

This template is to be used only by programs that have received specific written approval from the Provost's office to proceed with internal proposal development and review. The proposal template should be completed in full and submitted to the University Provost's Office [[mailto: curriculumplanning@asu.edu](mailto:curriculumplanning@asu.edu)]. It must undergo all internal university review and approval steps including those at the unit, college, and university levels. A program **may not** be implemented until the Provost's Office notifies the academic unit that the program may be offered.

MASTER'S DEGREE PROGRAM

College/School: The College of Liberal Arts and Sciences

Note: Program ownership is coded at the College/School level first and may not be a center, department or division apart from it.

Department/Division/School: School of Earth and Space Exploration (CEARTH&SPX)

Proposing faculty group (if applicable):

Name of proposed degree program: Master of Science (MS) in Exploration Systems Design

Proposed title of major: Exploration Systems Design

Master's degree type: MS - Master of Science

If Degree Type is "Other", provide degree type and proposed abbreviation: N/A

Is a program fee required? No, a program fee is not required.

Note: for more information about program fee requests, visit <https://provost.asu.edu/curriculum-development/changemaker/form-instructions#fees>

Is the unit willing and able to implement the program if the fee is denied? N/A

Requested effective term and year: Fall 2021

(The first semester and year for which students may begin applying to the program)

Delivery method and campus or location options: *select all locations that apply*

- ☐ Downtown Phoenix
 ☐ Polytechnic
 ☒ Tempe
 ☐ West
 ☐ Other:
- Standalone
 - Instrumentation
 - Systems Engineering
 - Sensor Networks

☐ **Both on-campus and** ☐ ASU Online* - (check applicable campus(es) from options listed above)

☐ ASU Online only (all courses online and managed by ASU Online)

Note: Once students elect a campus or Online option, students will not be able to move between the on-campus and the ASU Online options. Approval from the Office of the University Provost and Philip Regier (Executive Vice Provost and Dean) is required to offer programs through ASU Online. Please complete the ASU Online Offering form in [Curriculum ChangeMaker](#) to begin this request. Prior to completing the online Curriculum ChangeMaker form, please contact EdPlus at edplusprogrammanagement@asu.edu who can provide you with additional information regarding the online request process.

Do Not Fill in this information: Office Use Only

Plan Code:

CIP Code:

PROPOSAL CONTACT

Name: Christopher Groppi

Title: Associate Professor

Phone number: 480-965-6436

Email: cgroppi@asu.edu

DEAN APPROVAL(S)

This proposal has been approved by all necessary unit and college/school levels of review, and the college/school(s) has the resources to offer this degree program. I recommend implementation of the proposed degree program.

Note: An electronic signature, an email from the dean or dean's designee, or a PDF of the signed signature page is acceptable.

College/School/Division Dean **Fabio Milner**
name:

Signature:



Date: 10/13/2020

Please note: Proposals for new degrees also require the review and recommendation of approval from the University Graduate Council, Curriculum and Academic Programs Committee (CAPC), the Academic Senate (2 readings), and the Office of the Provost before they can be put into operation.

The final approval notification will come from the Office of the Provost.

Standalone Parent Degree: Master of Science in Exploration Systems Design

College/School: The College of Liberal Arts and Sciences

Note: Program ownership is coded at the College/School level first and may not be a center, department or division apart from it.

Department/Division/School: School of Earth and Space Exploration (CEARTH&SPX)

Proposing faculty group (if applicable):

Concentration: Master of Science in Exploration Systems Design (Instrumentation)

College/School: The College of Liberal Arts and Sciences

Note: Program ownership is coded at the College/School level first and may not be a center, department or division apart from it.

Department/Division/School: School of Earth and Space Exploration (CEARTH&SPX)

Proposing faculty group (if applicable):

Concentration: Master of Science in Exploration Systems Design (Systems Engineering)

College/School: The College of Liberal Arts and Sciences

Note: Program ownership is coded at the College/School level first and may not be a center, department or division apart from it.

