the theoretical courses with an update on current industrial methods and practices, Industry Seminars will be arranged. The seminars will be led by company specialists and also include excursions to reduction, cast house and carbon plants.
Course material: Selected parts of relevant textbooks and literature articles.
Evaluation form: Exercises (project work) 67% + oral 33%.

Department of Petroleum Engineering and Applied Geophysics

TPG4120 ENG/ENVIRONM GEOPHYS
Engineering and Environmental Geophysics
Ingeniør- og miljøgeofysikk

Lecturer: Professor Ole Bernt Lile
Weekly hours: Autumn: 2F + 2Ø + 8S = 7.5Cr
Time: Autumn:
F mo 12-14 B3 Ø tu 17-19 B3
Examination: Dec 18 09.00 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: Applications of geophysical methods for mapping the underground for technical purposes, groundwater, soil mechanical problems and for environmental purposes. Mapping overburden sediments, quality of rock, ground water, soil and water contamination, etc.
Recommended previous knowledge: Course TPG4100 Physics and Geophysics or corresponding basic course in Applied Geophysics.
Academic content: Electrical methods. Resistivity (RP). Profiling. Vertical electrical sounding (VES). EM methods (VLF). Radar (GPR). Refraction seismics. Reflection seismics. Nuclear/Proton magnetic resonance (NMR, PMR). Logging methods.
Teaching methods and activities: Project work (PBL). Interpretation of refraction seismics. Demonstration in field. Lectures. Exercises count for 60% of the final grade. The course will be held in English if international Master´s students attend.
Course material: John M. Reynolds: An Introduction to Applied and Environmental Geophysics, Wiley, or Telford, Geldart, Sheriff: Applied Geophysics, Cambridge. Course notes. NGU-reports.
Evaluation form: Oral 50% + exercises (project) 50%.

TPG4130 SEISMIC INTERPRET
Seismic Interpretation
Seismisk tolkning

Lecturer: Førsteamanuensis Egil Tjåland
Weekly hours: Spring: 2F + 3Ø + 7S = 7.5Cr
Time: Spring:
F tu 15-17 P2 Ø th 11-14 P2
Examination: June 8 09.00 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: The course will give an overview in advanced interpretation and modelling of reflection seismic data using state-of-the-art computer applications.
Recommended previous knowledge: Course TPG4125 Seismic waves is recommended.
Academic content: Interpretation of two and three dimensional data on graphical work station. Generation of seismic time contour maps. Depth conversion of seismic time map (both from stacked sections and time migrated sections). Inversion of seismic data after stack. Three dimensional seismic modelling using ray-tracing. Use of seismic modelling to plan seismic data acquisition.
Teaching methods and activities: Lectures and exercises on work station. Excercises count for 60% of the final grade. PBL. The lectures will be held in English if international Master´s students attend.
Course material: Compendia.
Evaluation form: Oral 50% + exercises 50%.

TPG4145 RESERVOIR FLUIDS
Reservoir Fluids and Flow
Reservoarfluider og strømning

Lecturer: Professor Curtis H. Whitson
Weekly hours: Autumn: 4F + 6Ø + 2S = 7.5Cr
Time: Autumn:

F	mo	08-10	P1		Ø	tu	12-13	P1
F	we	10-12	P1					

Examination: Dec 2 09.00 Examination support: C Exercises: Compulsory Grade: Letter grade

Learning outcomes: The topic will give a basic introduction of two main topics within reservoir engineering; reservoir fluids physical behavior and flow in wells.
Recommended previous knowledge: None.
Academic content: The PVT part describes reservoir fluid properties, hydrocarbon phase behavior, PVT labtests, and use of PVT data in reservoir calculations. The flow part of the course treats single-well behavior for steady state condition of gas and oil wells, as well as material balance calculation.
Teaching methods and activities: Lectures, exercises and project work. Exercises count for 50% of the final grade. Project work, PBL. Lectures are held in English. The examination can be changed from written to oral at the re-sit examinations (continuation examination).
Course material: Parts of Phase Behaviour SPE monograph (Whitson and Brule). Distributed notes and articles. E-notes on the internet.
Evaluation form: Written 50% + exercises 50%.

TPG4150 RESERVOIR REC TECHN
Reservoir Recovery Techniques
Reservoarutvinningsteknikk

Lecturer: Professor Jon Kleppe
Weekly hours: Autumn: 4F + 4Ø + 4S = 7.5Cr
Time: Autumn:

F	tu	08-10	P1		Ø	we	13-14	P1
	th	08-10	P1			3 hours as agreed		

Examination: Dec 15 09.00 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: The course aims at giving the students extensive knowledge of physical parameters, behavior, principles and methods related to recovery of oil and gas from reservoirs.
Recommended previous knowledge: Recommended background is passed TPG4110 Fluid Flow in Porous Media/Fluid Mechanics and TPG4115 Reservoir Properties, or similar.
Academic content: The course addresses internal and external energy sources for reservoir production, and analysis of their influence on recovery of oil and gas from the various types of reservoirs. Topics: Oil, gas and condensate reservoir systems; microscopic and macroscopic displacement efficiency; natural drive mechanisms; injection of water and gas; material balance analysis; flow equations; simplified recovery estimation methods.
Teaching methods and activities: Lectures, compulsory exercises and group project. Portfolio evaluation will be the basis for the grade, and includes final examination (60%) and exercises/group work (40%). Each element is %-based, while final grade is letter-based. The lectures are in English. Re-sit examinations may be oral.
Course material: Course material will be given at semester start.
Evaluation form: Written 60% + exercises 40%.

TPG4160 RESERVOIR SIMULATION
Reservoir Simulation
Reservoarsimulering

Lecturer: Professor Jon Kleppe
Weekly hours: Spring: 4F + 4Ø + 4S = 7.5Cr
Time: Spring:

F	tu	08-10	P1		Ø	th	14-15	P1
	fr	10-12	P1			3 hours as agreed		

Examination: June 4 09.00 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: The course aims at giving the students basic knowledge of numerical simulation of fluid flow in petroleum reservoirs.
Recommended previous knowledge: Recommended background is passed TPG41110 Fluid Flow in Porous Media/Fluid Mechanics, TPG4115 Reservoir Properties and TPG4160 Reservoir Recovery Techniques, or similar.
Academic content: The course partial differential equations for one-phase and multiphase flow in porous materials, and numerical methods for solving these. Topics: Summary of rock and fluid properties; derivation of PDE's;

numerical solution of PDE's using Finite differences; methods for solving linear and non-linear equations; discussion of different types of reservoir simulation methods; practical sides of reservoir simulation applications.
Teaching methods and activities: Lectures, compulsory exercises and group project. Portfolio evaluation will be the basis for the grade, and includes final examination (60%) and exercises/group work (40%). Each element is %-based, while final grade is letter-based. The lectures are in English. Re-sit examinations may be oral.
Course material: Course material will be given at semester start.
Evaluation form: Written 60% + exercises 40%.

TPG4170 RESERVOIR SEISMICS
Reservoir Seismics
Reservoarseismikk
Lecturer: Professor Bjørn Ursin, Professor Rune M. Holt
Coord: Professor Bjørn Ursin
Weekly hours:Spring: 4F + 1Ø + 7S = 7.5Cr
Time: Spring:
F tu 08-10 P2 Ø th 10-11 P2
fr 08-10 P2
Examination: June 10 09.00 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: The topic will give an understanding of seismic methods used in reservoir geology and reservoir techniques.
Recommended previous knowledge: Course TPG4125 Seismic Waves.
Academic content: P- and S-waves in isotropic and anisotropic rocks. Principles for the measurement of acoustic properties in the laboratory. Simple rock physics models, mainly based on the Biot-Gassmann poro-elastic theory and critical porosity. Observed and modelled relations between seismic velocities and porosity, lithology, fluid saturation and mechanical stress/pore pressure. Seismic amplitude as a function of offset (AVO) and angle (AVA). Inversion of seismic data. Reservoir monitoring using repeated seismic measurements. Ocean bottom seismics.
Teaching methods and activities: Lectures and exercises. The lectures will be held in English if international Master´s students attend. The examination can be changed from written to oral at the re-sit examinations (continuation examination).
Course material: Compendia and articles.
Evaluation form: Written 100%.

TPG4177 CARB RESERVOIR CHAR
Carbonate Reservoir Characterization
Karbonat reservoarkarakterisering
Lecturer: Amanuensis Helge Langeland, Professor Mai Britt Mørk
Coord.: Amanuensis Helge Langeland
Weekly hours:Autumn: 4F + 2Ø + 6S = 7.5Cr
Time: As agreed
Examination: Dec 1 09.00 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: Give an overview of basic terminology and concepts of carbonate rocks in order to understand the geology and carry out petrophysical interpretation of carbonate reservoirs.
Recommended previous knowledge: Basic knowledge of geology and petrophysics.
Academic content: Carbonate reservoirs are considered to be the most significant source of hydrocarbon production for this century. This course is offered to provide an introduction to carbonate reservoir evaluation through use of academic and industry source material. The following courses will be covered in the course: Basic terminology and concepts. Necessary terminology and concepts will be taught through lectures and self study assignments. This material will be focused to form a foundation for the reminder of the course. A variety of contrasting carbonate reservoirs will be used to demonstrate the importance of integrating subsurface geoscience disciplines in effective reservoir management. The integration of geology and integration will be stressed through lecture and self-study assignments. A review session will be provided to place the course into a wider context.
Teaching methods and activities: Practical case studies. Practical data sets will be provided for class and self study to teach the methods of "how to evaluate a carbonate reservoir". Assignments writing essays. Assignments and tests in the semester will cound 50% on the examination grade. If there is a re-sit examination, an oral examination may be given.
Course material: Relevant reference material will be provided during the course. A good basic background overview is found in: Schole, P., A. Bebout, D.G, and Moore, C.H., eds: Carbonate depositional environments. American Association of Petroleum Geologists, Memoir 33.
Evaluation form: Written 50% + exercises 50%.

TPG4180 PETR PHYS INTERPR AC
Petrophysics, Interpretation of Well Data, Advanced Course
Petrofysikk, tolking av brønndata, videregående kurs

Lecturer: Amanuensis Helge Langeland, Professor Rune M. Holt, Professor II Terje Eidesmo
Professor Ole Bernt Lile
Coord.: Amanuensis Helge Langeland
Weekly hours: Spring: 4F + 2Ø + 6S = 7.5Cr
Time: Spring:

F	mo	15-17	P1		Ø	fr	13-15	P2
	fr	12-13	P2					

1 hour as agreed
Examination: May 24 09.00 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: Give a deeper understanding of data from boreholes, measurement methods used in boreholes, the information potential of these data and use in integrated evaluation of reservoirs.
Recommended previous knowledge: The course builds on course TPG4175 Petrophysics BC, TPG5120 Petrophysics BC or similar knowledge.
Academic content: The course focuses on selected topics from well data acquisition methods and the interpretation of these data, extending the concepts taught in the basic course in petrophysics. There will be project exercises connected to the Gullfaks database. Integration with other data types. Basic petrophysical relations and points of view. Radiometric methods in open and cased boreholes: Spectrometry - natural and induced, neutron lifetime logging (saturation behind cases), mud logging. Nuclear magnetic resonance, NMR. Properties of clay and shale. Water saturation models in shaly formations. Uses of core data. Pressure measurements. Acoustic and mechanical rock properties. Properties of carbonates.
Teaching methods and activities: Lectures, compulsory exercises, well data analysis software laboratory. Project based learning methods (PBL) and group work is used. The course is given in English when international students are attending. Semester tests will count 25% on the examination grade. At re-sit examination, an oral examination may replace written examination.
Course material: Articles, lecture notes and other relevant literature.
Evaluation form: Written 75% + midterm 25%.

TPG4185 FORMATION MECHANICS
Formation Mechanics
Formasjonsmekanikk

Lecturer: Professor Rune M. Holt
Weekly hours: Autumn: 3F + 3Ø + 6S = 7.5Cr
Time: Autumn:

F	mo	11-12	P2		Ø	fr	13-15	P2
	we	08-10	P2				1 hour as agreed	

Examination: Dec 18 09.00 Examination support: B Exercises: Compulsory Grade: Letter grade

Learning outcomes: The topic will give a deeper understanding and an introduction to application of rock mechanics in petroleum recovery, withing reservoir engineering, drilling and production.
Recommended previous knowledge: Basis in mechanics.
Academic content: Reservoir geomechanics; Introduction to poroelasticity theory. Reservoir compaction, linear elastic model and inelastic effects. Surface subsidence. Stress evolution during production. Compaction as a drive mechanism. Stress effects on porosity and permeability. Coupled reservoir simulation. Reservoir monitoring. Borehole stability: Diagnostics. Critical mud weight limits to prevent hole collapse and mud losses. Effects of temperature and mud composition on borehole stability. Stability of deviated and horizontal holes. Effects of plasticity. Modelling of borehole stability.
Sand and particle production: Basic mechanisms. Sand control. Sand predition. Volumetric sand production. Hydraulic fracturing: Initiation and growth of hydraulic fractures. Thermal fracturing during water injection. Use of fracturing during simulation, for stress determination, and for waste storage.
Teaching methods and activities: Lectures and exercises. PBL. Students will accomplish a semester project and present the results oral and in writing. This work counts for 25% of the final grade. The lectures are held in English if international Master´s students attend. Re-sit examinations may be oral.
Course material: Will be given at semester start.
Evaluation form: Written 75% + exercises 25%.

TPG4190 SEISMIC DATA
Seismic Data Acquisition and Processing
Seismisk datainnsamling og prosessering
Lecturer: Professor Martin Landrø
Weekly hours: Autumn: 3F + 2Ø + 7S = 7.5Cr
Time: Autumn:
F th 08-11 P2 Ø we 10-12 P2
Examination: Dec 15 09.00 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: The course gives an introduction to how huge amounts of seismic data are handled and processed. **Recommended previous knowledge:** Courses TPG4125 Seismic Waves and TPG4165 Geophysical Signal Analysis.
Academic content: Seismic data acquisition. Seismic sources and receivers. Seismic arrays. Spatial sampling. Deconvolution. Velocity analysis and stacking. Traveltime equations. Two-dimensional filtering. Dip moveout. Wave equation migration. 3D seismic and VSP.
Teaching methods and activities: Lectures. Exercises in datalab. Lessons are based on the project, where the project consists of processing a seismic data set. The project work counts for 40% of the final grade. The lectures are held in English if international Master´s students attend.
Course material: Ö. Yilmaz: Seismic data processing, SEG, Tulsa. Compendia.
Evaluation form: Written 60% + exercises 40%.

TPG4195 GRAVIMETR MAGNETOMET
Gravimetry and Magnetometry
Gravimetri og magnetometri
Lecturer: Professor II Jan Reidar Skilbrei
Weekly hours: Autumn: 4F + 1Ø + 7S = 7.5Cr
Time: Autumn: As agreed
Examination: Dec 14 09.00 Examination support: C Exercises: Compulsory Grade: Letter grade

Learning outcomes: The topic will give knowledge on modern techniques for processing and interpretation of gravimetric and magnetic data. Exercises include calculations, field data acquisition, processing, map production and interpretation using Euler Deconvolution (Geosoft PC software is used).
Recommended previous knowledge: Course TPG4100 Physics and Geophysics or corresponding previous knowledge.
Academic content: Potential field theory. Instrumentation. Gravity and magnetic measurements, processing, and image analysis. Map production. Interpretation of potential field data, including Fourier analysis, regional-residual analysis, Autocorrelation, 3D Euler Deconvolution. Petrophysical properties of rocks. Interpretation using GIS, and modern software including forward modelling of potential fields with constraints taken from geology and seismic data. Data availability (including internet databases).
Teaching methods and activities: Lectures and exercises. The lectures are held in English if international Master´s students attend. Some exercises are compuslory. The examination can be changed from written to oral at the re-sit examinations (continuation examination).
Course material: M. B. Dobrin and C.H. Savit: Introduction to Geophysical Prospecting, 4th ed., McGraw-Hill Book Company, 1988, or John M. Reynolds: An Introduction to Applied and Environmental Geophysics, Wiley. Compendia and articles.
Evaluation form: Written 100%.

TPG4205 DRILL TECH PR CONTR
Drilling Technique Pressure Control
Dypboringsteknikk - trykkontroll
Lecturer: Førsteamanuensis Pål Skalle
Weekly hours: Spring: 2F + 2Ø + 8S = 7.5Cr
Time: Spring: As agreed
Examination: June 8 09.00 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: Provide a summary over the most important safety elements that constitute a drilling programme; evaluations and initiatives to avoid or solve problems.
Recommended previous knowledge: Basic topics in drilling.
Academic content: Pressure in sedimentary formations, prediction or pore and fracture pressure, setting and cementation of casing, conventional pressure control (detection of unstable hole, well shut-in, killing procedures), mud transport of free gas and gas in solution, security aspects concerning drilling in deep water, cold environment, lowfracture gradients, high kick-frequency, hydrate formation, shallow gas and water currents.

Teaching methods and activities: Lectures and PBL-group work. Portfolio evaluation gives the basis for final grade; written examination 50%, exercises 20%, midterm examination 30%. Results are presented by %, final grade by letter grade. The lectures will be held in English if international Master´s students attend. The examination can be changed from written to oral at the re-sit examinations (continuation examination).
Course material: Spe book: Applied Drilling Engineering. Compendium.
Evaluation form: Written 50% + exercises 20% + midterm 30%.

TPG4215 HIGH DEV DRILLING
High Deviation Drilling
Høyavviksboring

Lecturer: Professor Arild Rødland
Weekly hours: Autumn: 4F + 1Ø + 7S = 7.5Cr
Time: Autumn:

F	mo	12-14	P1		Ø	we	12-13	P1
	th	10-12	P1					

Examination: Dec 3 09.00 Examination support: A Exercises: Compulsory Grade: Letter grade

Learning outcomes: The topic gives an introduction to the methods used for high deviation and horizontal drilling, identifies conditions which are of significant importance and gives an insight into calculations which are necessary for planning and accomplishment of such boreholes.
Recommended previous knowledge: Basic topics in drilling.
Academic content: Deviation drilling, history and background. Actually, viewpoints on benefits and problems, methodology for assessment of feasibility of different alternatives of well types. Presentation and analysis of equipment and methodology for deviation, high deviation and horizontal boreholes, axial movements, rotation and pumping, also borehole pressure control equipment and methodology. Analysis on methodology of borehole steering, directional changes and control, design and implementation of complex borehole trajectories, presentation of related equipment and components. Borehole trajectory calculations, accuracies. Forcebalances in the borehole, analysis; tension, compression, buckling criteria, fatigue. Application of borehole tractors, concepts and consequences. Drilling of slimhole; use of coiled tubing: Benefits, problems, changes in force- and power application analysis. Discussions.
Teaching methods and activities: Lectures and exercises. Exercises count for 25% of the final grade. The course is held in English if international Master´s students attend. The examination can be changed from written to oral at the re-sit examinations (continuation examination).
Course material: Compendium. Relevant textbooks will be announced at semester start.
Evaluation form: Written 75% + exercises 25%.

