ASU
ARIZONA STATE UNIVERSITY

GENERAL STUDIES COURSE PROPOSAL COVER FORM

Course information:

*Copy and paste **current** course information from Class Search/Course Catalog.*

College/School: College of Liberal Arts and Sciences | Department/School: **School of Earth and Space Exploration**

Prefix: **SES** | Number: **130** | Title: Coding for Exploration | Units: 3.0

Course description: **A series of lectures and computer labs on data processing and analysis in Earth and Space sciences using Python. Introduction to programming with scratch and python. Numerical methods for data analytics.**

Is this a cross-listed course? No | If yes, please identify course(s):

Is this a shared course? No | If so, list all academic units offering this course:

*Note- For courses that are crosslisted and/or shared, a letter of support from the chair/director of **each** department that offers the course is required for **each** designation requested. By submitting this letter of support, the chair/director agrees to ensure that all faculty teaching the course are aware of the General Studies designation(s) and will teach the course in a manner that meets the criteria for each approved designation.*

Is this a permanent-numbered course with topics? No

If yes, all topics under this permanent-numbered course must be taught in a manner that meets the criteria for the approved designation(s). It is the responsibility of the chair/director to ensure that all faculty teaching the course are aware of the General Studies designation(s) and adhere to the above guidelines.

Chair/Director Initials _____ (Required)

Requested designation: Mathematical Studies–CS

Mandatory Review: (Choose one)

*Note- a **separate** proposal is required for each designation.*

Eligibility: Permanent numbered courses **must** have completed the university's review and approval process. For the rules governing approval of omnibus courses, contact Phyllis.Lucie@asu.edu.

Submission deadlines dates are as follow:

For Fall 2018 Effective Date: October 1, 2017

For Spring 2019 Effective Date: March 10, 2018

Area(s) proposed course will serve:

A single course may be proposed for more than one core or awareness area. A course may satisfy a core area requirement and more than one awareness area requirements concurrently, but may not satisfy requirements in two core areas simultaneously, even if approved for those areas. With departmental consent, an approved General Studies course may be counted toward both the General Studies requirement and the major program of study.

Checklists for general studies designations:

Complete and attach the appropriate checklist

- Literacy and Critical Inquiry core courses (L)
- Mathematics core courses (MA)
- Computer/statistics/quantitative applications core courses (CS)
- Humanities, Arts and Design core courses (HU)
- Social-Behavioral Sciences core courses (SB)
- Natural Sciences core courses (SQ/SG)
- Cultural Diversity in the United States courses (C)
- Global Awareness courses (G)
- Historical Awareness courses (H)

A complete proposal should include:

- ☒ Signed course proposal cover form
- ☒ Criteria checklist for General Studies designation being requested
- ☒ Course catalog description
- ☒ Sample syllabus for the course
- ☒ Copy of table of contents from the textbook and list of required readings/books

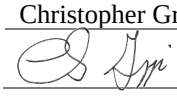
It is respectfully requested that proposals are submitted electronically with all files compiled into one PDF.

Contact information:

Name: Becca Dial | E-mail: bdial@asu.edu | Phone: 480-965-2213

Department Chair/Director approval: *(Required)*

Chair/Director name (Typed): Christopher Groppi | Date: 1/18/18

Chair/Director (Signature): 

Arizona State University Criteria Checklist for

MATHEMATICAL STUDIES [CS]

Rationale and Objectives

The **Mathematical Studies** requirement is intended to ensure that students have skill in basic mathematics, can use mathematical analysis in their chosen fields, and can understand how computers can make mathematical analysis more powerful and efficient. The **Mathematical Studies** requirement is completed by satisfying both the **Mathematics [MA]** requirement and the **Computer/Statistics/Quantitative Applications [CS]** requirement explained below.

The **Mathematics [MA]** requirement, which ensures the acquisition of essential skill in basic mathematics, requires the student to complete a course in College Mathematics, College Algebra, or Pre-calculus; or demonstrate a higher level of skill by completing a mathematics course for which a course in the above three categories is a prerequisite.

The **Computer/Statistics/Quantitative Applications [CS]** requirement, which ensures skill in real world problem solving and analysis, requires the student to complete a course that uses some combination of computers, statistics, and/or mathematics.* Computer usage is encouraged but not required in statistics and quantitative applications courses. At a minimum, such courses should include multiple demonstrations of how computers can be used to perform the analyses more efficiently.