Department/Division/School: School of Earth and Space Exploration (CEARTH&SPX)

Proposing faculty group (if applicable):

Concentration: Master of Science in Exploration Systems Design (Sensor Networks)

College/School: The College of Liberal Arts and Sciences

Note: Program ownership is coded at the College/School level first and may not be a center, department or division apart from it.

Department/Division/School: School of Earth and Space Exploration (CEARTH&SPX)

Proposing faculty group (if applicable):

1. PURPOSE AND NATURE OF PROGRAM

A. Provide a brief program description:

The proposed MS in Exploration Systems Design program is a unique combination of science applications and engineering knowledge and skills to create engineering literate scientists and science literate engineers. Students in this program will take a combination of graduate-level engineering and science courses focused on

applications in Earth science, space science and astrophysics. Three concentrations (instrumentation, systems engineering and sensor networks) further focus this training towards the student's desired career goals.

The instrumentation concentration serves students interested in the design, construction and implementation of scientific instrumentation. The concentration will train students to design the next generation of in-situ or remote sensing instrumentation for exploration of the Earth, space and the universe.

The systems engineering concentration serves students interested in the design, construction and implementation of next generation space missions and large projects. The concentration will train students to design the next generation of large projects and space missions for exploration of the Earth, space and the universe.

The sensor networks concentration serves students interested in the use of robotics, data science and other computational tools applied to science problems in Earth and space sciences. The concentration will train students to solve some of the most complex science problems humanity faces using modern computational tools.

The MS degree in Exploration Systems Design is designed to seamlessly fuse the intellectual disciplines of science and engineering by training science literate engineers and engineering literate scientists. This training is particularly important to enable the ASU charter's charge to conduct use-inspired research. This degree is specifically designed to create scientists who understand the implementation of their work and engineers who understand the meaning and motivation of their work.

The high degree of flexibility in the degree enables student success with three concentrations that allow customization of the degree to a particular student's needs and interests. The proposed MS in Exploration Systems Design will complement the already existing PhD degree in Exploration Systems Design offered by School of Earth and Space Exploration (SESE) in collaboration with the Fulton Schools of Engineering.

B. Will concentrations be established under this degree program? ☒ Yes ☐ No

(Please provide additional concentration information in the curricular structure section – number 7.)

2. PROGRAM NEED

Explain why the university should offer this program (include data and discussion of the target audience and market).

Engineering fields are growing rapidly, and the “New Space” revolution driven by private space companies is rapidly expanding jobs in space-related fields. SESE has unique and extensive experience in the space sector, having been working on NASA and privately funded space missions and technologies for decades. Our school can provide unique hands-on education and experience in space in a way that emphasizes use-based applications of space technology. The proposed MS degree in Exploration Systems Design will offer this opportunity to students in both engineering and science fields at ASU, giving them direct contact with faculty who design, build and use state-of-the-art space exploration technology every day.

The US department of labor predicts that the economy will add an additional 63,000 jobs in engineering fields related to the exploration systems design MS degree (electrical and electronics, aerospace, mechanical and computer engineering). This is in addition to the already existing 900,000 jobs in the economy in these fields (<https://www.bls.gov/careeroutlook/2018/article/engineers.htm>). Within Arizona, there is a considerable presence of aerospace and other technology companies with high demand for skilled labor (e.g., General Dynamics, Raytheon, Northrop Grumman Innovation Systems, Intel, ON Semiconductor). In particular, local aerospace companies have high demand for students with direct experience and training in the space sector. SESE and the proposed MS in Exploration Systems Design degree are uniquely positioned to provide this training.

An EMSI analysis for the Southwestern region and Arizona shows significant potential for growth for jobs in engineering fields related to the MS in Exploration Systems Design. Existing jobs are 17-18% above the national average for both the southwest region and Arizona, with 7-8% job growth predicted from 2019-2024.

