

Elective Descriptions - STEM

In Forms VI-VII, Cistercian students must choose one elective course each semester. These courses meet twice a week, and are intended to round out the established curriculum in more particular areas of interest common to both students and teachers. The hope is that these courses both spark new excitement and support existing academic passions toward a fuller education. Faculty will often offer courses that grow out of their own academic pursuits and so these electives also serve to strengthen the faculty and the general academic conversation on campus through continual professional growth.

While the Cistercian curriculum is very structured as a whole, the elective system is by its design and nature very fluid. If a teacher can design a course that appeals to at least six students, then they are allowed to offer the course. If a student can gather six comrades and approach a teacher to request a course be offered, then the School will do its best to meet that need. It regularly occurs that alumni, alumni parents, and other outside professionals temporarily join the faculty to offer elective courses that meet needs which the full-time faculty may be unable to fill. For example, courses in Architecture, Finance, Law, Marketing, and Epidemiology have been taught in recent years.

As these courses meet just twice a week and are not required of all students at a given grade level, these courses do not receive an Honors designation. However, through repeated exploration in an academic area, a student can both encounter and produce high-level, thoughtful work in a particular subject area.

The following courses fall under the general description of *STEM fields* and are categorized within several subgroups (sometimes with membership in more than one, depending on cross-over academic areas). Thus, an individual course, by its very nature, may be listed under more than one section.

Mathematics

3D Modeling and Printing

Would you like to learn how to turn your ideas into solid reality? If so, 3D Modeling and Printing might be the course for you. In this course, you will first learn how to create 3D models on the computer, starting with the Tinkercad and SketchUp web-based programs, and then moving up to the more advanced Blender program. You will also learn about how 3D printing works and how to operate the school's 3D printers. Finally, you will turn your best 3D creations into physical form using 3D printing. Your grade will be based on quizzes, class participation, and several projects.

Cryptography

Cryptography is crucial to our present state as a society. Cryptography is the science of creating codes and structures for securing transmission and storage of information and the reverse, the ability to decode previously encrypted data. These processes are vital to most everything we do or depend upon. From the security of a nuclear reactor's control system to the messages sent through a national defense communications satellite, from the storage or maintenance of personal financial transactions to the security of a Facebook page, we all depend upon cryptography on a daily basis. This course will look at both encryption and decryption from perspectives of history, mathematical procedure and problem solving. The class will begin with basic ciphers and progress through the history up to RSA public key. Students will explore known ciphers, build their own encryption systems, and learn the basic approaches to breaching the security of ciphers. Basic algebra and number theory skills should suffice for understanding the mathematical foundations for ancient and modern cryptography.

Introduction to Game Theory

What, if anything, does the game of chess have to do with understanding free market competition? Can “rock-paper-scissors” tell us anything about whether there is a “best” way to compete in a particular market economy? Are there points of stability (equilibria) within a competitive game or market, situations where both sides perhaps have an incentive *not* to make a move? At the crossroads of mathematics and economics lies an exploration of the issues of competition and/or cooperation – which are ideas often best explored in the context of “games.” This course will introduce the motivated student to the principles of Game Theory through a variety of applications with a focus on *non-cooperative* games. We will examine the definition and existence of equilibrium points in various settings. Possible applications include auctions, bargaining, oligopoly, strategic market games, team production, and behavioral game theory. Grades will be based primarily on in-class quizzes and tests. While this course is open to students in Forms V-VII, it is recommended that a student have at least a B average in their Algebra course(s).

Introduction to Finance

This course will provide an overview concerning how capital markets operate, both in the US and globally, with particular emphasis on stocks, bonds, markets and valuation methodologies, as well as other relevant topics. Some portion of every class period will be left open for discussion of current financial issues (e.g. the European debt crisis or worries about US government debt/deficits, or consumer and student loan debt) in order to connect these issues with the theory of the course. Finally, the hope is to provide students a strong framework for considering how to value things financially. While people may follow a variety of career paths not directly related to finance, most will still make significant financial purchases over their lifetime, such as for a house, a car, or an education. Valuing these personal assets financially is remarkably similar to how the most sophisticated financial analyst values all sorts of financial securities because the financial/investment “ecosystem” is very similar to other systems with which we are more familiar. Grading will be based on class participation, group projects and individual presentations.

