Study Abroad Proposal

Essay

When I was little, I dreamt of studying at one of the world's top universities so that later I could make a positive impact on the people connected to me. Though I easily made the decision to leave my home country for an opportunity to fulfill my dream, I was initially torn between whether to study in the US or the UK. Caltech made my dream come true and advanced it even further by allowing me to study in both.

Today I am a representative of Caltech's community of international students. It taught me that in order to produce powerful influence on others, I should first absorb the energy of a grand experience myself. I have already made a noticeable progress towards my dream by collecting vibrant energy from the US experience in general and the Caltech experience in particular. Studying in Europe would provide me with a completely different energy and a very contrasting life with that at Caltech. For me, getting outside of the famous "Caltech Bubble" would mean moving on from being safety-cushioned from the real world problems by the caring Caltech community. Studying Abroad will enable me to reach a new level of maturity and master solving problems both inside and outside of the classroom. The maturity and newly acquired energy that I will bring back to Caltech after a term abroad will be the foundation of my giving back to the community.

I learn best when I can observe the problem from different angles, try out different solutions, and after careful analysis, choose the perfect approach. I do think that, in order to understand a particular topic in depth, I need first to comprehend its breadth. That is why I strongly wish to complete my Advanced Mechanical Engineering breadth requirements in a school that is very different from my Alma Mater. The UK schools' structures and teaching approaches are very unlike those of Caltech. Comparatively big schools, they provide more freedom of choice when it comes to the available classes and the possible learning techniques. In Europe I will hone the learning strategies and skills I gained from Caltech and share them with the European students I meet. Moreover, in the UK I will master new academic approaches and carry them back across the ocean to share with Caltech students. My Study Abroad will then be a true exchange experience not only for me, but also for the communities of two powerful institutions I will belong to. It will greatly accelerate my goal of delivering positive impact to people around me.

I am convinced that an engineer who looks at a system from various perspectives of different disciplines is much more efficient at designing and building that system to fit perfectly into the surrounding world. That is why I am pursuing both Mechanical Engineering and Computer Science degrees and why I am so passionate about Study Abroad. I want to gain a different point of view not only on engineering, but also on humanitarian and social sciences that I am planning on exploring at the citadel of art - Europe. I believe that such diverse experience will help me broaden the spectrum of my thoughts and will wire up the neurons in my brain that were previously not connected. Caltech's Study Abroad program would not just bring me a step closer to my dream, but will help me build a whole new bridge to reach the mind power I have never had before.

Program fit

1. UCL

UCL captivates me with its strong and diverse Mechanical Engineering program that has such a wide course variety as I have not seen in other universities. It offers upper-level Engineering courses that would satisfy my 18 Caltech units of Advanced Mechanical Engineering breadth requirements in such areas as Design & Mechatronics and Dynamics & Control. I have always been fascinated with how people can bring a man-made machine to life with some wires and electrical tricks. An "Electrical Power Systems and Electrical Propulsion" course (MECH0071) will advance me from an undergraduate with one year of theoretical electricity experience to an engineering wizard who can design and execute electrical power systems. Furthermore, I would like to explore Dynamics and Control course at UCL. This class will provide me with tools for analysis of real-world mechanical models and issues connected with them. In this course, I will put the very strong theoretical knowledge I acquired at Caltech into a practical framework. In addition to an excellent course selection in my major, UCL amazes me with the spectrum of humanity courses available, making it hard to pick just two. I chose courses that would truly open my mind. London Architecture (HART0023) will take me through space and time of one of the most influential European capitals, while "The making of Modern Russian Culture" will show me how the western community perceives and explains the origins of the country I was raised in. That will put everything I was taught since elementary school into a different perspective, broadening my mind from the very core.

2. Cambridge Michaelmas

Cambridge is very appealing to me because of its wide variety of business and management courses that are closely connected to technology. As an engineer, I think it is important to know how systems work from both the constructional and the economical perspective. Each potential project has to go through not only the designing part, but also through a fund acquisition process. In order to effectively choose viable projects from a pool of ideas, an engineer should have a financial background and intuition that can be applied to desired technology. At Cambridge I will learn how to design mechanical systems with both structural (3D3: Structural Materials & Design") and financial (4E6: Accounting and Finance) perspectives. I would also advance my understanding of the place of engineering in the world by taking a Management of Technology course. I will learn how a technology is raised from an idea to a fully developed engineering system and managed as a financial entity. Adding a Modeling Risk course to my knowledge bank will provide the business and financial background for me to understand which ideas can cause potential losses so that they can be modified at the appropriate time. While Structural Design and Management Technology courses will satisfy my option breadth requirements, Accounting & Finance and Risk Modeling will fulfill additional HSS requirements needed for my graduation from Caltech.