TPG4220 DRILLING FLUID
Drilling Fluid
Boreslam

Lecturer: Førsteamanuensis Pål Skalle
Weekly hours: Spring: 2F + 2Ø + 8S = 7.5Cr
Time: Spring:

F	th	08-10	-		Ø	tu	10-12	-

Examination: June 7 09.00 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: Provide insight how the drilling fluid and hydraulic elements in the drilling programme are decided.
Recommended previous knowledge: Basic courses in drilling.
Academic content: Different types of drilling fluid and selection of these; driling fluid rheology, density and filter properties, clay mineralogy and the clay's reaction with water, polymers, oil-based drilling fluid, chemical and mechanical hole stability; laminar and turbulent pressure loss in pipes, hydraulic optimization, cement slurry properties.
Teaching methods and activities: Lectures and PBL-group work. Portfolio evaluation gives the basis for final grade; written examination 50%, exercises 20%, midterm examination 30%. Results are presented by %, final grade by letter grade. The lectures will be held in English if international Master´s students attend. The examination can be changed from written to oral at the re-sit examinations (continuation examination).
Course material: SPE book**:** Applied Drilling Engineering. Compendium.
Evaluation form: Written 50% + exercises 20% + midterm 30%.

TPG4225 FRACTURED RESERVOIRS
Fractured Reservoirs
Oppsprukne reservoarer
Lecturer: Professor Ole Torsæter
Weekly hours: Spring: 3F + 2Ø + 7S = 7.5Cr
Time: Spring: As agreed
Examination: May 23 09.00 Examination support: A Exercises: Compulsory Grade: Letter grade

Learning outcomes: The students will learn basic methods for analyzing flow in fractured reservoirs.
Recommended previous knowledge: Basic knowledge in reservoir engineering.
Academic content: Classification of and concepts for fractured porous media. Model selection. Geological reasons for fracturing. Single phase flow: well tests, storage effects, type curves. Drive mechanisms: capillary forces, gravity, viscous forces, diffusion. Production models: water drive models, gas cap models, modified material balance models and numerical simulation models.
Teaching methods and activities: Lectures and exercises. The lectures will be held in English if international Master´s students attend. The examination can be changed from written to oral at the re-sit examinations (continuation examination).
Course material: Articles and lecture notes.
Evaluation form: Written 100%.

TPG4230 WELL TECHNOLOGY
Well Technology
Brønnteknologi
Lecturer: Professor Michael Golan
Weekly hours: Spring: 3F + 2Ø + 7S = 7.5Cr
Time: Spring:
F tu 12-15 P2 Ø th 16-18 P2
Examination: May 27 09.00 Examination support: B Exercises: Compulsory Grade: Letter grade

Learning outcomes: The topic aims to give an extensive insight in well construction and well maintenance.
Recommended previous knowledge: None.
Academic content: The course addresses the following topics: Production systems including well centrifugations, gathering system and surface processing and stabilization of produced fluids. Production performance of wells and fields. Connectivity between reservoirs and the well. Flow in wells and production systems. Well construction and well interventions. Well equipment and mechanical analysis. Well service and well stimulations, introduction to artificial lift. Well completions and deep water operations.
Teaching methods and activities: Lectures and exercises. Exercises count for 40% of the final grade. Lectures will be held in English if international Master´s students attend.
Course material: Given at semester start.
Evaluation form: Written 60% + exercises 40%.

TPG4700 FORM EV-ENG SPEC
Formation Evaluation - Engineering, Specialization
Formasjonsevaluering - teknologi, fordypningsemne
Lecturer: Professor Ole Torsæter, Professor Curtis H. Whitson, Professor Jon Kleppe, Professor Tom Aage Jelmert, Professor II Terje Eidesmo, Professor Rune M. Holt, Amanuensis Helge Langeland, Professor Ole B. Lile
Coordinator: Professor Ole Torsæter
Weekly hours: Autumn: 36S = 22.5Cr
Time: Autumn: As agreed
Examination: Nov 30 09.00 Examination support: D Exercises: None Grade: Letter grade

Learning outcomes: The specialization the project should give thorough knowledge within selected parts of Formation Evaluation through independent project work combined with individual supervision and studies of the supporting courses.
Recommended previous knowledge: The students must fulfil the requirements for selecting specialization project in Formation Evaluation. These requirements are either stated in the degree programmes or can exceptionally be approved by the lecturer.
Academic content: The course of interdisciplinary character, with elements from earth science and petroleum engineering. Knowledge of rock parameters, reservoir fluids and flow in porous media from reservoir engineering are combined with knowledge from petrophysics and seismics to obtain improved understanding of the reservoir and its production performance. The most relevant courses for specialization are:

Petrophysics, selected theory, methods or software (Lile/Langeland/Eidesmo)(3.75 Cr) Rock Acoustics (Holt) (3.75 Cr) PVT/EOR/GAS (Whitson) (3.75 Cr) Reservoir evaluation (Jelmert) (3.75 Cr) Fractured reservoirs (Torsæter) (3.75 Cr) Reservoir simulation (Kleppe) (3.75 Cr) Reservior physics (Torsæter) (3.75 Cr).
Teaching methods and activities: The topic is divided in two, one project work equivalent to 15 CR and a specialized study equivalent to 7.5 Cr. The final grade in the specialization course is determined as a combination between the examination (1/3) and the project work (2/3). Postponed examination for the theory part is held before the examination period expires.
Course material: Information at start of semester.
Evaluation form: Oral 33% + exercises (project work) 67%.

TPG4705 PETR PROD SPEC
Petroleum Production, Specialization
Petroleumsproduksjon, fordypningsemne
Lecturer: Professor Harald Asheim, Professor Michael Golan, Professor Jon-Steinar Gudmundsson, Professor Sigbjørn Sangesland
Coordinator: Professor Harald Asheim
Weekly hours: Autumn: 36S = 22.5Cr
Time: Autumn: As agreed
Examination: Nov 30 09.00 Examination support: D Exercises: None Grade: Letter grade

Learning outcomes: To develop deeper knowledge of selected areas of production technology. This will be achieved through supervised and guided self-study. The particular topic from the specified list will be selected in collaboration with the teacher.
Recommended previous knowledge: All compuslory courses for specialization in production technology, or acceptance by responsible Professor.
Academic content: Courses related to well construction and productivity. One-phase and multiphase flow wells and equipment. The problem can be attacked analytically, numerically or by physical attempts. Possible sub-topics for the specialization can be: Two-phase flow: Specially aimed against transient effects/Separation: Development or testing of new methods to split oil and gas/Well equipment: Flow relationship in wells, completion/Production with the help from horizontal wells/Underwater completion/Gas technology, gas fields/Optimization of production strategy: Wells, localization, production systems. The following supporting courses to the semester project are offered: Production lab.technique (Asheim) (3.75 Cr), Modelling and simulation of production processes (Golan) (3.75 Cr), Flow in production wells (Asheim) (3.75 Cr), Well technology (Sangesland) (3.75 Cr), Natural gas technology (Gudmundsson) (3.75 Cr), Production- and process technology (Gudmundsson) (3.75 Cr)
Teaching methods and activities: The topics are divided into two, one project work corresponding to 15 CR and a specialized study corresponding to 7.5 CR. The final grades will be determined by a combination of an examination (1/3) and the project work (2/3. Postponed examination for the theory part will be held before the end of the examination period.
Course material: Given at semester start.
Evaluation form: Oral 33% + exercises (project work) 67%.

TPG4710 DRILLING SPEC
Drilling, Specialization
Boring, fordypningsemne
Lecturer: Førsteamanuensis Pål Skalle, Professor Sigbjørn Sangesland, Professor Arild Rødland, Professor Rune M. Holt
Coordinator: Førsteamanuensis Pål Skalle
Weekly hours: Autumn: 36S = 22.5Cr
Time: Autumn: As agreed
Examination: Nov 30 09.00 Examination support: D Exercises: None Grade: Letter grade

Learning outcomes: The drilling specialization will focus on developing special knowledge within selected topics based on self-studies combined with support from the lectures. The offered subtopics will be selected in cooperation with the lecturer.
Recommended previous knowledge: The students must have completed all listed subtopics required for the specialization in drilling, or approval must have been given by the lecturer.
Academic content: Drilling technology is a functional, engineering course. It spans over a wide range of interests like mechanics, hydraulics, corrosion, mechanical construction, measuring techniques, chemistry and petroleum technology.
The following subtopics are offered:
Drilling fluid technology (Pål Skalle)(3.75 Cr), Formation Mechanics (Rune M. Holt) (3.75 Cr), Underbalanced Drilling (Arild Rødland) (3.75 Cr), Geothermal Energy Drilling (Arild Rødland) (3.75 Cr), Deep Water Technology (Sigbjørn Sangesland) (3.75 Cr), Well Technology (Sigbjørn Sangesland) (3.75 Cr).

Teaching methods and activities: The specialization is divided in two parts, a project work corresponding to 15 Cr and specialized study corresponding to 7.5 Cr. The final grade will be based on a combination of examination (1/3) and a project work (2/3).
Course material: Information at start of semester.
Evaluation form: Oral 33% + exercises (project work) 67%.

TPG4715 RESERVOIR ENG SPEC
Reservoir Engineering, Specialization
Reservoarteknikk, fordypningsemne

Lecturer: Professor Ole Torsæter, Professor Curtis H. Whitson, Professor Jon Kleppe, Professor Tom Aage Jelmert
Coordinator: Professor Tom Aage Jelmert
Weekly hours: Autumn: 36S = 22.5Cr
Time: Autumn: As agreed
Examination: Nov 30 09.00 Examination support: D Exercises: None Grade: Letter grade

Learning outcomes: To develop deeper knowledge of selected areas of production technology. This will be achieved through supervised and guided self-study. The particular topic from the specified list will be selected in collaboration with the teacher.
Recommended previous knowledge: All compulsory courses that are listed in the syllabus for reservoir engineering specialization or special approval from the supervisor.
Academic content: Many aspects of reservoir are included, for example:
Properties of reservoir rocks and fluids. One- and multiphase flow in porous media. The storage and transport capacities of hydrocarbon reservoirs. Production strategies. Well test interpretation. Mathematical and physical models. Reservoir simulation and laboratory experiments.
The most important areas for specialization are: Geological field trip to Svalbard (E.Tjåland)(3,75CR), PVT/EOR/ GAS (C.H.Whitson)(3,75CR), Reservoir Evaluation (T.Aa.Jelmert) (3.75 Cr), Fractured Reservoirs (O.Torsæter)(3,75CR), Applied reservoir simulation (J.Kleppe)(3,75CR), Reservoir Physics (O.Torsæter)(3,75CR).
Teaching methods and activities: The course consists of project work with a work load corresponding to 15 CR and specialized studies corresponding to 7.5 Cr. The final grade will be based both on the examination, with weighting factor 1/3, and the project 2/3. A re-sit examination for the theoretical part will be arranged within the ordinary examination period for those who fail.
Course material: Given at semester start.
Evaluation form: Oral 33% + exercises (project work) 67%.

TPG4720 PETR GEOSCIENCE SPEC
Petroleum Geosciences, Specialization
Petroleumsgeofag, fordypningsemne

Lecturer: Professor Bjørn Ursin, Professor II Terje Eidesmo, Førsteamanuensis Egil Tjåland, Professor II Trond H. Torsvik, Professor Rune Martin Holt, Professor Ole Torsæter, Professor Martin Landrø, Professor Ole Bernt Lile, Professor II Jan Reidar Skilbrei, Amanuensis Helge Langeland
Coordinator: Førsteamanuensis Egil Tjåland
Weekly hours: Autumn: 36S = 22.5Cr
Time: Autumn: As agreed
Examination: Nov 30 09.00 Examination support: D Exercises: None Grade: Letter grade

Learning outcomes: This specialized course aims at deeper knowledge within selected courses in geosciences through project work combined with course modules, which are meant to support the project work. The specialized study is further meant to serve as a preparation for the main thesis by making the student acquainted to common scientific work procedures.
Recommended previous knowledge: It is assumed that the student has completed a study which is required to choose a specialization course in Petroleum Geosciences. The study can be in accordance with specifications given in the curricula or under special circumstances from a curriculum approved by the course teacher.
Academic content: Petroleum geosciences encompasses application and development of all geophysical and geological methods which are important for exploration of petroleum, mapping and description of petroleum reservoirs, together with all types of measurement performed in boreholes. In-depth studies can be done in: Seismic data acquisition and processing/Inversion and analysis of 4C and 4D seismic data/Interpretation of seismic, magnetometric and gravimetric data/Basin modelling/Sedimentologic studies/Saturation and migration studies/ Special methods for measurements in boreholes or for using data from boreholes together with other types of data.
The most relevant courses for specialization are: Rock Physics (Holt)(3,75CR), Geoscience fieldcourse at Svalbard (Tjåland)(3,75CR), Gravimetry and magnetometry (Skilbrei)(3,75CR), Fractured reservoirs (Torsæter)(3,75CR), Petrophysics, selected theory, methods or computer applications (Lile/Langeland/Eidesmo)(3,75CR), Plate

tectonics and basin development (Torsvik)(3,75CR), Reservoir seismics (Ursin)(3,75CR), Seismic imaging of sedimentary layers, field course (Landrø/Johansen)(3,75CR), Seismic Topics (Tjåland)(3,75CR).
Teaching methods and activities: The course is divided in two parts, a project work, worth 15 CR and a specialized study (courses) worth 7.5 Cr. Final grades will be given as a combination of examination (1/3) and project work (2/3). The re-sit examination for the theoretical part will be held within the end of the examination period.
Course material: Given at start of semester.
Evaluation form: Oral 33% + exercises (project work) 67%.

TPG5100 MATH/COMPUTER METHOD
Applied Mathematics and Computer Methods in Petroleum
Anvendt matematikk og datateknikk i petroleumsfag
Coord.: Professor Jon Kleppe
Weekly hours: Autumn: 2F + 8Ø + 2S = 7.5Cr
Time: Autumn: As agreed
Examination: - Examination support: - Exercises: None Grade: Letter grade

Learning outcomes: Review of important methematical concepts and develop skills in numerical techniques and computer applications used for solving petroleum related technical problems.
Recommended previous knowledge: None.
Academic content: The course covers methods for curve fitting, numerical differentiation, integration, interpolation, solution of equations, solution of systems of equations, statistical methods, numerical solution of differential equations etc. With applications to typical problems in petroleum engineering and geoscience. Emphasis is put on individual programmeming and use of software packages on the department computers.
Teaching methods and activities: Lectures and Fortran programmeming exercises.
Course material: W.H. Preuss and S.A. Teukolsky: Numerical Recipes in Fortran (2nd edition), Cambridge University Press, Cambridge, 1992. Fortran textbook to be announced.
Evaluation form: Exercises 100%.

TPG5110 PETROLEUM ECONOMICS
Petroleum Economics
Petroleumsøkonomi
Lecturer: NN
Coord.: Førsteamanuensis Pål Skalle
Weekly hours: Spring: 3F + 2Ø + 7S = 7.5Cr
Time: Spring: As agreed
Examination: Not decided Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: Enhance understanding of the principal economic framework within petroleum sector.
Recommended previous knowledge: BSc
Academic content: Oil price model; An introduction to the economic theory of exhaustible resources. Capital budgeting techniques and decision analysis: The main methods of evaluation of investment projects - including the effects of taxes and price variations, cost of capital and the main principles in economic risk analysis.
Teaching methods and activities: Lectures and exercises.
Course material: Detailed information will be given at the beginning of the course.
Evaluation form: Written 100%.

TPG5120 PETROPHYSICS BC
Petrophysics, Basic Course
Petrofysikk, grunnkurs
Lecturer: Professor Ole Bernt Lile, Seniorforsker Ton Loermans, Amanuensis Helge Langeland
Coordinator: Professor Ole Bernt Lile
Weekly hours: Autumn: 4F + 2Ø + 6S = 7.5Cr
Time: Autumn: As agreed
Examination: Not decided Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: Acquire knowledge and understanding of the basic concepts and techniques in petrophysics, to a degree sufficient to be able to study petrophysics at a more advanced level or continue study in those disciplines which might not require more petrophysics competence than acquired from the basic course.
Recommended previous knowledge: BSc in an engineering discipline, including some geoscience study.
Academic content: Introduction to geology and petrology. Physical characterization of rocks, including porosity, permeability and fluid saturation. Fluid flow through porous media. Capillary pressure concepts. Methods of pp data acquisition including mudlogging, coring, wireline and FEWD logging. Principles of measuring techniques, incl. gamma ray, density, neutron, sonic, formation pressure testing, resistivity, pulsed neutron, nuclear magnetic

resonance, borehole, casing and production measurements. Practical experience with cores. Basic log interpretation methods, Archie equation. Practical log evaluation methods in simple situations and predominately siliciclastic environments. Influence of shale, rudimentary concepts on interpretation of shaly formations.
Teaching methods and activities: Lectures and exercises. Semester tests count total 50% of final grade. Exercises must have been completed to enter examination.
Course material: Lecture notes, Western Atlas: Introductin to Well Log Analysis, Schlumberger: Log Interpretations Principles/Applications.
Evaluation form: Written 50% + midterm 25% + midterm 25%.

TPG5200 PET ENG/GEO INT PROJ
Petroleum Engineering and Geoscience, Interdisciplinary Project
Petroleumsteknologi og petroleumsgeofag, tverrfaglig prosjekt
Lecturer: Professor Helge Langeland, Professor Pål Skalle
Coordinator: Professor Helge Langeland
Weekly hours: Autumn: 1F + 3Ø + 8S = 7.5Cr
Time: Autumn: As agreed
Examination: - Examination support: - Exercises: None Grade: Letter grade

Learning outcomes: Students will develop knowledge and expertise across traditional disciplines within exploration and production of oil and gas through a realistic project work. Students will be organized in groups, with students from petroleum geoscience and petroleum engineering.
Recommended previous knowledge: For students in the third semester of the international MSc programme in petroleum engineering and petroleum geoscience.
Academic content: The groups will be assigned realistic data from selected oil and gas provinces in the world. They carry out a realistic project where they typically prepare a plan for development and production of an oil or gas field, or a plan for completion of an exploration project. At the end of the project, the groups will make a formal presentation of the report for a panel of Professors.
Teaching methods and activities: Exercises (project work).
Course material: Description of objectives, required data and references will be handed out.
Evaluation form: Exercises (project work) 100%.