Intended careers and codes from the US Bureau of Labor Statistics for the proposed MS in Exploration Systems Design include:

19-2021.00 Atmospheric and Space Scientists
 15-1199.02 Computer Systems Engineers/Architects
 17-2141.00 Mechanical Engineers
 17-2071.00 Electrical Engineers
 17-2199.00 Engineers, All Other
 17-2061.00 Computer Hardware Engineers
 17-2199.08 Robotics Engineers
 15-1111.00 Computer and Information Research Scientists
 17-2011.00 Aerospace Engineers
 15-1199.04 Geospatial Information Scientists and Technologists
 19-2012.00 Physicists
 19-2099.01 Remote Sensing Scientists and Technologists

3. IMPACT ON OTHER PROGRAMS

Attach any letters of collaboration or support from impacted programs (see checklist sheet). Please submit as a separate document.

This degree is in collaboration with the Fulton Schools of Engineering's School of Electrical, Computer and Energy Engineering (ECEE) and School for Engineering of Matter, Transport and Energy (SEMTE) departments. Letters of support are included with this proposal.

4. PROJECTED ENROLLMENT

How many new students do you anticipate enrolling in this program each year for the next five years?

Note: The Arizona Board of Regents (ABOR) requires that nine master's degrees be awarded every three years. Thus, the projected enrollment numbers must account for this ABOR requirement.

5-YEAR PROJECTED ANNUAL ENROLLMENT					
Please utilize the following tabular format	1 st Year	2 nd Year (Yr. 1 continuing + new entering)	3 rd Year (Yr. 1 & 2 continuing + new entering)	4 th Year (Yrs. 1, 2, 3 continuing + new entering)	5 th Year (Yrs. 1, 2, 3, 4 continuing + new entering)
Number of Students Majoring (Headcount)	10	30	60	60	60

5. ACCREDITATION OR LICENSING REQUIREMENTS (if applicable)

Provide the names of the external agencies for accreditation, professional licensing, etc. that guide your curriculum for this program, if any. Describe any requirements for accreditation or licensing.

None

6. STUDENT LEARNING OUTCOMES AND ASSESMENT

Attach a PDF copy of the assessment plan printed from the University Office of Evaluation and Educational Effectiveness assessment portal demonstrating UOEEE's approval of your assessment plan for this program. Visit the assessment portal at <https://uoeee.asu.edu/assessment-portal> or contact uoeee@asu.edu with any questions.

See Appendix II for Assessment Plans approved by UOEEE.

7. CURRICULAR STRUCTURE

A. Curriculum Listing

<i>Standalone Parent Degree: Master of Science in Exploration Systems Design</i>			
Required Core Courses for the Degree			
Prefix and Number	Course Title	New Course?	Credit Hours
SES 501	SESE Colloquium	No	1
SES 502	Exploring SESE Research	No	1
SES 510	Graduate Exploration Project I	Yes	3
Section sub-total:			5
Elective or Research Courses (as deemed necessary by supervisory committee)			
Prefix and Number	Course Title	New Course?	Credit Hours
	Students will select courses with AST, GLG, SES or Engineering prefixes in consultation with their faculty advisor. 6 credit hours must be "science" coursework, approved by the faculty advisor. Other courses can be used with academic unit approval.	No	22
Section sub-total:			22
Culminating Experience(s) <i>E.g. – Capstone course, portfolio, written comprehensive exam, applied project, thesis (must be 6 credit hours with oral defense)</i>			Credit Hours
Capstone Course: SES 511 Graduate Exploration Project II			3
Section sub-total:			3
Total required credit hours			30

<i>Concentration: Master of Science in Exploration Systems Design (Instrumentation)</i>			
Required Core Courses for the Degree			
Prefix and Number	Course Title	New Course?	Credit Hours
SES 501	SESE Colloquium	No	1
SES 502	Exploring SESE Research	No	1
SES 510	Graduate Exploration Project I	Yes	3
Section sub-total:			5
Required Concentration Courses <i>Students select 3 courses from the list below</i>			
Prefix and Number	Course Title	New Course?	Credit Hours
AST 540	Astronomical Instrumentation in Data Analysis	No	3
EEE 543	Antenna Analysis and Design	No	3
EEE 545	Microwave Circuit Design	No	3
EEE 548	Coherent Optics	No	3
MAE 503	Finite Elements in Engineering	No	3
MAE 557	Mechanics of Composite Materials	No	3
EGR 608	Advanced Simulation	No	3