Statistics

Basic concepts and techniques of statistics will be covered, with many real-life examples employed. Topics included: describing data distributions with graphs and numbers; normal distributions; correlation, causation, and regression; probability theory; and basic inference. Students must obtain TI-83 graphing calculators for this course. Rising freshmen can register with the approval of the Math Department Chair.

Engineering, Programming, and Computer Technology

3D Modeling and Printing

Would you like to learn how to turn your ideas into solid reality? If so, 3D Modeling and Printing might be the course for you. In this course, you will first learn how to create 3D models on the computer, starting with the Tinkercad and SketchUp web-based programs, and then moving up to the more advanced Blender program. You will also learn about how 3D printing works and how to operate the school’s 3D printers. Finally, you will turn your best 3D creations into physical form using 3D printing. Your grade will be based on quizzes, class participation, and several projects.

Architecture: Folly by Design

Folly - noun; 1: a foolish act or idea. 2: an often extravagant, picturesque building with no practical purpose erected to suit a fanciful taste. In this course, you will attempt to produce the latter while avoiding the former. The class will be modeled on a college-level architectural design studio that will

introduce architectural history, design concepts, physical and digital drawing/modeling/rendering techniques, and presentation skills. Students will design, describe, and present an architectural folly project. Grades will be evaluated primarily on class participation and completion of assignments. The Midterm and final presentations will be graded qualitatively based on the students' graphic presentation, verbal presentation, and ability to respond to critique questions during the reviews.

Introduction to Publications

In order for School publications like *The Informer*, *Reflections*, and *Exodus* to reach their full potential, their student staff members need to develop and enlist a wide variety of skills, such as copy-writing, photo editing, layout design and caption creation in their construction. This class will be a hands-on tutorial and practicum in those skill sets. Students will work with Adobe Photoshop, InDesign, Lightroom, and Bridge to complete projects such as newspaper stories and yearbook layouts. Some projects may even be featured in the School's publications. Assessments will be based on the completed projects and in-class productivity. Come learn new skills that could help you become an integral staff member for the School's publications.

God in a High-Tech World

Many people today think that belief in God is impossible in our modern world of science and high-technology because science has explained everything that used to be explained by religion, and technology has given us capabilities that would have seemed god-like to the ancients. This course addresses these challenges to faith and explores the wealth of evidence that is available today to support the claims of Christianity. If you are a person with strong faith, this course can equip you to answer difficult questions you may encounter. If you are skeptical or have doubts about your faith, this course is a place where you can seek answers to your questions. The format of the course will be a mixture of lecture and group discussion covering some predetermined topics as well as questions from the students. Grades will be based on class discussion and a few argumentative essays.

Graphics Programming

In this course, students will learn how to create programs to produce and manipulate digital images. We will start with simple 2D shapes and move to animation, altering photographs, particles, 3D shapes, and visualizing data. Programs will be written using the Processing programming language (processing.org), which is the Java programming language with some of the difficult parts hidden to make it easier for beginners. Therefore, students will be learning much of the Java language while learning computer graphics.

Digital Marketing and Social Media

Digital Marketing & Social Media is a course designed to educate students on the ever-changing digital world, as well as to immerse students in real-world, hands-on experiences with live digital marketing campaigns, industry standard digital tools, resources, and more. Topics covered include an overview of Marketing principles (the 4 P's) and digital marketing strategy, digital marketing tools and tactics, social media platforms, use of social media for business, and best practices for personal social media usage. The course will have three primary and concurrent components: 1) Classroom discussion/lecture and interaction to introduce basic marketing and digital marketing concepts, 2) hands-on study, creation, and analysis of digital content (including social posts, blogs, articles, and videos that may be used in Cistercian's own social media platforms), and 3) a social media-for-business simulation where students will apply their learnings to a real-world scenario with hands-on work in a live simulation environment. Students will be primarily measured on class participation, progress achieved during hands-on project work (group based and/or individual), and an occasional quiz over lecture material.

Digital Photography I

Discover digital photography in the Cistercian Digital Arts Lab. Learn the how and why of photography with the newest digital camera technology. Students will learn to effectively use the controls of their digital SLR cameras including shutter speeds, f-stops, control of focus and exposure. Photocomposition, lighting and lenses are also covered. Students will use the “digital darkroom” with high-powered computers and Photoshop for digital image manipulation. Color and Black & White printing methods using the latest inkjet technology printers will be available. Students may use their own DSLR cameras or a limited number of the school's *Nikon* digital cameras.