Department of Engineering Cybernetics

TTK4130 MODELLING/SIMULATION
Modelling and Simulation
Modellering og simulering
Lecturer: Professor Olav Egeland
Weekly hours: Spring: 4F + 4Ø + 4S = 7.5Cr
Time: Spring: Not decided for 2005/06
Examination: Not decided Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: Introduction in methods for modelling and simulation of physical processes in control applications.
Recommended previous knowledge: Course Control Engineering or similar.
Academic content: Mathematical modelling: Models based on state-space, transfer functions, networks models with unilateral interconnections. Analysis based on frequency response, energy-based methods and passivity. Signal-flow versus energy-flow for interconnection of models. Development and interconnection of subsystem models in a modular approach to modelling. Models for electrical motors, hydraulics, friction, vehicles and manipulators, balance equations for mass, momentum and energy in control volume, isentropic gas dynamics, and compressor dynamics. Simulation of state-space models, Runge-kutta methods, stiff systems, stability. Brief introduction to the simulation of partial differential equations using finite elements (FEM) and finite volumes (CFD).
Teaching methods and activities: Lectures and exercises (5 calculation exercises and 3 data exercises must be approved).
Course material: O. Egeland/S.T. Gravdahl: Modelling and Simulation for Automatic Control, Marine Cybernetics 2003.
Evaluation form: Written 100%.

TTK4150 NONLINEAR CONTR SYST
Nonlinear Control Systems
Ulineære systemer
Lecturer: Førsteamanuensis Kristin Y. Pettersen
Weekly hours: Autumn: 3F + 2Ø + 7S = 7.5Cr
Time: Autumn: Not decided for 2005/06
Examination: Not decided Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: Give knowledge about analysis and design of nonlinear, dynamic systems, with special focus on control applications.
Recommended previous knowledge: Course Control Engineering or similar.
Academic content: The course includes methods for analysis and control of nonlinear dynamic systems. In particular: Mathematical models of nonlinear systems and fundamental differences between linear and nonlinear systems behaviour. Equilibrium points, limit cycles, general invariant sets and stability properties of to these. The analysis methods Phase plane analysis, Describing functions method, Lyapunov analysis and Passivity. Nonlinear control design by describing functions method, feedback linearization techniques, gain scheduling, Lyapunov's direct method and energy-based control.
Teaching methods and activities: Lectures and exercises (6 exercises and a laboratory exercise must be approved).
Course material: Information will be given at the beginning of the semester.
Evaluation form: Written 80% + Midterm 20%.

TTK4190 GUIDANCE AND CONTROL
Guidance and Control
Fartøystyring
Lecturer: Professor Thor Inge Fossen
Weekly hours: Spring: 3F + 2Ø + 7S = 7.5Cr
Time: Spring: Not decided for 2005/06
Examination: Not decided Examination support: A Exercises: Compulsory Grade: Letter grade

Learning outcomes: Modelling of vessel movements and design/analysis of guidance systems for ships and underwater vehicles.
Recommended previous knowledge: Course Control Engineering and TTK4150 Nonlinear Control Systems or similar.
Academic content: Methods for design and implementation of industrial GNC systems for ships, underwater, vehicles, high-speed vehicles and spacecraft. This includes mathematical modelling of marine vessels and the environment (waves, currents and wind) in 6 Emphasis is placed on kinematics (Euler angles and unit quaternions), rigid-body dynamics, hydrodynamics and vectorial mechanics. Control theory and synthesis in terms of linear quadratic optimal control and state estimation (Kalman filtering), nonlinear observer the control with extensions to nonlinear systems, Lyapunov methods, sliding mode control, feedback linearization, backstepping designs, observer-based feedback, and integration filters for satellite and strapdown navigation systems.
Teaching methods and activities: Lectures, compulsory problem sets and project work (with grading). The problems sets count for 30 % of the final grade.
Course material: Thor I. Fossen: Marine Control Systems: Guidance, Navigation and Control of Ships, Rigs and Underwater Vehicles (Marine Cybernetics, Trondheim) ISBN 82-92356-00-2.
Evaluation form: Written 70% + midterm 30%.

TTK5100 GUID/NAV SYST SPEC
Guidance and Navigation Systems, Specialization Course
Fartøystyring og navigasjon, spesialiseringemne
Lecturer: Professor Thor I. Fossen
Weekly hours: Autumn: 4F + 4Ø + 4S = 7.5Cr
Time: Autumn: As agreed
Examination: Dec 2004 Examination support: D Exercises: None Grade: Letter grade

Learning outcomes: Supporting topics within the area of the thesis work.
Recommended previous knowledge: Compulsory courses in the MSc programme in Marine Control Systems.
Academic content: Two topics selected from a list presented for the students in connection with the project work.
Teaching methods and activities: Lectures and voluntary exercises.
Course material: Lecture notes.
Evaluation form: Oral 100%.

Department of Electronics and Telecommunications

TTT4140 FUND OF NAVIGATION
Fundamentals of Navigation
Navigasjon
Lecturer: Professor Børje Forssell
Weekly hours: Autumn: 4F + 2Ø + 6S = 7.5Cr
Time: Autumn: Not decided for 2005/06
Examination: Not decided Examination support: D Exercises: None Grade: Letter grade

Learning outcomes: Give knowledge about fundamental geodetic, mathematical and statistical conditions for application of navigation systems.
Recommended previous knowledge: Calculus 1 or similar.
Academic content: Geodetic and geophysical fundamentals of navigation, positioning, localization and survey. Courses dealt with are the shape and physics of the Earth, reference and coordinate systems, mapping and map projections, calculations on the surface of the Earth, satellite orbits, accuracy calculations, tides, and optimum utilization of navigational data, particularly Kalman filtering.
Teaching methods and activities: Lectures and voluntary exercises.
Course material: B. Forssell: Radionavigation Systems, Prentice Hall 1991.
Evaluation form: Written 100%.

TTT4150 NAVIGATION SYSTEMS
Navigation Systems
Navigasjonssystemer
Lecturer: Professor Børje Forssell
Weekly hours: Spring: 4F + 2Ø + 6S = 7.5Cr
Time: Spring: Not decided for 2005/06
Examination: Not decided Examination support: D Exercises: None Grade: Letter grade

Learning outcomes: Give the students knowledge about principles and conditions for design and application of navigation systems.
Recommended previous knowledge: Calculus 1-4 and basic knowledge in electronics.
Academic content: Spatial and atmospherical wave propagation and along the Earth's surface, hyperbolic navigation, terrestrial radionavigation systems such as LORAN-C and direction finding, satellite navigation systems such as GPS, GALILEO and GLONASS, special systems for aircraft navigation and landing, radar and inertial navigation.
Teaching methods and activities: Lectures and voluntary exercises.
Course material: B. Forssell: Navigation System, Prentice Hall 1991.
Evaluation form: Written 100%.

Department of Hydraulic and Environmental Engineering

TVM5100 HYDROPOWER PLAN 1 BC
Hydropower Planning 1, Basic Course
Vannkraftplanlegging 1, grunnkurs
Coord.: Professor Haakon Støle
Weekly hours: Autumn: 8F + 8Ø + 8S = 15Cr
Examination: Autumn 2004 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: The course is offered in English to the students in the first year in the MSc programme "Hydropower Development". The course covers the basics in geo-courses and dam engineering for civil engineers.
Recommended previous knowledge: Admission to the HPD MSc programme requires as a minimum 3 year BSc in civil engineering or Water resources engineering.
Academic content: Each topic is lectured as full-day seminar over one or two weeks and the course covers: Engineering geology, rock blasting and tunnelling, properties of concrete, soil mechanics, embankment dams and concrete dams.
Teaching methods and activities: Each topic is taught over one or two weeks. Lectures and exercises are integrated. The lecturers come from the university and the hydropower industry, all with international experience. All lectures and exercises are given in English.
Course material: Books from the series Hydropower Development and supplementary lecture notes (English).
Evaluation form: Written 100%.

TVM5110 HYDROPOWER PLAN 2 BC
Hydropower Planning 2, Basic Course
Vannkraftplanlegging 2, grunnkurs
Coord.: Professor Haakon Støle
Weekly hours: Autumn: 8F + 8Ø + 8S = 15Cr
Examination: Autumn 2004 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: The course is offered in English to the students in the first year in the MSc programme "Hydropower Development". The course covers the basics in hydro-courses for civil engineers.
Recommended previous knowledge: Admission to the HPD MSc programme requires as a minimum 3 year BSc in civil engineering or Water resources engineering.
Academic content: Each topic id lectured as full-day seminar over one or two weeks and the course covers: Basic and applied hydrology, fluid mechanics, hydraulic design, scour protection and sediment transport, turbines and surge tanks, hydraulic steel works and power house design.
Teaching methods and activities: Each topic is taught over one or two weeks. Lectures and exercises are integrated. The lecturers come from the university and the hydropower industry, all with international experience. All lectures and exercises are given in English.
Course material: Books from the series Hydropower Development and supplementary lecture notes (English).
Evaluation form: Written 100%.

TVM5120 HYDROPOWER PLAN 3 BC
Hydropower Planning 3, Basic Course
Vannkraftplanlegging 3, grunnkurs
Coord: Professor Haakon Støle
Weekly hours: Spring: 8F + 8Ø + 8S = 15Cr
Examination: Spring 2005 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: The course is offered in English to the students in the first year in the MSc programme "Hydropower Development". The course covers the basics in economics, environmental issues and project management for civil engineers.
Recommended previous knowledge: Admission to the MSc programme requires as a minimum 3 year BSc in civil engineering or water resources engineering.
Academic content: Each topic is lectured as full-day seminar over one or two weeks and the course covers: Economic design criteria, project management, investment and socio-economic analysis, contracts implementation of hydropower and water resources projects, environmental impact studies, construction management and small scale hydropower.
Teaching methods and activities: Each topic is taught over one or two weeks. Lectures and exercises are integrated. The lecturers come from the university and the hydropower industry, all with international experience. All lectures and exercises are given in English.
Course material: Books from the series Hydropower Development and supplementary lecture notes (English).
Evaluation form: Written 100%.

TVM5130 HYDROPOWER PROJECT
Hydropower Plants, Project Work
Vannkraftverk, prosjekt
Lecturer: Professor Haakon Støle
Weekly hours: Spring: 12Ø + 12S = 15Cr
Examination: - Examination support: - Exercises: None Grade: Letter grade

Learning outcomes: The project assignment objectives are the application of integrated planning, covering technical, economic and environmental issues.
Recommended previous knowledge: The project work assumes completion of the basic courses: Hydropower Planning 1, 2 and 3.
Academic content: The project work covers a pre-feasibility study for an actual river system.
Teaching methods and activities: Lectures covering the planning process and supervision throughout the project period as required by the students.
Course material: Maps, dato on hydrology and geology, cost data, etc.
Evaluation form: Exercises 100%.

TVM5150 RIVER SYSTEM ANAL AC
River System Analysis, Advanced Course
Hydrofysiske vassdragsstudier, videregående kurs
Lecturer: Professor Ånund Killingtveit, Amanuensis Knut Alfredsen
Coord.: Professor Ånund Killingtveit
Weekly hours:Autumn: 3F + 2Ø + 7S = 7.5Cr
Examination: Autumn 2004 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: The course is offered in English to the students in the second year in the MSc programme "Hydropower Development" and to master i teknologi/siv.ing.students in the programme of study "bygg og miljøteknikk". The course objective is extended knowledge of computer and numerical model applications in river system studies.
Recommended previous knowledge: The course assumes completion of the basic course TVM5110 Hydropower Planning 2 in the first year of the MSc programme or TVM4105 Hydrology.
Academic content: Discussion and application of the main computer models for river system analysis. Applied separately or integrated (River System Simulator).
Teaching methods and activities: Lectures, workshops, computer model applications, both as exercises and applied on actual rivers.
Course material: Å. Killingtveit and N.R. Sælthun: Hydrologi. Articles, reports and computer model descriptions.
Evaluation form: Oral 100%.

TVM5160 HEADWORKS AND SED AC
Headworks and Sedimentation Engineering, Advanced Course
Dammer og inntak i sedimentførende elver, videregående kurs
Coord.: Professor Haakon Støle
Weekly hours:Autumn: 3F + 2Ø + 7S = 7.5Cr
Examination: Autumn 2004 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: The course is offered in English to the students in the second year in the MSc programme "Hydropower Development" and to master i teknologi/siv.ing.students in the programme of study "bygg og miljøteknikk". The course covers planning, design and operation of headworks in sediment carrying rivers.
Recommended previous knowledge: The course assumes completion of the basic course TVM5110 Hydropower Planning 2 in the first year of the MSc HPD programme or TVM4115 Fluid Mechanics and preferably TVM4125 Water Resources Engineering.
Academic content: Extended discussion of sediment transport theory and use of water resources in sediment loaded rivers, reservoir sedimentation, headworks for run-of-river hydropower plants, sediment handling techniques, sediment sampling programmes and analysis of sediment data.
Teaching methods and activities: Lectures, workshops, assignments and laboratory study.
Course material: Lysne, Glover, Støle and Tesaker: Hydraulic Design. Vanoni: Sedimentation Engineering. Støle: Withdrawal of Water from Himalayan Rivers, World Commision on Dams: Dams and Development and hand-out literature with supplementary articles, cases and lecture-notes (English).
Evaluation form: Oral 100%.

TVM5170 SOCIAL IMPACT ASS AC
The Process of Social Impact Assessment, Advanced Course
Sosiale konsekvenser - Utredning og tiltak, videregående kurs
Lecturer: Professor Haakon Støle
Weekly hours:Autumn: 5Ø + 7S = 7.5Cr
Examination: Autumn 2004 Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: The course is offered in English to the students in the second year in the MSc programme "Hydropower Development". The objectives are to improve the knowledge of the different stages of the process of socio-economic assessment, including strategic priorities and national guidelines, and to improve tools for planning projects in the best possible way on a national, regional and local level.
Recommended previous knowledge: The course assumes completion of the basic course TVM5120 Hydropower Planning 3 in the first year of the MSc programme.
Academic content: The course consists of 15 modules, and one new module is presented every week. The course consists of 15 modules: 1: Background and development of SIA, 2: Social impact assessment methodologies, 3: Baseline data and mitigation measures, 4: Stakeholder consultation process, 5: Ethnic minorities and cultural heritage issues, 6: Health issues, 7: Education and training, 8: Gender issues, 9: The role of NGOs and CBOs, 10: Resettlement, 11: Livelihood developmnt and food securities, 12: Environmental and technical issues (catchment management), 13: Monitoring, 14: Institutional strengthening and capacity building and 15: Finance and budget issues.

Teaching methods and activities: The main core of the course is a distance-learning course on the Internet. The introduction to the course will be in a classroom setting and advisors will be available on a weekly basis in order to facilitate discussions and assistance to the students related to the weekly quiz or set of multiple-choice questions in each module and writes short reports. Evaluation will be based on each students workbook, containing all weekly reports etc. and an oral examination.
Course material: All the course material is available for the participants on the Internet (English).
Evaluation form: Oral 100%.

PhD courses

MT8300 ELECTR LIGHT METAL 2
Electrolysis of Light Metals 2
Lettmetallelektrolyse 2
Lecturer: Professor II Halvor Kvande
Weekly hours: Spring: 3F + 2Ø + 7S = 7.5Cr
Time: Spring: As agreed
Examination: Not decided Examination support: D Exercises: Voluntary Grade: Letter grade

Learning outcomes: (Not reported).
Recommended previous knowledge: It will be advantageous to have knowledge corresponding to the course MT8104 Electrolysis of Light Metals 1. The present course is a continuation of this course, with emphasis on the industrial application of the process.
Academic content: The course is given every year.
The course concerns the practical application of the theory of light metals production, with emphasises the aluminium electrolysis.
The main topics are:
Energy balance and thermochemistry
Bath chemistry, additives and physico-chemical properties of the bath,
Alumina, its properties, solubility in the bath, and alumina feeding
Current efficiency and energy consumption
Magnetic fields
Operation of industrial cells
Process control
Practical improvements of the process in the past, present and in the future.
Teaching methods and activities: Voluntary exercises.
Course material: K. Grjotheim og H. Kvande (Editors): "Introduction to Aluminium Electrolysis - Understanding the Hall-Heroult Process", 2nd Edition, Aluminium-Verlag, Düsseldorf, 1993.
Evaluation form: Oral 100%.

MT8301 CARBON MAT TECHN
Carbon Materials Technology
Karbonmaterialteknologi
Lecturer: Professor II Morten Sørlie
Weekly hours: Autumn: 2F + 2Ø + 8S = 7.5Cr
Time: Autumn: As agreed
Examination: Not decided Examination support: D Exercises: Compulsory Grade: Letter grade

Learning outcomes: (Not reported).
Recommended previous knowledge: (Not reported).
Academic content: (Not reported).
Teaching methods and activities: Mandatory exercises.
Course material: Selected parts from published books and articles from publications.
Evaluation form: Oral 100%.

Faculty of Architecture and Fine Art

AAR4230 PLAN IN DEV COUNTRY
Planning and Construction in Developing Countries, Advanced Course
Planlegging og bygging i utviklingsland, videregående kurs
Lecturer: Professor Hans Christie Bjønness
Weekly hours: Spring: 3F + 1Ø + 8S = 7.5Cr
Time: Spring: As agreed
Examination: Not decided Examination support: C Exercises: Compulsory Grade: Letter grade

Learning outcomes: To provide the students with understanding and applicable knowledge on sustainable planning and development of infrastructure in a society.
Recommended previous knowledge: BSc in Civil Engineering or similar.
Academic content: The course gives an introduction to issues that are important for understanding planning, construction and infrastructure management in developing countries (ideology; cultural, social and environmental issues, economy, resources and technology etc.). Focus will be on those features that differ from industrialized countries, with emphasise on problems related to planning and management of the implementation of projects. The project work emphasises project planning and evaluation techniques, and given an introduction to writing project documentation using the UN format.
Teaching methods and activities: Lectures and exercises/projects.
Course material: Textbooks, lecture notes and selected papers/reports.
Evaluation form: Written 100%.

AAR8300 RES METHODS FOR ARCH
Research Methods for Architects and Planners
Forskningsmetoder for arkitekter og planleggere
Lecturer: Professor Ann Carolyn Mo
Weekly hours: Autumn: 2F + 3Ø + 7S = 7.5Cr
Time: Autumn: As agreed
Examination: - Examination support: - Exercises: None Grade: Letter grade

Learning outcomes: The student learns how to write a project proposal, how to carry out a research project and write a report. The student will learn to read and evaluate research reports based on different methods and approaches, students will learn both statistical and qualitative methods (case studies).
Recommended previous knowledge: The student will develop a research question in cooperation with his/her PhD supervisors. The supervisors must be involved in the work on a project proposal and must attend when the student has a mini-disputas in the class.
Academic content: The course is to give basic knowledge of research to students who are to use research methods in relation to a project.
Teaching methods and activities: Various research methods will be reviewed (hypothesis-testing vs. hypothesis generating, deductive vs. inductive) in relation to real projects and literature about research methods. There may be contributions from guest lecturers. Through presentation of own projects, students will earn to evaluate their own and others research designs. Written presentations will be revised to become a project proposal.
Course material: Individual choice of literature. A compendium is available. The Architecture Library has a shelf with literature on closed reserve.
Evaluation form: Exercises 100%.