Section sub-total:			9
Elective or Research Courses (as deemed necessary by supervisory committee)			
Prefix and Number	Course Title	New Course?	Credit Hours
	Students will select 13 credit hours of courses with AST, GLG, SES or Engineering prefixes in consultation with their faculty advisor. 6 credit hours must be "science" coursework, approved by the faculty advisor. Other courses can be used with academic unit approval.	No	13
Section sub-total:			13
Culminating Experience(s) <i>E.g. – Capstone course, portfolio, written comprehensive exam, applied project, thesis (must be 6 credit hours with oral defense)</i>			Credit Hours
Capstone Course: SES 511 Graduate Exploration Project II			3
Section sub-total:			3
Total required credit hours			30

Concentration: Master of Science in Exploration Systems Design (Systems Engineering)			
Required Core Courses for the Degree			
Prefix and Number	Course Title	New Course?	Credit Hours
SES 501	SESE Colloquium	No	1
SES 502	Exploring SESE Research	No	1
SES 510	Graduate Exploration Project I	Yes	3
Section sub-total:			5
Required Concentration Courses <i>Students select 3 courses from the list below</i>			
Prefix and Number	Course Title	New Course?	Credit Hours
MAE 565	Rocket Propulsion	No	3
MAE 547	Modeling and Control of Robots	No	3
MAE 557	Mechanics of Composite Materials	No	3
MAE 587	Radiation Heat Transfer	No	3
IEE 573	Reliability Engineering	No	3
EGR 530	Principles of Systems Engineering	No	3
EGR 608	Advanced Simulation	No	3
EGR 611	Complex Engineering Systems	No	3
Section sub-total:			9
Elective or Research Courses (as deemed necessary by supervisory committee)			
Prefix and Number	Course Title	New Course?	Credit Hours
	Students will select 13 credit hours of courses with AST, GLG, SES or Engineering prefixes in consultation with their faculty advisor. 6 credit hours must be "science" coursework, approved by the	No	13

	faculty advisor. Other courses can be used with academic unit approval.		
Section sub-total:			13
Culminating Experience(s) <i>E.g. – Capstone course, portfolio, written comprehensive exam, applied project, thesis (must be 6 credit hours with oral defense)</i>			Credit Hours
Capstone Course: SES 511 Graduate Exploration Project II			3
Section sub-total:			3
Total required credit hours			30

Concentration: Master of Science in Exploration Systems Design (Sensor Networks)			
Required Core Courses for the Degree			
Prefix and Number	Course Title	New Course?	Credit Hours
SES 501	SESE Colloquium	No	1
SES 502	Exploring SESE Research	No	1
SES 510	Graduate Exploration Project I	Yes	3
Section sub-total:			5
Required Concentration Courses <i>Students select 3 courses from the list below</i>			
Prefix and Number	Course Title	New Course?	Credit Hours
EEE 507	Multidimensional Signal Processing	No	3
EEE 511	Artificial Neural Computation	No	3
EEE 515	Machine Vision and Pattern Recognition	No	3
EEE 551	Information Theory	No	3
CEN 571	Hardware Acceleration and FPGA Computing	No	3
MAE 547	Modeling and Control of Robots	No	3
Section sub-total:			9
Elective or Research Courses <i>(as deemed necessary by supervisory committee)</i>			
Prefix and Number	Course Title	New Course?	Credit Hours
	Students will select 13 credit hours of courses with AST, GLG, SES or Engineering prefixes in consultation with their faculty advisor. 6 credit hours must be "science" coursework, approved by the faculty advisor. Other courses can be used with academic unit approval.	No	13
Section sub-total:			13
Culminating Experience(s) <i>E.g. – Capstone course, portfolio, written comprehensive exam, applied project, thesis (must be 6 credit hours with oral defense)</i>			Credit Hours
Capstone Course: SES 511 Graduate Exploration Project II			3
Section sub-total:			3
Total required credit hours			30

1. List all required core courses and total credit hours for the core (required courses other than internships, thesis, capstone course, etc.).
2. Omnibus numbered courses cannot be used as core courses.
3. Permanent numbers must be requested by submitting a course proposal to Curriculum ChangeMaker for approval.