3. Edinburgh

Edinburgh attracts me with its project-based engineering classes and a practical approach to learning industrial technology. The Mechanical Engineering Group Project class will teach me how to investigate and analyze specific engineering topics. It is a great class in the Design and Systems field of Mechanical Engineering and it will equip me with analytical methods of assessment of real-life technologies. The Group Project taken together with "Manufacture 3" (MECE09032), which incorporates a great variety of practical labs into a course on Solids and Materials, will present me with invaluable industry preparation experience and will also satisfy my Mechanical Engineering breadth requirements. The practical application of the classroom knowledge is great for a mind like mine that always seeks tangible results. In Edinburgh that practical approach even goes beyond engineering courses. Even Social Sciences like Psychology, that I would like to take as an HSS elective, include labs in their coursework at the University of Edinburgh. Furthermore, the "History of Art" course, which will help me broaden my knowledge beyond STEM, offers tutorials that are conducted right in the museums and galleries of Edinburgh. I am a visual learner, and that is why Edinburgh creates the perfect learning environment for me.

Proposed Course Lists

UCL Proposed Course List

Total ECTS/UCL Credits: 30 ECTS /2 UCL
Total ECTS/UCL Credits in Admitting Dept: 15 ECTS /1 UCL
Total CIT Units: 39
Course by Correspondence/Units: 0

1. Dynamics and Control, MECH0023
Level: 6 (Undergraduate Year 3)
Faculty: Engineering
Department: Mechanical Engineering
Admitting Department? Yes
Term: Fall
UCL credits: 0.5
Caltech units: 9
Type of Caltech credit: Mechanical Engineering (option) breadth elective
State CIT equivalent course, if applicable: NA
Caltech evaluator: Austin Minnich
Course description:

This module aims to provide students with an understanding of issues involved in creating models of real mechanical systems, and in designing controller strategies to improve performance. It will also provide experience of the impact of vibration, resonance, and of the characteristics of different controller types, e.g. to stabilize an unstable system.
Topics covered:
Modelling: Modelling of dynamic systems using ordinary differential equations and linear Laplace transfer functions; Accounting for non-linearity in models; Numerical methods of simulation, e.g. using Matlab /

Simulink; Single-Input-Single-Output and multi-degree-of-freedom models including state-space representation.
Dynamic Response: Free vibration of single degree of freedom mass-spring system: natural frequency; Free vibration of damped oscillator; different types of damping; Forced response of single degree of freedom systems; Transient vibration; Application: Base excitation and vibration isolators; Free vibration of multi degree of freedom systems; Mode shapes and natural frequencies; Modal decomposition; Continuous systems, string, bars and beams, free and forced vibration
Frequency Response Techniques: Calculating frequency response from Laplace Transfer Function models; Measuring frequency response and identifying a system model from experimental data; Mechanical resonance; Bandwidth (including resonance and mechanical systems); Analogue to Digital interfacing: sample rate (including effects of time-delay lag on stability)
Controller Design: Root-locus methods of controller design (stabilising unstable systems); Frequency response stability analysis (margins of stability); PID & other controller types; Control system hardware and practical implementation.

2. Electrical Power Systems and Electrical Propulsion, MECH0071
Level: 7 (Undergraduate Year 4 / MSc)
Faculty: Engineering
Department: Mechanical Engineering
Admitting Department? Yes
Term: Fall
UCL credits: 0.5
Caltech units: 9
Type of Caltech credit: Mechanical Engineering (option) breadth elective
State CIT equivalent course, if applicable: NA
Caltech evaluator: Austin Minnich
Course description:

This module provides students with detailed knowledge of the design, performance and analysis of electrical power systems. The module aims to achieve competency in using analytical methods for understanding the design and operational behavior of electrical power systems under steady-state and transient conditions. It provides technical knowledge in electrical power system technologies such as generators, cables, distribution and protection, and end-use equipment so as to appreciate the design features for different electrical power distribution and electrical propulsion systems.
Through Computer based software and with understanding of their algorithms, students become proficient at calculating performance parameters in small and large scale electrical power systems used in electric vehicle, electric ship or grid systems.
Prerequisites:
Mathematics to second year undergraduate level to include complex number theory, ordinary differential equations linear, non-linear 1st order and linear 2nd order homogenous with constant coefficients.
Electricity at first year undergraduate level to include basic theory and circuit analysis i.e. Kirchoff's Laws, Ohm's Law, Faraday's law, Thevenin/Norton equivalent circuits, single-phase, three-phase and dc circuit analysis.
Topics covered:
Power System Representation: Three-phase systems; Per unit representation; Impedance and reactance networks; Network theory; Waveform quality; Matrix methods
Power System Technologies: Synchronous machines; Transformers; Transmission lines and cables; Loads; Switchgear; Protection device
Power System Analytical Methods: Load flows in simple and complex networks; Fault analysis by method of symmetrical components; Bus admittance methods; System stability; Control methods: frequency, voltage and power; Harmonic penetration into networks
Electrical Propulsion; Electrical v Mechanical v Hybrid propulsion; Commonality and discord in transport applications; Marine electrical propulsion in ships; Naval electrical propulsion; Rail traction; Road vehicles

3. London Architecture I, HART0023
Level: 1
Faculty: Social & Historical Sciences
Department: History of Art
Admitting Department? No
Term: Fall
UCL credits: 0.5
Caltech units: 9
Type of Caltech credit: Advanced Humanities/Additional HSS
State CIT equivalent course, if applicable: NA
Caltech evaluator: Christopher Hitchcock
Course description:

This course looks at how architects and designers have transformed London in the past century. Beginning with a visit to the Architecture Gallery at the Victoria & Albert Museum, we will discuss iconic buildings of 20th-century London through a series of site-based classes. We will explore the theme of 'modernisms' in visits to private dwellings by the international architects Wells Coates (Lawn Road Flats, 1933) and Ernö Goldfinger (2 Willow Road, 1939) and as well as key public modernist buildings in and around Bloomsbury, the RIBA headquarters at 66 Portland Place (1933) and The Royal College of Physicians (1960s). We will also look at modernist schemes of social regeneration, such as the radical Finsbury Health Centre (1938) and later the Spa Green and Bevin Court estates. The opportunities to rebuild London after the Second World War will form the core of second part of the course, in tours to the Royal Festival Hall and the South Bank compound, as well as landmark housing projects from the 1960s-1970s, the Barbican, Balfron Tower and Robin Hood Garden estates. The course will conclude with visits to Canary Wharf as an example of urban regeneration in the
1980s Docklands, and to King's Cross, looking towards post-modern developments in urban planning and architecture in London. The aim of the course is to introduce students the history and theory of architecture and equip them with critical and analytical skills to examine and discuss the built environment of the past century.

4. The Making of Modern Russian Culture, SERS0010A
Level: First
Faculty: School of Slavonic and East European Studies
Department: Slavonic and East European Studies
Admitting Department? No
Term: Fall
UCL credits: 0.25
Caltech units: 6
Type of Caltech credit: Additional HSS
State CIT equivalent course, if applicable: NA
Caltech evaluator: Christopher Hitchcock
Course description:

This course provides an introduction to the development of Russian society and culture from the 1917 Revolution to the present day. The materials chosen to illustrate this development are drawn from the areas of prose fiction, poetry, art and film. The course focuses on the contexts in which these works emerged, their themes, and their formal properties. The texts will be read in good quality and accessible English translations, but with the introduction of some Russian language material as appropriate. Students with A-level Russian will be required to undertake more reading in Russian. Film showings will be scheduled as appropriate. The texts studied include: Evgenii Zamiatin's *My* (We, 1920); Sergei Eizenshtein's *Stachka* (Strike, 1924); Mikhail Bulgakov's *Sobach'e serdtse* (Heart of a Dog, 1925);

Aleksandr Solzhenitsyn's *Odin den' Ivana Denisovicha* (A Day in the Life of Ivan Denisovich, 1962); and Viktor Pelevin's *Sinii fonar'* (Blue Lantern, 1993) collection.