Faculty of Social Sciences and Technology Management

GEOG3506 GEO HEALTH AND DEV
Geography, Health and Development
Geografi, helse og utvikling
Lecturer: Førsteamanuensis Stig H. Jørgensen
Weekly hours: Autumn: 20 hours F + 8 hours S = 7.5Cr
Time: Autumn: As agreed
Examination: Not decided Examination support: C Exercises: Compulsory Grade: Letter grade

Learning outcomes: The course aims to give a broad overview of geographical perspectives on health with two main focuses:
1) Health status, disease/injury and risk/risk factors.
2) Geography of health services at different levels, with emphasis on demand and use, availability and accessibility, prevention, and treatment.
Recommended previous knowledge: See formal requirements.

Academic content: The main emphasis of the course is on the situation in developing countries, but more general development trends in health and health services in different parts of the world are also covered. As well as a common core curriculum, two in-depth courses (curriculum variations) are offered: one that studies developing countries' perspectives in more detail, and a guideline for studying westernized countries (among which Norway is central). The course covers studies in quantitative and qualitative method traditions.
Part of the study is based on student's own reading which forms the foundation for carrying out the semester essay. This is presented at a seminar. A seminar is also arranged on searching for medical and health literature in libraries and databases (3 hours). The semester essay and presentation must be approved before the written examination can be taken.
Teaching methods and activities: Teaching method and activities: 20 hours lectures, 8 hours seminars.
Compulsory activity: Approved semester paper and presentation. Form of assessment: 4 hour written examination.
Course material: (Not reported).
Evaluation form: Written 100%.

SUMMARY OF SUPPORTING COURSES - EARTH SCIENCES AND PETROLEUM ENGINEERING

TPG4700 Formation evaluation - Engineering, Specialization:	**Teachers:**
Supporting courses:	
Reservoir Simulation	Professor Jon Kleppe
Rock Acoustics	Professor Rune M. Holt
Geoscientific Field Course at Svalbard	Førsteamanuensis Egil Tjåland
Fractured Reservoirs	Professor Ole Torsæter
Reservoir Physics	Professor Ole Torsæter
Petrophysics, Selected Theory, Methods or Software	Professor Ole B. Lile/Amanuensis Helge Langeland/Professor II Terje Eidesmo
PVT/EOR/GAS	Professor Curtis H. Whitson
Reservoir Evaluation	Professor Tom Aage Jelmert

TPG4705 Petroleum Production, Specialization:	
Supporting courses:	
Well Technology	Professor Sigbjørn Sangesland
Geoscientific Field Course at Svalbard	Førsteamanuemsis Egil Tjåland
Modelling and Simulation of Production Processes	Professor Michael Golan
Natural Gas Technology	Professor Jon-Steinar Gudmundsson
Production Laboratory Techniques	Professor Harald Asheim
Flow in Production Wells	Professor Harald Asheim

TPG4710 Drilling, Specialization:	
Supporting courses:	
Drilling Fluid Technology	Førsteamanuensis Pål Skalle
Well Technology	Professor Sigbjørn Sangesland
Deep Water Technology	Professor Sigbjørn Sangesland
Formation Mechanics	Professor Rune M. Holt
Geoscientific Field Course at Svalbard	Førsteamanuensis Egil Tjåland
Geoenergy: Drilling Engineering	Professor Arild Rødland
Underbalanced Drilling	Professor Arild Rødland

TPG4715 Reservoir Engineering, Specialization:	
Supporting courses:	
Reservoir Simulation	Professor Jon Kleppe
Geoscientific Field Course at Svalbard	Førsteamanuensis Egil Tjåland
Fractured Reservoirs	Professor Ole Torsæter
Reservoir Physics	Professor Ole Torsæter
PVT/EOR/GAS	Professor Curtis H. Whitson
Reservoir Evaluation	Professor Tom Aage Jelmert

TPG4720 Petroleum Geoscience, Specialization:	
Supporting courses:	
Rock Acoustics	Professor Rune M. Holt
Geoscientific Field Course at Svalbard	Førsteamanuensis Egil Tjåland
Seismic Topics	Førsteamanuensis Egil Tjåland
Gravimetry and Magnetometry	Professor II Jan Reidar Skilbrei
Fractured Reservoirs	Professor Ole Torsæter
Petrophysics, Selected Theory, Methods or Software	Professor Ole B. Lile/Amanuensis Helge Langeland/Professor II Terje Eidesmo
Plate Tectonics and Basin Formation	Professor II Trond Torsvik
Reservoir Seismics	Professor Bjørn Ursin
Seismic Mapping of Sedimentary Layers, Field Course	Professor Martin Landrø/Førsteamanuensis Sverre Ola Johnsen

MASTER OF PHILOSOPHY IN ENGLISH LANGUAGE AND LINGUISTICS

Admission requirements
Applicants should hold a BA or an equivalent degree in English or Linguistics with a sufficient background in topics related to English language or linguistics. Only students with a minimum of 3 English language/linguistics courses will be considered.
Officially certified copies of all educational certificates, including transcripts and diplomas from secondary school and university education, must be submitted.
An English proficiency test must be included. Applicants must pass either the TOEFL with a minimum paper score of 550 (230 computer) or IELTS with 6.0 or better. Citizens from Ireland, the UK, the US, Canada, Australia and New Zealand do not have to submit TOEFL/IELTS test results. This is also the case for applicants who have spent at least one year in any of these countries, while attending upper secondary school or a university. Applicants from African countries with a BA/BSc/BEng. degree where the language of instruction has been English and those who have passed English as a course at GCE A-level with grade C or better are also exempted. Applicants with a university degree in English language (BA in English) are also exempted from the language requirement. Please be aware that applicants from Asian countries (for example Bangladesh, India, Nepal, Pakistan, Sri Lanka, Thailand, and Vietnam) with a BA/ BSc/ BEng. degree where the language of instruction has been English are not exempted from the English language requirements, except for students holding a BA degree in English.
NB! The programme is also open for non-quota programme applicants.

Course outline
The MPhil Programme will take 2 years of full-time studies, and starts in the autumn term. The credits are divided between 4 courses (each counting 15 credits or any combination of advanced and Master´s courses producing a total of 60 credits) and a thesis of 60 credits. 60 credits indicate the normal workload for a full-time student for one academic year. The 4 courses should include advanced and Master´s courses of the student's choice, where at least two of them should be advanced. The courses should be selected from among courses offered to regular students at the Department of Modern Foreign Languages. The courses should be completed during the first year of study, and the second year should be devoted to the thesis.

Courses offered in the programme
The range of courses includes advanced courses in Modern English syntax, English synchronic and diachronic variation, Studies of the lexicon, First language acquisition and second language acquisition studies, Translation theory and communication studies.

Teaching and examinations
Each course - whether advanced or Master´s- is assessed based on a combination of written work and final examination. In addition, students may be required to give oral presentations and/or complete course projects. Normally each course has 3 hours of teaching per week in the form of lectures and seminars.

Supervision
The Department offers supervision from the history of English, the Syntax/Semantics to First and second language acquisition and interface, and Contemporary information structure theories.
After the first year of studies - in the period 15 June-15 August - the students are given the opportunity to go back to their home countries to do fieldwork if this is necessary for the completion of their theses. Students who are supported by the Quota programme are awarded an extra grant to cover field-trip expenditure.

MASTER OF PHILOSOPHY IN LINGUISTICS

The degree is also called 'International MPhil in Linguistics'.

Admission requirements

Applicants should hold a BA or an equivalent degree in Linguistics or in a field with a sufficient background in topics related to Linguistics. Only students with a minimum of three Linguistics courses will be considered.
Officially certified copies of all educational certificates, including transcripts and diplomas from secondary school and university education, must be submitted.
An English proficiency test must be included. Applicants must pass either the TOEFL with a minimum paper score of 550 (230 computer) or IELTS with 6.0 or better. Citizens from Ireland, the UK, the US, Canada, Australia and New Zealand do not have to submit TOEFL/IELTS test results. This is also the case for applicants who have spent at least one year in any of these countries, while attending upper secondary school or a university. Applicants from African countries with a BA/BSc/BEng degree where the language of instruction has been English, and those who have passed English as a course at GCE A-level with grade C or better, are also exempted. Applicants with a university degree in English language (BA in English) are also exempted from the language requirement. Please be aware that applicants from Asian countries (for example Bangladesh, India, Nepal, Pakistan, Sri Lanka, Thailand, and Vietnam) with a BA/ BSc/ BEng degree where the language of instruction has been English are not exempted from the English language requirements, except for students holding a BA degree in English.
The MPhil programme is also open for non-quota programme applicants.

Course outline

The MPhil Programme will take two years of full-time studies, and starts in the autumn semester. The credits are divided between courses comprising of a total of 60 credits, and a thesis of 60 credits. 60 credits indicate the normal workload for a full-time student for one academic year. The courses should include both intermediate courses (LING 2000) and Master's courses (LING3000) of the student's choice, where at least one of them should be at Master's level (LING 3000). The courses should be selected from among topics offered to regular students at the Department of Language and Communication Studies. The courses should be completed during the first year of study, and the second year should be devoted to the thesis.

Courses offered in the programme

The range of courses that could be offered is a subset of the courses offered in the general Bachelor's and Master's Programmes in Linguistics, namely:

LING2201	Syntax II	7.5	Spring
LING2202	Phonology II	7.5	Autumn
LING2203	Semantics II	7.5	Spring
LING2204	Pragmatics II	7.5	Autumn
LING2207	Grammar Engineering I	7.5	Spring
LING2217	Grammar Engineering II	7.5	Spring
LING2221	Intonation	15	Autumn*
LING2222	Language Typology	15	Autumn

* The number of available courses may diverge. You can contact the Department for more details and further information.

LING3001	Syntax and Semantics	15	Autumn and Spring
LING3003	Pragmatics III	15	Spring
LING3005	Grammar Engineering III	15	Autumn

Teaching and examinations

Each course, whether intermediate or Master´s – has a take-home examination, of a duration of one or two weeks. Normally each 15 credit course has four hours of teaching per week in the form of lectures and seminars.

After the first year of studies – for the period 15 June-15 August – the students are given the opportunity to go back to their home countries to do field-work if this is necessary for the completion of their theses. Students who are supported by the Quota programme are awarded an extra grant to cover field-trip expenditures.

MPhil in Linguistics: Example with focus on grammar and pragmatics

Sem.	7.5 credits	7.5 credits	7.5 credits	7.5 credits
4	LING3391 MPhil thesis			
3	LING3391 MPhil thesis			
2	LING3001 Syntax and Semantics		LING 3003 Pragmatics III	
1	LING2203 Semantics II	LING2204 Pragmatics II	LING2222 Language Typology	

MPhil in Linguistics: Example with focus on phonology and pragmatics

Sem.	7.5 credits	7.5 credits	7.5 credits	7.5 credits
4	LING 3391 MPhil thesis			
3	LING3391 MPhil thesis			
2	LING3003 Pragmatics III		LING2202 Phonology II	LING2201 Syntax II
1	LING2003 Semantics II	LING2204 Pragmatics II	LING2221 Intonation	

MPhil in Linguistics: Example with focus on syntax and semantics

Sem.	7.5 credits	7.5 credits	7.5 credits	7.5 credits
4	LING 3391 MPhil thesis			
3	LING 3391 MPhil thesis			
2	LING3001 Syntax and semantics		LING2207 Grammar Engineering I	LING2201 Syntax II
1	LING2001 Semantics II	LING2204 Pragmatics II	LING2222 Language Typology	

MASTER OF PHILOSOPHY IN SOCIAL CHANGE, SPECIALIZING IN GEOGRAPHY

The MPhil in Social Change is a programme designed for students who want to specialize in development studies and social change. The degree is awarded by the Faculty of Social Sciences and Technology Management at NTNU and administered by the Department of Geography. It has a stronger focus on Geography than on other social sciences, but is still an interdisciplinary degree that is relevant for students with backgrounds in different social sciences and development studies.
The programme is relevant for a variety of jobs, including research, planning, resource management, and teaching. The programme is also relevant for further studies within the field of Geography, other social sciences, and interdisciplinary studies such as development studies and natural resource management.
The programme is open to both foreign and Norwegian students. There are 10 places for students financed by the Quota programme, 5 for students financed by NORAD, 5 places for Norwegian students, and up to 4 places open for other exchange students who whish to follow an individual course plan.

Admission requirements
Applicants should preferably hold a Bachelor in Geography, a Cand.mag. with Geography ”mellomfag” from a Norwegian university, or other equivalent education. Students with a bachelor/Cand.mag. in other social sciences are also considered for admission if their first degree includes studies within geography or development studies.
The teaching language is English, and the applicants must document their English proficiency by achieving one of the following:

- Pass in the foundation course (“grunnkurs”) in English at a Norwegian Upper Secondary School

– TOEFL-test with a minimum of 550 points. (213 computer based test)

– IELTS-test with 6.0 points or better

Exceptions from this requirement can be given for certain groups of applicants under the guidelines determined by the Faculty.

Grades
NTNU uses the following grading scale:
A, B, C, D, E, and F (fail)

Course outline
The programme involves 2 years of full-time studies. The programme is structured around core courses (45 credits), electives (30 credits) and a Master’s thesis (45 credits). The normal workload for a full-time student for one academic year, is equivalent to 60 credits.
The core courses comprise: GEOG 3050 Theories of Social Change, GEOG 3051 History of Geographical Thought and GEOG 3052 Research Methodology.

Students can choose electives worth 30 credits from a number of courses offered by the Department of Geography. Most of the electives will be offered in the autumn semester. Students can obtain a maximum of 15 credits in GIS/ Remote Sensing (i.e. either GEOG 3510 or GEOG 3511). Courses offered by other departments can be chosen as electives if approval is given by the Department of Geography.

1st semester:

Core course:	GEOG 3050 Theories of Social Change (15 credits)
Electives:	GEOG 3505 Landscape and Planning (15 credits.)
	GEOG 3511 Remote Sensing (15 credits)
	GEOG3510 Geographical Information Systems (GIS)– Principles and Application (15 credits)
	GEOG 3506 Geography, Health and Development (7.5 credits)
	GEOG 3561 Gender and Social Change (7.5 credits)
	BARN 3001 Childhood and Culture (7.5 credits)

2nd semester:

Core courses: GEOG 3051 History of Geographical Thought (15 credits)
GEOG 3052 Research Methodology (15 credits)

Electives: AAR4945 Planning and Construction in Developing Countries (7.5 credits)

3rd semester:

Core course: GEOG 3920 Master's thesis (45 credits)

Electives: GEOG 3505 Landscape and Planning (15 credits)
GEOG 3510 Geographical Information Systems (GIS)– Principles and Application (15 credits)
GEOG 3511 Remote Sensing (15 credits)
GEOG 3506 Geography, Health and Development (7.5 credits)
GEOG 3561 Gender and Social Change (7.5 credits)

4th semester:

Core course: GEOG 3920 Master's thesis (45 credits)

Students are expected to use the summer between the second and third semesters to collect data and conduct field-work for their thesis. The thesis is expected to be completed within four semesters from admission to the course. Supervision of theses will not be given beyond this. The thesis must be written in English.

Course plan
Compulsory core courses

GEOG 3050	**Theories of Social Change**
Credits:	15
Semester:	1 semester (autumn)
Lectures:	28 hours
Compulsory:	Assignment
Assessment:	Written examination (6 hours)

Aims and description of the course:
GEOG 3050 Theories of Social Change is compulsory for students at the MPhil in Social Change and elective for students doing a Master in Geography. The course serves as an introduction to the main theme of the Social Change programme. Students are to broaden their knowledge of theories of social change through an introduction to different analytical perspectives on the study of social change. The course will focus on conceptualizations of development and social change, and on themes such as the relationship between growth and poverty, globalization and processes of marginalization. The course will also include presentations of relevant empirical material from research within development studies. The teachers for the course represent several disciplines within the social sciences.

GEOG 3051	**History of Geographical ThougtHistory of Geographical Thougt**
Research MethodologyCredits:	15
Semester:	1 semester (spring)
Lectures:	18 hours
Seminars:	16 hours
Compulsory:	Assignment
Assessment:	Assignment and oral examination

This course is only for students who are taking the MPhil in Social Change.

Aims and description of the course:
The course deals with the historical development of central geographical ideas and approaches relevant to the conceptualising, implementation and writing of a Master's thesis. The course is divided into two sections. The first section, based on lectures and readings, focuses on theory. The second section, grounded in seminar participation, focuses on preparing and writing a paper on how the history of geographical thought can be related to the formulation of the thesis.

GEOG 3052	**Research Methodology**
Credits:	15
Semester:	1 semester (spring)
Lectures:	14 hours (introduction)
Seminars:	6 hours
Field trip:	7-10 days (incl. preparations), compulsory
Assessment:	Assignment and oral examination

This course is only for students who are taking the MPhil in Social Change.

Aims and description of the course:
The course will give an introduction to research methodology and different kinds of research methods, covering both qualitative and quantitative approaches. The aim of the course is to give students the necessary tools for their thesis work, concerning defining a research problem, research design, and techniques for data collection and analysis. The course builds on a common introductory course and a choice of modules. Each student chooses 1 out 2 modules, one covering quantitative and one covering qualitative methodologies.
The field trip is a compulsory part of the course. One of the aims of the field trip is to give students practical training in using different methods. Participation in preparatory lectures and seminars for the field trip is compulsory. After the field trip all students must write contributions to a common report (group work). The report contributions have to be approved by the Department of Geography, but a grade will not be given.

GEOG 3920	**Master's Thesis in Social Change**
Credits:	45
Assessment:	Thesis and oral examination. The oral examination is used to adjust the grade given for the thesis.

This course is only for students who are taking the MPhil in Social Change.

Aims and description of the course:
The thesis consists of a scientific presentation of a chosen topic. The thesis should be 90 - 100 pages (Times Roman 12/ spacing 1.5/ approximately 40 000 words). The student must prepare a project proposal of at least 4 pages before the 15 February in the second semester. On the basis of the project proposal, a faculty member will be ap-

pointed as supervisor in accordance with the guidelines approved by the Board of the Department. The supervisor must be kept informed about the progress in the thesis writing. Seminars with emphasis on theoretical and practical issues related to the writing of a Master's thesis will be held during the first and the second year. Students are expected to present their thesis work for fellow students and faculty members at 2-3 seminars. It is expected that students will need a full academic year to complete the thesis. It is recommended that students start to work on their thesis in their second semester.

