

Notat

Til: Studieavdelingen

Kopi til:

Fra: Fakultet for naturvitenskap og teknologi

Forslag til studieprogramportefølje for 2013-2014 og på lengre sikt ved NT-fakultetet - Runde 2

Endringer fra innsendte forslag i runde 1

Forslag til endringer for 2013-2014

Fakultet for naturvitenskap og teknologi har i forbindelse med runde 1 i studieprogramporteføljesaken 2012 (ePhorte 2011/16120-10), meldt inn følgende forslag til endringer i studieprogramporteføljen for 2013-2014:

1. Det 2-årige masterprogrammet i biologi (MBI) ble foreslått nedlagt og erstattet av et 2-årig internasjonalt studieprogram i biologi: MSc in Biology (MSBIO).
2. Det 2-årige masterprogrammet i fysikk (MFY) og det 2-årige internasjonale studieprogrammet Condensed Matter Physics (MSCONMAT) ble foreslått nedlagt og erstattet av et 2-årig internasjonalt masterprogram i fysikk: MSc in Physics (MSPHYS).
3. Et nytt nordisk 2-årig masterprogram innenfor biodiversitet og systematikk ble foreslått.
4. Erasmus Mundus søknad om opprettelse av et 2-årig internasjonalt masterprogram, «AquaMundi».

MSc in Biology og MSc in Physics

Forslag nummer 1 og 2 videreføres i runde 2 av programporteføljesaken.

Nordisk samarbeid om Biodiversitet og systematikk - NABIS

Forslag nummer 3 blir endret fra tidligere innsendt forslag. Denne endringen innebærer også en justering av forslag nummer 1. I stedet for opprettelse av et eget nordisk masterprogram, ønsker samarbeidspartnerne foreløpig å organisere utdanningssamarbeidet slik at hver av de samarbeidende institusjonene gir dette studietilbudet som en studieretning innenfor eksisterende masterprogram i biologi ved institusjonene. Det er ønskelig å opprette et eget studieprogram på sikt, men samarbeidspartnerne finner det enklere på nåværende tidspunkt ved å organisere utdanningssamarbeidet gjennom felles emneportefølje og samarbeid om undervisning. De fleste felles emnene vil bli tilbudt gjennom nettbasert undervisning. Som følge av disse endringene opprettes dette studietilbudet som en fjerde studieretning innunder det nye internasjonale masterprogrammet i biologi. Det vil som i det nåværende norske programmet, bli opptak direkte til hver av de fire studieretningene.

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Erasmus Mundus program, AquaMundi

«Erasmus Mundus»-søknaden (forslag 4) ble ikke innvilget av EU, og det er derfor ikke aktuelt å videreføre arbeidet med å opprette dette som et studietilbud for 2013-14 eller i overskuelig framtid.

Innovative and Sustainable Energy Engineering

MSc in Innovative and Sustainable Energy Engineering (ISEE) er et nordisk 2-årig masterprogram som allerede er etablert med DTU, Chalmers, HI, Alto, KTH og NTNU som samarbeidspartnere. KTH har så langt vært vertsinstitusjon for dette studietilbudet. Fra 2013 skal NTNU overta rollen som vertsinstitusjon (vedtatt av rektor). Samtidig har det vært en prosess mellom samarbeidspartnerne rundt innholdet i dette nordiske masterprogrammet, som har medført at de studieprofilene som NTNU skal bidra til har endret seg i forhold til tidligere planer. Dette har medført at NT-fakultetet har kommet inn som en tung aktør i studieprogrammet fra NTNUs side. Professor Gabriella Tranell, Institutt for materialteknologi, har blitt forespurt og har sagt seg villig til å ta på seg rollen som ansvarlig studieprogramleder for dette nordiske studieprogrammet, og NT-fakultetet er foreslått som vertsfakultet for studieprogrammet ved NTNU. Fakultetet vurderer det administrative arbeidet med dette studieprogrammet til å være omfattende, spesielt i den perioden der NTNU overtar rollen som vertsinstitusjon. Så langt har det vært omfattende endringer i programmet, og det må forventes at revidering av studiet innhold vil fortsette en periode framover. NT-fakultetet vurderer at dette studieprogrammet en periode framover vil kreve 50% av en administrativ stilling. Fakultetet har ingen ledige studieadministrative ressurser som kan ta denne oppgaven og vil be om at Rektor bevilger SO-midler for å dekke en 50% administrativ stilling i en 3-årsperiode fra januar 2013 for nødvendige administrative ressurser til dette programmet. Fakultetet vil sende en egen søknad til rektor om SO-midler til dette formålet. Professor Tranell har allerede mange store oppgaver, blant annet som leder for Senter for fornybar energi (SFFE) og er helt avhengig av god administrativ oppfølging for å ha kapasitet til å påta seg oppgaven som studieprogramleder. Uten ekstra tilførte ressurser i en overgangsperiode ser ikke NT-fakultetet seg i stand til å ta på seg oppgaven som vertsfakultet for dette studieprogrammet. Utkast til beskrivelse av programmet ligger vedlagt.

Forslag til endringer på lengre sikt – en kort oversikt:

Utover tidligere innsendt betraktninger i år (ePhorte 2011/16120-10), vil NT-fakultetet her kort nevne to mulige nye utdanningssamarbeid, og en mulig nedleggelse av et program på lengre sikt:

Nordic Master in Polymer Technology

NT-fakultetet ønsker å delta i utviklingen av et nordisk utdanningstilbud innenfor polymerteknologi. Dette utdanningstilbudet faller innenfor satsningsområdet Materialer. Aktuelle samarbeidspartnere foruten NTNU, er KTH, CTH og Alto. Flere fagmiljøer ved NT-fakultetet kan være aktuelle bidragsytere (IBT, IFY og IKP). Koordinerende institusjon KTH vil sende inn en søknad om finansiering til Nordisk Ministerråd via SIU om støtte til utvikling av Nordic Master in Polymer Technology innen fristen 14.09.12. Kontaktperson ved NT-fakultetet vil være professor Wilhelm Glomm. Vi ber Rektor godkjenne at NTNU deltar i denne søknaden til Nordisk ministerråd, som vil innebære at NTNU forplikter seg til å opprette et masterprogram innen polymerteknologi om søknaden om etableringsmidler innvilges.

«Food for Life»

HiST har tatt initiativ til å utrede mulighetene for et mulig trøndersk utdanningssamarbeid om et felles masterprogram innenfor «Verdikjede Mat i blå og grønn sektor». Deltagende institusjoner vil være HiNT, HiST, NTNU og SINTEF. Dette samarbeidet vil omfatte deltagelse fra fagmiljøer både ved IVT- og NT-fakultetet ved NTNU. Ved NT-fakultetet vil Institutt for bioteknologi bli sentral i dette eventuelle samarbeidet. Etter et toppmøte i 2010 hvor rektor ved de involverte institusjonene og konsernsjef Unni Steinsmo ved SINTEF deltok, er det dannet en styringsgruppe med dekanene fra aktuelle fakultet ved de deltagende institusjonene. Disse har avholdt et møte i juni 2012 om dette samarbeidet. Konklusjonen fra dette møtet er at dette er for umodent til at en intensjonsavtale kunne inngås i møtet.

HiST er prosjektansvarlig og pådriver for et slikt mulig samarbeid. Det er ønsket at første opptak til programmet skjer høsten 2014. HiST vil høsten 2012 arbeide videre for å konkretisere et mulig samarbeid. Inntil NT-fakultetet får konkretisert hva et slikt samarbeid vil innebære, holdes spørsmålet om deltagelse i samarbeidet åpent.

HiST og HiNT vil, hvis opprinnelig tidsplanen følges, søke NOKUT om godkjenning for å kunne gi mastergrad innenfor et slikt utdannings samarbeid innen 01.02.13. Hvis ikke HiNT og HiST får en slik godkjenning, er deres plan B at NTNU skal ta ansvar for denne utdanningen. NT-fakultetet ønsker ikke å ta ansvaret for et slikt utdanningstilbud. Et slikt studium vil overlape med tilbud innenfor eksisterende masterprogrammer ved NTNU (eks. MIKJ, MSBIOTECH og MSAQFOOD ved NT). Det finnes også flere andre norske institusjoner som har utdanningstilbud innenfor fagfeltet. Hvis NTNU skal opprette enda et nytt program som vil favne bredt innenfor dette fagområdet, vil vi ha flere programmer som kommer i konkurranse om å rekruttere studenter fra NTNU og HiST. Vi rekrutterer allerede studenter fra bl.a. HiST til studieprogrammene Industriell kjemi og bioteknologi (MIKJ) og MSc in Biotechnology. Det NT-fakultetet evt kan bidra med er sin allerede eksisterende emneportefølje innenfor fagområdet, og evt veiledning av studenter i masterprosjekter.

Medical Technology

Det internasjonale masterprogrammet innenfor medisinsk teknologi (MSMEDTEK) var opprinnelig planlagt evaluert i 2012-2013 ifm. at de nåværende tematiske satsningsområdene utgår i 2012. Det er imidlertid nå klart at det ikke blir noen evaluering av tematisk satsingsområde Medisinsk teknologi. Programmet var tenkt tilbudt tom. opptaket høsten 2013 i påvente av denne evalueringen.

Programmet har ikke rekruttert studenter slik som forutsatt da programmet ble foreslått videreført etter den opprinnelige prøveperioden på 5 år (ePhorte 2010/642-15 og 24). Den studieretningen som har hatt best rekruttering er fom. høst 2012 flyttet til studieprogrammet MSc in Biotechnology. Selv om det ikke på nåværende tidspunkt ikke er gjennomført noen evaluering, mener NT-fakultetet at det ikke er grunnlag for videreføring av studietilbudet med dagens rekrutteringssituasjon. Saken må imidlertid drøftes med studieprogramrådet og IME-fakultetet som tilbyr flere av studieretningen på dette studieprogrammet. NT-fakultetet vil foreslå at studieprogrammet legges ned fra studieåret 2014-2015, men er også åpen for at studieprogrammet nedlegges allerede for 2013-2014. Et slikt vedtak krever imidlertid en dialog med involverte parter, som så langt ikke er gjennomført.

NT-fakultetets endelige forslag til endringer for studieåret 2013-2014 iht kravspesifikasjon for opprettelse av nye studieprogram

I det følgende vil det gis en kort oppsummering av forslagene til etablering av MSc in Biology og MSc in Physics iht hvert av punktene gitt i NTNUs kravspesifikasjon for opprettelse av nye studieprogram. Kun aktuelle punkter i kravspesifikasjonen blir adressert under. For detaljer henvises det til vedlegg (innspillene fra instituttene).

1. Strategisamsvar

I NTNUs strategi for perioden 2011-2020 er bl.a. følgende mål og veivalg satt for utdanning og læringsmiljø:

- Mål: NTNUs kandidater har relevant og anerkjent høy kompetanse. De er etterspurt nasjonalt og internasjonalt.
- Mål: NTNU har motiverte studenter som er rekruttert nasjonalt og internasjonalt, og som kan arbeide på tvers av faggrensene og læringskulturer.
- Veivalg: Studiene skal gi tydelige og dokumenterte kvalifikasjoner for nasjonalt og internasjonalt arbeidsliv.
- Veivalg: Fagmiljøene skal konsentrere studieprogramporteføljen for å styrke kvaliteten og gi internasjonalt samarbeid høyere prioritet.

Fakultet for naturvitenskap har for perioden 2011-2020 blant annet følgende strategiske mål og veilevalg innenfor utdanning og læringsmiljø som legger føringer for utviklingen i studieprogramporteføljen:

- Mål: Omfanget av studieprogrammer og emnetilbud skal være tilpasset behov for kvalitet og tydelig profil i studietilbudet.
- Mål: NTs studieprogrammer er attraktive i forhold til tilsvarende utdanninger internasjonalt. Fakultetet har utvalgte studietilbud som er tilrettelagt for internasjonale studenter.
- Veivalg: Studieprogramporteføljen skal revideres med sikte på færre studieprogrammer og færre emner tilbudt.
- Veivalg: Undervisning på masternivå skal fortrinnsvis tilbys på engelsk.

NTNUs internasjonale handlingsplan legger vekt på at vi skal legge til rette for og bygge den faglige virksomheten innenfor det globale fellesskapet. Ambisjonen er at all internasjonalisering skal integreres i all faglig virksomhet. Internasjonaliseringen skal finnes i en eller annen form i alle studieprogrammer.

De foreslåtte endringene ved NT-fakultetet åpner for å innordne utdanningstilbudet ved fakultetet i færre og mer robuste 2-årige masterprogram enn ved mer spissede internasjonale masterprogram. I tillegg åpnes det for internasjonalt utdanningssamarbeid uten nødvendigvis å opprette nye studieprogram (jfr. eksempel under med NABiS). Endringene åpner også for både nasjonal og internasjonal mobilitet for studenter som ønsker å studere biologisk og fysikk på masternivå i Norge og ved NTNU.

2. Krav til masterprogram

Begge studieprogrammene som foreslås opprettet, vil følge kravende til et masterprogram på 120 studiepoengs omfang innenfor realfag, hvor en 60 studiepoengs masteroppgave inngår.

3. Studieplan og emnebeskrivelser

Ingen nye emner opprettes i sammenheng med opprettelsen av MSc in Physics. Et nytt emne vil bli opprettet som følge av den nye spesialiseringen i biodiversitet og systematikk i MSc in Biology. Skisse til emnebeskrivelse er vedlagt. Alle emner tilbudt i disse programmene vil bli tilbudt på engelsk. I forhold til endringer i undervisningsspråk vil dette ikke innebære noen stor endring da fakultetets policy i en årrekke har vært at alle emner på masternivå skal kunne tilbys utvekslingsstudenter, og som konsekvens av dette undervises på engelsk ved behov. I tillegg kommer at noen av emnene allerede inngår i internasjonale masterprogram og av den grunn allerede tilbys på engelsk.

4. Læringsmål og læringsutbytte

Læringsmål for de to nye internasjonale studieprogrammene er beskrevet iht til nasjonalt kvalifikasjonsrammeverk. Noen justeringer kan komme i forbindelse med studieplanarbeidet høsten 2012.

5. Fastsettelse av studieplan

Detaljerte studieplaner vil bli utarbeidet i forbindelse med studieplanarbeidet høsten 2012. Dekanus har vedtaksmyndighet for disse programmene da de er definert som realfagsprogram.

6. Kostnadsberegning og finansiering

Begge de foreslåtte internasjonale programmene vil dekkes av basisbevilgningene for de programmene som foreslås nedlagt, og vil av den grunn ikke føre til merkostnader for fakultetet.

Vitenskapsmuseet dekker kostnadene med å undervise NTNUs nye emne i studieretningen MSBIO – Biodiversity and Systematics. Studentene må selv i utgangspunktet dekke evt. kostnader med reise og opphold ved fellessamlinger med mer.

7. Oppdragsundervisning

Ikke aktuelt

8. Antall studenter (fordeling mellom kategorier)

Antall norsk-nordiske søkere forventes ikke endret ift opptak til de nåværende norske programmene. Programmene vil være det eneste tilbudet på masternivå innenfor biologi og fysikk ved NTNU. Det er derfor av stor viktighet at det settes av tilstrekkelig med plasser for de norsk-nordiske søkerne i relasjon til internasjonale søkere. For begge programmene ønskes det at 2/3 av plassene som programmene tildeles, skal forbeholdes norsk-nordiske søkere.

For MSc in Biology ønskes en total ramme på 35 plasser, mens det for MSc in Physics ønskes 30 studieplasser. Nedre og øvre grense for antall studieplasser defineres ifm. fastsettelse av opptaksrammene for hele studieprogramporteføljen ved fakultetet.

9. Opptakskrav og rangeringsregler

Det stilles krav om bachelorgrad eller tilsvarende utdanning for opptak til begge programmene, henholdsvis innenfor biologi og fysikk. Detaljerte opptakskrav angis i studieplanen for de ulike studieretningene innenfor MSc in Biology.

10. Samarbeidende fakultet

Institutt for biologi ved NT-fakultetet samarbeider med Vitenskapsmuseet om en studieretning innenfor MSc in Biology: Biodiversity and Systematics. Instituttet er ansvarlig for utarbeidelse av studieplaner iht. til gjeldende regler. Det vises til felles søknad fra partene ifm. runde 1 i studieprogramporteføljesaken (ePhorte 2012/1511-5 og 2011/16120-10).

Det er ikke noe tverrfakultært samarbeid for MSc in Physics.

11. Forskning og tverrfaglighet

Begge de to programforslagene er forankret i aktuelle forskningsområder ved faginstuttene ved NT-fakultetet, og ved Vitenskapsmuseet for studieretningen Biodiversity and Systematics.

12. Eksterne samarbeidspartnere

Eksterne samarbeidspartnere inngår i samarbeidet om emne tilbudet i studieretningen MSBIO – Biodiversity and Systematics. NABiS (Nordic Academy of Biodiversity and Systematics Studies) består per i dag av samarbeidspartnerne Göteborgs universitet, Lunds universitet, Stockholms universitet, Uppsala universitet, Københavns universitet, Århus universitet, Universitetet i Oslo og Universitetet i Tromsø. Alle disse institusjonene har full autonomi innenfor dette utdanningssamarbeidet. Samarbeidspartnerne danner en programkomité bestående av et medlem fra hvert av universitetene. Komiteen er ingen juridisk bindende enhet. Göteborgs universitet er administrativt ansvarlig for utdanningssamarbeidet. Ny oppdatert avtale er ikke på plass før fristen for denne oversendelsen, men ventes ferdigstilt i september 2012. Mange av de samme elementene vil inngå som i den gamle avtalen som ble oversendt i runde 1 av studieprogramporteføljesaken. NT-fakultetet tar forbehold om oppretting av denne studieretningen dersom NABiS-avtalen ikke er ferdigstilt innen studieplanen for 2013-2014 vedtas av Dekanus. Uten avtaleinngåelse, vil kun de tre andre studieretningene bli opprettet.