5. Russian Cinema: History, Ideology and Society, SERS0014A
Level: First
Faculty: School of Slavonic and East European Studies
Department: Slavonic and East European Studies
Admitting Department? No
Term: Fall
UCL credits: 0.25
Caltech units: 6
Type of Caltech credit: Additional HSS
State CIT equivalent course, if applicable: NA
Caltech evaluator: Christopher Hitchcock
Course description:

Russian cinema has borne important witness to the turbulent and traumatic events of the last 100+ years, reflecting, more than other national cinemas, key ideological and social shifts. This module examines the way in which Russian cinema has represented, interrogated and responded to historical, ideological and social change. Ranging from the pre-Revolutionary period to the post-Soviet present, it explores 17 films that illustrate and explore some of the major changes that have taken place in Russia since the release of the first Russian feature film in 1908, including: social developments in the late-Tsarist period, the Revolution and subsequent Civil War, the Stalinist thirties, the Khrushchev thaw, the Brezhnevite stagnation, the collapse of the Soviet Union in 1991 and the immense upheaval and social changes of recent years. This module also considers the cinematic evolution of Russian film during this period, examining such issues as: the first filmmakers' attempts to differentiate film from theatre by creating a specifically cinematic language, the uses of melodrama, the development of montage, the fraught relationship between Soviet and American cinema, the coming of sound in the 1930s, Socialist Realism, the introduction of new genres, such as the musical, the war film and the gangster film, the representation of identity that is Soviet, but not Russian, the emergence and development of post-Soviet auteur cinema, and the arrival of new young filmmakers.

Cambridge Proposed Course List

Total CIT Units for term abroad: 36
Course by Correspondence/Units: 0

1. 3D3: Structural Materials & Design
Tripos: Engineering
Part: IIA
Term: Michaelmas
Number of lectures: 16
Lecture times, if available: NA
Caltech units: 9
Caltech evaluator: Austin Minnich
Type of Caltech credit: Mechanical Engineering (option) breadth elective
State CIT equivalent course, if applicable: NA
Course description:

Aims : cover the basic principles of practical design of typical engineering structures, with applications across a range of commonly-used structural materials; establish links between the theory of structures, taught in the Part I courses IA Structural Mechanics and IB Structures, and the properties of materials as covered in courses on Materials and Engineering Applications; study what differing approaches to design are appropriate for structures in different materials; develop a design methodology that provides a firm basis for the structures courses taught in Part IIA and for the more advanced courses in the fourth year. *Objectives :* have developed a good understanding of the structural forms appropriate in the various materials; be aware of the likely critical factors (requirements, properties, behaviour) for design in the different materials; be able to make sensible initial layout and sizing choices for simple structures in the various materials; be able to carry out design calculations for basic structural elements in the various materials; be aware of what design approaches will be appropriate, and what calculations necessary, for more complex structures in the various materials; appreciate the influence of risk, and variability of loading and material properties, on structural design and calculations.

2. 4E4: Management of Technology
Tripos: Engineering
Part: IIB
Term: Michaelmas
Number of lectures: 8 x 2 hours
Lecture times, if available: NA
Caltech units: 9
Caltech evaluator: Austin Minnich
Type of Caltech credit: Mechanical Engineering (option) breadth elective
State CIT equivalent course, if applicable: NA
Course description:

Aims : provide students with an understanding of the ways in which technology is brought to market by focusing on key technology management topics from the standpoint of an established business as well as new entrepreneurial ventures; place emphasis on frameworks and methods that are both theoretically sound and practically useful; provide students with both an understanding of the issues and the practical means of dealing with them in an engineering context.

Objectives : have a thorough appreciation of how technology is brought to address market opportunities, and how technology management supports that process; assess and utilise appropriate technology management methods in different contexts; understand the core issues of technology management and the practical means of dealing with them in an engineering context.

