CURRICULUM COMMITTEE TEMPLATE

NEW COURSE PROPOSAL FORM

Faculty: ***Indicate all relevant Faculty(ies) i.e. AS/AK/SC/MATH***	SC/NATS

Department: *Indicate department and course prefix (e.g. Languages, GER)*	Division of Natural Science NATS	**Date of Submission:**	17 Apr 2013

Course Number: Special Topics courses *Include variance (e.g. HUMA 3000C 6.0, Variance is "C")*	1580	**Var:**	**Academic Credit Weight:** *Indicate both the fee, and MET weight if different from academic weight (e.g. AC=6, FEE=8, MET=6*	3

Course Title: *The official name of the course as it will appear in the Undergraduate Calendar and on the Repository*	Sun, Space Weather and Life on Earth

Short Title: *Appears on any documents where space is limited - e.g. transcripts and lecture schedules -* ***maximum 40 characters***	Space Weather

With every new course proposal it is the Departmental/Divisional responsibility to ensure that new courses do not overlap with existing courses in other units. If similarities exist, consultation with the respective departments/ divisions is necessary to determine degree credit exclusions and/or cross-listed courses.

Brief Course Description:

***Maximum 40 words or 200 characters**.*

The course description should be carefully written to convey what the course is about. It should be followed by a statement of prerequisites and corequisites, if applicable. This description appears in the calendar.

Prerequisites / Co-requisites: None.
Course credit exclusions: None.

Generic Course Description:

This is the description of the "Parent/Generic course" for Special Topics courses under which variances of the "Generic" course can be offered in different years (Max. 40 words). Generic course descriptions are published in the calendar.

Please list all degree credit exclusions, prerequisites, integrated courses, and notes below the course description (these will be in addition to the 40 word brief course description).

Space Weather refers to variations of near-Earth space conditions originating in Solar activity which could potentially cause damage to astronauts, critical technology and infrastructure. Modern society should be prepared for extreme Space Weather events.

Expanded Course Description:

Please provide a detailed course description, <u>including topics/theories and learning objectives,</u> as it will appear in supplemental calendars

The term "space weather" refers to the variable conditions on the sun and in space that can influence the performance of technology we use on Earth. This course introduces students to the science of Sun-Earth interactions, the magnetic field of the Earth, how natural variations of the Sun can affect society and technology on Earth and in the near-Earth space environment. Students are exposed to a subject of intense recent interest and of high potential impact to future policy makers and society at large. Students will learn to make connections made between natural phenomena such as Earth as a magnet and how this magnetic field sustains life on Earth as we know it. The course will describe the formation of aurora and magnetic storms and identify the potential radiation hazards to astronauts and satellite equipment and hazards of Coronal Mass Ejections to electrical power grids. Through simple concepts and historical accounts such as impact of magnetic storms on telegraph systems, students learn to appreciate the scientific method, understand the causes behind day-to-day events driven by the Sun occurring on a global scale, and how changing body of our scientific knowledge of the Sun will impact policies on satellite and communication systems and policies to prepare for or minimize the impact of space weather effects.

The Sun is a variable star that – aside from sustaining life on Earth – ejects high-energy particles and deadly radiation continuously out into space. This radiation can impact and destroy technological systems and is a major concern for human space travel and high flying aircrafts. The discovery of magnetically-confined charged particles (electrons and ions) around Earth by Van Allen and others around 1960 demonstrated that the space environment around Earth, above the sensible atmosphere, was not benign. Measurements by spacecraft in the five decades since Van Allen's work has demonstrated that Earth's near space environment is filled with particle radiation of sufficient intensity and energy to cause significant problems for satellite materials and electronics that might be placed into it.

Course content is roughly structured around five major sections:

(1) The Variable Sun and Space Weather
(2) Earth's Magnetic Field and Earth's Space Environment
(3) Technological Impacts of Space Storms
(4) Hazards to astronauts, satellites, and power grids
(5) Disaster management considerations and policies for the future.

Each section is introduced in two phases: the main topic describing space weather phenomena and their impacts; and supplements describing important physical concepts behind the topic.

Section 1 will introduce the students with the key concepts of Space Weather by defining – space weather, climate, meteorology, Earth's atmosphere, electromagnetic radiation, heat transfer, solar atmosphere and solar cycle. A brief history of the topic will be covered, along with the definitions of key terms such as aurora, geomagnetic field, sunspots, and the standard solar model.

Section 2 will cover the key concepts (introductory, mainly qualitative, a few elementary algebraic equations) such as the Earth's magnetic field, magnetosphere, the Van Allen radiation belt, magnetic reconnection, and geomagnetic storms. A detailed description of the interaction of the solar wind and magnetosphere will be covered.

Section 3 will introduce the students with the key concepts (descriptive, qualitative) – atmospheric drag, radiation effect on satellites, radio wave propagation and Faraday's law of induction.