13. Fellesgrader og fellesprogram, allianser

Ikke aktuelt.

14. Markedsvurdering

Begge de nye studieprogrammene er det eneste mastertilbudet NTNUs bachelorstudenter i henholdsvis biologi og fysikk vil kunne velge ved NTNU. Det forventes derfor at disse programmene først og fremst rekrutterer fra disse bachelorprogrammene, men at også andre norsk-nordiske søkere ventes å søke som i dag. I og med at programmene nå gjøres til internasjonale program, vil de også kunne rekruttere fra Europa og andre verdensdeler. Denne omleggingen fører mao. til økt mulighet for mobilitet mellom utdanningsinstitusjoner i inn- og utland innenfor de generiske fagene biologi og fysikk. Sterke fagmiljøer som allerede samarbeider internasjonalt, vil bidra til å tiltrekke gode studenter gjennom forskningssamarbeid i inn- og utland.

Med de miljø- og helsemessige utfordringene vi står overfor i dag vil biologikompetanse være attraktiv for mange arbeidsgivere innenfor forvaltning, forskning og industri. Flere av fagområdene som i dag tilbys som internasjonale masterstudier ved Institutt for biologi, har tidligere vært en del av det norske masterprogrammet i biologi eller andre norske spissede studieprogram ved NTNU. Flere av disse internasjonale programmene rekrutterer godt både blant norsk-nordiske og internasjonale søkere til de biologirettede studieretningene innenfor programmene. Eksempler er masterprogrammene Marine Coastal Development og Environmental Toxicology and Chemistry.

Arbeidsmarkedet i Norge for fysikere er for tiden godt, jfr. innspill fra Institutt for fysikk. Fysikk-kompetanse er etterspurt i mange bransjer, blant annet oljeindustrien som i høyeste grad opererer internasjonalt. I tillegg tilsier erfaringene med MSc in Condensed Matter Physics (MSCONMAT) at det er interesse for å studere fysikk i Norge blant internasjonale studenter. Det har ikke vært mange studenter som har søkt opptak til MSCONMAT, men dette skyldes antageligvis at dette har vært et spisset studieprogram innenfor fysikk. Det ventes at det blir større interesse blant internasjonale søkere nå når det åpnes for spesialisering i flere retninger innenfor fysikk.

15. Særskilte programaspekt

Emnetilbudet innenfor studieretningen Biodiversity and Systematic vil avvike fra NTNUs emnemoduler på 7,5 studiepoeng eller et multiplum av dette, som følge av utdanningssamarbeidet med andre institusjoner som har annen inndeling av arbeidsbelastningen for sine emner.

16. Innmelding av nytt studieprogram til FS

Fakultetet vil melde inn de nye studieprogrammene til Studieavdeling ifm styrevedtak i oktober. Ønskede programkoder for de nye programmene er

MSBIO	MSc in Biology
MSPHYS	MSc in Physics

17. Vitnemålstekster

Vitnemålstekster vil bli utarbeidet iht gjeldende regler og frister.

Vedlegg:

1. Beskrivelse av MSc in Physics
2. Beskrivelse av MSc in Biology
3. Skisse til emnebeskrivelse for emnet Diversification in time and space (10 studiepoeng)
4. Beskrivelse av ISEE-programmet per 10.09.12
5. Samarbeidsavtale mellom partene i NABiS (oppdatert avtale ettersendes)

Fakultet for naturvitenskap og teknologi
Institutt for fysikk

Dato
06.08.2012

Referanse
2012/9243/PKB

Notat

Til: Sigurd Håkon Madsen

Kopi til:

Fra: Institutt for fysikk

Svar IFY - Studieprogramporteføljen ved NT-fakultetet 2013/2014 - eventuelle endringer før endelig innsending.

Institutt for fysikk ønsker nedleggelse av Master i Fysikk og Master of Science in Physics, og opprettelsen av ett internasjonalt masterprogram: Master of Science in Physics.

Vedlagt er kopi av tidligere innsendt forslag fra Institutt for fysikk.

Institutt for fysikk ber om at det tas kontakt hvis det forventes at instituttet skal gjøre noe mer.

Mvh,
Peder Kristian Brenne
Studiekonsulent
Institutt for fysikk

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Institutt for fysikk fremmer følgende forslag:

Forslag til endringer i studieprogramporteføljen for 2012/2013

Forslag om etablering av 2-årig, internasjonalt studieprogram:

MSc Programme in Physics, NTNU

Gradsnavn: Master of Science in Physics

Det søkes herved om opprettelse av et 2-årig internasjonalt studieprogram innen fysikk med oppstart studieåret 2013/2014. Programmet skal erstatte to eksisterende 2-årige masterprogram; Master i fysikk (MFY) og Master of Science in Condensed Matter Physics (MSCONDMAT).

Forslaget er utarbeidet av Institutt for fysikk (IFY) og programrådene for MFY og MSCONDMAT og er utarbeidet i henhold til NTNUs kravspesifikasjon i forbindelse med etablering av nye studieprogram. Under beskrives det nye programmet, og teksten er organisert med nummerering som sammenfaller med punktene i kravspesifikasjonen.

IFY har i 2011 gjennomført en undersøkelse blant berørte studenter som viser at studentene er gjennomgående positive til å gjøre om MFY til et internasjonalt masterprogram.

1) Strategi-samsvar

Tydelighet i den akademiske profilen er et sentralt tema i strategiprosesser ved NTNU og NT-fakultetet.

NTNUs strategi 2011-2020, "Kunnskap for en Bedre verden", gir grunnlag for at IFY rekrutterer motiverte og dyktige studenter fra både inn- og utland. Masteroppgaver som tilbys i fysikk vil være i samsvar med "Kunnskap for en Bedre verden", og nært tilknyttet NTNUs eksisterende strategi og hovedprofil innen teknologi og naturvitenskap. På det nye internasjonale studieprogrammet, som på de to masterprogrammene som legges ned, vil studentene få anledning til å velge masteroppgaver innen samtlige av IFYs satsingsområder, som spenner fra grunnleggende teoretisk fysikk til eksperimentell fysikk av mer anvendt karakter. Det vil alltid være et stort behov i samfunnet for denne typen kompetanse.

Ved å etablere et bredt anlagt internasjonalt masterprogram i fysikk, som erstatter Master i fysikk og Master of Science in Condensed Matter Physics, vil vi bedre kunne tilpasse og

tilknytte oss kunnskap og kompetanse om internasjonale masterstudier i fysikk.

2) Krav for bachelorprogram og masterprogram i forskrifter

Forslaget til studieplan er i henhold til Forskrift om mastergrad fastsatt av Utdannings- og forskningsdepartementet 01.12.2005 og kravene som stilles i NTNU §20 Om mastergrad i Forskrift om studier ved NTNU. Forslaget fører til en mastergrad som bygger på en fullført bachelorgrad eller tilsvarende godkjent utdanning.

Mastergraden omfatter fire semestre med fulltidsstudium, 120 studiepoeng. Ifølge Utfyllende regler § 20.3. skal masteroppgaven dekke 60 studiepoeng i mastergraden.

3) Studieplan, emnebeskrivelser

Forslaget bygger på eksisterende oppbygging av Master i fysikk. Ingen nye emner vil bli opprettet i forbindelse med oppstarten av det nye programmet.

Undervisningen, kursmateriell og emnebeskrivelser vil bli gitt på engelsk.

Den tentative studieplanen for MSc in Physics:

Courses and ECTS Credits		7.5	7.5	7.5	7.5
2nd year 4th semester Spring	<i>Special Curriculum</i>	Master's Thesis (FY3900)			
2nd year 3rd semester Autumn	<i>Elective course</i>				
1st year 2nd semester Spring	<i>Elective course</i>	<i>Elective course</i>	Experts in Teamwork	Master's Thesis	
1st year 1st semester Autumn	<i>Elective course</i>	<i>Elective course</i>	<i>Elective course</i>		

Det vil være mulig å spesialisere seg innen ulike retninger: astro- og partikkelfysikk, biofysikk og medisinsk fysikk, energi- og miljøfysikk, optikk og kondenserte mediers fysikk, komplekse materialers fysikk, numerisk fysikk og undervisningsrettet fysikk.

MSc in Physics vil være to år med fulltidsstudier. Den normale arbeidsbelastningen for en fulltidsstudent for ett studieår er 60 studiepoeng.

Det er to hovedkomponenter i masterstudiet:

- Masteroppgave (60 studiepoeng)
- Teoretiske og metodiske emner. Foruten Eksperter i team (obligatorisk) vil programmet bestå av valgfrie emner (52.5 studiepoeng), med krav om minimum fire fysikkemner (30 studiepoeng) på 3000-nivå/masternivå.

4) Læringsmål for MSc in Physics

MSc in Physics skal gi studentene kunnskaper, ferdigheter og generell kompetanse på et avansert nivå, med sikte på jobber innen forskning, industri, konsulentvirksomhet, undervisning og offentlig forvaltning, eller med sikte på videre utdanning i et doktorgradsstudium.

Masteroppgaven skal gi spesialkompetanse innen et av forskningsområdene som er representert ved Institutt for fysikk: astro- og partikkelfysikk, biofysikk og medisinsk fysikk, energi- og miljøfysikk, optikk og kondenserte mediers fysikk, komplekse materialers fysikk, numerisk fysikk og undervisningsrettet fysikk. Alternativt skal oppgaven gi kompetanse på et fysikkrelatert område ved teknologimiljøet utenfor Institutt for fysikk.

Kunnskaper

Kandidaten skal få

- solide kunnskaper i fysikk, gode basiskunnskaper i matematikk og kunnskaper i andre valgte støtteemner som datateknikk
- dybdekunnskap i form av forskningserfaring innen et avgrenset spesialområde, gjennom et veiledet mastergradsprosjekt som strekker seg over flere semestre
- avanserte kunnskaper innen et utvalg av emner, hvorav noen kan støtte opp om mastergradsprosjektet
- kjennskap til bredden i forskningen som foregår i fysikk i dag

Ferdigheter

Kandidaten skal

- få bakgrunn og erfaring for å kunne modellere, analysere og løse avanserte fysiske problemer
- beherske et utvalg av avanserte teoretiske og/eller eksperimentelle metoder, inkludert bruk av numeriske metoder og simuleringer
- kunne kombinere innsikt fra flere fagfelt
- kunne foreta kritiske og selvstendige vurderinger av metoder og resultater
- kunne fornye og videreutvikle sin faglige kompetanse -- på egen hånd, via kurs eller gjennom et doktorgradsstudium innenfor fysikk eller en fysikkrelatert disiplin
- som fysiker ha spesielt gode forutsetninger for å gå inn i nye problemområder der det er behov for en analytisk tilnærming og nyskapende bidrag

- kunne formidle fagstoff og resultater både til spesialister og til et bredere publikum

Generell kompetanse

Kandidaten skal

- forstå fysikkens rolle i samfunnet og ha bakgrunn for å kunne vurdere etiske problemstillinger
- kjenne til den historiske utviklingen av fysikken, dens muligheter og begrensninger, og forstå behovet for livslang læring
- være i stand til å skaffe seg, vurdere og bruke relevant og pålitelig ny informasjon
- ha bakgrunn for å kunne gjennomføre avanserte arbeidsoppgaver og prosjekter, både selvstendig og sammen med andre, også tverrfaglig
- ha en god faglig bakgrunn for praktisk-pedagogisk utdanning
- ha et internasjonalt perspektiv på sitt fagområde

5) Fastsettelse av studieplan

Fastsettelse av studieplan vil gjøres etter gjeldende rutiner.

6) Kostnadsberegning og finansiering

Institutt for fysikk har fått bekreftet fra Økonomi og eiendom stab, ved Andreas Wangen at det ikke blir endringer i basisbevilgningene ved nedleggelsen av Master i fysikk og Master of Science in Condensed Matter Physics, og opprettelsen av Master of Science in Physics. Kostnadsberegningen og finansieringen blir den samme som for Master i fysikk og Master of Science in Condensed Matter Physics.

7) Oppdragsundervisning, egenbetaling

Ikke relevant.

8) Antall studenter

Basert på eksisterende opptakstall de siste fem årene, hvor MFY har hatt ramme på gjennomsnittlig 16 studenter og MSCONDMAT på 8, foreslår vi at opptaket for den foreslåtte MSc in Physics settes til 30 studenter, inkludert både norske/nordiske og internasjonale studenter. Fordeling 2/3 norsk/nordisk bakgrunn, 1/3 internasjonal bakgrunn.

9) Opptakskrav og opptaksregler

Standard opptak som tidligere, med minimumskrav om BSc in Physics.

Institutt for fysikk har allerede uttrykt støtte for et karakterkrav på C fra bachelorstudiets hovedprofil.

10) Samarbeidende fakulteter

MSc in Physics vil, foruten EiT og masteroppgaven, bestå av valgbare emner, med krav om minimum fire fysikkemner på 3000-nivå. Kandidatene har i samråd med veileder mulighet til å velge relevante emner fra andre fakultet.

11) Forskningskobling og tverrfaglighet

Det 2-årige Master of Science in Physics vil i stor grad være fleksibelt når det gjelder valg av emner. Hvor det er ønske om fordypning kontra bredde. Spesialiseringene er nært knyttet til forskningen innen de respektive områder.

12) Eksterne samarbeidspartnere

Det vil være åpent for at kandidater utfører masteroppgaven ved eksterne institusjoner og bedrifter. Ved de program som legges ned har kandidater skrevet oppgaver for eksempelvis SINTEF, Statoil og Petrell.

Det foreligger ingen samarbeidsavtaler mellom IFY og eksterne bedrifter og institusjoner, ut over standardavtaler som skrives for å utføre masteroppgave ved eksterne institusjoner eller bedrifter.

13) Fellesgrader og fellesprogram

Ikke relevant.

14) Markedsvurdering

Fysikere er etterspurt i industrien, innenfor forskning, konsulentvirksomhet, offentlig forvaltning og undervisning. Arbeidsmarkedet for fysikere med bachelor- og mastergrad er

mye det samme som for sivilingeniører med fysikk og matematikk, og er for tiden godt.

I Teknas «Rapport om arbeidsmarkedet. Januar 2012» (Notat 001/2012: 2) beskrives arbeidsmarkedet for teknologer og realister som følger: "I følge NAV har mangelen på høyere utdannede teknologer og realister mer enn doblet seg i privat sektor fra desember 2010 til desember 2011. Samtidig er det en betydelig underdekning i offentlig sektor. Dette er ikke fordi norsk økonomi er inne i en høykonjunktur, men fordi dette er normalsituasjonen skapt av tilgang på for få kandidater fra høyere utdanning. Vi forventer derfor at det i 2012 vil være fortsatt høy etterspørsel etter våre medlemsgrupper. I tillegg er det ventet høyere investeringer i oljesektoren, noe som kan komme til å øke etterspørselen videre.»

15) Særskilte programaspekter

Det er ingen særskilte programaspekter, men det bør være en overgangsordning hvor kandidater med opptak til Master i fysikk høsten 2012 og våren 2013 fullfører nedlagt program til normert tid (hhv. vår 2014 og høst 2014), og opptak til Master of Science in Condensed Matter Physics høsten 2012 fullfører nedlagt program til normert tid (vår 2014).

16) Innmelding av nytt studieprogram til FS (etter Styrets vedtak)

Institutt for fysikk vil etter Styrets vedtak, forutsatt at vedtaket er å opprette MSc in Physics, gjøre de pålagte innrapporteringer; innrapportere opptaksrammen og fylle ut skjemaet «Innmelding av nytt studieprogram» og sende det til Studieavdelingen/FS.

Det vil være fordelaktig at det er samsvar i FS mellom oppmeldingen av MSc in Physics og de to nedlagte programmene, slik at det vil være mulig å hente statistikk tilbake i tid og se eventuelle endringer i overgangen.

17) Vitnemåltekster

Vitnemåltekster justeres i forbindelse med studieplanarbeidet.

Fakultet for naturvitenskap og teknologi
 Institutt for biologi

Dato
 04.09.2012

Referanse
 2012/9243/LAU

Notat

Til: Sigurd Håkon Madsen

Kopi til:

Fra: Institutt for biologi

Studieprogramporteføljen ved NT-fakultetet 2013/2014 - eventuelle endringer før endelig innsending.

Institutt for biologi

Vedlagt følger forslag fra VM og Institutt for biologi for opprettelse av hhv en Nordic Master in Biodiversity and Systematics og Master of Science in Biology.

Postadresse	Org.nr. 974 767 880	Besøksadresse	Telefon	Saksbehandler
7491 Trondheim	E-post: postmottak@bio.ntnu.no	Realfagbygget D1, Hogskoleringen 5	+47 73 59 60 90	Lisbeth Aune
	http://www.ntnu.no		Telefaks +47 73 59 61 00	Tlf: +47 73 59 62 73

All korrespondanse som inngår i saksbehandling skal adresseres til saksbehandleren ved NTNU og ikke direkte til enkeltpersoner. Ved henvendelse vennligst oppgi referanse.