3. 3E3: Modeling Risk
Tripos: Engineering
Part: IIA
Term: Michaelmas
Number of lectures: 16
Lecture times, if available: NA
Caltech units: 9
Caltech evaluator: Colin Camerer
Type of Caltech credit: Advanced Social Sciences /Additional HSS
State CIT equivalent course, if applicable: NA
Course description:

Prerequisites : Basic probability theory and statistics and basic knowledge of using Excel of Microsoft.
Aims : Provide an understanding of the mechanics of a range of management science modelling methods involving randomness, such as statistics, decision analysis, portfolio management, queueing theory,

Markov chains, dynamic programming, forecasting, & regression. For each of the modelling areas, students will become familiar with the types of situations in which the method is useful.
Objectives: Understand basic concepts of probability and the rationale behind statistical reasoning. Be able to calculate statistical measures like mean and variance, and interpret these in realistic situations. Use confidence intervals to quantify risk. Conduct hypothesis testing. Be able to understand decision trees and how to apply them in decision making. Be able to describe a Markov chain and analyse its long-term behaviour and steady state distribution. Understand and use simple formulas for queues in which arrivals occur as a Poisson process. Be able to model staged decisions by dynamic programming and to solve some dynamic programs using value iteration and policy iteration algorithms. Forecast data using short range extrapolative techniques such as exponential smoothing. Know how to take account of seasonality when forecasting. Apply regression techniques to estimate the way in which two variables are related. Be able to understand investment strategies for portfolios. Be able to incorporate risk into investment and decision making.

4. 4E6: Accounting & Finance
Tripos: Engineering
Part: IIB
Term: Michaelmas
Number of lectures: 16
Lecture times, if available: NA
Caltech units: 9
Caltech evaluator: Colin Camerer
Type of Caltech credit: Advanced Social Sciences /Additional HSS
State CIT equivalent course, if applicable: NA
Course description:

Aims: provide an introductory understanding of financial reporting and decision making by companies.
Objectives: construct the company financial statements from a jumble of raw data; interpret these statements using financial ratios; understand how to identify and finance the investments companies should undertake; understand why and how companies compensate their investors.
Content: The first part of the module examines fundamental accounting concepts, and shows how to construct and interpret company accounts, a critical source of information to outside investors. The second part of the module tackles the three key areas of company decision making: the capital budgeting decisions of how the company should invest; the financing decisions of how the company should raise the investment capital; and the payout decisions of how the company should compensate its shareholder
Financial Accounting: Detailed discussion of fundamental accounting concepts; construction of company financial statements (balance sheet, income statement, cash flow statement); an awareness of creative accounting
Finance: Nature and objectives of finance; time value of money and risk versus return; capital budgeting decisions (opportunity cost of capital, investment rules such as Net Present Value; financing decisions (debt versus equity); payout decisions (dividends and share repurchases).

Edinburgh Proposed Course List

Total Edinburgh Credits: 80
Total CIT Units: 36
Course by Correspondence/Units: 0

1. Manufacture 3 (MECE09032)
College: Science and Engineering
School: Engineering
Department: Mechanical

Level: SCQF 9 (Year 3 Undergraduate)
Semester: 1
Credits: 20
Caltech units: 9
Caltech evaluator: Austin Minnich
Type of Caltech credit: Mechanical Engineering (option) breadth elective
State CIT equivalent course, if applicable: N/A
Course description:

1. Introduction. Processing overview. Materials-process matrix.
2. Microstructure and properties, Mechanical properties, length scales, examples
3. Materials Selection, Ashby approach using materials selection maps, Processes
4. Casting, Liquid to solid transition; phase diagrams. The importance of oxide films and residual stresses. Microstructure of castings; porosity; removal of porosity. Defects in castings, Sand casting, Die casting, Centrifugal casting, Slush casting. Investment casting aerospace turbine blade. Design for castings. Trends in casting
5. Thermomechanical processing (forging, extrusion and rolling) , the importance of grain size; Hall - Petch relationship , Forging , General deformation characteristics, Hot working, Cold working, Open die forging, Closed die forging,
Impression die forging. Rolling, Rolling dynamics, Rolling forces, Rolling design. Extrusion, Direct and indirect extrusion processes. The role of friction in extrusion.
6. Heat treatment, Steel heat treatment; precipitation hardening. Problems with heat treatment processes.
7. Machining processes, Single-point cutting, Multiple - point cutting, Tool geometry, Chip formation, Chip types. Cutting dynamics: Chip formation, Chip types, Cutting forces, Shear angle vs. shear stress, tool materials, tool life, cutting tool materials, Non-traditional machining processes Electrochemical machining, Electrodischarge machining, Ultrasonic machining, Electron - beam and laser machining. Polymers, composites, ceramics and glasses
8. Manufacture with plastics and composites, Plastic forming processes, compression moulding, blow moulding, extrusion, vacuum forming.
9. Ceramic and glass processing
10. Finishing and Surface treatments: Chemical cleaning, Ultrasonic cleaning, electropolishing, electroplating, and vapour deposition.
11. Joining, Fastening, Welding, MIG, TIG, laser, EBM, Bonding
12. Process Selection, How to select a process.