B. Will concentrations be established under this degree program? ☒ Yes ☐ No

i. If "Yes" is selected, please select the appropriate box:

- ☒ Students must select a concentration as part of this degree program
☐ Concentrations are optional

ii. If "Yes" is selected, list the name of the concentrations and the minimum number of credit hours required for each concentration.

Concentration Name	Number of credit hours for courses specific to the concentration
Instrumentation	9
Systems Engineering	9
Sensor Networks	9

8. COURSES

A. Course Prefix(es): Provide the following information for the proposed graduate program.

i. Will a new course prefix(es) be required for this degree program?

Yes ☐ No ☒

If yes, complete the [Course Prefixes / Subjects Form](#) for each new prefix and submit it as part of this proposal submission. Form is located under the courses tab.

B. New Courses Required for Proposed Degree Program: Provide course prefix, number, title, credit hours and brief description for any new courses required for this degree program.

SES 510 Graduate Exploration Project I - 3 credits

Design and development of an Earth, solar system, or space exploration project. Conceptualization, design, development, deployment, data analysis, communication. The course is the first in a year-long project for the development and testing of instruments and robots for scientific exploration. Students are expected to define the mission and develop an instrument while applying realistic science-based goals and constraints to their design work.

SES 511 Graduate Exploration Project II - 3 credits

Development of Earth, solar system, or space exploration project. Conceptualization, design, development, deployment, data analysis, communication. The course is second in a year-long project for the development and testing of instruments and robots for scientific exploration. Students are expected to define the mission and develop an instrument while applying realistic science-based goals and constraints to their design work.

9. FACULTY, STAFF, AND RESOURCE REQUIREMENTS

A. Faculty

i. **Current Faculty** – Complete the table below for all current faculty members who will teach in the program.
If listing faculty from an academic unit outside of the one proposing the degree, please provide a support statement from that unit.

Name	Rank	Highest Degree	Area of Specialization/Expertise	Estimated Level of Involvement
Christopher Groppi	Associate Professor	PhD	Astronomical Instrumentation	High
Paul Scowen	Research Professor	PhD	Astronomical Instrumentation	High
Daniel Jacobs	Assistant Professor	PhD	Smallsats, astronomical instrumentation	High
Philip Mauskopf	Professor	PhD	Astronomical instrumentation, device physics	Medium
James Bell	Professor	PhD	Planetary science	Low
Craig Hardgrove	Professor	PhD	Planetary science, smallsats	Low
Mark Robinson	Professor	PhD	Planetary Science	Medium
Nathanial Butler	Associate Professor	PhD	Astronomical Instrumentation	Low
Judd Bowman	Professor	PhD	Astronomical Instrumentation	Low
Jnaneshwar Das	Assistant Research Professor	PhD	Robotics, machine learning	High
Werner Dahm	Professor	PhD	Aerospace engineering	Low
Hamidreza Marvi	Assistant Professor	PhD	Robotics	Low
Aditi Chattopadhyay	Regents Professor	PhD	Aerospace engineering	Low
James Aberle	Associate Professor	PhD	Microwave engineering	Medium
Georgios Trichopolous	Assistant Professor	PhD	Microwave engineering	Medium
David Allee	Professor	PhD	Electrical engineering	Medium
Jennifer Kitchen	Associate Professor	PhD	Electrical engineering	Medium
Jennie Si	Professor	PhD	Signal processing	Low
Lalitha Sankar	Associate Professor	PhD	Information theory	Low

- ii. **New Faculty** - Describe the new faculty hiring needed during the next three years to sustain the program. List the anticipated hiring schedule and financial sources for supporting the addition of these faculty members.