Forslag om etablering av 2-årig, internasjonalt studieprogram (MSc-Programme in Biology) inkludert utdanningssamarbeid med Nordic Academy of Biodiversity and Systematic Studies (NABiS)

Forslag om etablering av 2-årig, internasjonalt studieprogram:
'MSc-Programme in Biology', NTNU
Gradsnavn: 'Master of Science in Biology'

Institutt for biologi og Seksjon for naturhistorie (NTNU Vitenskapsmuseet) søker med dette om opprettelse av et toårig, internasjonalt studieprogram innen biologi med oppstart studieåret 2013/2014 som erstatter det eksisterende 2-årige masterprogrammet 'Master i biologi'. Programmet vil ha fire studieretninger hvorav 'Nordic Master in Biodiversity and Systematics' utgjør den fjerde studieretningen. Vi viser her til første runde med studieporteføljendringer 2013/2014 og søknad om opprettelse av henholdsvis en 'MSc in Biology' og en 'Nordic Master in Biodiversity and Systematics'.

'Nordic Academy of Biodiversity and Systematics Studies' (NABiS) er et utdanningssamarbeid/felles studieprogram mellom Göteborgs universitet (koordinator, finansiert av Nordisk Råd), Københavns universitet, Lunds universitet, Universitetet i Oslo, Stockholms universitet, Universitetet i Tromsø, Uppsala universitet og Aarhus universitet. Per i dag har hver institusjon eget opptak og utsteder egne vitnemål. På sikt ønsker samarbeidspartnerne og Nordisk Ministerråd å opprette NABiS som en 'joint degree'.

Forslagene er utarbeidet i henhold til NTNUs kravspesifikasjon i forbindelse med etablering av nye studieprogram, og dokumentet er organisert med nummerering sammenfallende med nevnte mal.

1) Strategi-samsvar:

Vi viser til den internasjonale handlingsplan for NTNU for perioden 2011-2014 innenfor rammene av strategien '*Kunnskap for en bedre verden*'. En av hovedprioriteringer i planperioden er samarbeid i Europa (inkludert Norden). En internasjonal mastergrad vil legge til rette for internasjonalt samarbeid, bedre mobilitet av studenter og fremme rekrutteringen av motiverte og flinke studenter også fra utlandet. Utdanningssamarbeidet NABiS legger spesielt til rette for allianser med sterke fagmiljøer nasjonalt og internasjonalt, og derved skape attraktive studietilbud, og øke kvaliteten i utdanningen.

En internasjonal MSc i biologi vil være i samsvar med NT-fakultetets strategi om å utvikle et studieprogram rettet mot samfunnets behov bl.a. for miljøkompetanse, og derigjennom bidra til utvikling av et globalt bærekraftig samfunn. En internasjonal MSc i biologi vil også være i tråd med NTNUs strategi om å konsentrere studieporteføljen ved fagmiljøene og å gi internasjonalt samarbeid høyere prioritet, samt bidra til å oppfylle NTNUs ansvar i forhold til å øke samfunnets kunnskap om naturvitenskap. Dette siste vil være relatert til NTNUs fokus på globalisering, herunder kunnskap om globale miljøutfordringer, som et tematisk satsingsområde, og utfordringer innen tilgang til energi, miljø, helse, mat og vann. Det er et stort og økende behov i samfunnet for denne typen kompetansen.

'MSc in Biology' vil gi en mer enhetlig akademiske profil som har vært en av de sentrale temaene i strategiprosesser ved NTNU og NT-fakultetet. Forslaget til deltagelse i NABiS er i tråd med Kunnskapsdepartementets strategi om å øke samarbeidet om internasjonale fellesgrader (St. melding 14 2008-2009, Internasjonalisering av utdanning), og i NTNU Vitenskapsmuseets målbilde for 2016 står det at man skal ha sterke forskergrupper innenfor biologisk mangfold i tid og rom. Dette vil oppfylles ved å delta i utdannings samarbeidet NABiS da dette sikrer et bredt kurstilbud og vil kunne øke rekruttering på masternivå.

2) Krav for bachelorprogram og masterprogram i forskrifter:

Forslaget til studieplan er i henhold til Forskrift om mastergrad fastsatt av Utdannings- og forskningsdepartementet 01.12.2005 og kravene som stilles i NTNU §20 Om mastergrad i Forskrift om studier ved NTNU. Forslaget fører til en mastergrad som bygger på en fullført bachelorgrad eller tilsvarende godkjent utdanning. Mastergraden omfatter fire semestre med fulltidsstudium, 120 studiepoeng. Ifølge Utfyllende regler § 20.3, skal masteroppgaven dekke 60 studiepoeng i mastergraden.

3) Studieplan, emnebeskrivelser:

Det vil bli gitt fire studieretninger:

- Cell and Molecular Biology
- Physiology
- Ecology, Behaviour, Evolution and Biosystematics
- Biodiversity and Systematics (NABiS)

Forslaget bygger på eksisterende oppbygging av master i biologi. De fire retningene er noe ulike når det gjelder obligatoriske emner for opptak. Med unntak for et nytt emne i tilknytning til NABiS vil ingen nye emner vil bli opprettet i forbindelse med oppstarten av dette nye programmet for disse fire studieretningene.

Det er to hovedkomponenter i masterstudiet:

- masteroppgave (60 studiepoeng)
- teoretiske og metodiske kurs, obligatoriske og valgfrie emner (60 studiepoeng)

For alle studieretninger gjelder det at 'MSc in Biology' er to år med fulltidsstudier. Den normale arbeidsbelastningen for en fulltidsstudent for ett studieår er 60 studiepoeng. Undervisningen vil bli gitt på engelsk for alle fire studieretninger.

Utkast for studieplan 'MSc in Biology' for følgende studieretninger:

- Cell and Molecular Biology,
- Physiology
- Ecology, Behaviour, Evolution and Biosystematics

Semester	7,5 ECTS	7,5 ECTS	7,5 ECTS	7,5 ECTS
4. Spring	BI3091 Special			

	Syllabus			
3. Autumn	Optional course	Optional course		
2. Spring	Experts in Teamwork	Optional course		
1. Autumn	Optional course	Optional course	Optional course	

De ulike retningene har ulike obligatoriske emner og anbefalte emner, dette vil synliggjøres fullstendig i studieplanarbeidet, og er likt med tidligere master i biologi:

- Cell and Molecular Biology; Experts in team work, BI3016 Molecular and Cell Biology, BI 3091 Special Syllabus
- Physiology; Experts in team work, BI3020 Ecophysiology or BI3021 Advanced physiology, BI 3091 Special Syllabus
- Ecology, Behaviour, Evolution and Biosystematics; Experts in team work, BI3081 Scientific Seminars, BI 3091 Special Syllabus; minimum 2 av emnene; BI3032 Population Dynamics, BI3005 Fish Ecology and Fish Behaviour, BI3010 Population Genetics, , BI3036 Plant Ecology, BI3037 Freshwater Ecology, BI3040 Behavioural Ecology, BI3051 Evolutionary Analysis, BI3082 Biodiversity and Conservation Biology II, BI3083 Evolutionary and Ecological Genetics,

Utkast til studieplan for 'MSc in Biology' studieretning:

- Biodiversity and Systematics (NABiS)

	5 ECTS	5 ECTS	5 ECTS	5 ECTS	5 ECTS	5 ECTS
4. Spring	Master thesis					
3. Autumn	Master thesis					
2. Spring	Optional courses					
1. Autumn	Alpha taxonomical principles (UiO. compulsory)	Fundamental and molecular systematics (Uppsala U, compulsory)		Optional courses		

Utdannings samarbeidet NABiS baserer seg på at studentene skal ta alle sine masteremner innen NABiS-programmet. Derfor vil oppbygging av emner avvike fra standard ved NTNU som er kurs på 7,5 ECTS. Dette inkluderer også fritak fra 'Ekspert i team' da deltakelse i NABiS vil medføre utveksling mellom og flere møtepunkter ved de ulike institusjonene. Deltakelse i NABiS vil gi studentene ved denne studieretningen tilgang til en svært attraktiv emneportefølje innen biosystematikk fra avanserte kurs innen floristikk og faunistikk, til emner innen taksonomisk klassifikasjon for ulike organismegrupper, teoretisk systematikk, evolusjonsbiologi og fylogeografi, bioinformatikk og molekylærbiologi. NTNU Vitenskapsmuseet/Institutt for biologi bidrar med ett nytt emne i denne porteføljen: 'Diversification in time and space' som også vil være åpent for andre studenter ved NTNU. NABiS programmet tilbyr per dags dato 24 kurs som blir kategorisert som følger:

- biodiversitets-identifisering (9 kurs hver på 5 ECTS)
- biodiversitets-klassifisering (6 kurs hver på 10 ECTS)
- systematikk-teori (3 kurs hver på 10 ECTS)
- verktøy og ferdigheter (6 kurs hver på 5 ECTS)

Studenter er forventet å ta minimum ett kurs innen hver av disse kategoriene. For kursoversikt, se <http://www.nabismaster.org/courses.php>. Kursene blir gitt ved Göteborgs

universitet, Københavns universitet, Lunds universitet, Universitetet i Oslo, Stockholms universitet, Universitetet i Tromsø, Uppsala universitet (UU), Aarhus universitet og NTNU. Teori-kursene er i hovedsak lagt opp som e-læring, men kan inkludere gruppemøter med praktiske elementer. Noen kurs inneholder en intensiv laboratorie-del og dette krever oppmøte på kursstedet. Dette gjelder det obligatoriske kurset: 'Fundamental and molecular systematics' som starter med to ukers intensiv laboratorie-del på en biologisk stasjon i begynnelsen av første semester for at studentene som deltar ved programmet skal bli kjent med hverandre ved oppstart. Oppmøte på kurssted gjelder også for feltkurs.

4) Læringsmål for 'MSc in Biology':

Masterutdanningen i biologi gir kandidaten forskningsbaserte, spesialiserte kunnskaper. Praktisk prosjektarbeid gir ferdigheter og generell kompetanse på et avansert nivå, med sikte på arbeid innen forskning, industri, konsulentvirksomhet, undervisning og offentlig forvaltning eller videre utdanning i et doktorgradsstudium. Masteroppgaven gir spesialkompetanse innen et av forskningsområdene: Celle- og molekylærbiologi; fysiologi; økologi, atferd, evolusjon og biosystematikk

Masterkandidaten skal etter fullført utdanning:

Kunnskaper

- Ha spisskompetanse og forskningserfaring innen utvalgte tema i biologi, hvor noen støtter opp om masterprosjektet.
- Ha inngående kunnskap til forskjellige arbeids- og analysemetoder som brukes i fagfeltet.
- Ha inngående kunnskap til bredden i forskningen som foregår i biologi i dag.
- Ha inngående kunnskap og erfaring om forskjellige arbeids- og analysemetoder.

Ferdigheter

- Kunne skriftlig så vel som muntlig presentere forskningsresultater til spesialister og til et bredere publikum.
- Kunne kombinere innsikt fra flere fagfelt.
- Kunne arbeide med tidsfrister i forhold til ett større prosjekt.
- Kunne oppdatere seg på kunnskap innen sin spesialisering.

Generell kompetanse

- Kunne kritisk vurdere vitenskapelige arbeider inklusiv metoder og resultater.
- Kunne selvstendig gjennomføre et vitenskapelig arbeid gjennom hele prosessen fra hypotese, innhenting og analyse av data, til muntlig og skriftlig rapport i vitenskapelig format.
- Kunne skaffe seg og vurdere forskningsinformasjon.
- Kunne arbeide i prosjekter, selvstendig og i samarbeid med andre, inklusive tverrfaglige team.
- Kunne analysere sentrale problemstillinger innen sin spesialisering.
- Kunne formidle og kommunisere omfattende selvstendig arbeid.
- Kunne bidra til nytenking innen sin spesialisering.
- Ha kompetanse og erfaring i risikoanalyser og i håndtering av kjemiske stoffer og biologisk materiale og forstå miljømessige konsekvenser av disse, med fokus på helse, miljø og sikkerhet (HMS).
- Kunne kommunisere skriftlig og muntlig på engelsk om faglige spørsmål.

Studieretning: Cell and Molecular Biology

Spesialiseringen skal gi dyp molekylær forståelse av cellebiologiske mekanismer og deres regulering. Etter å ha fullført studiet skal kandidaten ha gode kunnskaper om sentrale metoder innen celle- og molekylærbiologi. Kandidaten skal også ha innsikt i bruk av moderne eksperimentell teknikk og apparatur. Det skal gjennomføres en vitenskapelig undersøkelse med påfølgende skriftlig presentasjon innenfor et avgrenset emne. Her skal kandidaten vise faglig spisskompetanse og evne til kritisk vurdering av vitenskapelige arbeid.

Masterkandidaten skal etter fullført utdanning:

Kunnskap

- Ha avansert forskningsbasert oppdatert kunnskap om viktige cellebiologiske kommunikasjonsprinsipper og prosesser og hvordan disse reguleres.
- Ha avansert kunnskap om fagområdet celle- og molekylærbiologi.
- Ha anvendbar kunnskap innen celle- og molekylærbiologi.

Ferdigheter

- Kunne benytte og beherske sentrale metoder til å utføre selvstendig laboratoriearbeid og gjennomføre en selvstendig vitenskapelig undersøkelse.
- Kunne bruke celle- og molekylærbiologiske metoder i en forskningsoppgave og gi skriftlig presentasjon av forskningsresultater.
- Kunne anvende eksisterende teorier innen celle- og molekylærbiologi.

Studieretning: Physiology

Spesialiseringen gir innsikt i hvordan dyr eller planter fungerer i sitt naturlige miljø. Kandidatene skal tilegne seg grundig forståelse for sammenhengen mellom spesielle faktorer i det ytre miljø og fysiologiske karaktertrekk. Det gjennomføres en vitenskapelig undersøkelse med påfølgende skriftlig presentasjon innenfor et avgrenset emne. Her skal kandidatene vise faglig spisskompetanse og evne til kritisk vurdering av vitenskapelige arbeid.

Masterkandidaten skal etter fullført utdanning:

Kunnskap

- Ha oppdatert forskningsbasert kunnskap om hvordan dyr eller planter fungerer i sitt naturlige miljø og har tilegnet seg grundig forståelse for sammenhengen mellom spesielle faktorer i det ytre miljø og fysiologiske karaktertrekk.
- Ha inngående kunnskap om fagområdet fysiologi.
- Kunne analysere og løse fysiologiske problemer.

Ferdigheter

- Kunne beherske sentrale metoder (i felt og/eller laboratorium) og å gjennomføre en selvstendig vitenskapelig undersøkelse med påfølgende skriftlig presentasjon innenfor et avgrenset emne.
- Kunne analysere teorier i fysiologi.

Studieretning: Ecology, Behaviour, Evolution and Biosystematics

Spesialiseringen gir en grundig innføring i et av feltene økologi, atferd, evolusjon og biosystematikk. Med tanke på spesialfeltet skal studiet gi en grundig innføring i levende organismers forhold til miljøet og til andre levende organismer, både innen og mellom arter. Spesialiseringen gir forståelse for mikro- og makroevolusjonære prosesser, samt metoder som brukes for å studere disse, inklusiv metoder basert på morfologiske og molekylære karakterer.

Masterkandidaten skal etter fullført utdanning

Kunnskap

- Ha ny forskningsbasert kunnskap på teoretiske og/eller eksperimentelle områder innen sitt spesialfelt og bred kunnskap innen nærliggende felt.
- Ha inngående kunnskaper om hvordan biologi kan gi forståelse og løsninger på miljøspørsmål.
- Ha dybdekunnskaper om biologisk mangfold.
- Kunne forstå evolusjonær historie og økologiske prosesser.

Studieretning: Biodiversity and Systematics

Spesialiseringen gir en grundig innføring i biodiversitet og systematikk inkludert identifiseringsferdigheter i en eller flere organismegrupper. Studiet skal gi en oversikt over levende organismer og slektskap/klassifisering dem imellom, arters tilblivelse og evolusjonære historie og prosesser som ligger til grunn for diversitetsmønstre observert, samt kunnskap om regler som gjelder ved navnetting av arter. Det skal gjennomføres en vitenskapelig undersøkelse innenfor et avgrenset emne med påfølgende skriftlig presentasjon. Her skal kandidatene vise faglig spisskompetanse og evne til kritisk vurdering av vitenskapelige arbeid.

Masterkandidaten skal etter fullført utdanning:

Kunnskap

- ha avansert kunnskap og forståelse av teorier knyttet til fagfeltene biodiversitet og systematikk og spesialisert innsikt i et avgrenset område
- ha inngående kunnskap innen nåværende forskningspraksis og innen metodikk innen biodiversitet og systematikk

Ferdigheter

- kunne beskrive evolusjonære mekanismer som fører til artsdannelse
- kunne gjøre rede for artsbegrep og være i stand til å produsere og analysere kritisk molekylære data
- kunne evaluere eget arbeidet kritisk og derved bidra til kunnskapsutvikling innen fagfeltet

Generell kompetanse

- forstå betydningen av biodiversitet i et globalt perspektiv, og forståelse av etiske og økonomiske aspekter knyttet til bevaring av biologisk mangfold
- vise bevissthet knyttet til etiske aspekter i forhold til forskning og forvaltningspraksis

6) Kostnadsberegning og finansiering:

Samme som for master i biologi. Reiseutgiftene på studieretningen biodiversitet og systematikk er lagt på et slikt nivå at det skal finansieres av studentene innenfor studentenes studiefinansiering.

8) Antall studenter:

Basert på eksisterende opptakstall, foreslår vi at opptaket for den foreslåtte 'MSc in Biology' settes til 35 studenter, inkludert både norske og internasjonale studenter. Fordeling 2/3 norsk/nordisk bakgrunn, 1/3 internasjonal bakgrunn

9) Opptakskrav og opptaksregler:

Samme opptakskrav gjelder som for andre mastergrader, med Bachelor of Science i biologi (180 ECTS), eller tilsvarende, de ulike retningene vil ha litt ulike krav til fordypningen i biologi i bachelorgraden.