*CS does *not* stand for computer science in this context; the "S" stands for statistics. Courses in computer science must meet the criteria stated for CS courses.

Revised April 2014

Proposer: Please complete the following section and attach appropriate documentation.

ASU--[CS] CRITERIA

A COMPUTER/STATISTICS/QUANTITATIVE APPLICATIONS [CS] COURSE MUST SATISFY ONE OF THE FOLLOWING CRITERIA: 1, 2, OR 3

YES	NO		Identify Documentation Submitted
		1. Computer applications*: courses must satisfy both **a** and **b**:	
☒	☐	**a.** Course involves the use of computer programming languages or software programs for quantitative analysis, algorithmic design, modeling, simulation, animation, or statistics.	Course syllabus
		b. Course requires students to analyze and implement procedures that are applicable to at least one of the following problem domains **(check those applicable)**:	
☐	☒	i. Spreadsheet analysis, systems analysis and design, and decision support systems.	
☐	☒	ii. Graphic/artistic design using computers.	
☐	☒	iii. Music design using computer software.	
☐	☒	iv. Modeling, making extensive use of computer simulation.	
☐	☒	v. Statistics studies stressing the use of computer software.	
☒	☐	vi. Algorithmic design and computational thinking.	Course syllabus

***The **computer applications** requirement **cannot** be satisfied by a course, the content of which is restricted primarily to word processing or report preparation skills, the study of the social impact of computers, or methodologies to select software packages for specific applications. Courses that emphasize the use of a computer software package are acceptable only if students are required to understand, at an appropriate level, the theoretical principles embodied in the operation of the software and are required to construct, test, and implement procedures that use the software to accomplish tasks in the applicable problem domains. Courses that involve the learning of a computer programming language are acceptable only if they also include a substantial introduction to applications to one of the listed problem domains.

YES	NO		Identify Documentation Submitted
		2. Statistical applications: courses must satisfy **a**, **b,** and **c**.	
☐	☐	**a.** Course has a minimum mathematical prerequisite of College Mathematics, College Algebra, or Pre-calculus**,** or a course already approved as satisfying the MA requirement.	
		b. The course must be focused principally on developing knowledge in statistical inference and include coverage of all of the following:	
☐	☐	i. Design of a statistical study.	
☐	☐	ii. Summarization and interpretation of data.	
☐	☐	iii. Methods of sampling.	
☐	☐	iv. Standard probability models.	
☐	☐	v. Statistical estimation	
☐	☐	vi. Hypothesis testing.	
☐	☐	vii. Regression or correlation analysis.	
☐	☐	**c.** The course must include multiple demonstrations of how computers can be used to perform statistical analysis more efficiently, if use of computers to carry out the analysis is not required. .	

YES	NO		Identify Documentation Submitted
		3. Quantitative applications: courses must satisfy **a**, **b, and c:**.	
☐	☐	**a.** Course has a minimum mathematical prerequisite of College Mathematics, College Algebra, or Pre-calculus**,** or a course already approved as satisfying the MA requirement.	
		b. The course must be focused principally on the use of mathematical models in quantitative analysis and decision making. Examples of such models are:	
☐	☐	i. Linear programming.	
☐	☐	ii. Goal programming.	
☐	☐	iii. Integer programming.	
☐	☐	iv. Inventory models.	
☐	☐	v. Decision theory.	
☐	☐	vi. Simulation and Monte Carlo methods.	
☐	☐	vii. Other (explanation must be attached).	
☐	☐	**c.** The course must include multiple demonstrations of how computers can be used to perform the above applications more efficiently, if use of computers is not required by students.	

Course Prefix	Number	Title	General Studies Designation
SES	130	Coding for Exploration	

Explain in detail which student activities correspond to the specific designation criteria. Please use the following organizer to explain how the criteria are being met.

Criteria (from checksheet)	How course meets spirit (contextualize specific examples in next column)	Please provide detailed evidence of how course meets criteria (i.e., where in syllabus)
1a	The course teaches computer programming using languages Scratch and python. The students use computers to design algorithms and analyze Earth and space science data.	As outlined in the course syllabus, problems from The Zelle textbook treat programming in python and algorithmic design. Exercises utilize real earth and Space science data.
1 b vi	Students learn the how to Approach programming tasks And how to design algorithms.	Exercises outlined on the syllabus teach functional and object-oriented program design, designing or selecting algorithms, and applying these to earth And space science data.