Section 4 will be an introduction on how Spacecraft and astronauts are directly exposed to intense radiation that can damage or disable systems and sicken or kill astronauts, and conditions when even passengers in high flying aircraft can be potentially exposed to high doses of radiation. This section will also cover how radio signals from satellites to ground communication and navigation systems such as the Global Positioning System (GPS) are also susceptible to space weather impacts.

Section 5 will cover disaster management scenarios and policies in order to protect people and systems that might be at risk from space weather effects. Space weather can produce electromagnetic fields that induce extreme currents, disrupting power lines and even causing wide spread blackouts. These power outages may have cascading effects causing – loss of water and waste water distribution, loss of perishable foods and medications, loss of heating/air conditioning, loss of computer systems, telephone systems and loss of all electrical systems that do not have backup power.

Learning outcomes for this course include demonstrating (a) familiarity with the form of scientific literature as well as its electronic access, (b) the ability to understand scientific and technical literature in the context of technology, human health, economy, and society
(c) the ability to recognize and appreciate the nature of Sun-Earth relationships and methods to investigate it
(d) an appreciation of the challenges of Space Weather to society at large.

At the end of the course students will be able to:

(1) Define Space weather and identify various phenomena such as aurora, geomagnetic field, sunspots and solar cycle.
(2) Demonstrate an understanding of Earth's magnetic field, magnetosphere, the Van Allen radiation belt, magnetic reconnection, and geomagnetic storms
(3) Describe atmospheric drag, radiation effect on satellites, radio wave propagation and Faraday's law of induction
(4) Outline the historical impacts of major space weather events.
(5) Identify the hazards of extreme space weather on life on Earth as well as to astronauts and equipment in space.
(6) Recognize the threat to communication and navigation system such as GPS in an event of solar storm.
(7) Prepare themselves for emergency situations such as power outages and the consequent effect on life.
(8) Identify various disaster scenarios and the policies in place to protect people and systems from extreme space weather effects.

Course Design:

Indicate how the course design supports students in achieving the learning objectives. For example, in the absence of scheduled contact hours what role does student-to-student and/or student-to-instructor communication play, and how is it encouraged.

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The course design is 3 hours of lectures per week. Assessment will be by way of tests and assignments. Course content is primarily delivered by text-supported lectures. Direct instruction designed to achieve course learning objectives (other than mere content) are achieved through tutorials and assignments.

Instruction:

1. Planned frequency of offering and number of sections anticipated (every year, alternate years, etc.).

2. Number of department/division members currently competent to teach the course.

3. Instructor(s) likely to teach the course in the coming year.

*4. An indication of the number of contact hours (defined in terms of hours, weeks, etc.) involved, in order to indicate whether an effective length of term is being maintained **OR** in the absence of scheduled contact hours a detailed breakdown of the estimated time students are likely to spend engaged in learning activities required by the course.*

1. This course would normally be offered once a year in either the fall or winter session, presumably in one section.

2. Several current members of the faculty in the Department of Earth and Space Science and the Division of Natural Science are competent to teach the course.

3. Dr. Jagruti Pathak in EATS/NATS is likely to teach the course next year.

4. 36 lecture contact hours

Evaluation:

A detailed percentage breakdown of the basis of evaluation in the proposed course must be provided.

If the course is to be integrated, the additional requirements for graduate students are to be listed.

A possible evaluation scheme is:

One midterm test:	30%
Two assignments (2x 20%)	40%
Final exam:	30%

If the course is amenable to technologically mediated forms of delivery please identify how the integrity of learning evaluation will be maintained. (e.g. will "on-site" examinations be required, etc.)	Individual instructors may wish to modify somewhat the above prescription, such as varying the weights among assignments, or adding a small component for participation. It is not envisaged that this course would be offered as a distance education course.

Bibliography: *A READING LIST MUST BE INCLUDED FOR ALL NEW COURSES* *The Library has requested that the reading list contain complete bibliographical information, such as full name of author, title, year of publication, etc., and that you distinguish between required and suggested readings. A statement is required from the bibliographer responsible for the discipline to indicate whether resources are adequate to support the course.* *<u>Also please list any online resources</u>.* *If the course is to be integrated (graduate/ undergraduate), a list of the additional readings to be required of graduate students must be included. If no additional readings are to be required, a rationale should be supplied.* **LIBRARY SUPPORT STATEMENT MUST BE INCLUDED.**	This course would be supported by a selection of topics from various texts, or by an assembled course pack. If a single existing text were to be selected, a current option that is written in a style suitable for general science education that would broadly support the stated learning objectives is: Introduction to Space Weather by Mark Moldwin (Cambridge University Press), available from Amazon.ca ($62.95). Other optional texts: The Sun from Space (Astronomy and Astrophysics Library) by Kenneth R. Lang, available from Amazon.com $109.00 (This book could be placed on reserve in the library)

Other Resources: *A statement regarding the adequacy of physical resources (equipment, space, etc.) must be appended. If other resources will be required to mount this course, please explain* ***COURSESWILL NOT BE APPROVED UNLESS IT IS CLEAR THAT ADEQUATE RESOURCES ARE AVAILABLE TO SUPPORT IT.***	**Classroom space**: It is anticipated that this course would require lecture hall space to accommodate 200 students. **Other resources**: Tutorial Assistance for assignment advising and marking.