11) Forskningskobling og tverrfaglighet:

Det 2-årige Master of Science in Biology er tverrfaglig på flere nivåer. Emnene i programmet gjenspeiler utvikling av kunnskap og ferdigheter som fokuserer på grundig kunnskap om grunnleggende biologiske prosesser, tilgjengelige teknologier for å studere slike prosesser, og kunnskapsbaserte metoder for å endre eller optimalisere prosesser for å takle store samfunnsmessige, miljømessige eller bærekraftige utfordringer.

Institutt for biologi ble nylig evaluert (Forskningsråds evalueringen av biofag 2011) og denne bekrefter biologiundervisningen som en forskningsbasert utdanning. Flere av gruppene fikk meget god faglig evaluering, hvorav en av gruppene er videre i runde 2 om SFF. Både Institutt for biologi og Seksjon for Naturhistorie har en lang tradisjon med å involvere studenter innen både forskning, samlingsforvaltning og formidling.

12 Eksterne samarbeidspartnere (gjelder NABiS):

Per i dag er NABiS et samarbeid mellom: Göteborgs universitet, Københavns universitet, Lund universitet, Universitetet i Oslo, Stockholm universitet, Universitetet i Tromsø, Uppsala universitet og Århus universitet. Alle institusjoner har full autonomi innen et slikt utdanningssamarbeid. De samarbeidende universitetene danner en programkomité bestående av ett medlem fra hvert av universitetene. Komiteen danner ingen juridisk bindende enhet, og disputer vil bli søkt løst innen komiteen eller i henhold til det juridiske rammeverket til hver enkelt institusjon. Göteborgs universitet er administrativt ansvarlig for utdanningssamarbeidet ved koordinator Bente Eriksen. Ny avtale mellom enhetene er under utarbeidelse.

14) Markedsvurdering:

Uteksaminerte kandidater i biologi får seg jobber innen forskning, privat næringsliv, forvaltning og undervisning i Norge og internasjonalt. NTNU er sammen med UiO og UiB ledende innen utdanning av masterstudenter i biologi i Norge. En spørreundersøkelse nylig utført av instituttet viser at 40% av masterkandidatene fra biologi får seg jobb før avsluttet studiet, innen utgangen av 3mnd etter endt masterutdanning har over 65% fått relevant arbeid. Markedet for kandidater vil etter vår mening ikke reduseres, og på grunn av miljøutfordringer vil behovet for kompetanse og kandidater trolig øke eller i alle fall holde seg stabilt. Henviser i den sammenheng til NTNU strategidokumentet.

Study Track Table: Innovative Sustainable Energy Engineering (ISEE) – Master Program

Final version

Study Tracks for the new ISEE Program							
Program Leader: Gabriella Tranell							
Nr.	Study track name	Lead University Board Member	The first year Basic master courses, Specializations		The second year Specialization courses, Master thesis		
			Where?	What?	Where?	What?	
1	<i>Solar Cell Systems and Materials</i>	NTNU Gabriella Tranell	DTU Peter Sommer-Larsen	Sustainable Energy, Energy and Environment, Energy Engineering	Solar cell systems, Physics, Chemistry	NTNU Gabriella Tranell	Solar cell materials, Physics, Material science
2	<i>System Integration of Wind Power</i>	DTU Poul Erik Morthorst	NTNU Lars Einar Norum		Electrical engineering, Energy markets, Smart grid	DTU Poul Erik Morthorst	Wind Energy planning, design and integration
3	<i>Heat and Power Engineering</i>	Chalmers David Pallarès	Uol Háldor Pálsson		Thermal energy, Energy intensive processes	Chalmers David Pallarès	Heat and power engineering, Industrial energy
4	<i>Geothermal Energy</i>	Uol Háldor Pálsson	Chalmers David Pallarès		Thermal energy, Industrial energy	Uol Háldor Pálsson	Geothermal energy
5	<i>Bio Energy</i>	Aalto Martti Larmi	KTH Reza Fakhrai		Sustainable power generation	Aalto Martti Larmi	Bio energy in transport, Power generation from bio mass
6	<i>Energy Systems</i>	KTH Mark Howells	Aalto Martti Larmi		Energy systems, Energy markets	KTH Mark Howells	Energy systems analysis, Energy efficiency, Energy policy

Innovative and Sustainable Energy Engineering (ISEE)

General program goals:

The purpose of the Nordic Master Program in "Innovative Sustainable Energy Engineering" is to provide state-of-the-art education in the fields of conventional and renewable energy sources like conventional and new power generation, solar energy, biomass energy, wind power, geothermal power, and energy utilization in the built environment by means of economically and environmentally sustainable systems and technologies. The term 'sustainable energy engineering' comprises a wide array of practices, policies and technologies (conventional and renewable/alternative) aimed at providing energy at the least financial, environmental and social cost. A strong emphasis is placed on dealing with energy engineering tasks with due consideration of technical, environmental and socio-economic issues. Another strong emphasize is put on the Innovative and Entrepreneurial aspects of the energy society, especially related to how existing and new efficiency improvement innovations can be brought to the market in different countries. The innovative aspects inside the program are both related to the advanced renewable concept in the Nordic countries as well as regards to new businesses in the energy sector. Advanced methods are applied to identify, describe, quantify and find solutions to a diverse range of energy engineering problems. Participants gain proficiency in project design and implementation, operation and maintenance, as well as in crucial phases of policy generation. Advanced training in a research-oriented perspective is also included.

Study track:

Bio Energy

Cooperating universities:

1. Year	2. Year
KTH	Aalto University
Department of Energy Technology/Division of Heat and Power Technology	School of Engineering/Department of Energy Technology
Reza Fakhrai	prof. Martti Larmi

Study track focus and goals:

Bio energy track provides state-of-the-art education in thermal conversion of biomass into power and biofuel production. Thermal conversion of biomass is considered one of the main methods to reduce carbon dioxide emissions and in the replacement of fossil carbon sources. This is due to the fact that biomass is a carbon neutral fuel as the emitted CO₂ was previously captured from the atmosphere by the plants being thermally processed. Power generation technology from biomass can be achieved through different processes, for example: combustion, gasification, pyrolysis and combined processes. While biofuel production technology can be achieved through pyrolysis, gasification, fermentation and/or distillation process.

Bio energy track at Aalto University for second year includes two modules: Power Generation from Biomass and Bioenergy in Transport. The Power Generation from Biomass module focuses on sustainable production of power from biomass which includes all aspects related to bio-boilers principles, planning, structure and operation. The Bio energy in Transport module focuses on the use and usability and combustion of bio-derived fuels in transport. On-road, off-road and marine transport is covered. The basics of bio-fuel production principles are covered too. The courses of both modules consist of lectures, literature, simulation exercises, excursions, seminars and group project work.

Learning outcomes:

- Student acquire a state-of-the-art education and training in the fields of sustainable power generation from biomass and biofuel; become familiar with the principles, planning, structure and operation of bio-boilers, combustion and gasification techniques in different types of boilers; obtain constructive knowledge in biofuel production, use, combustion and relevant environmental aspects.
- Student become skilled in calculation, simulation, design and analysis of thermal processes in bio energy power plant through training in multidisciplinary problem analysis and solving with emphasis on critical thinking
- Close collaboration with industry during thesis work and organizing excursion for many courses (especially project work courses) to provide students with enough knowledge about biomass technology both in theory and practice.

Course table:

1. Semester	2. Semester	3. Semester	4. Semester
KTH		Aalto University	
		Bioenergy in Transport:	
<i>Introduction to Energy Technology, MJ1402, 3 ECTS</i>	<i>Computational Methods in Energy Technology, MJ2424, 6 ECTS</i>	<i>Internal Combustion Engine Technology, Kul-14.4100, 5 ECTS</i>	Thesis , 30 ECTS
<i>Renewable Energy Technology, MJ2411, 6 ECTS</i>	<i>Energy Management, MJ2410, 6 ECTS</i>	<i>Transport Biofuels, Combustion and Emission Control, Kul-14.4700, 5 ECTS</i>	
<i>Sustainable Power Generation, MJ2405, 9 ECTS</i>	<i>Renewable Energy Technology, Advanced course, MJ2412, 6 ECTS</i>	<i>Introduction to Biorefineries and Biofuels, KE-40.4120, 5 ECTS</i>	
<i>Sustainable Energy Utilization, MJ2407, , 9 ECTS</i>	<i>Applied heat and power technology, MJ2426, 6 ECTS</i>	<i>Energy Systems for Communities, Ene-59.4301, 5 ECTS</i>	
<i>Energy and Environment, MJ2413, 6 ECTS</i>	<i>Elective course from list 1</i>	<i>Elective courses from list 2 to complete 30 ECTS</i>	
= 33 ECTC	= 30 ECTS	= 30 ECTS	

1. Semester	2. Semester	3. Semester	4. Semester
KTH		Aalto University	
		Power generation from biomass:	
<i>Introduction to Energy Technology, MJ1402, 3 ECTS</i>	<i>Computational Methods in Energy Technology, MJ2424, 6 ECTS</i>	<i>Combustion and Gasification Technology I, Ene-47.5120, 3 ECTS</i>	Thesis , 30 ECTS
<i>Renewable Energy Technology, MJ2411, 6 ECTS</i>	<i>Energy Management, MJ2410, 6 ECTS</i>	<i>Combustion and Gasification Technology II, Ene-47.5121, 3 ECTS</i>	
<i>Sustainable Power Generation, MJ2405, 9 ECTS</i>	<i>Renewable Energy Technology, Advanced course, MJ2412, 6 ECTS</i>	<i>Electricity Production from Biomass II b, Ene-47.411, 3 ECTS</i>	
<i>Sustainable Energy Utilization, MJ2407, , 9 ECTS</i>	<i>Applied heat and power technology, MJ2426, 6 ECTS</i>	<i>Process-Integration, Simulation and Optimization, Ene-47.5130, 3 ECTS</i>	
<i>Energy and Environment, MJ2413, 6 ECTS</i>	<i>Elective course from list 1</i>	<i>Waste to Energy, Ene-47.4114, 3 ECTS</i>	
		<i>Project in New Energy Technologies, Ene-47.4150, 5 ECTS</i>	
		<i>Introduction to Biorefineries and Biofuels, KE-40.4120, 5 ECTS</i>	
		<i>Elective courses from list 2 to complete 30 ECTS</i>	
= 33 ECTC	= 30 ECTS	= 30 ECTS	= 30 ECTS

Elective course list 1

MJ2438 – Modeling of Energy Systems – Heat and Power Generation, 6 cr

MJ2470 Climate Change Mitigation Tools, 6 cr

MJ 2473 Energy Policy Design, 6 cr

Elective course list 2

Ene-47.5120 Combustion and Gasification Technology I P, 3 cr

Ene-47.5121 Combustion and Gasification Technology II P, 3 cr

Ene-47.4112 Electricity Production from Biomass II b, 3 cr

Ene-47.5130 Process-Integration, Simulation and Optimization, 3 cr,

Ene-59.4301 Energy Systems for Communities, 5 cr

Ene-59.4310 Special Course in Energy for Communities, 5cr

Tfy-56.4311 New Energy Sources, 5 cr

Puu-0.5000 Economics of Forest Products Industry, 4 cr

Research areas for projects / master thesis

Responsible professor, 2. year university, department	Second supervisor, 1. year, university, department	Research area
<i>prof. Martti Larmi, Aalto University, department of Energy Technology</i>	<i>To be announced</i>	<i>Biofuel production and combustion</i>
<i>prof. Mika Järvinen, Aalto University, department of Energy Technology</i>	<i>To be announced</i>	<i>Combustion and gasification, fuel spraying and modeling</i>
<i>prof. Risto Lahdelma, Aalto University, department of Energy Technology</i>	<i>To be announced</i>	<i>Energy: Modeling, simulation and optimization</i>
<i>Prof. Markku Lampinen, Aalto University, department of Energy Technology</i>	<i>To be announced</i>	<i>hydrogen and fuel cell technologies, CFD and various problems concerning heat- and mass transfer</i>

Degree requirements for admission process

A BSc degree corresponding to a minimum 180 ECTS credits in the following fields:	Energy Engineering or Mechanical Engineering and Chemical Engineering
Applicants that are enrolled in an integrated five year degree with no bachelor level:	
A BEng in ... Engineering is accepted for start at ...	
Applicants with a BEng in ..., or a BSc or BEng in ..., will be considered on an individual basis.	
The applicant's qualifications must include a strong working knowledge of mathematics and ..., and applicants must document that they have fulfilled the following minimum requirements:	<p>The minimum requirements includes the following:</p> <ul style="list-style-type: none"> - Mathematics: 20 ECTS including linear algebra, calculus and differential equations. - Thermodynamics and heat transfer: 5 ECTS. - Energy & Environment: 5 ECTS - Statistics and dynamics: 5 ECTS. - Fluid mechanics: 5 ECTS. - Materials science: 5 ECTS. <p>Moreover, the applicant must have sufficient qualifications within numerical methods and elementary programming using e.g. MATLAB or a similar programming language.</p>
Applicants with a Polytechnic (FI), Högskoleingenör (SE) and Diplomingeniør (DK) degree may be expected to do extra course work to qualify for the programme.	

**Nordic Five Tech – Joint M. Sc. Programme
Innovative and Sustainable Energy Engineering (ISEE)**

General program goals.

The purpose of the Nordic Master Program in "Innovative Sustainable Energy Engineering" is to provide state-of-the-art education in the fields of conventional and renewable energy sources like conventional and new power generation, solar energy, biomass energy, wind power, geothermal power, and energy utilization in the built environment by means of economically and environmentally sustainable systems and technologies. The term 'sustainable energy engineering' comprises a wide array of practices, policies and technologies (conventional and renewable/alternative) aimed at providing energy at the least financial, environmental and social cost. A strong emphasis is placed on dealing with energy engineering tasks with due consideration of technical, environmental and socio-economic issues. Another strong emphasize is put on the Innovative and Entrepreneurial aspects of the energy society, especially related to how existing and new efficiency improvement innovations can be brought to the market in different countries. The innovative aspects inside the program are both related to the advanced renewable concept in the Nordic countries as well as regards to new businesses in the energy sector. Advanced methods are applied to identify, describe, quantify and find solutions to a diverse range of energy engineering problems. Participants gain proficiency in project design and implementation, operation and maintenance, as well as in crucial phases of policy generation. Advanced training in a research-oriented perspective is also included.

Study track:

<i>Energy Systems</i>

Cooperating universities:

1. Year	2. Year
<i>Aalto</i>	<i>KTH</i>
<i>Department of Energy Technology</i>	<i>Department of Energy Technology</i>
<i>Martti Larmi</i>	<i>Mark Howells</i>

Study track focus and goals:

Background

Affordable access to essential services underpins development. Energy fuels many such services. The 'energy-system' harnesses resource, transforms it to energy carriers that are used in *appliances and machinery* to provide those services. In order to provide services to current and future generations, the 'energy-system' itself needs to be sustainable. This 'energy system' may impact and interact with the economy, the environment (including other physical resource or commodity systems) and society. The effects of this impact and interaction should also be sustainably managed. The energy decision maker is thus concerned with: (i) enabling appropriate, affordable and adequate service access; (ii) ensuring the energy-system can do so in a sustainable manner; and (iii) ensure that the broader interactions between systems does not compromise the planet's sustained development.

The goal of the program is to:

Expose the student to the context, role and process of energy systems analysis for medium to long term decision making; Have the student apply a range of standard energy modeling techniques to stereo-typical problems; Elucidate the role of energy modeling for Policy, technology, economic assessments; Have the student design, implement and apply a fully-fledged optimization energy systems model to a given assessment.

In the process, the student should be understand:

Why Energy Systems (rather than discrete energy technology) is important and how systems are analysed and modelled. The process of energy-environment-economic (3E) modeling: knowing why modelling is important, as well as who the stakeholders and decision makers are. - Introduction to the formulation of accounting, econometric, input-output, CGE and optimization modeling. Development of energy service and energy demand projections. Characterization of resources, technologies, economic, policy, and other elements to be considered within the modeling process. The role of scenarios and assumptions (forecasting, back casting etc...) and the importance of transparency. The relationship between modeling and action (policy / investment formulation / technology development). Typical model scopes, types and their application; Assessment of limitations and dealing with uncertainty

Course table:

1. Semester	2. Semester	3. Semester	4. Semester
<i>Aalto</i>		<i>KTH</i>	
Ene-59.4201 Energy Markets (5 cr) I-II	Ene-59.4010 Models and Optimization of Energy Systems (5 cr) III	(Code: TBA) Introduction to Energy-Environment-Economic optimization modeling (9cr)	MJ210x Thesis , 30 ECTS
Ene-59.4301 Energy Systems for Communities (5 cr) II	Ene-47.4151 Individual Assignment in Environment Friendly Energy Processes (5 cr), III - IV	MJ2413 Energy and the environment (6.0 cr)	
Tfy-56.4311 New Energy Sources P (5 cr) I - II		MJ2470 Climate Change Mitigation Tools (6.0 cr)	
Ene-47.5130 Process Integration, Simulation and Optimization P (3 cr), I		MJ 2473 Energy Policy Design (6.0 cr)	
Ene-47.5131 Life-Cycle Assessment and Environmental Auditing P (3 cr), II		(Code: TBA) Energy Systems Analysis - Minor Project (3cr)	
Ene-47.4150 Project in New Energy Technologies (5 cr), I-II			
Ene-47.5140 Wind Energy P (5 cr), I-II	Elective courses from list 1.		
= 31 ECTC	= 30 ECTS	= 30 ECTS	= 30 ECTS

Elective course list 1

Tfy-56.4323 Solar Energy Engineering P (5cr) III – IV (alternative years)

Tfy-56.4332 Fuel Cells and Hydrogen Technology P (5cr) IV (alternative years)

Plus other courses to be agreed on with local supervisor as a function of availability (Note there are a number of special courses that are run as a function of demand): Loay Saeed., Aalto University, department of Energy Technology.