2. Mechanical Engineering Group Project 4 (MECE10007)
College: Science and Engineering
School: Engineering
Department: Mechanical
Level: SCQF 10 (Year 4 Undergraduate)
Semester: 1
Credits: 20
Caltech units: 9
Caltech evaluator: Austin Minnich
Type of Caltech credit: Mechanical Engineering (option) breadth elective
State CIT equivalent course, if applicable: N/A
Course description:

In this course you will build upon your existing knowledge of engineering (both technical and non-technical) to solve an engineering problem that one may encounter in the real world. As many engineering problems are solved in teams, the student will learn to solve engineering problems as a team. Therefore, students are allocated into teams of 4-6 and assigned an academic supervisor.

This course has three main objectives:
1. To give students the experience of working as a member of a team carrying out a major project. Within industrial & research environments, almost all work is undertaken in teams.
2. To improve the student¿s communication and inter-personal skills through reporting and formally presenting his/her analysis and findings.
3. To serve as a vehicle for integrating the necessary technical subject materials in order to reach the project's goals.
In order to meet these objectives each group is expected to:
A. Identify, select, collate and evaluate relevant information from a variety of sources for their project.
B. Give short, professionally presented seminars on the aspects of their project.
C. Discuss the importance of technical and non-technical aspects of engineering towards their project.
D. Write a clear, well-presented report containing critical assessment of the information they have found and setting it in context with sound conclusions.
E. Have a final presentation (oral exam) to describe, support and critically praise the aspects of their project.

3. History of Art 1A (HIAR08010)
College: Humanities and Social Science
School: Edinburgh College of Art
Department: History of Art
Level: SCQF 8 (Year 1 Undergraduate)
Semester: 1
Credits: 20
Caltech units: 9
Caltech evaluator: Christopher Hitchcock
Type of Caltech credit: Additional HSS
State CIT equivalent course, if applicable: N/A
Course description:

Under the collective title, Art and Belief in Europe (c. 500 ¿ c.1700), the lectures in Semester 1 address developments in European art from the rise of Christianity, through the Middle Ages and into the Renaissance, concluding with the Reformation and Counter-Reformation. Geographies studied include Britain, Italy, France and Germany. We look at the work of both early anonymous and later celebrated artists, such as Giotto, Jan van Eyck, Durer, Michelangelo and Leonardo da Vinci, all within a broad range of social contexts. We consider issues surrounding art and identity, including gender, sexuality, nationality, religious and political belief, as well as issues surrounding the art objects themselves, such as patronage, materiality, display and reception.
Students begin the course with very different levels of knowledge, and our intention is that, by the end, all will have acquired an overview of certain specific areas in the history of art. By building up art historical skills, through lectures, ALGs [Autonomous Learning Groups] and tutorials, students develop an understanding of the crucial issues raised by the subject and of the methods used to deal with them. Whenever appropriate the weekly tutorials are conducted in the museums, galleries and public spaces of Edinburgh, which has world-renowned art collections.

4. Psychology 1A (PSYL08009)
College: Humanities and Social Science
School: Philosophy, Psychology and Language Sciences
Department: Psychology
Level: SCQF 8 (Year 1 Undergraduate)
Semester: 1
Credits: 20
Caltech units: 9
Caltech evaluator: Colin Camerer

Type of Caltech credit: Additional HSS
State CIT equivalent course, if applicable: N/A
Course description:

This course aims to develop an integrated understanding of modern approaches to some of the core areas of psychology such as individual differences, cognitive neuroscience, perception and learning (the remaining core areas to be covered in Psychology 1B). Students are also presented with a broader conceptual and methodological framework of scientific and psychological research, as well as key ideas in science (e.g. naturalism, complexity, levels of analysis). Besides this, students are taught and can practice a range of general research skills.