SES130: Coding for Exploration

Instructors:

Nathaniel Butler
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Email: Nathaniel. Butler@asu.edu

Sang-Heon (Dan) Shim
Office: ISTB4 575
Phone: 480-727-2876
Email: SHDShim@asu.edu

Office Hours: To be determined or by appointment

1. Course Description
A series of lectures and computer labs on data processing and analysis in Earth and Space sciences using Python. Introduction to programming with scratch and python. Numerical methods for data analytics.

2. Learning Outcomes
Upon completion, students will be able to:

- Learn to solve problems, in groups, using computers.
- Utilize procedural programming concepts including data types, variables, control structures, arrays, and data I/O.
- Utilize software engineering concepts including testing, incremental development, understanding requirements, and teamwork.
- Design strategies to analyze Earth and Space science data
- Write codes to process Earth and Space science data
- Present key properties of Earth and Space science data
- Interpret data for understanding Earth processes and Astronomy

3. Exercises, Test and Term Project
The course will be evaluated based on seven exercises, one final examination and six individual problem sets. The final examination consists of 5-7 coding questions based on the materials taught in this course. An instructional sheet will be provided for each problem set. All evaluation materials will be available with sufficient time for completion.

4. Grading
The course is for 3 units. Grading is based on A to E with +/- letter grading: 97.5% - 100% = A+, 92.5% - 97.4% = A, 90% - 92.4% = A-, 87.5% - 89.9% = B+, 82.5% - 87.4% = B, 82.4% - 80% = B-, 77.5% - 79.9% = C+, 70% - 77.4% = C, 60% - 69.9% = D, 0% - 59.9% = E.

Item	**Percentage**
Attendance	10.0%
Problem set #1	10%

Problem set #2	10%
Problem set #3	10%
Problem set #4	10%
Problem set #5	10%
Problem set #6	10%
Final examination	30%
Total	100%

Extra Credit
There will be **no extra credit opportunities** assigned for this course. However, individualized honors contracts and opportunities for independent study credit supervised by the instructor will be made available for projects that go beyond the scope of this course.

5. Readings and weekly itineraries

"Python Programming: An Introduction to Computer Science 3rd Edition", by John Zelle

"Python for Data Analysis, Agile Tools for Real World Data," Wes McKinney

Week 1 Course overview, why python?; Zelle Ch1

Week 2 Computers and Simple Programs; Zelle Ch 2

Week 3 Data Types, numbers; Zelle Ch 3

Plate velocities
The students analyze the hot spot age versus distance data along the Hawaii-Emperor seamount chain to obtain average plate velocities over the past 60 million years.

Week 4 String; Zelle Ch 5

Week 5-6 Files & Functions; Zelle Ch 6

Equations of state
The students conduct numerical integrations and differentiations to understand the effects of high pressure on the thermodynamic properties of materials in the deep interiors of planets.

Week 7-8 Decision Structures; Zelle Ch 7

Week 9-10 Loops & Booleans; Zelle Ch 8

Mass-radius relations of extrasolar planets
The students simulate the mass-radius relations of exoplanets with different materials (gas, ice, rock, and metal) and compare the results with astrophysical measurements of exoplanets.

Week 11Classes; Zelle Ch 10

Least-squares fitting Using Variable Stars
The students return to this data set in order to find and fit a model (sum of sinusoids) to better fit the variable star time history.

Week 12 Data Collections; Zelle Ch 11

Earthquakes
The students analyze the relationship between the depth and distance of epicenters along the Japan trench. The data will be used for modeling the pattern of subduction in the region. They also conduct time-series analysis of the data and measure changes in earthquake frequencies over the past 50 years.

Week 13 Numerical Python; McKinney Ch 4

Image Denoising Using FFTs
The students analyze an image of a moon rock from the Apollo missions to the moon. Electronic noise is present, and low-pass filter is demonstrated in order to clean up the image. The students experiment with the visualization of the 2D FFT and the placing of cut-off levels that zero-out the high-frequency components of the signal.