Elective course list 2

Plus other courses to be agreed on with local supervisor as a function of availability (Note there are a number of special courses that are run as a function of demand): Loay Saeed, Aalto, Department of Energy Technology.

Research areas for projects / master thesis

Responsible professor, 2. year university, department	Second supervisor, 1. year, university, department	Research area
Mark Howells, KTH, Department of Energy Technology	Martti Larmi, Aalto, Department of Energy Technology Risto Lahdelma, Aalto University, department of Energy Technology	Development of a local, national, regional or global energy assessments. Focusing on relevant issues such as: The role of specific technologies or systems of technologies, the impact on the environment, system economics.

Degree requirements for admission process

A BSc degree corresponding to a minimum 180 ECTS credits in the following fields:	<i>Economics. Engineering.</i>
Applicants that are enrolled in an integrated five year degree with no bachelor level:	<i>Economics. Engineering.</i>
A BEng in ... Engineering is accepted for start at ...	<i>Economics. Engineering.</i>
Applicants with a BEng in ..., or a BSc or BEng in ..., will be considered on an individual basis.	<i>Economics. Engineering.</i>
The applicant's qualifications must include a strong working knowledge of mathematics and ..., and applicants must document that they have fulfilled the following minimum requirements:	<i>The minimum requirements include the following: - Mathematics: 20 ECTS including linear algebra, calculus and differential equations. - Statistics and probability theory: 5 ECTS. - Thermodynamics and heat transfer: 5 ECTS Moreover, the applicant must have sufficient qualifications within numerical methods and elementary programming using e.g. MATLAB or a similar programming language.</i>
Applicants with a Polytechnic (FI), Högskoleingenör (SE) and Diplomingeniør (DK) degree may be expected to do extra course work to qualify for the programme.	<i>No</i>

**Nordic Five Tech – Joint M. Sc. Programme
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General program goals:

The purpose of the Nordic Master Program in "Innovative Sustainable Energy Engineering" is to provide state-of-the-art education in the fields of conventional and renewable energy sources like conventional and new power generation, solar energy, biomass energy, wind power, geothermal power, and energy utilization in the built environment by means of economically and environmentally sustainable systems and technologies. The term 'sustainable energy engineering' comprises a wide array of practices, policies and technologies (conventional and renewable/alternative) aimed at providing energy at the least financial, environmental and social cost. A strong emphasis is placed on dealing with energy engineering tasks with due consideration of technical, environmental and socio-economic issues. Another strong emphasize is put on the Innovative and Entrepreneurial aspects of the energy society, especially related to how existing and new efficiency improvement innovations can be brought to the market in different countries. The innovative aspects inside the program are both related to the advanced renewable concept in the Nordic countries as well as regards to new businesses in the energy sector. Advanced methods are applied to identify, describe, quantify and find solutions to a diverse range of energy engineering problems. Participants gain proficiency in project design and implementation, operation and maintenance, as well as in crucial phases of policy generation. Advanced training in a research-oriented perspective is also included.

Study track:

Geothermal energy

Cooperating universities:

1. Year	2. Year
Chalmers University of Technology	University of Iceland
Department of Energy and Environment	Faculty of Mechanical Engineering, Industrial Engineering and Computers Science
David Pallarès	Halldór Pálsson

Study track focus and goals:

The focus in this study track is the utilization of geothermal energy for both power and heat generation. Renewable geothermal energy sources are present universally, but the feasibility of using geothermal energy depends strongly on temperature changes in relation to the depth into the ground and therefore location is important. Geothermal energy is traditionally classified into high temperature areas and low temperature areas, which indicates utilization possibilities.

The main goal of the study track can be divided into five topics, where students gain necessary engineering knowledge to enable them to execute geothermal related projects:

- Fundamental geophysical processes related to underground thermal energy as well as groundwater flow in geothermal systems. An important part of such studies is development and use of numerical and mathematical models.
- Geothermal exploration methods, well drilling and design of steam gathering systems, as well as required measurements on the grounds surface and in geothermal wells.
- Utilization of geothermal energy for sustainable power production, involving different power cycles and technologies. A special focus is on problems particularly related to geothermal fluids.
- Direct utilization of geothermal energy in form of heat. This involves district heating, various industrial processes using heat, as well as food production (e.g. greenhouses, fish farming).
- Environmental issues related to geothermal utilization, such as wastewater disposal and gas emission.

After performing the study track on geothermal energy, the students will possess basic knowledge regarding physical behavior of geothermal systems, especially in cases where water and steam are the main source of energy transport in the ground. The students will be acquainted with drilling methods and will be able to participate in design of geothermal wells. The students will be skilled in geothermal power plant design, choice of plant components as well as selection of appropriate materials. This involves thorough analysis and application of insight when working on complex problems. Finally, the students will be able to assess both low and high temperature areas with respect to optimal energy utilization, both on the power production side as well as in direct utilization. This involves knowledge of all part of such systems and skills to perform necessary calculations for all parts of both simple and multi component systems.

Course table:

1. Semester	2. Semester	3. Semester	4. Semester
Chalmers University of Technology		University of Iceland	
<i>Heat and Power Systems Engineering, MEN120, 7.5 ECTS</i>	<i>Design of Industrial Energy Equipment, KVM071, 7.5 ECTS</i>	<i>Reservoir Engineering, VÉL119F, 7.5 ECTS</i>	Thesis , 30 ECTS
<i>Turbomachinery, TME210, 7.5 ECTS</i>	<i>Elective course from list 2</i>	<i>Geothermal Power Plants, VÉL120F, 7.5 ECTS</i>	
<i>Industrial Energy Systems, KVM013, 7.5 ECTS</i>	<i>Elective course from list 2</i>	<i>Geothermal Drilling, VÉL121F, 7.5 ECTS</i>	
<i>Elective course from list 1</i>	<i>Elective course from list 2</i>	<i>Elective course from list 3</i>	
= 30 ECTS	= 30 ECTS	= 30 ECTS	= 30 ECTS

Elective course list 1

- Computational Fluid Dynamics (CFD), MTF072, 7.5 ECTS*
- Multiphase Flow, TME160, 7.5 ECTS*

Elective course list 2

- Environmental Risk Assessment in Engineering, BOM060, 7.5 ECTS*
- Compressible Flow, TME085, 7.5 ECTS*
- Energy Systems Modeling and Planning, MEN115, 7.5 ECTS*
- Computational Fluid Dynamics for Engineers, KKR072, 7.5 ECTS*
- Advanced Separation Technology, KAA102, 7.5 ECTS*

Elective course list 3

- Corrosion, VÉL501M, 6 ECTS*
- System Dynamics Modeling, IÐN113F, 7.5 ECTS*
- Groundwater and Reservoirs, JED502M, 7.5 ECTS*
- Design and Optimization, VÉL103F, 7.5 ECTS*

Research areas for projects / master thesis

Responsible professor, 2. year university, department	Second supervisor, 1. year, university, department	Research area
Halldór Pálsson, University of Iceland, IVT	<i>Mathias Gourdon</i>	<i>Reservoir modeling, geothermal power plant cycles</i>
Magnús Þór Jónsson, University of Iceland, IVT		<i>Mechanical design and optimization of steam gathering systems.</i>

Degree requirements for admission process

A BSc degree corresponding to a minimum 180 ECTS credits in the following fields:	<i>Mechanical Engineering</i>
Applicants that are enrolled in an integrated five year degree with no bachelor level:	<i>Minimum three years of Mechanical Engineering studies</i>
A BEng in ... Engineering is accepted for start at ...	<i>No</i>
Applicants with a BEng in ..., or a BSc or BEng in ..., will be considered on an individual basis.	<i>No</i>
The applicant's qualifications must include a strong working knowledge of mathematics and ..., and applicants must document that they have fulfilled the following minimum requirements:	<i>The applicant must have sufficient qualifications within numerical methods and elementary programming using e.g. MATLAB or a similar programming language.</i>
Applicants with a Polytechnic (FI), Högskoleingenör (SE) and Diplomingeniør (DK) degree may be expected to do extra course work to qualify for the programme.	<i>Not possible at the University of Iceland</i>

**Nordic Five Tech – Joint M. Sc. Programme
Innovative and Sustainable Energy Engineering (ISEE)**

General program goals:

The purpose of the Nordic Master Program in "Innovative Sustainable Energy Engineering" is to provide state-of-the-art education in the fields of conventional and renewable energy sources like conventional and new power generation, solar energy, biomass energy, wind power, geothermal power, and energy utilization in the built environment by means of economically and environmentally sustainable systems and technologies. The term 'sustainable energy engineering' comprises a wide array of practices, policies and technologies (conventional and renewable/alternative) aimed at providing energy at the least financial, environmental and social cost. A strong emphasis is placed on dealing with energy engineering tasks with due consideration of technical, environmental and socio-economic issues. Another strong emphasize is put on the Innovative and Entrepreneurial aspects of the energy society, especially related to how existing and new efficiency improvement innovations can be brought to the market in different countries. The innovative aspects inside the program are both related to the advanced renewable concept in the Nordic countries as well as regards to new businesses in the energy sector. Advanced methods are applied to identify, describe, quantify and find solutions to a diverse range of energy engineering problems. Participants gain proficiency in project design and implementation, operation and maintenance, as well as in crucial phases of policy generation. Advanced training in a research-oriented perspective is also included.

Study track:

<i>Heat and Power Engineering</i>

Cooperating universities:

1. Year	2. Year
<i>University of Iceland</i>	<i>Chalmers University of Technology</i>
Faculty of Mechanical Engineering, Industrial Engineering and Computers Science	<i>Dept. of Energy and Environment</i>
<i>Háldor Pálsson</i>	<i>David Pallarès</i>

Study track focus and goals:

This track meets the challenge set global warming and depletion of fossil fuel resources by providing state-of-the-art education in advanced technologies and systems for efficient, clean and competitive conversion, distribution and use of electricity, heating and cooling.

Training is provided in the use of optimization and modelling tools for design and planning on the technical plant level, including state-of-the-art technologies, at the same time that necessary knowledge on energy systems is given in order to gain perspective.

Learning outcomes

Students become skilled in analysis, optimization and design of combined heat and power plants and industrial heat processes, acquiring also state-of-the-art knowledge on Carbon Capture and Storage technologies.

By acquiring complementary knowledge on an energy systems level, students are trained to approach problem-solving in an interdisciplinary way.

Students are prepared for a professional career within the energy industry and power generation companies.

Course table:

1. Semester	2. Semester	3. Semester	4. Semester
<i>University of Iceland</i>		<i>Chalmers University of Technology</i>	
<i>Introduction to Renewable Energy, UAU120F, 6 ECTS</i>	<i>Interdisciplinary Energy Project Course, UMV240F, 4 ECTS</i>	<i>Heat and Power Systems Engineering, MEN120, 7.5 ECTS</i>	Thesis , 30 ECTS
<i>Energy Intensive Production Processes, VÉL102M, 6 ECTS</i>	<i>Heat Transfer in Macro, Micro and Nanoscales , VÉL215M, 6 ECTS</i>	<i>Industrial Energy Systems, KVM013, 7.5 ECTS</i>	
<i>Elective courses from list 1</i>	<i>Elective courses from list 2</i>	<i>Elective courses from list 3</i>	
= 30 ECTC	= 30 ECTS	= 30 ECTS	= 30 ECTS

Elective course list 1

- *Energy Economics and Policy, UAU111F, 10 ECTS*
- *System Dynamics Modelling, IDN115F, 7.5 ECTS*
- *Seminar 1: Sustainability, decision-making and policy, UAU 101F, 6 ECTS*
- *Transport Phenomena in Single and Two Phase Flows, VÉL504M, 6 ECTS*
- *Corrosion, VÉL501M, 6 ECTS*
- *Finite Element Analysis, VÉL103M, 6 ECTS*

Elective course list 2

- *Numerical Solutions in Fluid Mechanics and Heat Transfer Computerized Fluid Dynamics, VÉL215F, 7.5 ECTS*
- *Hydropower Plants, UMV213F, 7.5 ECTS*
- *Environmental Planning, UMV201M, 7.5 ECTS*
- *Electric Power Generation, RAF608M, 6 ECTS*
- *Electricity Markets and Economics, RAF610M, 6 ECTS*
- *Sustainable Energy Options (resources, environment and sustainability), UAU213F, 6 ECTS*
- *Life-cycle Assessment, UAU205F, 6 ECTS*

Elective course list 3

- *Introduction to nuclear reactors, TIF215, 7.5 ECTS*
- *Sustainable Electric Power Systems, ENM125, 7.5 ECTS*
- *Turbomachinery, TME210, 7.5 ECTS*
- *Sustainable Energy Futures ,FFR170, 7.5 ECTS*
- *Computational fluid dynamics (CFD), MTF072, 7.5 ECTS*
- *Multiphase flow, TME160, 7.5 ECTS*
- *Gas turbine technology, MTF171, 7.5 ECTS*
- *Power market management, EEK201, 7.5 ECTS*

Research areas for projects / master thesis

First supervisor, 2. year university, department	Second supervisor, 1. year, university, department	Research area
Prof. Filip Johnsson, Chalmers University, Energy and Environment	<i>To be announced</i>	Fluidized bed processes
David Pallarès, Chalmers University, Energy and Environment	<i>To be announced</i>	Fluidized bed processes
Fredrik Norrmann	<i>To be announced</i>	Oxyfuel combustion, flue gas treatment
Mathias Gourdon	<i>To be announced</i>	Optimization of industrial energy use
Magnus Rydén	<i>To be announced</i>	Chemical looping combustion

Degree requirements for admission process

A BSc degree corresponding to a minimum 180 ECTS credits in the following fields:	Mechanical Eng., Chemical Eng., Chemistry, Physics
Applicants that are enrolled in an integrated five year degree with no bachelor level:	Mechanical Eng., Chemical Eng., Chemistry, Physics
A BEng in ... Engineering is accepted for start at ...	
Applicants with a BEng in ..., or a BSc or BEng in ..., will be considered on an individual basis.	Any technical degree
The applicant's qualifications must include a strong working knowledge of mathematics and ..., and applicants must document that they have fulfilled the following minimum requirements:	<p>Energy/thermal engineering</p> <ul style="list-style-type: none"> - Mathematics: 21.5 ECTS including linear algebra, calculus and differential equations. - Thermodynamics: 6 ECTS. - Mass and/or heat transfer: 6 ECTS <p>Students without this qualification must be prepared to complete their curriculum during the first year.</p> <ul style="list-style-type: none"> - Fluid mechanics: min. 5 ECTS <p>Moreover, the applicant must have sufficient qualifications within elementary programming using e.g. MATLAB or a similar programming language.</p>
Applicants with a Polytechnic (FI), Högscoleingenör (SE) and Diplomingeniør (DK) degree may be expected to do extra course work to qualify for the programme.	

**Nordic Five Tech – Joint M. Sc. Programme
Innovative and Sustainable Energy Engineering (ISEE)**

General program goals:

The purpose of the Nordic Master Program in "Innovative Sustainable Energy Engineering" is to provide state-of-the-art education in the fields of conventional and renewable energy sources like conventional and new power generation, solar energy, biomass energy, wind power, geothermal power, and energy utilization in the built environment by means of economically and environmentally sustainable systems and technologies. The term 'sustainable energy engineering' comprises a wide array of practices, policies and technologies (conventional and renewable/alternative) aimed at providing energy at the least financial, environmental and social cost. A strong emphasis is placed on dealing with energy engineering tasks with due consideration of technical, environmental and socio-economic issues. Another strong emphasize is put on the Innovative and Entrepreneurial aspects of the energy society, especially related to how existing and new efficiency improvement innovations can be brought to the market in different countries. The innovative aspects inside the program are both related to the advanced renewable concept in the Nordic countries as well as regards to new businesses in the energy sector. Advanced methods are applied to identify, describe, quantify and find solutions to a diverse range of energy engineering problems. Participants gain proficiency in project design and implementation, operation and maintenance, as well as in crucial phases of policy generation. Advanced training in a research-oriented perspective is also included.

Study track:

<i>Solar Cell Systems and Materials</i>

Cooperating universities:

1. Year	2. Year
<i>Technical University of Denmark</i>	<i>Norwegian University of Science and Technology</i>
<i>Department of Energy Conversion and Storage</i>	<i>Faculty of Natural Science and Technology, Department for Material Science and Engineering</i>
<i>Peter Sommer-Larsen</i>	<i>Gabriella Tranell</i>

Study track focus and goals:

The overall goal of the study track “Solar Energy and Photovoltaic (PV) Materials” is to educate MSc level candidates with theoretical knowledge and practical competence, qualified to a professional career in the PV industry, or for PhD level studies in the field. The study track focuses on the fundamental principles behind- and the application and development of- photovoltaic materials and/or devices, and systems. The students will, based on bachelor background, have the opportunity to choose between a physics direction and a materials science direction.

In the first year at DTU, a broad basis in energy systems, technology and economics will be offered to all students. The fundamentals of solar energy harvesting are provided, in addition to basic courses in semiconductor physics and materials synthesis.

In the second year at NTNU, depending on study line/ direction, advanced courses in solid state physics, optics etc. will be offered to students in the physics direction. For students in the materials science direction, courses covering process metallurgical, electro-chemical and chemical methods to synthesize semiconducting and light harvesting PV materials are offered. In addition, courses in PV Si-materials processing such as crystallization, wafering and passivation are available. The year at NTNU contains a 15 ECTS project, in addition to the 30 ECTS MSc project. Depending on project and MSc direction, course choice will be recommended by project supervisor.