Course Rationale:

The following points should be addressed in the rationale:

How the course contributes to the educational objectives of the unit and of the Faculty.

The relationship of the proposed course to other existing offerings, particularly in terms of overlap in objectives and/or content. If inter-Faculty overlap exists, some indication of consultation with the Faculty affected should be given.

The expected enrolment in the course.

The Division of Natural Science seeks to offer additional courses to broaden choices for students to fulfill their general education requirement in science, including increasing the slate of 3-credit courses. This course proposal is structured to follow the recent establishment of guidelines for ensuring NATS courses meet the expectations of the Division and Faculty and to reflect the principles expressed in General Education models.

In particular, this course promotes *awareness and breadth* by virtue of providing students with a sampling of scientific content and process. It promotes the value of *interdisciplinary studies* (a theme of special interest to York University) by touching upon a number of science topics in investigating the domain of Space Weather, the variable Sun, Earth's space environment, the technological impacts of space storms, the perils of living in space, and disaster management to minimize the impact of space weather effects. It promotes the *critical skills* of searching the scientific literature, communicating about science using writing, applying the scientific method, and identifying ways in which the public can participate in science. It promotes *independent learning* through the completion of assignments designed to achieve other learning objectives, and it invites students to be engaged in their communities (*civic engagement*) by having them discover and demonstrate an understanding of disaster management and emergency preparedness.

There are currently no courses directly approaching this topic within the Division that teach Space weather effects.

Sun, Space Weather and life on Earth is a multi-faceted subject, making it a useful theme for student's development in understanding science. This is because students learn not only about a particular aspect of the natural world, but also about what tools and perspectives scientists employ to make sense of Sun-Earth relationship. This course, accordingly, will present almost entirely unique material within the Division offerings.

The expected enrolment in the course is between 50 and 200 students.

Faculty and Department/ Division Approval for Cross-listings: *If the course is to be cross-listed with another department/division this section needs to be signed by all parties. In some cases there may be more than two signatures required (i.e. Mathematics, Women's Studies). In the majority of the cases either the Undergraduate Director or Chair of a unit approves the agreement to cross-list. All relevant signatures must be obtained prior to submission to the Faculty curriculum committee.*	Dept.: ____________________ ________ ________ Signature (Authorizing cross-list) Dept./Division Date Dept.: ____________________ ________ ________ Signature (Authorizing cross-list) Dept./Division Date Dept.: ____________________ ________ ________ Signature (Authorizing cross-list) Dept./Division Date

STEACIE SCIENCE & ENGINEERING LIBRARY
YORK UNIVERSITY

MEMORANDUM

To: Paul Delaney, Director, Division of Natural Science, Faculty of Science & Engineering

From: Sarah Shujah, Science Librarian

Re: NATSXXXX – Sun, Space Weather and Life on Earth

Date: September 20, 2013

I have reviewed the course proposal and attached bibliography for **NATSXXXX – Sun, Space Weather and Life on Earth** and can state that the York University Libraries have the required resources to support this undergraduate level course.

Please be aware that the library offers the following services to help students with their research:

- A librarian can go to the classroom or tutorial and introduce students to the various resources available at the library including electronic journals, newspaper indexes and other databases.
- A librarian is also available for individual consultations with students to help them find the materials they need for their research.
- A librarian can be available as a user on the course Moodle page to answer student questions using the Forum discussion, provide links to resources in the course, and post handouts presented in face-to-face instruction.

The following electronic resources licensed by the library may be of help to the students in this course:

- **Scopus** is the world's largest abstract and citation database of peer-reviewed literature. It has many articles that are relevant to natural science and specifically, astronomy. Additionally, it contains citation information.
- **Web of Science** is an extensive database that has very good coverage of sciences including astronomy and physics. Additionally, it allows for citation search.
- **General Science Abstracts**: This database indexes general science topics such as astronomy. It is appropriate for beginning undergraduate natural science students.
- **Encyclopedia of Astronomy and Astrophysics:** A comprehensive reference in the field of astronomy and astrophysics. This will be a good resource for first year undergraduate students to help understand major astronomy concepts.
- **GeoRef** is a unique multidisciplinary database that is Useful for undergraduate and graduate level earth science, earth space and science, and geography students.

A more complete listing of resources is available at the following LibGuides:

- Natural Science LibGuide http://researchguides.library.yorku.ca/natural science

Please note that the Steacie and Scott Libraries have extensive collections of books and reference materials that are relevant to this course.

In summary, I state that we are well positioned to support this course.

If you have any questions, please do not hesitate to contact me.

Sincerely,

Sarah Shujah, Science Librarian
Steacie Science & Engineering Library
416-736-2100 x33945
sshujah@yorku.ca