Electives

GEO 3505*	**Landscape and Planning**
Credits:	15
Semester:	1 semester (autumn)
Lectures:	30 hours
Assessment:	project/practical work + oral examination

Aims and description of the course:
The course discusses theoretical and methodological questions concerning landscape in relation to planning. The course will consider landscape as a concept, landscape values, and theoretical and methodological problems within landscape planning and landscape management. Social Change students will write an individual paper based on the recommended reading for the course.
Geography Master´s students will participate in a project exercise in which students carry out fieldwork, interviews and document analysis of an actual planning situation in which landscape and environmental values are involved. The project work will normally be carried out as group work. The aim of the project is to give insight into how and to what extent regard for landscapes and environments will be taken into account in planning and management, and also to illustrate which landscape and environmental problems are encountered in the general planning process.

The lectures will normally be given in English. Social Change students will write their individual paper in English. The practical coursework for Geography Master´s students will be conducted in Norwegian, and the group reports will normally be written in Norwegian.
During the oral examination students will be required to give an account of/explain their work (written paper or project report), and will be questioned on the basis of this and relevant course literature. Emphasis will be placed on the feedback and learning in the oral examination.

GEOG 3510*	**Geographical Information Systems (GIS) – principles and application**
Credits:	15
Semester:	1 semester (autumn).
Lectures:	24 hours
Practicals:	24 hours + project work
Requirements:	Min. 7.5 credits within mathematics, statistics or computing
Compulsory:	Exercises and project paper
Assessment:	Project paper and oral examination

Aim and description of the course:
This is an advanced course in Geographical Information Systems (GIS). It gives a comprehensive overview of the use of GIS-functions. It also gives a comprehensive introduction to GIS-components such as hardware, software, organization and databases. Students will become familiar with how the technology can be used in social and natural science problems. They will be introduced to different programme packages and become familiar with both methods for data collection and evaluation of the quality of the data sets they work with. Students will also be introduced to simple programmeming and use of GIS on the Internet.

During the semester students will complete short exercises and a more comprehensive project paper. The exercises and the project paper must be approved before the student is allowed to take the examination. The oral examination will be based on the project paper and the course reading list.

GEOG 3511*	**Remote Sensing**
Credits:	15
Semester:	1 semester (autumn).
Lectures:	24 hours
Practicals:	24 hours + project work
Requirements:	Min. 7.5 credits within mathematics, statistics or computing
Compulsory:	Exercises and project paper
Assessment:	Project paper and oral examination
Limited number of students	Yes

Aim and description of the course:
The course will give an introduction to the use of satellite images in geographical problems. There will be a comprehensive examination of how data collection from satellites is made. Students will be introduced to different sources (different satellites), methods for treatment and correction of digital images and different application possibilities for digital satellite images, aerial photographs and orthodox photography. An important element will be explanation of how digital images can be integrated into a geographical information system (GIS). Students will be introduced to specialist programme packages such as, for example, Idrisi.

During the semester students will complete short exercises and a more comprehensive project paper. The exercises and the project paper must be approved before the student is allowed to take the examination. The oral examination will be based on the project paper and the course reading list.

GEOG 3506*	**Geography, Health and Development**
Credits:	7.5
Semester:	1 semester (autumn)
Lectures:	20 hours
Seminars:	8 hours
Compulsory:	Assignment and presentation
Assessment:	Written examination (4 hours)

The course will be given in English and is designed for 3 groups:
- Students on the MPhil in Social Change Programme (anticipated to be the largest group)
- Other (Norwegian) Geography Master´s students
- Master´s students studying Health in ISH who take this course as an elective (listed in the study plan as an optional course for this study).

The course provides a general introduction to geographical aspects in health, with two main focuses:
Health status, disease/injury and risk/risk factors
The geography of different levels of health services, with emphasis on demand and use, offer and accessibility, development, and treatment (self treatment, care and cure)

Aim and description of the course:
The course has a development perspective with emphasis on the situation in developing countries. More general international development trends are also covered. In addition to a common core curriculum, in-depth courses (curriculum options) are available: one which focuses on developing countries and one which is on western countries (focusing on the situation in Norway). The course covers studies on approaches to quantitative and qualitative methods. Case studies. Part of the course will be based on individual reading, which will provide a basis for carrying out the assignment. These projects will be presented in seminars. A seminar will also be held on researching health and health geography in libraries and databases (3 hours).
Assignment and presentation must be approved before the student is allowed to take the examination.

GEOG 3561*	**Gender and Social Change**
Credits:	7.5
Semester:	1 semester (autumn)
Lectures:	10 hours
Assessment:	Written examination (4 hours)

Aim and description of the course:
The course offers an introduction to the main themes of Norwegian and international social scientific research on gender, and provides a theoretical platform for further studies of gender-related issues. The course seeks to combine an interdisciplinary and course-specific approach. It aims at outlining different perceptions of gender within different social-scientific traditions. Theoretical and methodological problems related to the use of gender as an analytical category and how these are manifested in social scientific research will be treated. The course will also include presentations of empirical material from gender-specific research within the field of geography and other social scientific disciplines. The course will be based on a few introductory lectures and on individual study with reading lists.

AAR 4945	**Planning and Construction in Developing Countries**
Credits:	7.5
Semester:	1 semester (spring)
Lectures:	30 hours
Seminars:	28 hours
Assessment:	Written examination (6 hours)

Aim and description of the course:
The course offers an introduction to issues that are important for an understanding of planning, construction and infrastructure in developing countries (ideology, cultural, social and geographical issues, economy, resources, technology, etc.). Focus will be on those features that differ fundamentally from industrialized countries, with particular emphasis on problems related to the practical implementation of projects.

BARN 3001	**Childhood and Culture**
Credits:	7.5
Semester:	1 semester (autumn 2004)
Lectures:	20 hours
Seminars:	8 hours
Required activities:	Approved working paper and oral presentation of this.
Form of evaluation:	4 hour written examination.

Aims and description of the course:
An objective of the course is to provide the student with fundamental insight to the ongoing debates and the prevailing concepts and theoretical perspectives being used in children and childhood research. Among other, a broad overview of how cultural representations of childhood are dynamic and change with both time and space. The course addresses issues both of a structural nature, which have an implication for children's everyday lives and childhood, as well as children's agency in defining and giving meaning to their lives and activities. The central issue is childhood and related themes such as generation, gender, identity and ethnicity as these take form through varying processes like globalization, institutionalization, consumption and commercialization.

During the first half of the semester the course will primarily comprise of lectures. Halfway through the semester the student is to devote time to writing a working paper which elaborates some of the issues covered in the lectures and relates this to *one* or more of the three: curriculum (e.g. collection of articles, a book, etc.), a concrete problem or a theme for a Master´s thesis. This working paper is to be orally presented and discussed at a seminar (1 hour per student). In addition to presenting one's own working paper, each student will be required to comment on another student's working paper. Participation in lectures and completion of both activities are required in order to gain admittance to the written examination.

MASTER OF SCIENCE IN EXERCISE PHYSIOLOGY / SPORT SCIENCES

The teaching and tutoring are in English.
There are no tuition fees in this programme, but international students have to prove their ability to cover living costs before they can obtain a student visa to Norway.

The MSc degree in Exercise Physiology is a two-year full-time programme.
Admission requirements to the MSc programme are a bachelor's degree or an equivalent 3-year university or college education, normally with a major in Exercise Physiology, Sport Sciences, Exercise Science, Biology, Physiotherapy, Nursing, Biochemistry, Occupational therapy or similar fields. A firm foundation in human biology is required within the Bachelor's degree.

The PhD programme is a three year full-time programme requiring a Master's Degree in a related field.
10 students will be admitted to the programme every year.
Information:
Dr. Jan Helgerud: +4791821892; Jan.Helgerud@medisin.ntnu.no
Dr. Jan Hoff: +4792609936; Jan.Hoff@medisin.ntnu.no
Internet address: http://www.ntnu.no/

Master of Science in Exercise Physiology / Sport Sciences programme

The MSc is a research and thesis-based integrated graduate degree programme in Exercise Physiology at the Faculty of Medicine. This is a 120-credit, two-year period of study. It is exclusively concerned with basic research training and comprises compulsory courses together with optional courses dependent upon the research specialization of students. The programme is connected to ongoing research and has a focus on training interventions and its basic mechanisms as well as effects in preventive medicine, treatment, rehabilitation and ageing, and in sports performance.
The Master of Science degree is a requirement for further research work at PhD level within the Exercise Physiology programme. Teaching and tutoring is given in English.

Year 1:
SPO 3010 Medicine for non-MD's.
7.5 credits, autumn term
Functional anatomy and physiology from cell to organ, health and activity related diseases, ethical aspects in medicine and research.

SPO 3020 Training Circulation and Oxygen Consumption.
7.5 credits, autumn term
Circulatory function, supply and demand. Limitations and adaptations in patients and athletes

SPO 3030 Training Muscle and Force Production.
7.5 credits, autumn term
Muscle architecture, changes, neural adaptations, limitations and functional adaptations in patients and athletes. Motor skill.

SPO 3040 Environmental Adaptations
7.5 credits, autumn term
Diving, high altitude, exercise in cold and hot environments

SPO 3050 Research Methods in Exercise Physiology
15 credits, Spring term
Introduction to theories of science and basic statistics.

SPO 3060 Specialization in Exercise Physiology
15 credits, Spring term
Specialization within the area of research planned for the thesis. Review of research literature, and writing a review article in the area of specialization for the thesis.
Compulsory literature: A minimum of 30 articles from peer-reviewed scientific journals.

Year 2:

SPO 3070 Research Apprenticeship in Exercise Physiology

15 credits, autumn term

This course contains the most usual data collection techniques in the area of Exercise Physiology. The student report consists of a pilot experiment to ensure that data collection techniques or methods planned for the thesis are reliable and valid

SPO 3901 Thesis in Exercise Physiology

45 credits

The thesis should be within the area of the research competence among the available supervisors. The theme has to build upon the specialization in EP 3060, and the research apprenticeship in EP 3070, and will be course to approval by the board of Professors. The thesis is to be in the format of an article in a peer reviewed research journal, and will be course to external evaluation.

MASTER OF SCIENCE IN URBAN ECOLOGICAL PLANNING

Compulsory core courses:

Semester:	Course no.:	Title:	Autumn	Spring
1.sem	AAR4525	Urban Ecological Planning in Developing Countries. Project work	15 Cr	
1.sem	AAR4816	Urban Ecological Planning. Method	7.5 Cr	
1.sem	AAR4820	Urban Ecological Planning. Theory	7.5 Cr	
2.sem		Electives (see list)		15 Cr
2.sem	AAR5300	Urban Ecological Planning in Diverse Cultures		15 Cr
3.sem	AAR5200	Analysis of Field Work for MSc thesis in Urban Ecological Planning	15 Cr	
3.sem	AAR5310	Planning Theory	15 Cr	
4.sem	AAR5400	Master´s degree		30 Cr

AAR4525 Urban Ecological Planning in Developing Countries. Project Work
Course responsibility: Professor Hans Christie Bjønness
Duration: 1 term (autumn semester 2005)
Credits:15 sp

The project is accomplished through a two months intensive fieldwork in a city in a developing country. The students are engaged with the real on site experience, through cooperation with local interest partners, together with formal and informal institutions. This is to give insight in the premises and the content of the local transformation processes, and demands for constructive solutions for improvement. Local persons are engaged to conduct a stronger and better group work. The project is presented for local users, interest partners, planners and local students and teachers. The group project is accomplished in Norway with emphasis on theory and method. Accomplishment: Group work and seminars. This is a very intensive course, where the project work is at the centre. This is an international course with NORAD and quota students, European exchange students and Nordic students. The accomplishment of the course gives emphasis to multicultural and multidisciplinary studies.

Course reading: Compendium prepared by the course responsible.
Examination: Evaluation of group work and presentation.

AAR4816 Urban Ecological Planning. Method
Course responsibility: Professor Hans Christie Bjønness
Duration: 1 term (autumn semester 2005)
Credits:7.5 sp

The method will be applied in the project work which starts with a two months intensive fieldwork in a city in a developing country. The students are engaged with "the real -on site" experience, through cooperation with local interest partners, together with formal and informal institutions. In this work will 'integrated action planning' be central, in addition will the students apply "Logical Framework Approach". This is based on NORAD and FN's standard for project planning. The methodology gives emphasis to working methods which gives insight in the local background of transformation processes, and to conduct constructive solutions for improvement. How can the local community and its premises be advocated? The project is presented for local users, interest partners, planners and local students and teachers. The group project is accomplished in Norway with emphasis on theory and method. Accomplishment: Seminars. This is a very intensive course, where the project work is the main assessment. International course with NORAD and international quota students, European exchange students and Nordic students. The accomplishment of the course emphasis multicultural and multidisciplinary studies.

Course reading: Compendium prepared by the course responsible.
Examination: Oral examination.

AAR4820 Urban Ecological Planning. Theory
Course responsibility: Professor Hans Christie Bjønness
Duration: 1 term (autumn semester 2005)
Credits:7.5

The theory will be applied in the project work which starts with two month´s intensive fieldwork in a city in a developing country. The students are engaged with "the real -on site" experience, through cooperation with local interest partners, together with formal and informal institutions. The theory emphasis principles within urban ecological planning, central discussion of development and modernization paradigms, theories within alternative development, theory of sustainable use of areas and urban approaches in developing and industrialized countries. Theoretical issues within communicative and democratic planning will also be discussed. The aim is to gain understanding in the local background of transformation processes, and to conduct constructive solutions for improvement. The project is done in Norway with emphasis on method and theory. Outcome: Seminars. This is a very intensive course, where the project work is the main assessment. International course with NORAD and international quota -students, European exchange students and Nordic students. The course puts emphasis to multicultural and multidisciplinary studies.

Course reading: Compendium prepared by the course responsible.
Examination: Oral examination.

AAR5300 Urban Ecological Planning in Diverse Cultures
Course responsibility: Professor Hans Christie Bjønness
Duration: 1 term (spring semester 2006)
Credits:15

The course will elaborate on theories of urban ecology and on methods of urban ecological planning and management. There will be introductions to value issues in theory, and to process-oriented and system-based theory taking up conditions for urban transformation and the complexity of relationships.
Planning and management methods for sustainable urban development based on urban ecological principles will be addressed through analysis of relevant international and Nordic case studies. Issues theory and method will be discussed in relation to urban ecological planning at various levels of planning, boundaries, processes of segregation and urban transformation.
Teaching method:Concentrated lectures, seminars and project work. The students must be prepared to participate actively. The writing of an essay is required.

Course reading: Compendium prepared by the course responsible.
Examination: Term paper which will be evaluated.

AAR5310 Planning Theory
Course responsibility: Professor Tor Medalen
Duration: 1 term (autumn semester 2006)
Credit: 15

The course seeks to give an understanding of the history of planning. Classical theories of planning, and their development until today, are presented and discussed. Practical examples and references present the theoretical material.
Teaching method:Concentrated lectures, seminars and project work. The students must be prepared to participate actively. The writing of an essay is required.
Course reading:Friedmann, John (1987).
Planning in the public domain: From knowledge to action
Princeton University Press, Princeton, New Jersey
Forester, John (1989).
Planning in the face of power.
California University Press, Berkeley, California
Sager, Tore (1994)
Communicative planning theory
Avebury, Aldershot, England
Schön, Donald A (1983)

The reflective practitioner: How professionals think in action.
Basic books, New York.
Compendium with additional papers.

Examination: Semester paper which counts 1/3 in the final evaluation
Written examination.

AAR5400 Master of Science Thesis in Urban Ecological Planning
Course responsibility: Professor Hans Christie Bjønness and /or appointed supervisors
Credits: 30

The thesis consists of a scientific presentation of a chosen topic. The thesis should be about 100 pages. The student must prepare a project proposal of at least 4 pages before 15 February in the second semester. On the basis of the project proposal, a faculty member will be appointed as supervisor in accordance with the guidelines approved by the Board of the Department. The supervisor must be kept informed about the progress of the writing of the thesis. Seminars with emphasis on theoretical and practical issues related to the writing of a Master's thesis will be held during the first and second year. Students are expected to present their thesis work for fellow students and faculty members at 2 seminars. It is recommended that students start to work on their thesis in their second semester. The last spring semester is fully devoted to the thesis.

Thesis evaluation: Thesis and presentation. The presentation is used to adjust the grade given for the thesis.
This course is only for students who are taking the full study in MSc in Urban Ecological Planning.

AAR5200 Analysis of Fieldwork for Master´s Thesis in Urban Ecological Planning
Course responsibility: Professor Hans Christie Bjønness and /or appointed supervisors
Credits:15
Duration: 1 term (autumn semester 2006)

A fieldwork plan is to be presented for and approved by the person with the course responsibility and / or the appointed supervisor prior to the fieldwork. The fieldwork is for a two month period during the summer between the second and the third semester. The fieldwork should preferably be in the home country of the participant from a developing country. During the third semester the fieldwork results will be recorded, analysed and presented.

Evaluation: Evaluation based on pre-fieldwork plan, recording and analysis of fieldwork results and presentation.

Electives:

Course no.	Title:	Note	Autumn	Spring
DIA5098	Housing Theory and History	1	7.5 Cr	
GEOG3050	Theories of Social Change	1	15 Cr	
GEOG3561	Gender and Social Change	1	7.5 Cr	
GEOG3505	Landscape and Planning	1	15 Cr	
GEOG3506	Geography, Health and Development	1	7.5 Cr	
AAR5250	Preparation for Fieldwork for Master's students	2		7.5 Cr
GEOG3052	Research Methodology	2		15 Cr
AAR4945	Planning and Construction in Developing Countries	2		7.5 Cr
DIA4091	Methods in Environmental Impact Assessments	2		7.5 Cr
DIA1094	Resource Use in Buildings	2		7.5 Cr
AAR5260	GIS in Urban Planning	2		7.5 Cr

1)
Autumn:
Elective courses offered during the autumn can only be selected if a study plan tailored to the MSc thesis course is agreed with the Faculty, and recommended by the MSc thesis supervisor and the person with the course responsiibility.

2)
Spring:
Elective courses amounting to 15 Credits are to be selected from the above list.

AAR5250Preparation for Fieldwork for Master's Students
Course responsibility: NN
Duration: 1 term (spring semester)
Credit: 7.5

The course is to give basic knowledge of research to students who are to use research methods in relation to a project.
The student learns how to write a project proposal how to carry out a research project and write a research report. The student will learn to read and evaluate research reports based on different methods and approaches.
Various research methods will be reviewed (hypothesis-testing vs. hypothesis generating, deductive vs. inductive) in relation to real projects and literature about research methods. Through presentation of their own projects, students will learn to evaluate their own and others research designs. Written presentations will be revised to become a project proposal.