Course table:

1. Semester	2. Semester	3. Semester	4. Semester
<i>Technical University of Denmark (DTU)</i> Search the course number(i.e.46220)		<i>Norwegian University of Science and Technology (NTNU)</i>	
<i>Modelling and Analysis of Sustainable Energy Systems</i> <i>Modelling and Analysis of Sustainable Energy Systems, 46220</i> 10 ECTS	Chose 30 ECTS of Elective courses list 1 (Physics line) or 2 (Materials line)	Elective course list 3 (Physics line) or Elective course list 4 (Materials line) 7.5 ECTS	TFY xxxx or TMT xxxx MSc Project , 30 ECTS
Energy Economics, Markets and Policies, 42003, 10 ECTS		Elective course list 3 (Physics line) or Elective course list 4 (Materials line) 7.5 ECTS	
Feasibility Studies and System Assessment of Energy Technologies, 42004, 5 ECTS		TFY xxxx or TMT xxxx Semester project, 15 ECTS	
Energy and Sustainability, 28870, 5 ECTS			
= 30 ECTC	= 30 ECTS	= 30 ECTS	= 30 ECTS

Elective course list 1 -Physics line , DTU

Advanced Solid State Physics, 10305,5 ECTS

Light emitting diodes and photovoltaics for energy applications, 34540, 5 ECTS (must be moved to spring semester)

Nanophotonics, 34051, 10 ECTS

Solar heating systems, 11117, 10 ECTS

Electronic Structure Methods in Material Physics, Chemistry and Biology Electronic Structure Methods in Experimental Surface Physics,10304, 10 ECTS

Elective course list 2 - Materials line, DTU

Applied Inorganic Chemistry,47303,5 ECTS

Electrochemistry, 47305, 5 ECTS

Catalysis and Sustainable Chemistry, 26510, 10 ECTS

Emerging Energy Technologies, 31778, 5 ECTS

Solid Oxide Fuel Cells and Electrolysis, 47306, 5 ECTS

Ceramic Science and Engineering, 47304, 10 ECTS

Material Physics, Chemistry and Biology, 10302, 10 ECTS

Elective course list 3- Physics line , NTNU

Depending on background, one can for example choose:

Fall: TFE4145 Semiconductor Physics and Electronic Devices, Introduction 7.5 ECTS (check language of instruction!)

Fall: TFY4300 Energy and environmental Physics 7.5 ECTS

Fall: TFY3114 Functional Materials 7.5 ECT

Fall: TFY4255 - Materials Physics 7.5 ECT

Fall: TMT4322 Solar Cells and Photovoltaic Nanostructures 7.5 ECTS

Elective course list 4 – Materials direction NTNU

Fall: TMT4305 Electrometallurgy (metallurgical route for solar cell silicon, silicon production) 7.5 ECTS

Fall: TMT4325 Refining and Recycling of Metals 7.5 ECTS

Fall: TMT4322 Solar Cells and Photovoltaic Nanostructures 7.5 ECTS

(Spring: TKP4190 Fabrication and Applications of Nanomaterials 7.5 ECTS)

(Spring: TMT 4283 Hydrogen, fuel cells and solar cells 7.5 ECTS)

Research areas for projects / master thesis

NTNU , Responsible professor , department	DTU, Second supervisor, department	Research area Topic (P= Physics line, M=Materials line)
Gabriella Tranell Merete Tangstad Departement of Material Science and Engineering	<i>Possible second supervisor, university, department SHOULD BE SOMEONE IN CHEMICAL ENGINEERING PERHAPS?</i>	<u>Si feedstock (M)</u> Si production and SoG-Si Refining
Marisa Di Sabatino Lundberg Lars Arnberg Eivind Johannes Øvrelid Departement of Material Science and Engineering	<i>Possible second supervisor, university, department</i>	<u>Crystallization (M)</u> Material properties Characterization Wafering
Mari-Ann Einarsrud Fride Vullum-Bruer Departement of Material Science and Engineering	<i>Possible second supervisor, university, department</i>	<u>Wet chemistry/sol gel (M)</u> TCO, nanoparticles Intermediate band materials
Turid W. Reenaas Ursula Gibson Randi Holmestad Ton Helvoort Morten Kildemo Mikael Lindgren Ingve Simonsen, Departement of Physics	<i>Possible second supervisor, university, department</i>	<u>Thin film/third generation solar cells (P)</u> Intermediate band solar cells Thin film/Intermediate band solar cells TEM characterization TEM characterization Optical characterization Optical characterization Modeling light/matter interaction
Bjørn-Ove Fimland Helge Weman Department of Electronics and Telecommunications	<i>Possible second supervisor, university, department</i>	<u>III-V solar cells (P)</u> Nanowire and intermediate band solar cells Nanowire solar cells

NOTE: The table should help to identify the possible research areas where the master students will end up writing their thesis. This will also show you where you have to build up cooperation / find common interests.

Degree requirements for admission process

<p>A BSc degree corresponding to a minimum 180 ECTS credits in the following fields:</p>	<p><u>Physics line:</u> Physics or relevant BSc <u>Materials line:</u> Materials Science, Inorganic Chemistry/Chemical Engineering</p>
<p>Applicants that are enrolled in an integrated five year degree with no bachelor level:</p>	
<p>A BEng in ... Engineering is accepted for start at ...</p>	
<p>Applicants with a BEng in ..., or a BSc or BEng in ..., will be considered on an individual basis.</p>	
<p>The applicant's qualifications must include a strong working knowledge of mathematics and ..., and applicants must document that they have fulfilled the following minimum requirements:</p>	<p>Applicants must document that they have fulfilled the following minimum requirements:</p> <p><u>Both lines:</u></p> <ul style="list-style-type: none"> - Mathematics: 25 ECTS including linear algebra, calculus and differential equations - Statistics and probability theory: 5 ECTS - Numerical methods and elementary programming using e.g. MATLAB or a similar programming language <p><u>Physics line:</u></p> <ul style="list-style-type: none"> - Physics 80 ECTS - Mathematics and statistics 60 ECTS <p>The university courses should cover curricula at a level comparable to that required for admittance to the graduate programme in physics at NTNU. As admission is extremely competitive, applicants should have excellent academic records (minimum B+/upper second/GPA 3.3/4).</p> <p><u>Materials Line:</u></p> <ul style="list-style-type: none"> - Chemistry: min. 15 ECTS - Thermodynamics: min. 7,5 ECTS - Materials Science: min. 15 ECTS - Mass and Heat Transfer: min 7,5 ECTS
<p>Applicants with a Polytechnic (FI), Högskoleingenör (SE) and Diplomingeniør (DK) degree may be expected to do extra course work to qualify for the programme.</p>	

Nordic Five Tech – Joint M. Sc. Programme
Innovative and Sustainable Energy Engineering (ISEE)

General program goals:

The purpose of the Nordic Master Program in "Innovative Sustainable Energy Engineering" is to provide state-of-the-art education in the fields of conventional and renewable energy sources like conventional and new power generation, solar energy, biomass energy, wind power, geothermal power, and energy utilization in the built environment by means of economically and environmentally sustainable systems and technologies. The term 'sustainable energy engineering' comprises a wide array of practices, policies and technologies (conventional and renewable/alternative) aimed at providing energy at the least financial, environmental and social cost. A strong emphasis is placed on dealing with energy engineering tasks with due consideration of technical, environmental and socio-economic issues. Another strong emphasize is put on the Innovative and Entrepreneurial aspects of the energy society, especially related to how existing and new efficiency improvement innovations can be brought to the market in different countries. The innovative aspects inside the program are both related to the advanced renewable concept in the Nordic countries as well as regards to new businesses in the energy sector. Advanced methods are applied to identify, describe, quantify and find solutions to a diverse range of energy engineering problems. Participants gain proficiency in project design and implementation, operation and maintenance, as well as in crucial phases of policy generation. Advanced training in a research-oriented perspective is also included.

Study track:

<i>System Integration of Wind Power</i>

Cooperating universities:

1. Year	2. Year
<i>NTNU</i>	<i>DTU</i>
<i>Department of Electric Power Engineering</i>	<i>DTU Management Engineering</i>
<i>Lars Einar Norum</i>	<i>Professor Poul Erik Morthorst & Professor Jens Nørkær Sørensen</i>

Study track focus and goals:

The student will learn:

In the study line System Integration of Wind power the participants will achieve a general understanding of wind energy as seen as a part of the total energy system. They will gain specific knowledge on wind turbines but also on the various technologies related to wind energy in a system context. The study line enables the participants to analyze, design, develop and operate wind energy systems. The study line combines socio-economic aspects of sustainable energy with relevant technical disciplines, such as measurement techniques, design of wind turbines, planning and development of wind farms, grid integration of wind energy systems and a relation to smart grid development.

Goal of the Study Track:

Candidates with a degree from the System Integration of Wind power study line are qualified for jobs not only in the rapidly expanding wind energy sector, but also in Engineering companies and public bodies carrying out planning and development in relation to wind power and energy systems.

Course table:

1. Semester	2. Semester	3. Semester	4. Semester
<i>NTNU</i>		<i>DTU</i>	
<i>TET4115 - Power System Analysis 7.5 ECTS</i>	<i>TEP4220 - Energy and Environmental Consequences 7.5 ECTS</i>	<i>Wind Power and aero technology, 46300, 10 ECTS</i>	Thesis , 30 ECTS
<i>TET4190 - Power Electronics for Renewable Energy 7.5 ECTS</i>	<i>TET4185 - Power Markets, Resources and Environment 7.5 ECTS</i>	<i>Integration of Wind Power in Power Systems, 31783, 5 ECTS</i>	
<i>TEP4175 - Energy from Environmental Flows 7.5 ECTS</i>	<i>TET4175 - Power Control in Smart Grids 7.5 ECTS</i>		
<i>Elective course from list 1</i>	<i>Elective course from list 2</i>	<i>Elective course from list 3</i>	
= 30 ECTC	= 30 ECTS	= 30 ECTS	= 30 ECTS

Elective course list 1

- TIØ4556 Energy Markets, Specialization Course 7.5 ECTS
- TEP4240 System Simulation 7.5 ECTS
- TVM4162 Industrial Ecology 7.5 ECTS

Elective course list 2

- TET4180 Electric Power System Stability 7.5 ECTS
- TET4135 Energy Systems Planning and Operation 7.5 ECTS
- TET4200 Marine and Offshore Power Systems 7.5 ECTS
- TEP4150 Energy Management and Technology 7.5 ECTS

Elective course list 3

- 28870 Energy and Sustainability 5 ECTS
- 42004 Feasibility studies and systems assessment of energy technologies 5 ECTS
- 46400 Wind power and measurement techniques 10 ECTS
- 31786 Design of wind turbines 10 ECTS
- 41315 Applied CFD 5 ECTS
- 46200 Planning and development of wind farms 5 ECTS
- 46100 Introduction to micrometeorology for wind power 5 ECTS
- 46320 Loads, Aerodynamics and Control of wind turbines 10 ECTS

Research areas for projects / master thesis

Responsible professor, 2. year university, department	Second supervisor, 1. year, university, department	Research area
<i>Poul Erik Morthorst, Management Engineering, DTU</i>	<i>To be announced</i>	<i>System Integration of wind power, Energy Markets, Energy Policies</i>
<i>Jens Nørkær Sørensen, Wind Energy, DTU</i>	<i>To be announced</i>	<i>System integration of Wind power, wind turbine technology, wind turbine design</i>
<i>To be announced</i>	<i>To be announced</i>	<i>Systems integration of wind power, grid integration of wind power, smart grids</i>

NOTE: The table should help to identify the possible research areas where the master students will end up writing their thesis. This will also show you where you have to build up cooperation / find common interests.

Degree requirements for admission process

A BSc degree corresponding to a minimum 180 ECTS credits in the following fields:	Electrical Engineering, Mechanical Engineering, or other relevant BSc
Applicants that are enrolled in an integrated five year degree with no bachelor level:	Electrical Engineering, Mechanical Engineering, or other relevant BSc
A BEng in ... Engineering is accepted for start at ...	
Applicants with a BEng in ..., or a BSc or BEng in ..., will be considered on an individual basis.	
The applicant's qualifications must include a strong working knowledge of mathematics and ..., and applicants must document that they have fulfilled the following minimum requirements:	<p>Specific minimum requirements:</p> <ul style="list-style-type: none"> - Mathematics: 25 ECTS including linear algebra, calculus and differential equations. - Statistics and probability theory: 5 ECTS. - Electric Circuits/Circuit Analyses: 5 ECTS - Basics in Control Systems - Basics in Electrical Machines - Basics in Fluid Mechanics <p>Students without this qualification must be prepared to complete their curriculum during the first year.</p> <p>Moreover, the applicant must have sufficient qualifications within numerical methods and elementary programming using e.g. MATLAB or a similar programming language.</p>
Applicants with a Polytechnic (FI), Högskoleingenör (SE) and Diplomingeniør (DK) degree may be expected to do extra course work to qualify for the programme.	No

Table: Nordic Five Tech Master – Innovative Sustainable Energy Engineering – Admission Requirements

Study Track and Responsible Institution	General Requirements for Admission	Specific Requirements for Admission
Solar Cell Systems and Materials, NTNU	<p>A BSc degree corresponding to a minimum 180 ECTS credits in the following fields:</p> <p><u>Physics line:</u> Physics or relevant BSc,</p> <p><u>Materials line:</u> Materials Science, Inorganic Chemistry/Chemical Engineering</p>	<p>Applicants must document that they have fulfilled the following minimum requirements:</p> <p><u>Both lines:</u></p> <ul style="list-style-type: none"> - Mathematics: 25 ECTS including linear algebra, calculus and differential equations - Statistics and probability theory: 5 ECTS - Numerical methods and elementary programming using e.g. MATLAB or a similar programming language <p><u>Physics line:</u></p> <ul style="list-style-type: none"> - Physics 80 ECTS - Mathematics and statistics 60 ECTS <p>The university courses should cover curricula at a level comparable to that required for admittance to the graduate programme in physics at NTNU. As admission is extremely competitive, applicants should have excellent academic records (minimum B+/upper second/GPA 3.3/4).</p> <p><u>Materials Line:</u></p> <ul style="list-style-type: none"> - Chemistry: min. 15 ECTS - Thermodynamics: min. 7,5 ECTS - Materials Science: min. 15 ECTS - Mass and Heat Transfer: min 7,5 ECTS
System Integration of Wind Power, DTU	<p>A BSc degree corresponding to a minimum 180 ECTS credits in the following fields: Electrical Engineering, Mechanical Engineering, or other relevant BSc</p> <p>Applicants that are enrolled in an integrated five year degree with no bachelor level: Electrical Engineering, Mechanical Engineering, or other relevant BSc</p>	<p>Applicants must document that they have fulfilled the following minimum requirements:</p> <ul style="list-style-type: none"> - Mathematics: 25 ECTS including linear algebra, calculus and differential equations. - Statistics and probability theory: 5 ECTS. - Electric Circuits/Circuit Analyses: 5 ECTS - Basics in Control Systems - Basics in Electrical Machines - Basics in Fluid Mechanics <p>Students without this qualification must be prepared to complete their curriculum during the first year.</p> <p>Moreover, the applicant must have sufficient qualifications within numerical methods and elementary programming using e.g. MATLAB or a similar programming language.</p>

<p>Heat and Power Engineering, Chalmers</p>	<p>A BSc degree corresponding to a minimum 180 ECTS credits in the following fields: Mechanical Engineering, Chemical Engineering, Chemistry and Physics</p> <p>Applicants that are enrolled in an integrated five year degree with no bachelor level: Mechanical Engineering, Chemical Engineering, Chemistry and Physics</p>	<p>The applicant's qualifications must include a strong working knowledge of:</p> <ul style="list-style-type: none"> - Mathematics: 21,5 ECTS including linear algebra, calculus and differential equations - Thermodynamics: 6 ECTS - Mass and/or heat transfer: 6 ECTS - Fluid mechanics: min. 5 ECTS - Numerical methods and elementary programming using e.g. MATLAB or a similar programming language
<p>Geothermal Energy, HI</p>	<p>A BSc degree corresponding to a minimum 180 ECTS credits in the following fields: Mechanical Engineering</p> <p>Applicants that are enrolled in an integrated five year degree with no bachelor level: Minimum 3 years of mechanical engineering</p>	<p>The applicant's qualifications must include a strong working knowledge of:</p> <ul style="list-style-type: none"> - Numerical methods and elementary programming using e.g. MATLAB or a similar programming language
<p>Bio Energy, Aalto</p>	<p>A BSc degree corresponding to a minimum 180 ECTS credits in the following fields: Energy Engineering, Mechanical Engineering, Chemical Engineering</p>	<p>The applicant's qualifications must include a strong working knowledge of:</p> <ul style="list-style-type: none"> - Mathematics: 20 ECTS including linear algebra, calculus and differential equations - Thermodynamics and heat transfer: 5 ECTS - Energy and environment: 5 ECTS - Statistics and dynamics: 5 ECTS - Fluid mechanics: 5 ECTS - Materials science: 5 ECTS <p>Moreover, the applicant must have sufficient qualifications within numerical methods and elementary programming using e.g. MATLAB or a similar programming language.</p>
<p>Energy Systems, KTH</p>	<p>A BSc degree corresponding to a minimum 180 ECTS credits in the following fields: Economics, Engineering</p> <p>Applicants that are enrolled in an integrated five year degree with no bachelor level: Economics, Engineering</p>	<p>The applicant's qualifications must include a strong working knowledge of:</p> <ul style="list-style-type: none"> - Mathematics: 25 ECTS including linear algebra, calculus and differential equations - Statistics and probability theory: 5 ECTS - Numerical methods and elementary programming using e.g. MATLAB or a similar programming language

Diversification in time and space (10 ECTS)

(Course code: NMP322)

Description (preliminary)

The course will focus on how to obtain information on species' histories, i.e., how to study processes and patterns associated with diversity and distribution of species in recent and distant past. The course will cover relevant methods in population genetics and phylogeography, climate modeling and species responses in the recent past, how to define species and recent hybridization between taxa, migration patterns through time, calibration of phylogenies, ancestral area reconstruction, character evolution and ancestral state methods.