Digital Photography II

This course is a continuation of the skills & techniques learned in the Digital Photography I course with the emphasis on taking photographs for specific assignments. Advanced techniques in the use of digital cameras such as previsualization of the photograph, advanced metering, control of depth of field for effect, and control of motion using the shutter speeds will be presented. Additional instruction in advanced Photoshop techniques, as well as color and Black & White printing will be part of this course. Students will use the latest versions of Photoshop and state of the art computers and inkjet printers. Mounting and presentation will be part of this course as well as entry into the annual “Retail as Art” Photography Scholarship competition. The course is project-based and graded on successful & timely completion of projects.

Advanced Digital Photo

With the permission of the instructor, students who have already completed *both* courses in digital photo and who wish to further their studies may sign up for Advanced Digital Photo (portfolio development). This course will meet at the same time as Photo II.

Film Making I

Lights, Camera, Action! Learn the art of digital short film making in the Cistercian Digital Arts Lab. Students will learn to develop a story concept into a screenplay and then plan and shoot a short film of their own using the School’s high definition Sony digital video cameras. Directing actors, lighting, and camera techniques will also be part of this course. Editing will be done using Adobe Premiere, professional level editing software. Special effects and DVD authoring are also part of the course. The short films will be screened at the ISAS Arts Festival next Spring, and possibly also entered into other high school film festivals.

Film Making II

Filmmaking II is a continuation of the techniques taught in Filmmaking I (previous enrollment required) with additional emphasis on editing technique, lighting for film and advanced shooting techniques. Using the latest professional editing software on the digital video lab computers and the School’s digital video cameras, each student will write, shoot, and edit his own short film and in the process learn to operate the cameras, direct actors, use lighting and effects to bring their own story to the big screen. The best films may be shown at the ISAS Arts Festival in the spring and at the end of the year in the School’s theatre. This is a project-based course, grading will be based on steady progress toward project completion.

Robotics with Legos

The course begins with a discussion of what robotics means today. We read the play *R.U.R. (Rossum's Universal Robots)*, a science fiction work by the Czech playwright Karel Čapek, who is credited for introducing and popularizing the term *robot*. Students continue investigating robotics using Python for the EV3 Lego Mindstorms Robotics System. Students will design robots that can sense the environment and navigate through a space with obstacles to achieve a determined goal using sonar, light and touch sensors. They will explore the use of omnidirectional wheels to achieve greater mobility.

Engineering Projects I

This course will be a “hands-on” approach in which students will research and construct various engineering designs. Topics will vary, depending upon students’ interests. Past topics have included hot air balloons, kites, CO2 dragsters, bridges, hover craft and robots. *New this year*, we’ll be adding Materials Engineering such as ceramics/glass making, metals and long-chain polymers (slime). Students will receive two types of grades: one for daily work and another for each successfully completed project.

Natural and Physical Sciences

Artificial Intelligence and the Human Soul

In 1997, a chess-playing computer system called Deep Blue beat the world chess champion, Garry Kasparov. In 2011, an artificial intelligence system called Watson defeated the two greatest Jeopardy champions. Even consumer products today use artificial intelligence techniques to respond to spoken questions, or create challenging game opponents. There are those who predict that machines will someday become more intelligent than humans, and that humans will be able to transfer their consciousness into machines in order to live forever. Is the human mind just a sophisticated computer program? Is there more to the human soul than what goes on in the brain? This course will look at the subject of artificial intelligence from a technological, philosophical and theological perspective. We will look at some of the techniques that have been used in artificial intelligence, and compare them with what philosophy and theology tells about the human mind, and the human soul. Students will be evaluated based on class discussion and presentations.

Athletic Training/Sports Medicine

This course will provide students with a broad look into the athletic training/sports medicine profession. The class will begin to prepare students for careers in allied healthcare – specifically athletic training and physical therapy. Topics addressed will include, but are not limited to: the prevention (taping & wrapping), evaluation, treatment and rehabilitation of athletic injury, first aid and CPR, and the professional responsibilities of an allied health provider. Students will be evaluated on class participation, assignments, mini quizzes/tests, clinical proficiencies, and practice/game day set up/participation as an athletic training student over the course of the semester.