None

- iii. **Administration of the program** - Explain how the program will be administered for the purposes of admissions, advising, course offerings, etc. Discuss the available staff support.

SESE has one dedicated graduate academic coordinator, Becca Dial, who will manage advising of the degree and provide support for degree operations. This coordinator works in the SESE Academic Program Office, overseen by manager Becky Polley. Two additional academic advisors, Kelli Wallace and Jessica Jenner handle undergraduate in-person and online advising and can assist Becca when necessary. The SESE graduate admission committee, lead by the SESE Associate Director for Graduate Initiatives will administer admissions and review the degree program and course offerings. The SESE Associate Director for Undergraduate Initiatives is responsible for teaching assignments for all SESE course offerings.

- B. **Resource requirements needed to launch and sustain the program:** Describe any new resources required for this program's success such as new staff, new facilities, new library resources, new technology resources, etc.

SESE and the partner FSE units have the required resources to launch and sustain the program.

APPENDIX I. A
OPERATIONAL INFORMATION FOR GRADUATE PROGRAMS(This information is used to populate the [Graduate Programs Search](#)/catalog website.)*Standalone Parent Degree: Master of Science in Exploration Systems Design*1. **Proposed title of major:** Exploration Systems Design2. **Marketing description** *(Optional - 50 words maximum. The marketing description should not repeat content found in the program description.)*

The MS in Exploration Systems Design is a unique program combining science and engineering to create the next generation of researchers capable of inventing and implementing the next generation of scientific experiments, instruments and missions for Earth exploration, planetary exploration and space exploration.

3. **Provide a brief program description** *(Catalog type (i.e. will appear in Degree Search) – no more than 150 words. Do not include any admission or curriculum information)*

The MS in exploration systems design is a unique combination of science applications and engineering knowledge and skills to create engineering literate scientists and science literate engineers. Students in the program will take a combination of engineering and science courses focused on applications in Earth science, space science and astrophysics. Three concentrations (instrumentation, systems engineering and sensor networks) further focus this training towards the student's desired career goals.

4. **Delivery/Campus Information Options:** On-campus only (ground courses and iCourses)5. **Campus(es) where program will be offered:**

ASU Online curriculum consists of courses that have no face-to-face content. iCourses are online courses for students in on-campus programs. iCourses may be included in a program, but may not comprise the entirety of a program. On-campus programs must have some face-to-face content.

Note: Office of the Provost approval is needed for ASU Online delivery option.

☐ ASU Online only (all courses online and managed by ASU Online)

All other campus or location options (please select all that apply):

☐ Downtown Phoenix ☐ Polytechnic ☒ Tempe ☐ West ☐ Other: _____

☐ **Both on-campus and** ☐ ASU Online* - (check applicable campus(es) from options listed above)

Note: Once students elect a campus or Online option, students will not be able to move between the on-campus and the ASU Online options. Approval from the Office of the University Provost and [Philip Regier](#) (Executive Vice Provost and Dean) is required to offer programs through ASU Online. Please complete the [ASU Online Offering form](#) in [Curriculum ChangeMaker](#) to begin this request. Prior to completing the online Curriculum ChangeMaker form, please contact EdPlus at edplusprogrammanagement@asu.edu who can provide you with additional information regarding the online request process.

6. **Admission Requirements:**

Applicants must fulfill the requirements of both the Graduate College and The College of Liberal Arts and Sciences.

Applicants are eligible to apply to the program if they have earned a bachelor's or master's degree in engineering, physical science or related field, from a regionally accredited institution.

Applicants must have a minimum cumulative GPA of 3.00 (scale is 4.00 = "A") in the last 60 hours of their first bachelor's degree program, or applicants must have a minimum cumulative GPA of 3.00 (scale is 4.00 = "A") in an applicable master's degree program.

All applicants must submit:

1. graduate admission application and application fee
2. official transcripts

3. written statement
4. three letters of recommendation
5. proof of English proficiency

Additional Application Information

An applicant whose native language is not English must provide proof of English proficiency regardless of current residency.