Table: Nordic Five Tech Master – Innovative Sustainable Energy Engineering – Admission Requirements

Study Track and Responsible Institution	General Requirements for Admission	Specific Requirements for Admission
Solar Cell Systems and Materials, NTNU	<p>A BSc degree corresponding to a minimum 180 ECTS credits in the following fields:</p> <p><u>Physics line:</u> Physics or relevant BSc,</p> <p><u>Materials line:</u> Materials Science, Inorganic Chemistry/Chemical Engineering</p>	<p>Applicants must document that they have fulfilled the following minimum requirements:</p> <p><u>Both lines:</u></p> <ul style="list-style-type: none"> - Mathematics: 25 ECTS including linear algebra, calculus and differential equations - Statistics and probability theory: 5 ECTS - Numerical methods and elementary programming using e.g. MATLAB or a similar programming language <p><u>Physics line:</u></p> <ul style="list-style-type: none"> - Physics 80 ECTS - Mathematics and statistics 60 ECTS <p>The university courses should cover curricula at a level comparable to that required for admittance to the graduate programme in physics at NTNU. As admission is extremely competitive, applicants should have excellent academic records (minimum B+/upper second/GPA 3.3/4).</p> <p><u>Materials Line:</u></p> <ul style="list-style-type: none"> - Chemistry: min. 15 ECTS - Thermodynamics: min. 7,5 ECTS - Materials Science: min. 15 ECTS - Mass and Heat Transfer: min 7,5 ECTS
System Integration of Wind Power, DTU	<p>A BSc degree corresponding to a minimum 180 ECTS credits in the following fields: Electrical Engineering, Mechanical Engineering, or other relevant BSc</p> <p>Applicants that are enrolled in an integrated five year degree with no bachelor level: Electrical Engineering, Mechanical Engineering, or other relevant BSc</p>	<p>Applicants must document that they have fulfilled the following minimum requirements:</p> <ul style="list-style-type: none"> - Mathematics: 25 ECTS including linear algebra, calculus and differential equations. - Statistics and probability theory: 5 ECTS. - Electric Circuits/Circuit Analyses: 5 ECTS - Basics in Control Systems - Basics in Electrical Machines - Basics in Fluid Mechanics <p>Students without this qualification must be prepared to complete their curriculum during the first year.</p> <p>Moreover, the applicant must have sufficient qualifications within numerical methods and elementary programming using e.g. MATLAB or a similar programming language.</p>

<p>Heat and Power Engineering, Chalmers</p>	<p>A BSc degree corresponding to a minimum 180 ECTS credits in the following fields: Mechanical Engineering, Chemical Engineering, Chemistry and Physics</p> <p>Applicants that are enrolled in an integrated five year degree with no bachelor level: Mechanical Engineering, Chemical Engineering, Chemistry and Physics</p>	<p>The applicant's qualifications must include a strong working knowledge of:</p> <ul style="list-style-type: none"> - Mathematics: 21,5 ECTS including linear algebra, calculus and differential equations - Thermodynamics: 6 ECTS - Mass and/or heat transfer: 6 ECTS - Fluid mechanics: min. 5 ECTS - Numerical methods and elementary programming using e.g. MATLAB or a similar programming language
<p>Geothermal Energy, HI</p>	<p>A BSc degree corresponding to a minimum 180 ECTS credits in the following fields: Mechanical Engineering</p> <p>Applicants that are enrolled in an integrated five year degree with no bachelor level: Minimum 3 years of mechanical engineering</p>	<p>The applicant's qualifications must include a strong working knowledge of:</p> <ul style="list-style-type: none"> - Numerical methods and elementary programming using e.g. MATLAB or a similar programming language
<p>Bio Energy, Aalto</p>	<p>A BSc degree corresponding to a minimum 180 ECTS credits in the following fields: Energy Engineering, Mechanical Engineering, Chemical Engineering</p>	<p>The applicant's qualifications must include a strong working knowledge of:</p> <ul style="list-style-type: none"> - Mathematics: 20 ECTS including linear algebra, calculus and differential equations - Thermodynamics and heat transfer: 5 ECTS - Energy and environment: 5 ECTS - Statistics and dynamics: 5 ECTS - Fluid mechanics: 5 ECTS - Materials science: 5 ECTS <p>Moreover, the applicant must have sufficient qualifications within numerical methods and elementary programming using e.g. MATLAB or a similar programming language.</p>
<p>Energy Systems, KTH</p>	<p>A BSc degree corresponding to a minimum 180 ECTS credits in the following fields: Economics, Engineering</p> <p>Applicants that are enrolled in an integrated five year degree with no bachelor level: Economics, Engineering</p>	<p>The applicant's qualifications must include a strong working knowledge of:</p> <ul style="list-style-type: none"> - Mathematics: 25 ECTS including linear algebra, calculus and differential equations - Statistics and probability theory: 5 ECTS - Numerical methods and elementary programming using e.g. MATLAB or a similar programming language



Consortium Agreement

Between

**Aalto University, Finland,
Chalmers Tekniska Högskola (Chalmers University of Technology), Sweden,
Kungliga Tekniska Högskolan (KTH Royal Institute of Technology), Sweden,
Norwegian University of Science and Technology, Norway,
Technical University of Denmark, Denmark,
Háskóli Íslands (University of Iceland), Iceland**

Concerning

The Nordic Master Programme in Innovative Sustainable Energy Engineering: ISEE

Preamble

This Agreement has been concluded by and between Aalto University (hereafter Aalto), Finland, Chalmers tekniska högskola (Chalmers University of Technology), Sweden (hereafter Chalmers), KTH Royal Institute of Technology, Sweden (hereafter KTH), Norwegian University of Science and Technology, Norway (hereafter NTNU), the Technical University of Denmark, Denmark (hereafter DTU) and the University of Iceland, Iceland (hereafter UoI), hereafter referred to as the Consortium.

This Agreement replaces the previous Consortium Agreement of the same name. The old ISEE programme has been coordinated by KTH; whilst the new ISEE programme is coordinated by NTNU and will enter into effect beginning with the academic year 2013-2014.

The consortium partners are all members of the Nordic Five Tech university alliance (N5T), except UoI. It is a strategic goal of the alliance to become the Nordic check point for international M.Sc. students and to create synergy between existing study offers in order to provide high class study programmes with an added N5T value to N5T as well as international students. The ISEE programme materializes this goal.

The faculties/departments responsible for implementing the ISEE programme are: the School of Engineering/Department of Energy Technology at Aalto; the Department Energy and Environment at Chalmers; the Department of Management Engineering DTU; Department of Energy Technology at KTH; and Faculty of Natural Science and Technology, Department for Material Science and Engineering at NTNU and the Faculty of Industrial Engineering, Mechanical Engineering and Computer Science at UoJ.

Article 1. Purpose and Scope of the Agreement

The purpose of this agreement is to outline the principles and terms of implementing the joint ISEE Master's programme by the Consortium. The programme has received the Nordic Master Programme acknowledgement from the Nordic Council of Ministers in 2007.

This Agreement has to be implemented within the legal requirements of each participating university. The provisions of this agreement shall not be construed so as to diminish the fully autonomous position of any one university.

Article 2. Structure and Organisation of the Cooperation

The ISEE programme is coordinated by NTNU. The implementation of the programme is overseen by a joint Programme Board, with two representatives from each university, one professor and one administrative representative¹. The Programme Board is chaired by the programme coordinator. The Programme Board can invite representatives of the Consortium universities who are not members of the Board to participate in individual tasks and projects. The Programme Board shall be responsible for ensuring that the teaching offered in the framework of the ISEE programme is delivered of the highest academic standards. Any considerable changes implemented to the courses and modules of the ISEE programme must be submitted to the Programme Board for approval. The Programme Board will meet at least once a year.

Article 3. Financing of the Programme

Each university covers its own expenses related to the teaching and administration of the Programme. Co-financing might be foreseen for some activities. The consortium will seek external funding opportunities where this is applicable, e.g. for student mobility costs.

Some consortium member universities charge tuition fees and some charge semester or student union fees, see article 12 and annex 6 to this agreement.

Article 4. Purpose of the Programme

The ISEE programme is a two-year Master's degree programme (120 ECTS) in Energy Engineering offered jointly by the Consortium. The ISEE programme is based on the expertise of the participating universities within the subject area of Energy Engineering.

¹ Representatives are listed in annex 1 to this agreement

The focus of the programme is to:

- Provide a state-of-the-art education in the fields of conventional and renewable energy sources like conventional and new power generation, solar energy, biomass energy, wind power, geothermal power, and energy utilization in the built environment by means of economically and environmentally sustainable systems and technologies

The aim of the programme is to:

- Increase MSc graduate output, enhance innovation and research and be a visible flagship for Nordic excellence in Sustainable Energy Engineering and Technologies.
- Provide the most comprehensive sustainable energy engineering degree programme in the world to respond to the demands of a global marketplace, and to serve as a driver for innovation in the growing environmental sector.
- Provide a common pool of well trained MSc graduates needed by the global marketplace by promoting internationalization of education through an increased mobility of students and academics between the Nordic Universities, and/or for potential PhD study.
- Offer degree programmes with increased depth and opportunity for specialization by pooling resources.
- Enhance Nordic research in Energy Technologies by providing a vehicle for joint Nordic research in Energy Engineering, based on collaboration on MSc thesis work.
- Internationalize and enhance the quality of the MSc programmes of the consortium universities.

Target Group

The programme targets students of all nationalities wishing to profit from the N5T universities' long standing tradition and competence in the field and N5T students wishing to specialize in a specific area of expertise offered within the alliance. The programme is open to students with a background in Energy Technology or a corresponding background.

Language

The language of the programme is English.

Article 5. Programme Structure

The programme is structured as according to the principles set out in the N5T Handbook on Joint Master Programmes and thus adheres to the following four principles:

- 1) The ISEE programme is a **double degree programme**, where students study at two degree awarding universities
- 2) The ISEE programme applies a **1 + 1 year model** where students study one year (60 ECTS, including 30 ECTS thesis work) at each of the two degree awarding universities. Students will choose between combinations of universities offering

- specified programme components. The model implies the possibility of having multiple entry universities, depending on the composition of the study tracks.
- 3) The programme is structured in **Pre-defined study and mobility tracks** with competence profiles. Each consortium member university has the lead responsibility for one track.
 - 4) **Co-supervision of thesis work:** Thesis work will be conducted with supervision from each of the two degree awarding universities involved in the study track in a way to ensure integration of the programme components. **The thesis should be censured by an external responsible who is neither one of the supervisors nor from one of the two universities issuing the double degree. (NEW by NTNU)**

Conditions for Issuing Double Degrees

In order for the consortium members to issue a M.Sc. diploma, the following regulations apply:

- Students must have obtained a minimum of 60 ECTS credits at each of two degree awarding universities including the Master's thesis. The Master's thesis must be co-supervised by each of two degree awarding universities and the thesis must be presented at the university where the thesis work was done.
- The programme does not offer the possibility to graduate from two universities within the same country.

Definition: Lead university and partner university

Each study track is co-ordinated by a lead university in collaboration with a partner university. Both universities may offer both the first and the second year, depending on the course offer and competence profile of the university.

Definition: university 1 and university 2

university 1 is where the student is admitted and spends the first two semesters.
university 2 is where the student spends the following two semesters and conducts his/her thesis.

Depending on the courses on offer, some universities may not be able to deliver the courses needed to function as university 1 or university 2. Possible combinations and study tracks must be clearly described in the admission material.

Article 6. Study Tracks

The programme is structured in pre-defined study tracks each governed by a clear competence profile and mobility structure.

In order to ensure progression in the study structure and that graduates obtain a well-defined competence profile each consortium member will act as lead university for at least one study track.

The thesis shall be a synthesis of the competencies gained in the previous blocks.

The study tracks and lead competence are further described in annex 2 to this agreement.

Article 7. Co-supervision of Master Thesis

The topic of the Master's thesis must be approved jointly by the two degree awarding universities that are part of the students study plan. The Programme Board will delegate the approval decision to the two supervisors/examiners appointed to the student. The two universities will provide co-/supervision for the thesis. The university where the student conducts the thesis work will act formally as the main supervisor. In cases where there is no compulsory thesis defence, a joint thesis presentation will be organised with the presence of both supervisors.

Student guidelines for thesis work and guidelines for co-supervision and a thesis agreement form will be elaborated based on the guidelines provided in the N5T Handbook on Joint Programmes.

Article 8. Degrees and Diplomas

Students successfully completing the programme will be awarded a double degree, one diploma from each of the two universities where the student has studied. A Diploma Supplement and official transcript will be issued from both universities.

The names of the degrees are specified in annex 3 to this agreement.

Students who have met the requirements of the joint ISEE programme will also receive a Nordic Five Tech document describing the consortium and the ISEE programme. For NTNU, the contents of the insert will be printed on the backside of the diploma.

Article 9. Student Admission

The consortium will apply joint admission criteria and a joint admission procedure.

Planned annual intake of students

Intake for the first year 2013: ca. 30 students

Intake for following years: ca. ... students

Admission Requirements

The common admission requirements are divided into three categories:

- Degree requirements
- Academic prerequisites
- Language requirements

Admission requirements will be reviewed annually.

The requirements are defined in detail in annex 4 to this agreement.

Ranking

All applications are academically evaluated by the consortium partner universities. For candidates fulfilling the admission requirements set by the consortium, the ranking of students is done on the basis of student's academic achievements. Admission is based on joint decision by the admission committee of the consortium.

For candidates fulfilling the above requirements, the ranking of students is done on the basis of the student's academic achievements.

Admission Process

The ISEE programme has joint admission and selection procedure which is coordinated by NTNU. The admission enquiries and applications are centrally managed by NTNU through email and on-line application system ???. The students apply for a specified study track which includes university 1 and 2. The responsibilities of the coordinating university are described in Article 13. (NEW by NTNU)

Admission procedures are further specified in annex 5 to this agreement.

Åge and Anette – check Annex 5!

Article 10. Rights and Status of the Students

For semesters one and two all students are registered as degree seeking students at their selected university no. 1. For semesters three and four students are registered as degree seeking students in university no. 1 and 2.

Students will be subject to the regulations and procedures of the university where they attend courses and sit for examinations in a given semester. Re-sits will take place according to the rules and regulations of the university where the student attended the course. ISEE students will be provided with the same academic resources and support services that are available to all students at that university.

Courses/modules included in the student's curriculum will be recognized fully and automatically by the two universities issuing the double degree. Upon completion of the stay in each of the two universities involved in the study plan, the university will provide the student with an official transcript of records necessary in order to provide for credit transfer.

Student counselling and Study Plan

All students will have two academic contact persons, one from each of the two universities issuing the double degree. The main contact person will be from the university where the student conducts his/her thesis work. The contact persons are appointed by the co-ordinator and are responsible for assisting the student with adjustments and approval of the study plan

Article 11. Use of ECTS and Grading System

The Consortium universities will use the national grading scale for the assessment of course work and thesis.

Article 12. Tuition Fees and Student Union Fees

Chalmers, DTU and KTH charge tuition fees to non-EU/EEA citizens.

Currently, Aalto and NTNU do not charge tuition fees. At Aalto, Chalmers and NTNU a student union fee or semester fee is charged. UoI charges a yearly registration fee.

The fees are specified in annex 6 to this agreement together with the tuition fee policy of the consortium.

Co-supervision and Tuition Fees

In connection to co-supervision of thesis work the consortium member universities are committed to ensuring that tuition fees are solely charged by the university where the student is physically present and ensure that the students are not subject to double charges.

Article 13. Rights and Obligations of the Parties

The Parties to this Agreement commit themselves to organizing and implementing the joint ISEE programme for a period of five academic years starting from the academic year **2013-2014**. The Parties to this Agreement shall individually and collectively, through their teaching and assessment, be responsible for the quality of the ISEE programme and for the high standards of the degrees.

As the programme coordinator, NTNU will be responsible for;

- the general coordination of the ISEE programme and the managerial matters relating to the project, including the convening of Programme Board meetings,
- the financial management of the ISEE programme project funding,
- the communication and reporting to programme sponsors,
- all communication to the partners on issues of general interest for the Consortium,
- keeping a register of ISEE students,
- organizing the admission committee meeting and procedure.
- keeping track of student mobility flows within the programme
- establishing and maintaining the programme website
- handing out the N5T document (diploma) to all graduates ??? (check handbook)
- centralized admission procedure and management of admission enquiries
 - centralized management of admission enquiries: ...@ntnu.no,
 - joint on-line application form (???)-system) for all applicants,
 - Administrative screening: the general eligibility of the applicant to the programme is checked by the coordinating university NTNU admissions office according to regular NTNU administrative rules (NEW by NTNU)

All ISEE Consortium members will be responsible for;

- ensuring that the programme receives accreditation according to national standards,

- organizing teaching in the ISEE programme according to the curriculum defined by the consortium,
- providing academic support, counselling and tutoring for all ISEE students, ensuring that appropriate library and computer facilities are made available for students,
- providing possibilities for ISEE students to attend courses in the national language on the same basis as other international students (if offered),
- sending appropriate representatives to Programme Board meetings,
- appointing one academic and one administrative representative to the Programme Board,
- performing continuous evaluation of the ISEE programme according to the institutional quality assurance procedures,
- providing updated lists of enrolled students to the programme board and the co-ordinator.