Week 14 Scientific Python; McKinney Ch 12

Periodicity Analysis Using Variable Stars
Use a 1d FFT to plot the periodogram for the time history of a variable star. The students identify the period and the overplot a sinusoid against the time history data. Data are taken from the Sloan Digital Sky Survey.

Week 15 Plotting; McKinney Ch 8

Image Classification and Shape Identification
The students return to an idealized version of the moon rock problem, using Sobel filtering to flag the edges of the moon rock and to identify the position of these edges in a captured image. Pseudo-code is written to use this information in an avoidance algorithm that would be of interest for an automated moon rover.

Questions at the end of each chapter serve as the weekly homework assignments, due at the start of class the following week.

A take-home mid-term exam will be given in liue of the week 6 homework. A final exam will be given during the final exam period at the end of the course.

6. Discussion Policy
Students should not discuss problem sets among themselves. No discussions are allowed for the final examination.

7. Other important announcements

ABSENCES
Students should expect to attend all classes. It is the responsibility of the student to inform the instructor(s) of an unexcused absence as soon as possible. Absences for emergency situations may be excused unofficially by the instructors. Instructor-excused absences must be obtained *prior to or on the day of the absence*. Make-ups for such absences will be at the discretion of the instructor(s). *There will be no make-ups for unexcused absences.*

The conditions under which assigned work or tests can be made up, including:

- Information on excused absences related to religious observances/practices that are in accordance with ACD 304–04 "Accommodations for Religious Practices."
- Information on excused absences related to university sanctioned events activities that are in accord with ACD 304–02 "Missed Classes Due to University-Sanctioned Activities."

ACADEMIC INTEGRITY

Academic honesty is expected of all students in all examinations, papers, and laboratory work, academic transactions and records. The possible sanctions include, but are not limited to, appropriate grade penalties, course failure (indicated on the transcript as a grade of E), course failure due to academic dishonesty (indicated on the transcript as a grade of XE), loss of registration privileges, disqualification and dismissal. For more information, see http://provost.asu.edu/academicintegrity

ACCOMODATING STUDENTS WITH DISABILITIES

Students who feel they will need disability accommodations in this class but have not registered with the Disability Resource Center (DRC) should contact DRC immediately. The DRC Tempe office is located on the first floor of the Matthews Center Building. DRC staff can also be reached at: (480) 965-1234 (V) or (480) 965-9000 (TTY). For additional information, visit: www.asu.edu/studentaffairs/ed/drc.

EXPECTED CLASSROOM BEHAVIOR

Classroom behavior: Be sure to arrive on time for class. Excessive tardiness will be subject to sanctions. Under no circumstances should you allow your cell phone to ring during class. Any disruptive behavior, which includes ringing cell phones, listening to your mp3/iPod player, text messaging, constant talking, eating food noisily, reading a newspaper will not be tolerated. The use of laptops (unless for note taking), cell phones, MP3, IPOD, etc. are strictly prohibited during class.

Policy against threatening behavior: All incidents and allegations of violent or threatening conduct by an ASU student (whether on-or off campus) must be reported to the ASU Police Department (ASU PD) and the Office of the Dean of Students. If either office determines that the behavior poses or has posed a serious threat to personal safety or to the welfare of the campus, the student will not be permitted to return to campus or reside in any ASU residence hall until an appropriate threat assessment has been completed and, if necessary, conditions for return are imposed. ASU PD, the Office of the Dean of Students, and other appropriate offices will coordinate the assessment in light of the relevant circumstances.

LATE ASSIGNMENTS

Requests for modifications in assignment due dates must be made in writing and an approved by the instructor **in advance of the due date of the assignment**.

GRADE APPEALS

The College of Liberal Arts and Sciences has formal and informal channels to appeal a grade.

INCOMPLETES

A mark of **"I" (incomplete)** is given by the instructor when you have completed most of the course and are otherwise doing acceptable work but are unable to complete the course because of illness or other conditions beyond your control. Students who are granted a grade of

"I" are required to arrange with the instructor for the completion of the course requirements and are recorded using the following form.

STUDENT STANDARDS
Students are required to act in accordance with university and Arizona Board of Regents policies as outlined in the ABOR Code of Conduct: Arizona Board of Regents Policies 5-301 through 5-308.

DROP AND ADD DATES/WITHDRAWALS
Please refer to the academic calendar on the deadlines to drop/withdraw from this course. Consult with your advisor and notify your instructor if you are going to drop/withdraw this course. If you are considering a withdrawal, review the following ASU policies: Withdrawal from Classes and Medical/Compassionate Withdrawal.