7. Application Review Terms (if applicable session):

Indicate the first term and year in which applications will be opened for admission. Applications will be accepted on a rolling basis after that time.

Note: It is the academic unit's responsibility to display program deadline dates on their website.

Terms	Years	University Late Fee Deadline
<input checked="" type="checkbox"/> Fall (regular) <input type="checkbox"/> Session B	(year): 2021 (year):	July 1st October 1st
<input checked="" type="checkbox"/> Spring (regular) <input type="checkbox"/> Session B	(year): 2022 (year):	December 1st February 8th
<input type="checkbox"/> Summer (regular) <input type="checkbox"/> Summer B	(year): (year):	May 14 th May 14th
<i>Note: Session B is only available for approved online programs.</i>		

Program admission deadlines website address: <https://sese.asu.edu/degrees/grad>

8. Curricular Requirements:
Curricular Structure Breakdown for the Academic Catalog:

(To be completed by the Graduate College)

30 credit hours including capstone course (SES 511)

Required Core (5 credit hours)

SES 501 SESE Colloquium (1)
SES 502 Exploring SESE Research (1)
SES 510 Graduate Exploration Project I (3)

Electives or Research (22 credit hours)
Culminating Experience (3 credit hours)

SES 511 Graduate Exploration Project II (3)

Additional Curriculum Information

For elective coursework, students will select from the AST, GLG, SES or engineering courses in consultation with their faculty advisor. Six credit hours must be science coursework approved by the faculty advisor. Other courses can be used with academic unit approval.

9. Comprehensive Exams:

Master's Comprehensive Exam (when applicable), please select from the appropriate option.

N/A

10. Allow 400-level courses: ☒ **Yes** ☐ **No**

Note: No more than 6 credit hours of 400-level coursework may be included on a graduate student plan of study.

11. Committee:

Required number of thesis committee members (must be at least 3 including chair or co-chairs): N/A

Required number of non-thesis option committee members (must be a minimum of one): 2

12. Keywords: List all keywords that could be used to search for this program. Keywords should be specific to the proposed program – limit 10 keywords.

Systems engineering, instrumentation, sensors, machine learning, data science, astrophysics, Earth Science

13. Area(s) of Interest
A. Select one (1) primary area of interest from the list below that applies to this program.

- | | |
|--|---|
| <input type="checkbox"/> Architecture & Construction | <input type="checkbox"/> Interdisciplinary Studies |
| <input type="checkbox"/> Arts | <input type="checkbox"/> Law & Justice |
| <input type="checkbox"/> Business | <input type="checkbox"/> Mathematics |
| <input type="checkbox"/> Communication & Media | <input type="checkbox"/> Psychology |
| <input type="checkbox"/> Education & Teaching | <input type="checkbox"/> STEM |
| <input type="checkbox"/> Engineering & Technology | <input checked="" type="checkbox"/> Science |
| <input type="checkbox"/> Entrepreneurship | <input type="checkbox"/> Social and Behavioral Sciences |
| <input type="checkbox"/> Health & Wellness | <input type="checkbox"/> Sustainability |
| <input type="checkbox"/> Humanities | |

B. Select one (1) secondary area of interest from the list below that applies to this program.

- | | |
|--|---|
| <input type="checkbox"/> Architecture & Construction | <input type="checkbox"/> Interdisciplinary Studies |
| <input type="checkbox"/> Arts | <input type="checkbox"/> Law & Justice |
| <input type="checkbox"/> Business | <input type="checkbox"/> Mathematics |
| <input type="checkbox"/> Communications & Media | <input type="checkbox"/> Psychology |
| <input type="checkbox"/> Education & Teaching | <input type="checkbox"/> STEM |
| <input checked="" type="checkbox"/> Engineering & Technology | <input type="checkbox"/> Science |
| <input type="checkbox"/> Entrepreneurship | <input type="checkbox"/> Social and Behavioral Sciences |
| <input type="checkbox"/> Health & Wellness | <input type="checkbox"/> Sustainability |
| <input type="checkbox"/> Humanities | |