Competitive Physics

If you like physics and have been a fan of math competitions, this class is for you. We will tackle problems and concepts covered in the physics bowl and the American physics Olympiad tests and will venture out internationally into the British first round of the physics Olympiad and the Physics competition from the University of Waterloo in Canada. The class is suitable for Juniors and Sophomores that want a challenge above the physics covered in the honors physics I class in form VI. Grades will be assigned according to participation, short concept presentations, and quizzes.

Culinary Chemistry

This elective covers the fundamental chemistry of food constituents, and especially the functionality of major food components, carbohydrates, proteins, lipids and water and their impact on food quality. Chemical interactions are investigated in laboratory exercises and students will be expected to analyze their observations through written lab reports.

Epidemic

This elective will be a survey of the most important infectious diseases of the last 600 years. During the course, students will learn that infectious diseases can explode onto society due to a perfect storm of factors beyond the microbiology of the individual pathogen. Starting with the bubonic plague, common

themes will be explored regarding contagion, ignorance, scientific method, public health, medical care and cultural changes. In addition, microbiologic concepts regarding bacteriology, parasitology, virology and molecular evolution will be mixed into the course. Historical diseases such as smallpox, yellow fever, and cholera will lay the groundwork to closely examine contemporary infections such as HIV/AIDS, hepatitis C, and West Nile virus. Emerging infections such as Ebola and Chagas' disease will also be on the docket. Finally, the innovations that helped in each epidemic wave will be appraised at each step with sometimes unexpected consequences such as: antibiotics and the advent of resistant bacteria, vaccines and the rise of “denialists,” and antivirals and the outrageous cost of pharmaceutical products. Three short paperback books will be needed. All students will also need to have "Plague Inc" for iPhone or Android. Grade will be based on class participation, occasional quizzes, and a final paper.

Meteorology

Meteorology, the study of the processes underlying atmospheric and weather phenomena, offers students a fascinating look into the forces of nature on a local and global scale. From how clouds and rainbows form to engineering hot air balloons and building a tornado model in a box, this introductory meteorology elective explores how meteorological data is collected, analyzed, and used to make short and long-range forecasts. Students will also learn to locate areas of potential tornadic activity on a given radar loop. Students will be assessed on their maintenance of a 30-day Weather Journal documenting the daily weather, reflections, and biweekly virtual quizzes.

Ornithology

In this elective, we will spend the majority of our time birding on or near our beautiful campus. Along the way, we will learn and hone the skills that are helpful in identifying the many species of birds we can see here – easily 70 or more! We will also learn about basic concepts in ornithology and bird behavior that will help us to appreciate all the more what we see in the field. Grades will be based on performance on numerous quizzes and class participation. We will take several trips to Campion Trail throughout the semester that will require a double period and a sack lunch.

Physics à la carte

If you love physics and want to explore the subject a little deeper or bridge the gap between middle school physics and the high school course, this elective is for you. In learning stations we'll explore a different topic in physics every week. Stations include: AP level and AP-style problems, physics bowl/F=ma competition prep, basic experiments, advanced experiments, and applications within projects. You can choose one of the stations every lesson and get to know physics “à la carte”. Grades will be determined by participation and class presentations.

Science and the Catholic Church

For the budding historian, scientist, philosopher, or theologian this class will provide an opportunity to survey some of the most important issues and events that shape our modern understanding of the relationship between “science” and the Catholic Church. How does the Church understand the vocation of the scientist? What happened with Galileo? Does the Big Bang prove or disprove God? Are the claims of Christian faith endangered by the progress of scientific explanation and technology? Is there more to reality than matter in motion? What about evolution? What are some resources that help us deal with these questions? And what did Bl. Pope John Paul II have to say about all this? Grades will be based on class participation, short quizzes over the daily reading assignments and some short papers.

Theory of Special Relativity

To many, the concepts of time dilation and length contraction seem like fictional ideas from sci-fi movies. However, with Albert Einstein's *Theory of Special Relativity*, we see that these ideas are real and correct. This elective will consist of a close reading of the first 17 chapters of Einstein's groundbreaking book

Relativity. We will also see how these revolutionary ideas have spread into popular culture in novels and movies. Grades will be based on class participation and one book report.