EMAIL COMMUNICATIONS
All email communication for this class will be done through your ASU email account. You should be in the habit of checking your ASU email regularly as you will not only receive important information about your classes, but other important university updates and information. You are solely responsible for reading and responding if necessary to any information communicated via email.

CAMPUS RESOURCES
As an ASU student, you have access to many resources on campus. This includes tutoring, academic success coaching, counseling services, financial aid, disability resources, career and internship help, and many opportunities to get involved in student clubs and organizations.

- Tutoring
- Counseling Services
- Financial Aid
- Disability Resource Center
- Major/Career Exploration
- Career Services
- Student Organizations

HARASSMENT PROHIBITIONS
ASU policy prohibits harassment on the basis of race, sex, gender identity, age, religion, national origin, disability, sexual orientation, Vietnam era veteran status, and other protected veteran status. Violations of this policy may result in disciplinary action, including termination of employees or expulsion of students. Contact Student Life (UCB 221) if you feel another student is harassing you based on any of the factors above; contact EO/AA (480-965-5057) if you feel an ASU employee is harassing you based on any of the factors above.

ESTABLISHING A SAFE LEARNING ENVIRONMENT
Learning takes place best when a safe environment is established in the classroom. Students enrolled in this course have a responsibility to support an environment that nurtures individual and group differences and encourages engaged, honest discussions. The success of the course rests on your ability to create a safe environment where everyone feels comfortable to share and explore ideas. We must also be willing to take risks and ask critical questions. Doing so will effectively contribute to our own and others intellectual and personal growth and development. We welcome disagreements in the spirit of critical academic exchange, but please remember to be respectful of others' view points, whether you agree with them or not.

SYLLABUS DISCLAIMER
The course syllabus is an educational contract between the instructor and students. Every effort will be made to avoid changing the course schedule but the possibility exists that unforeseen events will make syllabus changes necessary. The instructor reserves the right to make changes to the syllabus as deemed necessary. You will be notified in a timely manner of any syllabus changes via email or through Blackboard.

STUDENT CONDUCT STATEMENT
Students will be required to adhere to the behavior standards listed below:

- Arizona Board of Regents Policy Manual Chapter V – Campus and Student Affairs: Code of Conduct.
- ACD 125: Computer, Internet, and Electronic Communications.
- ASU's Student Academic Integrity Policy.

Students are entitled to receive instruction free from interference by other members of the class. If a student is disruptive, an instructor may ask the student to stop the disruptive behavior and warn the student that such disruptive behavior can result in withdrawal from the course. An instructor may withdraw a student from a course when the student's behavior disrupts the educational process under USI 201-10.
Course discussion messages should remain focused on the assigned discussion topics. Students must maintain a cordial atmosphere and use tact in expressing differences of opinion. Inappropriate discussion board messages may be deleted if an instructor feels it is necessary. Students will be notified privately that their posting was inappropriate. Student access to the course Send Email feature may be limited or removed if an instructor feels that particular students is sending inappropriate electronic messages to other students in the course.

RELIGIOUS ACCOMMODATIONS
Students who need to be absent from class due to the observance of a religious holiday or participate in required religious functions must notify the faculty member in writing as far in advance of the holiday or obligation as possible. Students will need to identify the specific holiday or obligatory function to the faculty member. Students will not be penalized for missing class due to religious obligations or holiday observance and a responsible for contacting the instructor to make arrangements for making up tests/assignments within a reasonable time.

SES 130 Coding for Exploration

Course description:

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Textbooks:

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Weekly Readings:

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Week 4 String; Zelle Ch 5
Week 5-6 Files & Functions; Zelle Ch 6
Week 7-8 Decision Structures; Zelle Ch 7
Week 9-10 Loops & Booleans; Zelle Ch 8
Week 11Classes; Zelle Ch 10
Week 12 Data Collections; Zelle Ch 11
Week 13 Numerical Python; McKinney Ch 4
Week 14 Scientific Python; McKinney Ch 12
Week 15 Plotting; McKinney Ch 8

Table of Contents for Python Programming: An Introduction to Computer Science, 3rd Edition, John Zelle

Table of Contents for Python for Data Analysis, Wes McKinney