It is recommended to take the course in ”Preparations for Fieldwork for Master’s Students” or the GEOG 3052 course in ”Research Methodology”. Students are recommended to apply for admission also in ”Preparations for Fieldwork for Master’s Students” if they apply for GEOG 3052. Places in for GEOG 3052 are limited.

Examination: Student evaluation is based on exercises and paper.

GEOG 3052 Research Methodology
Course responsibility: NN
Duration: 1 term (spring semester)
Course credits:15

This course is only for students who are taking the MPhil in Social Change.
Aims and description of the course:
The course will give an introduction to research methodology and different kinds of research methods, covering both qualitative and quantitative approaches. The aim of the course is to give students the necessary tools for their thesis work, concerning defining a research problem, making a research design, and techniques for data collection and analysis.
The course builds on a common introductory course and a choice of modules. Each student chooses 1 out 2 modules, one covering quantitative and one covering qualitative methodologies.
The field trip is a compulsory part of the course. One of the aims of the field trip is to give students practical training in using different methods. Participation in preparatory lectures and seminars for the field trip is compulsory. After the field trip all students must write contributions to a common report (group work). The report contributions have to be approved by the Department, but a grade will not be given.

It is recommended to take the course in ”Preparations for Fieldwork for Master’s Students” or the GEOG 3052 course in ”Research Methodology”. Students are recommended to apply for admission also in ”Preparations for Fieldwork for Master’s Students” if they apply for GEOG 3052. Places in for GEOG 3052 are limited.

Field trip:7-10 days (incl. preparations compulsory
Assessment:Assignment and oral examination

AAR 4945 Planning and Construction in Developing Countries
Course responsibility:Professor Hans Christie Bjønness
Duration: 1 term (spring semester)
Credit: 7.5

The course offers an introduction to issues that are important for an understanding of planning, construction and infrastructure in developing countries (ideology, cultural, social and geographical issues, economy, resources, technology, etc.). Focus will be on those features that differ fundamentally from industrialized countries, with particular emphasis on problems related to the practical implementation of projects.
The project work, which is a compulsory part of the course, emphasizes project planning techniques, and gives an introduction to writing a project document using the UN format.The course is interdisciplinary both in content and participation. The course is offered for MPhil in Social Change students and also for students at other faculties at NTNU.

Course reading: Compendium prepared by the course responsible.
Examination: Approved compulsory project-work and written examination.

DIA 4091 Methods in Environmental Impact Assessments
Course responsibility: NN
Duration: 1 term (spring semester)
Credit: 7.5

The course deals with different methods for impact assessments. The main focus is on ex ante environmental impact assessments. Social and strategic impact assessments are included. Decision-making and uncertainty is discussed. Moreover is evaluation (ex post) approaches and techniques we addressed. The Norwegian EIA system, which is coordinated with the European Union, exemplifies EIA as a political and social activity. It is compuslory to write a semester paper, which counts for 1/3 of final grade. The teaching language is English.

Examination: Semester paper which counts the 1/3 in the final evaluation
Written examination.

DIA 1094 Resource Use in Buildings
Course responsibility: Professor Anne Grete Hestnes
Duration: 1 term (spring semester)
Credit: 7.5

The aim of the course is to give an introduction to our resource situation, and to alternative possibilities for resource use in buildings. The course is a continuation of the course “Energy and Resource Utilization of Buildings”, which deals with the form and technical equipment of buildings with the aim of optimization the use of resources in buildings.
The course, “Resource Use in Buildings and Built Form”, adds to this background a more general range of issues regarding our relationship to our resources. The course will discuss existing possibilities and limitations, and present methods for estimating and controlling the use of resources by grouping and designing buildings in given situations. The following issues are to be treated: Local and global access to resources, use of resources, environmental auditing, and alternative solutions.
Course material:Compendium
Examination:Oral

AAR 5260 GIS in Urban Planning
Course responsibility: Associate Professor Alf Ivar Oterholm
Duration: 1 term (spring semester)
Credit: 7.5

The course is an introduction to Geographical Information Systems (GIS). Theory, methods, techniques and applications are illustrated in lectures, seminars, demonstrations and practical exercises. Issues that will be covered are: the GIS concept, the raster and vector principles, data capture, data modelling, handling of attribute tabular data, spatial analysis and query, mapping layout etc.

Course material: Heywood, Ian et al., 2002: An Introduction to Geographical Information Systems.

Examination:Oral examination

DIA 5098 Housing Theory and History
Course responsibility: Professor Sven Erik Svendsen

Duration: 1 term (autumn semester)
The objective is to provide an increased understanding of the development of the shelter sector in view of historical, cultural and professional factors. A presentation of relevant theoretical and historical issues and a discussion of different typologies and of contemporary housing and settlement interventions will form the main content of the course.
Classes will be conducted as seminars based on a list of compulsory literature.

Examination:An essay, or a semester report dealing with an agreed topic within the theme of the course to be written, written at the end of the course.

GEOG 3050 Theories of Social Change
Course responsibility NN
Credits: 15
Semester:1 semester (autumn)
Lectures:28 hours

GEOG 3050 Theories of Social Change is compulsory for students at the MPhil in Social Change and elective for students doing a Master´s in Geography. The course serves as an introduction to the main theme of the Social Change programme. Students will broaden their knowledge of theories of social change through an introduction to different analytical perspectives on the study of social change. The course will focus on conceptualizations of development and social change, and on themes such as the relationship between growth and poverty, globalization and processes of marginalization. The course will also include presentations of relevant empirical material from research within development studies. The teachers for the course represent several disciplines within the social sciences.

MSc in Urban Ecological Planning course have to apply for this course. Limited places.
Compulsory:Assignment
Assessment:Written examination (6 hours)

GEOG 3561* Gender and Social Change
Course responsibility: NN
Credits:7.5
Semester:1 semester (autumn)

The course offers an introduction to the main themes of Norwegian and international social scientific research on gender, and provides a theoretical platform for further studies of gender-related issues. The course seeks to combine an interdisciplinary and course-specific approach. It aims at outlining different perceptions of gender within different social-scientific traditions. Theoretical and methodological problems related to the use of gender as an analytical category and how these are manifested in social scientific research will be treated. The course will also include presentations of empirical material from gender-specific research within the field of geography and other social scientific disciplines. The course will be based on a few introductory lectures and on individual study with reading lists.

MSc in Urban Ecological Planning course have to apply for this course. Limited places.

Assessment:Written examination (4 hours)

GEO 3505* Landscape and Planning
Course responsibility: NN
Credits: 15
Course duration: 1 semester (autumn)

The course discusses theoretical and methodological questions concerning landscape in relation to planning. The course will consider landscape as a concept, landscape values, and theoretical and methodological problems within landscape planning and landscape management. Social Change students will write an individual paper based on the recommended reading for the course.
Geography Master´s students will participate in a project exercise in which students carry out fieldwork, interviews and document analysis of an actual planning situation in which landscape and environmental values are involved. The project work will normally be carried out as group work. The aim of the project is to give insight into how and to what extent regard for the landscape and the environment will be taken into account in planning and management, and also to illustrate which landscape and environmental problems are encountered in the general planning process.

The lectures will normally be given in English. Social Change students will write their individual paper in English. The practical coursework for Geography Master´s students will be conducted in Norwegian, and the group reports will normally be written in Norwegian.

There will be given one combined grade for the project paper and the oral examination.

MSc in Urban Ecological Planning course have to apply for this course. Limited places.

Assessment:project/practical work + oral examination

GEOG 3506* Geography, Health and Development
Course responsibility: NN
Credits:7.5
Semester:1 semester (autumn)

The course will be given in English and is designed for 3 groups:
- Students on the MPhil in Social Change (anticipated to be the largest group
- Other (Norwegian) Geography Master´s students
- Master´s students studying Health in ISH who take this course as an elective (listed in the study plan as an optional course for this study).

The course provides a general introduction to geographical aspects in health, with two main focuses:
Health status, disease/injury and risk/risk factors
The geography of different levels of health services, with emphasis on demand and use, offer and access ability, development, and treatment (self treatment, care and cure)
Aim and description of the course:
The course has a development perspective with emphasis on the situation in developing countries. More general international development trends are also covered. In addition to a common core curriculum, in-depth courses (curriculum options) are available: one which focuses on developing countries and one which is on western countries (focusing on the situation in Norway). The course covers studies on approaches to quantitative and qualitative methods. Case studies. Part of the course will be based on individual reading, which will provide a basis for carrying out the assignment. These projects will be presented in seminars. A seminar will also be held on researching health and health geography in libraries and databases (3 hours).

Assignment and presentation must be approved before the student is allowed to take the examination.
MSc in Urban Ecological Planning course have to apply for this course. Limited places.
Compulsory:Assignment and presentation
Assessment:Written examination (4 hours)

MASTER OF SCIENCE IN MATHEMATICS

Degree Programme
The degree programme for the Master of Science in Mathematics at NTNU is stipulated to take two years. One year of full-time studies corresponds to 60 credits, i.e. in total 120 credits are needed. The degree consists of two parts. The programme starts with course work corresponding to 82.5 credits and concludes with writing a thesis corresponding to 37.5 credits.

Admission requirements
To be accepted as a student to this programme one has to have:
(i) Bachelor's degree consisting of at least three years of university studies.
(ii) Studied mathematics at a university for at least 1½ years.
(iii)Reached the level and covered material equivalent to MA1101 Basis calculus I, MA1102 Basis calculus II, MA1201 Linear algebra and geometry, MA1202 Linear algebra with applications, MA1103 Vector calculus, MA1301 Number theory, MA2201 Algebra, MA2104 Differential equations and complex function theory.

(All codes for the courses refer to the 2004/2005-course catalogue).

Aim and description of the course
The Department of Mathematical Sciences offers various courses at graduate level in addition to more specialized graduate seminars. Currently we offer three directions of study, algebra, analysis (functional analysis and complex and harmonic analysis, differential equations) and topology. All students must take at least 30 credits amongst the courses MA3201 Rings and modules, MA3202 Galois theory, TMA4145 Linear methods, TMA4225 Foundations of analysis, TMA4190 Manifolds and MA3402 Analysis on manifolds (unless the material has been covered in previous courses).

For the algebra direction, which builds upon MA3201 Rings and modules, MA3202 Galois theory, the courses MA3203 Ring theory and MA3204 Homological algebra should be taken. Some possible areas for topics for the thesis in algebra are presently representation theory of finite dimensional algebras, Lie-algebras, homological algebra and higher dimensional rings and orders.

For the analysis direction, which builds upon TMA4145 Linear methods, TMA4225 Foundations of analysis, the courses TMA4230 Functional analysis and TMA4175 Complex analysis should be taken. Some possible areas for topics for the thesis in analysis are presently geometric function theory, function spaces, harmonic analysis, continued fractions, dynamical systems, operator theory, topological measure theory and partial differential equations.

For the topology direction, which builds upon TMA4190 Manifolds, MA3402 Analysis on manifolds, the course MA3403 Algebraic topology should be taken, and at least one more topology course. Some possible areas for the thesis in topology are homotopy theory, K-theory, generalized cohomology theories, category theory, non-linear dynamics, Lie-groups and differential geometry.

As mentioned above, the coursework will take almost 1½ year (87.5 / 60 year). All the courses in the degree must be approved by the Department of Mathematical Sciences, NTNU.

The thesis
The thesis could contain some independent research, but could also be of purely expository nature. The student may be required to follow seminars on the topic of the thesis. These seminars will in addition to the courses help the student to obtain the necessary background needed for writing the thesis. The work with the thesis should correspond to a workload of 37.5 credits.

Examinations
The examination in each of the courses is either a written examination or an oral examination normally at the end of the semester when the course is taught. However the examination in one course should be taken as a part of the final examination after the thesis has been handed in. This examination is oral. In connection with this examination the student can also be asked questions on the content of the thesis.

Grades
For all examinations and also for the thesis the scale of grading is from A (highest) to F (lowest) or Fail.

MASTER OF SCIENCE IN PHYSICS

The Master of Science programme (MSc) in Physics at NTNU is designed to train the student in a chosen field of physics, and in scientific work and research. The student will write a Masters Thesis within a selected field of speciality.

1 The programme

1.1 Entry requirements

For admission to the programme, the student is required to have completed a bachelor's degree of at least 3 years of duration at university level. This should include at least 1½ years of physics and one year of mathematics and statistics. The university courses should cover material at a level comparable to the requirements for admittance to the graduate programme in physics at NTNU.

1.2 Master programme

The Master of Science-programme in physics consists of two years corresponding to 120 credit points including a thesis of 60 credit points. The rest of the study is scheduled courses of 7.5 student points. The courses should be chosen in topics which are related to the specialisation in the thesis work and in collaboration with the supervisor. See below for the different specialisation.
The Master of Science programme (MSc) in Physics at NTNU is designed to train the student in a chosen field of physics, and in scientific work and research. The student will write a Masters Thesis within a selected field of speciality.

<table>
<tr><td>Year</td><td>Semester</td><td colspan="4"></td></tr>
<tr><td rowspan="2">2</td><td>Spring</td><td>Self study</td><td colspan="3" rowspan="2">Master thesis work</td></tr>
<tr><td>Autumn</td><td></td></tr>
<tr><td rowspan="2">1</td><td>Spring</td><td>Multidisciplinary course
(experts in team)</td><td></td><td></td><td rowspan="2">Master thesis work</td></tr>
<tr><td>Autumn</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Credits</td><td>7.5</td><td>7.5</td><td>7.5</td><td>7.5</td></tr>
</table>

1.3 Exams and grades

For each course an exam, oral or written, will be arranged at the end of the semester in which the course is offered. However, the exam in one of the courses or in a specially selected curriculum from scientific articles or books relevant for the thesis work must be taken as an oral exam as part of the final exam. The thesis must be submitted at least one month before this final exam, during which the candidate will also be questioned on the content of the thesis. The set of courses making the master degree and the topic for the thesis will be approved by the department after submitting the final examination form 8 weeks before the exam.

For all exams and also for the thesis the scale of grading is from A (highest) to E (lowest), or Fail.

2. Areas of specialisation

2.1 Experimental physics

Core courses suitable for this study:

TFY 4185 Electronics. Compulsory for all students planning to do a thesis in experimental physics.

Autumn:
FY3112 Solid state physics
TFY4185 Electronics
FY2302 Biophysics I
FY2201 Energy and environmental physics
FY3006 Sensors and transducers
TFY4240 Electromagnetic theory

Spring:
FY3008 Signal analysis
FY3201 Atmospheric Physics
FY3100 Optics
TFY4235 Numerical physics
TFY4190 Instrumentation
TFY4245 Solid state, advanced

2.2 Theoretical physics

Autumn:
FY2405 Introduction to Quantum Mechanics
FY3112 Solid state physics
TFY4240 Electromagnetic theory
TFY4305 Nonlinear dynamics

Spring:
FY2450 Astrophysics
FY3402 Subatomic physics
TFY4235 Numerical physics
TFY4275 Classical transport theory
TFY4270 Theory of classical fields

3 Thesis topics

3.1 Experimental physics

Specialisation is possible in the following fields:

Biophysics

The activity in biophysics is directed towards the fundamental bio-processes on the molecular level or in organisms. Both experimental and theoretical investigations are possible, as well as simulations and modelling studies. Research work for an MSc thesis may be carried out in the following fields: Biophysical systems analysis. Control

mechanisms in organisms, for instance balance system, oscillating systems and water transport within cells. Photo biophysics. Reactions induced by light in biological systems or molecules are studied by spectroscope techniques and electron and nuclear magnetic resonance. Transport processes. Transport of light through scattering and absorbing media and diffusion processes are studied. Physics of the human visual system.
Contact person: Anders Johnsson

Energy and Environmental Physics

Research is done on the mapping and description of the resources for renewable energy and on renewable energy systems. UV-radiation and its effects on biological systems are also studied. MSc thesis work may be based on both experimental and theoretical investigations as well as simulations and modelling studies in the following fields: Solar radiation. Spectra of direct radiation and spectral and angular distribution of diffuse radiation, in particular the UV part. UV radiation in aquatic systems. Time and space variations of the wind field, and wind energy applications. Concentrating solar energy systems.
Contact person: Berit Kjeldstad

Theses can also be given in other fields as for instance optics and solid state.

3.2. Theoretical physics

There are several research fields in theoretical physics, and suitable topics for MSc thesis candidates with a sufficient background can be found in the fields outlined below.

Physics of complex systems.

Ongoing research on soft condensed matter physics, specially in connection with protein folding, on transport and mechanical properties of granular matter, on self organisation and criticalness in macroscopic systems. Thesis topics may be found in any of these fields. Contact person: Alex Hansen
Statistical mechanics of many-particle systems

Ongoing research on self-consistent equations of state, liquid crystals and solid-solid transitions. Thesis topics can be found in the wider context of equilibrium statistical mechanics.
Contact person: Johan S. Høye

Field theory and particle physics
Contact person: Kåre Olaussen

Quantum optics

Ongoing research on cavity quantum electrodynamics, micro maser systems, dynamics of de-coherence, quantum computers. Thesis topics can be found in a much wider context of quantum optics.
Contact person: Bo-Sture Skagerstam

Strongly correlated systems and quantum fluids

Ongoing research in theoretical condensed matter physics, on the theory of strongly correlated fermion systems, in particular low-dimensional ones. Fermi liquids, heavy fermion systems, quantum magnets, non-fermi liquids, gauge-field theories of strongly correlated systems, novel phase transitions and quantum phase transitions.
Contact person: Asle Sudbø

4 Specification of courses

TFY4185 Electronics

Credits:7.5
Duration:1 semester (autumn)
Lectures:2 hours per week
Laboratory:8 hours per week
Instruction language:English
Examination:Peer evaluation (Evaluation of exercises and midterm tests)

Description:
Goal:
Introduction to electronic circuits for scientists and engineers. Introduction to data analysis and technical drawing.
Contents:
Electronic circuit elements: Simple passive circuits. Semi conducting circuit elements. Active circuits. Operational amplifiers. Noise in circuits.
PC laboratory: Simulation of circuits by means of computer tools. Data analysis and technical drawing by means of computer tools.
Laboratory in circuit techniques: Building and testing of selected electronic circuits.