The ISEE Programme Board will be responsible for;

- overseeing the implementation of the programme,
- ensuring that the teaching offered in the framework of ISEE programme is delivered to the highest academic standard,
- appointing an admission committee
- planning and implementing specific joint ISEE programme quality assurance activities, which will supplement the national and institutional quality work,
- seeking external funding for the ISEE programme,
- ensuring communication and cooperation between ISEE and the appropriate local authorities responsible for the Master-level education and international administration,
- agreeing upon and ensuring consensus on the structure of the ISEE programme and on possible changes in the content of the programme, as well as on changes in the Consortium,
- evaluating the project co-ordination and propose changes with regards to the division of responsibilities,
- ensuring continuous development of the ISEE programme,
- ensuring consensus on student selection,
- evaluating the admission criteria,
- maintaining dialogue with major stakeholders and industry with regards to candidates' competence profiles, labour market needs and scholarship possibilities,
- defining a marketing strategy for the programme and contributing accordingly in marketing activities.

The admission committee will be responsible for;

- the selection of students

Article 14. Quality Assurance

Quality assurance will be based both on the on-going national and university level practices and policies and on specific ISEE programme quality assurance activities agreed upon by the Consortium and implemented by the Programme Board.

In 2015, the programme will be evaluated as a whole based on the experience from the first student cohort. The evaluation will be financed by the consortium.

Article 15. Changes to the annexes

The consortium or the programme board may change the contents of the annexes pending on approval by each of the participating universities.

Article 16. Renewal, Termination and Amendments

This Agreement will come into effect with the appropriate signatures of each university of the Consortium and it will be in force for a period of five years. Parties to this Agreement may withdraw from the Agreement, and consequently from the Consortium, by giving one year notice to the other parties in writing. In the case of such withdrawal, it is agreed that any student, who at the date of the withdrawal has been accepted for the ISEE programme and has commenced studies at the university withdrawing from the Consortium, may complete the ISEE programme courses under the terms of this Agreement within 4 years from the time he/she was accepted into the Programme. The Agreement is renewable and may be amended by mutual written consent of all the Parties. All commitments already in progress must be fulfilled.

Article 17. Conflict Resolution

The ISEE programme board shall endeavour to jointly resolve any disputes arising from implementation and interpretation of this Agreement. Any disputes that cannot be solved by the Programme Board shall be subject to negotiations between the Presidents of the Consortium universities. If the Presidents are not able to reach a decision, the case will be submitted to the Swedish national court system based in Stockholm.

This Agreement has been signed in six originals, of which each university has taken one.

University	Signature	Place and date
Aalto University Prof. Martti Raevaara, Vice President
Chalmers tekniska högskola AB Prof. Karin Markides President and CEO
Norwegian University of Science and Technology Prof. Torbjørn Digernes Rector
Kungliga Tekniska högskolan Prof. Peter Gudmundson President
Technical University of Denmark Prof. Anders O. Bjarklev President
University of Iceland Prof. Kristín Ingólfssdóttir Rector

Annex 1, ISEE Programme Consortium Agreement

Consortium representatives

Aalto

Academic: Martti Larmi, Loay Saeed

Administrative

Central: Börje Helenius

Department: Department of Energy Technology

Chalmers:

Academic: David Pallarés

Administrative

Central Agreement Issues: Gustavo Ferrusquia

Department Student Issues: Rigmor Jörgensen

DTU

Academic: Poul Erik Morthorst, Peter Sommer-Larsen

Administrative

Central: Anne Mette Holt (International Alliances) and Louise Magnusson (International Office, Admissions)

Department: DTU Management Engineering

UoI

Academic: Halldór Pálsson

Administrative: Hafdís Eyjólfsdóttir

KTH:

Academic: Mark Howells

Administrative

Central: Johanna Simonsson, Christina Murray

NTNU

Academic: Gabriella Tranell

Administrative:

Central: Anette Moen, Åge Søsveen

Annex 2, ISEE Programme Consortium Agreement

Study tracks, mobility tracks, competence profiles and lead responsibility

The programme is designed according to the structure of the N5T joint programme model that is, as a double degree programme where students spend one year in the two degree awarding universities according to six pre-defined study/mobility tracks.

Study Tracks for the new ISEE Program							
Program Leader: Gabriella Tranell							
Nr.	Study track name	Lead University Board Member	The first year		The second year		
			Basic master courses, Specializations		Specialization courses, Master thesis		
			Where?	What?	Where?	What?	
1	<i>Solar Cell Systems and Materials</i>	NTNU Gabriella Tranell	DTU Peter Sommer-Larsen	Sustainable Energy, Energy and Environment, Energy Engineering	Solar cell systems, Physics, Chemistry	NTNU Gabriella Tranell	Solar cell materials, Physics, Material science
2	<i>System Integration of Wind Power</i>	DTU Poul Erik Morthorst	NTNU Lars Einar Norum		Electrical engineering, Energy markets, Smart grid	DTU Poul Erik Morthorst	Wind Energy planning, design and integration
3	<i>Heat and Power Engineering</i>	Chalmers David Pallarès	Uol Háldor Pálsson		Thermal energy, Energy intensive processes	Chalmers David Pallarès	Heat and power engineering, Industrial energy
4	<i>Geothermal Energy</i>	Uol Háldor Pálsson	Chalmers David Pallarès		Thermal energy, Industrial energy	Uol Háldor Pálsson	Geothermal energy
5	<i>Bio Energy</i>	Aalto Martti Larmi	KTH Reza Fakhrai		Sustainable power generation	Aalto Martti Larmi	Bio energy in transport, Power generation from bio mass
6	<i>Energy Systems</i>	KTH Mark Howells	Aalto Martti Larmi		Energy systems, Energy markets	KTH Mark Howells	Energy systems analysis, Energy efficiency, Energy policy

Annex 3, ISEE Programme Consortium Agreement

The names of the double degrees issued

!!! Can all partners please have a look on the degree name again? Please try to synchronize the name as much as possible !!!

- Aalto:** Master of Science (Technology)
???
- Chalmers:** Degree of Master of Science (two years)
Master's Programme: Sustainable Energy Systems
- DTU:** Master of Science in Engineering
Degree programme: Sustainable Energy
Nordic Master in Innovative Sustainable Energy Engineering
- KTH:** Teknologie masterexamen, Master of Science (2-years)
Degree programme: Master's Programme in ???
- NTNU:** Master of Science in Environmental Engineering
Degree programme: Master of Science in ???,
- UoI:** Master of Science in Mechanical Engineering
Nordic Master in Innovative Sustainable Energy Engineering

Annex 4, ISEE Programme Consortium Agreement

Admission requirements

Degree Requirements:

The degree requirements are dependent on the chosen study track/mobility track. The following table lists all requirements.

Study Track and Responsible Institution	General Requirements for Admission	Specific Requirements for Admission
<p><i>Solar Cell Systems and Materials, NTNU</i></p>	<p>A BSc degree corresponding to a minimum 180 ECTS credits in the following fields: <u>Physics line:</u> Physics or relevant BSc, <u>Materials line:</u> Materials Science, Inorganic Chemistry/Chemical Engineering</p>	<p>Applicants must document that they have fulfilled the following minimum requirements:</p> <p><u>Both lines:</u></p> <ul style="list-style-type: none"> - Mathematics: 25 ECTS including linear algebra, calculus and differential equations - Statistics and probability theory: 5 ECTS - Numerical methods and elementary programming using e.g. MATLAB or a similar programming language <p><u>Physics line:</u></p> <ul style="list-style-type: none"> - Physics 80 ECTS - Mathematics and statistics 60 ECTS <p>The university courses should cover curricula at a level comparable to that required for admittance to the graduate programme in physics at NTNU. As admission is extremely competitive, applicants should have excellent academic records (minimum B+/upper second/GPA 3.3/4).</p> <p><u>Materials Line:</u></p> <ul style="list-style-type: none"> - Chemistry: min. 15 ECTS - Thermodynamics: min. 7,5 ECTS - Materials Science: min. 15 ECTS - Mass and Heat Transfer: min 7,5 ECTS

<p><i>System Integration of Wind Power, DTU</i></p>	<p>A BSc degree corresponding to a minimum 180 ECTS credits in the following fields: Electrical Engineering, Mechanical Engineering, or other relevant BSc</p> <p>Applicants that are enrolled in an integrated five year degree with no bachelor level: Electrical Engineering, Mechanical Engineering, or other relevant BSc</p>	<p>Applicants must document that they have fulfilled the following minimum requirements:</p> <ul style="list-style-type: none"> - Mathematics: 25 ECTS including linear algebra, calculus and differential equations. - Statistics and probability theory: 5 ECTS. - Electric Circuits/Circuit Analyses: 5 ECTS - Basics in Control Systems - Basics in Electrical Machines - Basics in Fluid Mechanics <p>Students without this qualification must be prepared to complete their curriculum during the first year.</p> <p>Moreover, the applicant must have sufficient qualifications within numerical methods and elementary programming using e.g. MATLAB or a similar programming language.</p>
<p><i>Heat and Power Engineering, Chalmers</i></p>	<p>A BSc degree corresponding to a minimum 180 ECTS credits in the following fields: Mechanical Engineering, Chemical Engineering, Chemistry and Physics</p> <p>Applicants that are enrolled in an integrated five year degree with no bachelor level: Mechanical Engineering, Chemical Engineering, Chemistry and Physics</p>	<p>The applicant's qualifications must include a strong working knowledge of:</p> <ul style="list-style-type: none"> - Mathematics: 21,5 ECTS including linear algebra, calculus and differential equations - Thermodynamics: 6 ECTS - Mass and/or heat transfer: 6 ECTS - Fluid mechanics: min. 5 ECTS - Numerical methods and elementary programming using e.g. MATLAB or a similar programming language
<p><i>Geothermal Energy, HI</i></p>	<p>A BSc degree corresponding to a minimum 180 ECTS credits in the following fields: Mechanical Engineering</p> <p>Applicants that are enrolled in an integrated five year degree with no bachelor level: Minimum 3 years of mechanical engineering</p>	<p>The applicant's qualifications must include a strong working knowledge of:</p> <ul style="list-style-type: none"> - Numerical methods and elementary programming using e.g. MATLAB or a similar programming language

Bio Energy, Aalto	A BSc degree corresponding to a minimum 180 ECTS credits in the following fields: Energy Engineering, Mechanical Engineering, Chemical Engineering	The applicant's qualifications must include a strong working knowledge of: <ul style="list-style-type: none"> - Mathematics: 20 ECTS including linear algebra, calculus and differential equations - Thermodynamics and heat transfer: 5 ECTS - Energy and environment: 5 ECTS - Statistics and dynamics: 5 ECTS - Fluid mechanics: 5 ECTS - Materials science: 5 ECTS Moreover, the applicant must have sufficient qualifications within numerical methods and elementary programming using e.g. MATLAB or a similar programming language.
Energy Systems, KTH	A BSc degree corresponding to a minimum 180 ECTS credits in the following fields: Economics, Engineering Applicants that are enrolled in an integrated five year degree with no bachelor level: Economics, Engineering	The applicant's qualifications must include a strong working knowledge of: <ul style="list-style-type: none"> - Mathematics: 25 ECTS including linear algebra, calculus and differential equations - Statistics and probability theory: 5 ECTS - Numerical methods and elementary programming using e.g. MATLAB or a similar programming language

English language requirements:

With regards to language test scores, the rectors have approved that N5T consortia will apply the highest minimum scores. The following test and score-levels have been approved by all five universities within the framework of the N5T working group on joint N5T master programmes. The requirements meet the highest minimum standards of the five universities and can thus be applied by all partners.

They are defined as follows:

TOEFL:

Paper-based: 580 (written section grade 4,5)

Computer-based test: 237 (essay writing grade 4,5)

Internet-based test: 92 (written section grade 22)

IELTS:6.5, no section lower than 5.5 (only IELTS Academic Training accepted).

English language test exemptions:

1. Applicants who have completed a university degree instructed in English at a university that is physically located in one of the following countries:
 - USA
 - Canada
 - UK
 - Ireland
 - Australia
 - New Zealand

2. Applicants who have completed at least a 3-year degree instructed in English in an EU/EEA country.

3. Applicants with upper secondary education and a Bachelor's degree (issued or ongoing if the applicant is currently enrolled in the last semester) from a Nordic country may be exempted from an additional English test.

Annex 5, ISEE Programme Consortium Agreement

Admission Procedure

!!! Åge or Anette – Will this text/deadlines apply in that way??? (after we changed the admission procedure description further up, into “central admission”? !!!

The ISEE programme consortium will apply central admission, pre-screening criteria, and a joint admission procedure.

The following procedure and deadlines will apply:

- 1st Dec- 15th Jan: The applicants apply to NTNU. Common deadline 15th January.
- 15th Jan- 15th Feb: Pre-screening by NTNU admin staff using common pre-screening criteria
- 15th Feb – end of Feb: Local academic staff screens applications and shortlist eligible candidates.
- Beg. March: the Consortium Admission Committee meets and reviews all short listed candidates.
- Mid March: admission/rejection letters sent out by local admission officer

Deadline for changing study tracks: January 15 (after first year of study). Changes can be made only upon individual evaluation and will be based on the compatibility of the study track and the student's choice of courses during the first year.

Annex 6, ISEE Programme Consortium Agreement

Tuition fee model

Chalmers², DTU³ and KTH⁴ charge tuition fees to non-EU/EEA citizens.

At DTU, the following non-EU/EEA citizens are exempted from tuition fees:

- Students studying at DTU as exchange students according to agreements between DTU and one or more universities abroad.
- Students with a “*permanent residence permit*” or a “*time-limited residence permit issued with a possibility of permanent residence in Denmark, Finland, Iceland, Norway and Sweden*”.
- Students who have dual citizenship in both an EU country and a non-EU country.

Currently, Aalto University and NTNU do not charge tuition fees from the ISEE programme students.

At Chalmers and KTH, students are not required to pay tuition fees if they:

- have Swedish citizenship.
- have been granted permanent Swedish residency.
- have been granted temporary Swedish residency for reasons other than studies (having a temporary residency permit for studies in Sweden does NOT grant exemption from fee payments).
- are a family member of a citizen of an EU or EEA country (except Sweden) and have temporary or permanent right of residence in Sweden. Family members of a Swedish citizen must apply for a Swedish residence permit.
- are a family member of a citizen of Switzerland and have been granted Swedish residency.

At NTNU, all students enrolled pay the semester fee.⁵

At Aalto, the student union membership fee⁶ is compulsory for degree seeking students.

At Chalmers, according to local regulations, all students are obliged to pay Student Union membership fee⁷.

At Uoi all students pay a yearly registration fee.⁸

Students will pay fees directly to the two universities involved in their study track and fees will vary accordingly.

² In 2011-12 the tuition fee for non-EU students at Chalmers is EUR 15.000

³ In 2011-12 the tuition fee for non-EU students at DTU is EUR 13.500

⁴ In 2011-12 the tuition fee for non-EU students at KTH is SEK 145.000

⁵ 430 NOK each semester in academic year 2009-2010. The fee goes to the Student Welfare Organization.

⁶ 46 € each semester in academic year 2010-2011

⁷ Approximately 250 SEK each semester in academic year 2010-2011.

⁸ ISK 60,000 per year

Co-supervision and Tuition Fees

In connection to co-supervision of thesis work the consortium member universities are committed to ensuring that fees are solely charged by the university where the student is physically present and ensure that the students are not subject to double charges.

Tuition fee model applied by the ISEE Programme Consortium

The individual universities charge fees according to their regulations and students pay fees according to their mobility track and directly to the two universities involved in the track.

Studieavdelingen

Dato
10.09.2012Referanse
ISEE-godkjenning.
Utskrift

Notat

Til: Jon Inge Resell

Kopi til: FUS, Inge Fottland, Gabriella Tranell, Ida Fuchs

Fra: Åge Søsveen

Signatur:

Innovative Sustainable Energy Engineering. Godkjenning av revidert nordisk masterprogram fom. H2013

Sak 42/2012: Nordisk masterprogram Innovative Sustainable Energy Engineering til NTNU.

- Forslag til studieplan for det reviderte programmet
- Notat med drøfting og forslag til vedtak

Vedtak:

1. FUS godkjenner den prinsipielle faglige strukturen i det reviderte nordiske masterprogrammet Innovative Sustainable Energy Engineering.
2. Detaljer i programinnholdet og forkunnskapskrav bearbeides videre.
3. Det må sørges for god forankring i fakultetet av det reviderte masterprogrammet.
4. Rektor må oppnevne studieprogramråd for studieprogrammet. FUS anbefaler sammensetning av studieprogramråd for ISEE-programmet som fremlagt, med førsteamanuensis Gabriella Tranell, Institutt for materialteknologi. NT, NTNU som leder.
5. FUS forventer at NTNU skaffer administrative ressurser til programmet både på kort og lang sikt, og både til sekretariat for programmet og til rekruttering og opptak til programmet.
6. Videre detaljer om innhold i programmet samt økonomi mht. sosialiseringsprogrammet for studentene legges fram for endelig beslutning på et senere FUS-møte.
7. FUS-leder gis fullmakt til å godkjenne det endelige styreframlegget om ISEE-programmet

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Notat

Til: Studieavdelingen

Kopi til:

Fra: Fakultet for samfunnsvitenskap og teknologiledelse

Studieprogramporteføljen 2013/2014 - SVT-fakultetet - Runde 2

Det vises til notat av 27.04.12.

Fakultetet vil med dette bekrefte at det er ingen forslag på endringer i studieprogramporteføljen for 2013/2014 for SVT-fakultetet.

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All korrespondanse som inngår i saksbehandling skal adresseres til saksbehandlerenheten ved NTNU og ikke direkte til enkeltpersoner. Ved henvendelse vennligst oppgi referanse.