FY2201 Energy and environmental physics

Credits:7.5
Duration:1 semester (autumn)
Lectures:4 hours per week
Exercises: 1 hour per week
Laboratory:4 experiments
Instruction language:English
Examination:Written, 4 hours

Introduction to general problems in energy and environmental subjects, with emphasis on renewable energy sources and impacts of conventional use of energy.
Earth energy balance, green house effect, radiative forcing, changes in the atmosphere caused by antropogenic emissions. Methods to observe atmospheric changes, emphasis on optical methods. Methods and the physical basis for renewable energy as wind, wave, sun, geothermal energy and biofuel, costs and environmental effects. Nuclear power and environmental effects. Energy resources with emphasis on fossil sources. Anthropological effects on the atmosphere; ozone and climate change.

FY2302 Biophysics I

Credits:7.5
Duration: 1 semester (autumn)
Lectures:4 hours per week
Exercises:1 hour per week
Laboratory:appr. 4 experiments
Instruction language:English
Examination:Peer evaluation
Description: This course gives a general introduction to biophysics. The students will first be introduced to elementary cellular biology and biochemistry. Central life processes will then be discussed out from physical principles. The organisation of bio molecules is studied, based on the concepts of chemical bonds, hybrid orbitals etc. Light excitation of molecules and relaxation processes will be treated. Transport in biological systems is discussed, based first on diffusion processes, which are studied in detail. A more general treatment of transport is also given, based on thermodynamics and the concept of chemical potential. Electrical phenomena across membranes will be discussed as well as action potential and information flow in nerves.
The structure of macromolecules like DNA, RNA and proteins will be studied as well as the cellular replication processes and protein synthesis. Enzyme kinetics is discussed and the primary processes in photosynthesis will be emphasised. Some experimental techniques frequently encountered in biophysics will be treated.
Admittance to the examination requires the successful completion of the laboratory assignments, including written laboratory reports.

FY2450 Astrophysics

Credits:7.5
Duration:1 semester (spring)
Lectures:4 hours per week
Exercises:1 hour per week
Instruction language:English
Examination:Written, 4 hours

Description: The course gives a general introduction to astrophysics, discussing the solar system, stars and interstellar matter, stellar evolution, the Milky Way Galaxy, galaxies and large-scale structure in the Universe, and cosmology.

FY3006 Sensors and transducers
Credits:7.5
Duration:1 semester (autumn)
Lectures:4 hours per week.
Laboratory:Ca 3 experiments
1 project assignment
1 literature assignment
Instruction language: English
Examination:Peer evaluation (4 hours written examination, 75%, report, 25%)

Description: The course covers measurement techniques and the use of various measurement sensors/transducers. General properties of transducers and sensors will be discussed as well as response characteristics, noise rejection, transfer functions etc. Basic physical principles used in sensor techniques are discussed. In particular, sensors for measurements of position, velocity, acceleration, pressure, temperature, humidity, radiation, gas and ion concentration are covered. General measurement problems involving sensors are discussed.
Demonstrations of instruments and measurement principles will be given, along with case study calculations. After the completion of the ordinary laboratory exercises, the course contains a project exercise (that should be solved relatively independently) related to the construction of measurement setup or to the solution of a suggested measurement task.
In addition, a literature exercise is supposed to provide training for the student to get information about sensors and measurement techniques available. Admittance to the examination requires the successful completion of the assignments mentioned above, including written laboratory reports.

FY3008 Signal analysis
Credits:7.5
Duration: 1 semester (spring)
Lectures:4 hours per week
Exercises: 1 hour per week
Laboratory:ca 3 experiments
Instruction language: English
Examination:Written, 4 hours
Description: The course discusses the description and analysis of stochastic and random signals and measurement signals with noise. Typically, the signals will represent information from physical measurements of, e.g., position and velocity of mechanical elements, blood pressure or wind speed and direction. Excitation response analysis of linear systems, methods to describe correlation between signals and frequency distribution of energy, also called spectral analysis, will be treated. Power spectra from continuous signals as well as from time series will be discussed as will the use of Fast Fourier Transform and methods for digital spectral analysis. Also, binary random processes will be discussed, and a short introduction to discrete wavelet analysis will be given.
Admittance to the examination requires the successful completion of the laboratory assignments.

FY3100 Optics
Credits:7.5
Duration:spring
Lectures:3 hours per week
Exercises: 4 hours per week
Laboratory:4-6 experiments
Instruction language:English
Examination:Written, 4 hours

A general introduction to geometrical and physical optics.

FY3112 Solid-state physics
Credits:7.5
Duration:autumn
Lectures:3 hours per week
Exercises: 4 hours per week
Laboratory:6 experiments
Instruction language:English
Examination:Peer evaluation (4 hours written examination, 80%, midterm assignment, 20%)

A general introduction to solid-state physics.

FY3201 Atmospheric Physics
Credits:7.5
Duration:1 semester (spring)
Lectures:3 hours per week
Exercises: 1 hour per week

1 project assignment
Instruction language:English
Examination:Peer evaluation (4 hours written examination, 80%, assignment, 20%)

Description: The following topics are discussed: Composition and structure of the atmosphere; thermodynamic processes and stability. Scattering, absorption and transmission of solar and thermal radiation; dependence on aerosols, clouds and other variable components; greenhouse and climate effects. Spectral measurements of atmospheric radiation; polarisation effects; monochromators, detectors and standards; general characterisation of spectroradiometers; measurement errors.

FY3402 Subatomic Physics
Credits:7.5
Duration:1 semester (spring)
Lectures:4 hours per week
Exercises:1 hour per week
Instruction language: English
Examination: Take-home examination

Description: The course is an introduction to central phenomena in subatomic physics, mainly theory. Atomic nuclei and elementary particles are discussed, together with their forces and processes, including bindings, decays, and scattering processes.

FY3404 Relativistic quantum mechanics
Credits:7.5
Duration:Autumn
Lectures:3 hours per week
Exercises:
Instruction language:English
Examination:Peer evaluation (4 hours written, 67%, semester assignment, 33%)

The course gives insight into central material characterisation methods and their application in studies of crystalline matter with weight on metallic materials and their properties. An introduction to crystallography is given. The standard diffraction methods based on electrons, neutrons and x-rays are described. Interpretations are mainly based on kinematic theory and its relations to dynamical theory are discussed.

TFY4190 Instrumentation
Credits:7.5
Duration:spring
Lectures:2
Exercises:8
Instruction language:English
Examination:Peer evaluation (Evaluation of exercises, 80%, midterm tests 20%)

Goal:
Introduction to PC based measurements, experiment control and instrumentation for scientists and engineers.
Contents:
PC based measurement techniques: AD and DA converters. Interfacing of instrumentation to computers.
PC laboratory: Graphical programming and virtual instrumentation as well as programming in C/C++. Selected measurement and control problems using PC.

TFY4235 Numerical physics
Credits:7.5
Duration:spring
Lectures:3 hours per week
Exercises:1 hour per week
Instruction language:English
Examination:assignments

Scalar, vector and parallel computing, linear algebra, finite difference methods, stochastic methods, ordinary differential equations, partial differential equations, optimization, linear programming, genetic algorithms, simulated annealing, Fourier methods, wavelet analysis, Monte Carlo Methods, molecular dynamics, quantum mechanics, cellular automata.

TFY 4240 Electromagnetic theory
Credits:7.5
Duration:Autumn
Lectures:4 hours per week

Exercises:1 hour per week
Instruction language:English
Examination:4 hours written exam

Syllabus:
Electrostatics, the method of images, multipole expansions, and electric fields in matter. Magneto statics and magnetic fields in matter. Electromotive force, electromagnetic induction, and Maxwell's equations. Conservation laws for charge, energy, momentum, and angular momentum. Electromagnetic waves. Transmission line theory. Potentiality and fields, gauge transforms. Radiation from dipoles and moving charges. Relativity. Textbook: D.J. Griffiths, Introduction to Electrodynamics, Prentice Hall Lecture notes: H.M. Pedersen, Waves in electrical transmission lines.

TFY4270 Theory of classical fields
Credits:7.5
Duration:spring
Lectures:3 hours per week
Exercises:1 hour per week
Instruction language:English
Examination:4 hours written exam

Objective: To give an introduction to fundamental concepts and principles of classical field theory.
Working knowledge of the physics and mathematics normally covered during the three first years of a university study in physics. General field theory: The Lagrange and Hamilton formalisms. The principle of stationary action. Field equations. Invariance, symmetries and conservation laws. Applications: Scalar fields. Electromagnetic fields. General relativity: Curvilinear, compendium.

TFY4275 Classical Transport Theory
Credits:7,5
Duration:spring
Lectures:3 hours per week
Exercises:1 hour per week
Instruction language:English
Examination:Peer evaluation (4 hours written examination, 70%, semester assignment, 30%)

Objective: To provide an introduction to the most important transport phenomena in classical physics.

Prerequisites: Knowledge equivalent to that gained through the following courses: SIO1016 Fluid mechanics and SIF 4016 Thermal physics
Contents: 1) Hydrodynamic theory: equations of change, transport coefficients, Navier-Stokes equations, linearisation, hydrodynamic normal modes and fluctuations, viscoelasticity and mechanical spectroscopy. 2) Stochastic theory: stochastic variables, Markov processes, correlation functions, Wiener-Khinchin theorem, Chapman-Kolmogorov equations, master equation, Fokker-Planck equation, Langevin equation, equivalence of stochastic differential equations and Fokker-Planck equation, fluctuation-dissipation theorems, polymer dynamics and electrical noise. 3) Irreversible thermodynamics: entropy production, linear response, Onsager relations. 4) Kinetic theory: phase space description, Boltzmann's kinetic equation, H-theorem, linearisation, hydrodynamic normal modes, microscopic derivation of expressions for transport coefficients, test particles, Rayleigh gas and Brownian particles, equivalence of kinetic and stochastic theories.
Mode of instruction: lectures and exercises
Reading material: to be distributed at the beginning of the course

TFY4305 Nonlinear dynamics
Credits:7,5
Duration:Autumn
Lectures:3 hours per week
Exercises:1 hour per week
Instruction language:English
Examination:4 hours written exam

The aim is to present interesting phenomena that can occur in non linear dynamical systems, with emphasis on physical examples. Nonlinear dispersive wave equations in hydrodynamics and physics. Solitary waves and solitons. Soliton solutions of the Korteweg - de Vries equation. Nonlinear oscillations. Phase portraits. Poincare mappings, iterations. Bifurcations, period. Textbook: Steven H. Strogatz: Nonlinear Dynamics and Chaos. Compendium (in Norwegian): P.C. Hemmer: "Ikke-lineær dynamikk".

EXAMINATION REGULATIONS AT THE NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY (NTNU)

Adopted by the Board of NTNU on 11 February 2003 in accordance with the Act of 12 May 1995 relating to Universities and Colleges, no. 22 §§ 40, 46, 47, 48, 49, 50 and 52.

Chapter 1 Scope, Purpose and Definitions

§ 1 Scope and Purpose

The regulations are valid for all studies at the Norwegian University of Science and Technology (NTNU).

2. The regulations contain rules about the organization of studies, examinations and assessment, requirements for the award of degrees, and regulations concerning the rights and obligations of the University and students at NTNU. The regulations are to ensure that studies and examinations at NTNU are properly carried out.

§ 2 Definitions

final examination
A type of assessment that normally follows at the end of the semester under conditions that can be controlled. The final examination generally is the concluding assessment of the student in a course or a group of courses.

course
The smallest unit in which the student can receive an assessment and course grade. The extent of the course is measured in credits. The course involves activities that form the basis for assessment. The activities may be compulsory.

subject
A collection of courses in one group in the programme catalogue.

main profile
Courses in the programme catalogue which are defined as belonging to the same discipline which can supplement each other and build on foundation course level in a programme of study. In case a Master's degree is based on a completed Bachelor's degree, the main profile contains the academic qualifications required for admission to the Master's degree.

grade
The grade given in a course or group of courses. It is based on the assessments that count during that course. The weighting of the grades in assessments during the course is stated in the course description.

credits
Measure of the study workload. The normal workload in one academic year is 60 credits.

programme of study
A group of courses that forms one academic entity that students can apply for admission to, receive the right to study, and leads to a degree.

field of study
A specialization within a programme of study, which is described in the programme catalogue for that programme of study.

assessment
The evaluations a student receives on the basis of his/her performance in a course, or a group of courses and that lead to a grade.

When these regulations refer to the Act relating to Universities, this means the Act of 12 May 1995 relating to Universities and Colleges, no. 22, including amendments, the last of which are passed as an Act, dated 28 June 2002 no. 62.

Chapter 2 Admission and curriculum

§ 3 Admission
The valid admission regulations are the relevant regulations adopted by the Ministry of Education and Research and NTNU's own admission regulations.

§ 4 The right to study and study progress
Admission involves the right to take the courses in the programme of study or separate courses which the student has gained admission to. The right to study provides the opportunity to take the courses specified in the individual education plan or in accordance with the study progress approved by the Faculty. The right to study is valid from the day NTNU receives confirmation of the student's acceptance of his/her admission.
The right to take the programme of study which the student has been admitted to, ceases when
the student fulfils the criteria allowing him/her to receive a certificate after completing the programme of study
the student's performance (study progress) is insufficient, according to the definition given in § 4 subsection 3
the student himself/herself confirms that he/she has withdrawn from the programme of study before it is completed.
In programmes of study that are divided into year courses/ years, a student cannot take the next year if he/she has an outstanding deficit of more than 22.5 credits from the two previous years. Students who want to take the 4th year cannot have any unfinished courses from the 1st year. Students who want to take the 5th year cannot have any unfinished courses from the 1st and 2nd years, and students who want to take the 6th year cannot have any unfinished courses from the 1st, 2nd, and 3rd years.
The student loses the right to study a programme of study if he/she has an outstanding deficit of more than 22.5 credits. No student is permitted to use more than 2 academic years to take the same year in a programme of study. The time spent in each year should be adjusted according to any leave that has been granted, and any possible reductions in the study progress (part-time studies) that have been approved in the individual education plan, ref. §§ 5, 7, and 8.
It is to be evident from the programme catalogue whether the programme of study is divided into years, ref. § 14 subsection 1.
The Faculty is to decide whether the right to study should be terminated in accordance with the above regulations. The Faculty may grant exemptions from the regulations in § 4 subsection 3 in cases of illness, serious family problems, when the main part of the studies has already been completed, extraordinary conditions related to the subject (taking the next year) or other reasons found to warrant special treatment. Where the Board of NTNU has established an inter-Faculty board for a group of programmes of study, the latter board is authorized to reach decisions in cases related to exemptions.
A student who has gained admission to a programme of study and has had normal study progress (without adjustment for leave or reduced study progress), is not to be affected by changes in the disciplinary objectives, level and structure of the programme while completing his/her work on the programme. The student nevertheless has to accept that there may be changes in the courses and the structure of the programme of study that will not cause a delay in his/her study progress.
A student who has gained admission to a programme of study or individual courses at NTNU, has the right to follow other courses he/she is qualified to take and receive assessment of his/her performance in these courses. The student also has the right to follow lectures in courses outside the programme of study, if there are no restrictions on the admission to the courses. The student maintains these rights also after having completed the programme of study.

§ 5 Individual education plan
The Faculty together with students who have gained admission to study for 60 credits or more are to agree on an individual education plan before the end of the first semester. The plan can be amended in agreement with the Faculty. The individual education plan is a mutual agreement between the student and NTNU concerning the duties and responsibilities of each party for study progress as well as the duties and responsibilities of each student towards his/her fellow students. The individual education plan gives the content and progress of the planned studies, cf. § 6 subsection 2.

§ 6 Registration
Students with the right to study at NTNU have to register for study and pay the semester fee at NTNU every semester before the deadline set by the University Director. The deadlines are given in the programme catalogue and on the Internet pages of NTNU.

For students who have agreed to an individual education plan, this registration is to determine and confirm the information in the plan for the current semester concerning
which courses the student will attend
which courses the student is to be given assessment in
other possible activities determined in the programme of study which the student follows
other information where adjustments are possible and which is relevant for the student's progress in his/her studies.

Students who are not obliged to agree on an individual education plan or who have not yet agreed on their individual education plan also have the duty to register. This registration is to indicate which courses the student will attend and receive assessment in.

The registration gives access to the resources offered by NTNU in order to enable the student to complete his/her courses that semester.

§ 7 Leave
The Faculty is to handle applications for leave. Leave from study is primarily given for one academic year. For shorter periods, leave can be given until the end on the semester. A student must have completed more than 30 credits in the courses included in the programme of study in order to apply for leave without stating a reason.
The Faculty may accept an application for leave for more than one academic year if there are special circumstances or pressing reasons, such as illness, extensive demands for child-care etc., military service or civilian service.
The student must accept that there may be changes in the programme of study during a period of leave.

§ 8 Part-time studies
Studies at NTNU may be taken on a part-time basis following agreement with the Faculty. The percentage of the normal study progress is to be included in the individual education plan.

§ 9 Students without the right to study
Those who have not been granted admission to study, have the right to receive assessment in a course in accordance with the Act relating to Universities § 40. The Faculty decides whether the requirements for registration have been fulfilled and may specify further regulations concerning the access to assessment in the absence of normal admission.
The University Director may decide upon a special deadline for registration for this type of assessment. The University Director can also decide that those who have not been admitted as students should pay an examination fee in order to cover the extra cost to the University in order to carry out such assessments.

§ 10 Education - delegation of authority in accordance with the Act relating to Universities § 44a
The Faculty has the authority to reserve certain lectures just for the students of the University or specified groups of students if the nature of the lectures makes this necessary, cf. the Act relating to Universities § 44a subsection 2.
The Faculty has the authority to allow people who are not following normal courses to attend lectures and participate in exercises whenever there is sufficient space, cf. the Act relating to Universities § 44a subsection 3.

§ 11 Suspension, exclusion - delegation of authority in accordance with the Act relating to Universities § 42 subsection 1
In cases where a student behaves in a way that seriously disturbs the work of fellow students or the general activities of the University, the Faculty has the authority to give a written warning stating that a continuation of such behaviour will lead to a suspension recommendation being presented to the Board. In cases that are not specifically related to an individual Faculty, this authority rests with the University Director.

The Faculty has the authority to give a written warning to a student that an exclusion recommendation will be presented to the Board that unless the suspension decision made by the Board is respected. In cases that are not specifically related to an individual Faculty, this authority rests with the University Director.

Complaints about decisions involving a written warning should be sent to the University Appeals Committee

Chapter 3 Organization of studies

§ 12 The academic year
The academic year consists of 40 weeks and is divided into two semesters. The autumn semester extends over 19 weeks and finishes before the end of the year. The spring semester lasts 21 weeks.
The Board of NTNU may approve an NTNU programme of study that deviates from the ordinary structure described in §12 subsection 1 if the duration of the programme is more than 40 weeks and has teaching and/or studies which can be pursued independently of the other studies at NTNU.

§ 13 Programme of study
Programmes of study at NTNU are organized along different lines, in the sense that they:
lead to a Bachelor's degree which subsequently forms the basis for a Master's degree.
result in integrated study progress which eventually may result in a Master's degree or a professional degree
lead to a Master's degree which is based on a completed Bachelor's degree or something that is equivalent.

The Board establishes and closes each programme of studies at NTNU. When the Board creates a new programme of study, it should simultaneously decide which Faculty is to administer the programme.
Each programme of study has a main profile, which gives disciplinary specialization of at least 80 credits. All programmes of study involving 5-year integrated Master's degrees should also satisfy the requirements of the Bachelor's degree.
Each programme of studies consists of different courses. The courses offered should each be of 7.5 credits or a multiple of that. The courses given in the programme of study are either compulsory or optional. The Faculty establishes new courses and closes old ones. Where an inter-Faculty board has been created for a group of programmes of study, this authority is vested in this board.
All programmes of study leading to a lower degree as well as integrated programmes of study leading to a higher degree or a professional degree, should contain three introductory courses:
Course 1 of 7.5 credits should be a first semester course common for all students.
Course 2 of 7.5 credits could either consist of courses that are potentially interesting for all groups of students or courses representing a field that differs from those included in the programme of study which the student has gained admission to. This course should primarily be included in the first or second semester.
Course 3 of 7.5 credits is specific for the relevant Faculty. It should be included in the first semester and form a part of the main profile.

§ 14 Programme catalogue and course description
Each programme of study is to be described in a programme catalogue. The Faculty administering the programme of study is to approve the programme catalogue. Where an inter-Faculty board has been established by NTNU to cover a group of programmes of study, this board is responsible for compiling the programme catalogue. The programme catalogue should contain information about possible admission requirements and ranking regulations for the programme of study. The programme catalogue should stipulate:

the teaching objectives and professional objectives of the programme of study

any preliminary knowledge that is recommended to take the programme of study

which Faculty is to administer the programme of study

which courses are included in the programme of study

how many credits the programme of study is worth

what course combination meets the main profile requirements

the structure of the programme of study, whether the programme of study has been divided into years, the fields of study, which are the introductory courses, which are compulsory and optional courses, and the sequence of the courses

the possibilities for student exchanges abroad

other decisions which affect the implementation and quality assurance

transitional arrangements as a result of the introduction of the Quality Reform

All courses are to be presented in a course description. Each Faculty is to provide a description of its own subject areas. Each course description should include:

teaching objectives

the qualifications necessary to gain admission to the course

the content of the course

teaching methods

how many credits the course is worth

the extent of the education

possible compulsory education

which activities are included, their extent and which of them are compulsory, for instance courses in methodology, exercises, work experience, field courses, excursions, laboratory work, group exercises, semester papers and other written exercises, artistic performances

the requirements for receiving assessment

activities that will be subject to on-going assessment and which of them will count in towards the course grade

the organization of a possible final examination (how often, when in the semester, date and similar information)

what examination aids can be used

the form of assessment and grading scale for the assessments during the course

the weighting of assessments during the course that are to count in the course grade

§ 15 Recognition of external studies/practical experience
The Faculty is to handle applications concerning recognition of external studies or practical experience in accordance with the Act relating to Universities §§ 47, 48 and 49. A condition is that the external education has been approved as education at university or college level.

The Faculty is to handle applications concerning the approval of an equivalent degree or education in accordance with the Act relating to Universities § 48 subsection 2.

§ 16 Exemption from assessment
The Faculty is to grant exemption from the final examination, test or other assessment in cases where the student can document that similar assessment has already been done by NTNU or another institution. The Faculty may also grant exemption on basis of other recognized examinations, tests or other kinds of assessment, or on basis of documented practical experience, in accordance with the Act relating to Universities § 49. When processing such applications for exemption, the Faculty should take both a student's previous education into account, as well as the assessment in terms of level, extent and content.

The student is to send such an application to the Faculty that administers the programme of study in which he/she has the right to study.

§ 17 Reduction of credits
If a student receives assessment in courses where the content wholly or partially overlaps, the total of credits for these courses should be reduced accordingly. The Faculty decides the extent of the reduction in each separate case. If some of the courses to which the student has gained admission to are compulsory, the reduction should take place in the optional courses. The reduction should be done in a way that provides the student with the best grade that has been awarded. The basis for the reduction should be evident from the transcript or certificate.

Chapter 4 Degrees

§ 18 Awarding degrees
The Faculties award degrees with their respective titles in accordance with their delegated responsibility from the Board when the latter approves a new programme of studies.

§ 19 Bachelor's degree
The Faculty awards the Bachelor's degree on basis of a completed programme of study or a free selection of courses in cases where the student has completed a total of 180 credits. The 180 credits should include:

a main profile of at least 80 credits, where the programme catalogue defines the requirements of the main profile

introductory courses of 22.5 credits, ref. § 13 subsection 4.

If the Bachelor's degree is not based on an established programme of study, the Faculty that awards the degree is to cover the area where the main profile of the disciplinary content belongs. If the student has a degree where more than one main profile is included, the student can decide which of the relevant faculties should award the degree.

§ 20 Master's degree
In order to gain admission to a Master's programme which is based on a lower degree, the student must:

have been awarded a Bachelor's degree or its equivalent

have received a passing degree in courses corresponding to 80 credits in the subject area of the relevant Master's degree, as specified in the programme catalogue for the relevant Master's programme

have fulfilled the other requirements for admission, as specified in the programme catalogue for the Master's programme.

When admission to a Master's programme is based on experience, the second point is not valid. Instead, at least 2 years of relevant professional experience is demanded.

In order to receive a Master's degree, the student must
either satisfy the admission criteria of the Master's programme and in addition have passed relevant studies corresponding to 120 credits, where the programme catalogue may allow 30 credits to be replaced by relevant practical experience
or have completed a course of studies corresponding to 300 credits, where the requirements of the Bachelor's degree are included.

In the Master's programme described in § 20 subsection 2, a Master's thesis corresponding to at least 30 credits, but no more than 60 credits, should be included.

In order to receive a Master's degree corresponding to less than 90 credits, the specified requirements relevant for such a degree programme must have been met.

§ 21 Candidata/candidatus medicinae
In a programme of studies leading to the degree candidata/candidatus medicinae, introductory courses as defined in § 13 subsection 4 are included. The degree is based on a coherent course of study corresponding to 360 credits. The Faculty of Medicine will decide the content of the programme of study as well as additional criteria for awarding the degree.

§ 22 Candidata/candidatus psychologiae
In a programme of studies leading to the degree candidata/candidatus psychologiae, introductory courses as defined in § 13 subsection 4 are included. The degree is based on a study of 60 credits and a subsequent, coherent professional study corresponding to 300 credits. The Faculty of Social Sciences and Technology Management will decide the content of the programme of study as well as additional criteria for awarding the degree.

Chapter 5 Assessment

§ 23 Assessment
In all courses or groups of courses included in a programme of study, the possibility for assessment and subsequent grading of the knowledge and skills of the students should be available each academic year. The assessment should be given as a final evaluation, or possibly an evaluation based on different types of on-going assessments described in the programme catalogue.

In order to receive assessment, the student must have registered that same semester, and also meet the academic requirements for assessment given in the course description.

A student who has handed in a paper in an assessment cannot prevent the assessment from being done. The student cannot block an assessment if the examination began with an oral test.

§ 24 Examination periods
Final examinations take place at the end of each semester. The University Director decides the time of the examination periods. The dates are given in the programme catalogue. The University Director may decide to organize the examinations outside the regular examination periods, if practical considerations related to the courses or other things make this necessary.

§ 25 Final examination
The course description states whether the course is to be concluded with a final examination and what requirements the student has to satisfy in order to sit the final examination. A grade is always awarded at the final examination.

§ 26 Instructions at final examination
The University Director can issue general instructions for

students who are allowed to sit a final examination

invigilators

the presence of teaching staff during a written final examination.

These instructions are found in the programme catalogue.

§ 27 Legitimate leave of absence at final examination
If a student is unable to sit a final examination due to illness or other pressing reasons, an application for approved absence has to be submitted to the Division of Student and Academic Affairs. The application, which has to be submitted at the latest one week after the first final examination to which the absence applies, has to contain information about which final examinations the application concerns. Documentation should be included in the application. The period of absence is to be indicated on the medical certificate.

A student who is taken ill during a final examination should notify the principal invigilator in the examination hall or the external examiner/internal examiner at oral examinations. The student subsequently has to see a doctor quickly and submit a medical certificate, as stated in the regulations in § 27 subsection 1.

§ 28 Re-sit examination
In a course where the final examination is to be held only once in the academic year, a re-sit examination is to be arranged before the next normal examination. Students with an approved absence may take the re-sit examination. This also applies to students who have not passed the initial examination.

Students must register for the re-sit examination within the deadline stated by the Faculty or in the supplementary regulations.

The Faculty can in agreement with the University Director decide to organize the re-sit examination during the same period as the normal examination, in the next examination period or at a later time outside the examination period. For certain programmes of study, the time of the re-sit examination will be a standard arrangement that can be stated in the supplementary regulations.

During a re-sit examination, the quality of the assessment should correspond to the one given at the normal final examination. Alternative forms of assessment at re-sit examination should be stated in the course description.

§ 29 Approved absence from other types of assessment than final examination
The Faculty should, if practically possible, ensure that students with approved absence from other types of assessment than in the final examination can be assessed during the semester and before any possible final examination in the course.

§ 30 Re-examination
A student who has failed to pass the examination in a course has the right to repeat the examination and receive a new assessment. The course description or the supplementary regulations determine what areas have to be repeated after a student has failed to pass an examination.

The student has the right to complete a second period of practical work experience if he/she failed to pass the first period of practical work experience.

If the student has passed an examination, he/she has the right to repeat that examination once in one course every academic year in order to improve the grade. In this case, the best grade will count. In cases where the grade is based on a number of partial assessments, all the different components have to be repeated.

§ 31 New assessment of Master's thesis
A student may submit a new or revised Master's thesis once in cases where the thesis has not been awarded a passing grade. If the thesis has been given a passing grade, there is no opportunity for a new assessment in the same programme of study.

§ 32 Syllabus at new assessment/re-sit examinations
In case of new assessment and re-sit examinations, the syllabus of the course at the time of the new assessment or the re-sit examination is to be valid. In cases of changes in the national framework plans, the Ministry may decide upon special arrangements.

If there are significant changes in the syllabus, there is to be a possibility to be assessed according to the former syllabus for at least one year, but no more than two years after the introduction of the changes.

§ 33 Adjusted forms of assessment
In order to give all students approximately the same working conditions when receiving assessment, students with particular requirements that have been sufficiently documented may apply for an adjusted form of assessment. Such an assessment does not imply any reduction in the general degree requirements.

The adjusted forms of assessment may be practically oriented in order to allow the use of special aids or extended time. In particular cases, types of assessment that differ from the normal one may also be accepted.

If the requirements of the student are permanent, the use of special aids may be allowed throughout his/her studies.

An application, including documentation, should be sent to the Division of Student and Academic Affairs before the registration deadline. The application is to be decided by the University Director. Applications for different forms of assessment from the one given in the course description are to be decided by the University Director in consultation with the Faculty.

Students with sudden acute requirements should as far as possible be given the same rights with regard to assessment as described above. An application containing sufficient documentation should be sent to the Division of Student and Academic Affairs as soon as possible after the acute situation has arisen.

§ 34 Form of language/language by written assessment
Arrangements with regard to the form of language used in examination papers are given in Regulations concerning forms of language in examination papers of 7 July 1987. The regulations are in accordance with the Act of 11 April 1980 no. 5 concerning the use of forms of language in the public services.

Examination papers written in Norwegian should contain a version in the other form of the language (bokmål and nynorsk). The exception is examination papers in the subject Norwegian. In case all the students prefer the same form of language, the examination papers may only be written in this form. The students choose their form of language as they register for an examination.

If the lectures are given in a non-Scandinavian language, the examination paper should also include a version in the language that has been used in the lectures. Applications requesting the examination paper to be in a language different from Norwegian or that used in teaching are to be decided by the Faculty.

If a significant portion of the curriculum of the course is written in a language that is different from the one used in lectures, the Faculty may decide that the examination paper should contain a version in this language as well.

§ 35 Oral examinations behind closed doors
At the request of the student, the Faculty may decide against making an oral examination public in cases where there are pressing reasons, ref. the Act relating to Universities § 50 no. 3. The Faculty should ensure that the assessment in these cases also satisfies the normal academic level in the programme of study.

§ 36 Academic misconduct or an examination offence/attempted academic misconduct or an examination offence
In cases of academic misconduct or an examination offence/attempted academic misconduct or an examination offence, the University Appeals Committee may cancel the assessment in accordance with the Act relating to Universities § 54. The same applies to the recognition of courses, credits or education, as well as exemption from assessment.

In accordance with the Act relating to Universities § 42 subsection 3, the University Appeals Committee may expel a student who has behaved contrary to the regulations for up to one year. The student may also lose his/her right to sit for examinations within institutions affected by the ruling for up to one year.

More detailed information about reactions to academic misconduct or an examination offence is given in Guidelines for reactions to academic misconduct or examination offences/attempts at academic misconduct or examination offences at NTNU of 30 May 2001.

Chapter 6 Determination of grades

§ 37 Examiners
The Faculty appoints the examiners, ref. the Act relating to Universities § 50 subsection 2. The examiners are appointed for 3 years at a time.

At least two examiners are to be present at oral examinations and assessment of vocational training or other activities of a type that cannot be subsequently checked. At least two examiners, of whom at least one should be external, should be present at the assessment of Master's theses, ref. the Act relating to Universities § 50 subsection 2.

The Faculty determines the guidelines regarding external participation at the assessment, whether general or a specific programme of study. This could be done by external participation in each separate assessment or through an external evaluation of the assessment procedures.

§ 38 Deadlines for determination of grades
In accordance with the Act relating to Universities § 50 subsection 4, the deadline for determination of grades is 3 weeks following the examination, unless special reasons make it necessary to use more time. When special reasons occur, a new deadline should be announced. The deadline for assessment of the Master's thesis is 3 months after the thesis has been handed in.

Chapter 7 Grades

§ 39 Grading scales
Assessment is given on basis of grading, either through a scale ranging from A to F or on the basis of Passed/Not Passed. Grade A is the highest pass grade, while Grade E is the lowest pass grade. The grading scale is based on the following descriptions and general qualitative descriptions:

Grade	Description	General, qualitative description of valuation criteria
A	Excellent	An excellent performance, clearly outstanding. The candidate demonstrates excellent judgement and a high degree of independent thinking.
B	Very good	A very good performance. The candidate demonstrates sound judgement and a very good degree of independent thinking.
C	Good	A good performance in most areas. The candidate demonstrates a reasonable degree of judgement and independent thinking in the most important areas.
D	Satisfactory	A satisfactory performance, but with significant shortcomings. The candidate demonstrates a limited degree of judgement and independent thinking.
E	Sufficient	A performance that meets the minimum criteria, but no more. The candidate demonstrates a very limited degree of judgement and independent thinking.
F	Fail	A performance that does not meet the minimum academic criteria. The candidate demonstrates an absence of both judgement and independent thinking.

Passed/Not Passed is used where assessment is not required.

The Faculty is to provide descriptions of the assessment criteria that are specific for each subject.

§ 40 Grade Point Average
The Grade Point Average can be estimated as long as letter grades have been given for at least 75% of the credits. When estimating the Grade Point Average, all grades in each separate course should be included. The Grade Point Average is determined as follows:
Each letter grade is replaced by its equivalent number, A=5, B=4, C=3, D=2, E=1.
The numerical equivalent is multiplied by the number of credits in the course, and the separate sums of credits and numerical equivalents are added up for all courses that are included.
This total is subsequently divided by the total number of credits included in all the courses.
The quotient is calculated to one decimal place.

The Grade Point Average is the letter degree which represents the equivalent of the full number of the quotient after the normal rounding-up rule has been applied.

§ 41 Final grade
Whether or not a final grade is to be given is decided by supplementary regulations.

The final grade means the overall grade for the entire programme of study at the award of degree. The grade is a weighted average based on the letter grades in the courses included in the degree. In order to get a final grade the student must have a pass mark in courses at NTNU corresponding to at least 120 credits, and at least 75% of these must have been given a letter grade. The method for calculating the final grade is the same as that described for the Grade Point Average in § 40.

§ 42 Explanations and appeals
Cases involving the explanation of grades and complaints about them are to be handled in accordance with the Act relating to Universities § 52. Requests for an explanation of grades and complaints should be forwarded to the Faculty. If written guidelines for determining grades have been issued, these are to be made available for students after the grade has been decided, ref. the Act relating to Universities § 52 subsection 3.

If there is a new assessment of a grade, at least two new examiners, including at least one external, are to be involved, ref. the Act relating to Universities § 50 subsection 5. The new examiners should not have any information about the initial grade, the explanation for it or the basis of the student's complaint.

When on-going assessment is used, the student cannot lodge a complaint until he/she has received the grade in the relevant course or group of courses. Although the student cannot lodge a complaint following each separate assessment, he/she has the right to an explanation of the grading for each separate assessment.

Complaints against procedural errors can be submitted in accordance with the Act relating to Universities § 51. The complaint is to be sent to the Faculty. In accordance with § 51 of the Act relating to Universities, complaints can only be made about on-going assessments which will be included in the certificate or that count as part of the final grade.

Complaints about the grading of group work, where a common grade is given, all participating students must agree and sign the complaint. The same applies to complaints about procedural errors in these cases.

Chapter 8 Certificates and transcripts

§ 43 Certificates
Certificates are issued after the completion of a degree or an educational programme. A certificate is normally issued only once for the same degree/education. The certificate is to contain information about the programme of study the degree is based on. The certificate should show the semester and year the degree/educational programme was completed. The final grade (if applicable) is to be given on the certificate. Diploma supplements form a part of the certificate. A transcript of grades showing the courses the student has passed should be attached to the certificate.

In order to receive a certificate for a completed degree at NTNU, at least 60 credits have to been taken at NTNU. Of the 60 credits, at least 30 must belong to the main profile. With regard to a higher degree, the Master's thesis must be part of the 60 credits.

§ 44 Transcript
Upon request, students are to receive a transcript confirming their passing grades. The transcript should show the grades given in each course, the year and semester in which the grades were obtained, as well as the title and number of credits for the courses.

Chapter 9 Supplementary regulations and implementation

§ 45 Supplementary regulations
The Faculty has the authority to add supplementary regulations to these regulations. With inter-Faculty programmes of study, the supplementary regulations are to be accepted by all faculties involved. When an inter-Faculty board has been established by the Board of NTNU for a group of programmes of study, the supplementary regulations should be decided by the inter-Faculty board.

§ 46 Implementation
These regulations are to come into force from the academic year 2003/2004.