14. Contact and Support Information:

Office Location - Building Code & Room: <i>(Search ASU map)</i>	ISTB4 room 795
Campus Telephone Number: (may not be an individual's number)	480-965-5081
Program Email Address: (may not be an individual's email)	seseinfo@asu.edu
Program Website Address: (if one is not yet created, use unit website until one can be established)	https://sese.asu.edu/degrees/grad
Program Director (Name):	Hilairy Hartnett
Program Director (ASURITE):	hhartnet
Program Support Staff (Name):	Becca Dial
Program Support Staff (ASURITE):	rescobar

Admissions Contact (Name):	Becca Dial
Admissions Contact (ASURITE):	rescobar

15. **Application and iPOS Recommendations:** List the Faculty and Staff who will input admission/POS recommendations to Gportal **and** indicate their approval for Admissions and/or POS:

NAME	ASURITE	ADMSN	POS
Rebecca Polley	polley	Y	Y
Becca Dial	rescobar	Y	Y

APPENDIX I. B
OPERATIONAL INFORMATION FOR GRADUATE PROGRAMS

(This information is used to populate the [Graduate Programs Search](#)/catalog website.)

Concentration: Master of Science in Exploration Systems Design (Instrumentation)

1. **Proposed title of concentration:** Instrumentation

2. **Marketing description** *(Optional - 50 words maximum. The marketing description should not repeat content found in the program description.)*

N/A

3. **Provide a brief program description** *(Catalog type (i.e. will appear in Degree Search) – no more than 150 words. Do not include any admission or curriculum information)*

The MS in exploration systems design instrumentation concentration is a unique combination of science applications and engineering knowledge and skills to create engineering literate scientists and science literate engineers interested in the design, construction and implementation of scientific instrumentation. Students in the instrumentation concentration will take a combination of engineering and science courses focused on applications in Earth science, space science and astrophysics. The concentration will train students to design the next generation of in-situ or remote sensing instrumentation for exploration of the Earth, space and the universe.

4. **Delivery/Campus Information Options:** On-campus only (ground courses and iCourses)

5. **Campus(es) where program will be offered:**

ASU Online curriculum consists of courses that have no face-to-face content. iCourses are online courses for students in on-campus programs. iCourses may be included in a program, but may not comprise the entirety of a program. On-campus programs must have some face-to-face content.

Note: Office of the Provost approval is needed for ASU Online delivery option.

☐ ASU Online only (all courses online and managed by ASU Online)

All other campus or location options (please select all that apply):

☐ Downtown Phoenix ☐ Polytechnic ☒ Tempe ☐ West ☐ Other: _____

☐ **Both on-campus and** ☐ ASU Online* - (check applicable campus(es) from options listed above)

Note: Once students elect a campus or Online option, students will not be able to move between the on-campus and the ASU Online options. Approval from the Office of the University Provost and Philip Regier (Executive Vice Provost and Dean) is required to offer programs through ASU Online. Please complete the ASU Online Offering form in [Curriculum ChangeMaker](#) to begin this request. Prior to completing the online Curriculum ChangeMaker form, please contact EdPlus at edplusprogrammanagement@asu.edu who can provide you with additional information regarding the online request process.

6. **Admission Requirements:**

Applicants must fulfill the requirements of both the Graduate College and The College of Liberal Arts and Sciences.

Applicants are eligible to apply to the program if they have earned a bachelor's or master's degree in engineering, physical science or related field, from a regionally accredited institution.

Applicants must have a minimum cumulative GPA of 3.00 (scale is 4.00 = "A") in the last 60 hours of their first bachelor's degree program, or applicants must have a minimum cumulative GPA of 3.00 (scale is 4.00 = "A") in an applicable master's degree program.

All applicants must submit:

1. graduate admission application and application fee
2. official transcripts
3. written statement
4. three letters of recommendation
5. proof of English proficiency

Additional Application Information

An applicant whose native language is not English must provide proof of English proficiency regardless of current residency.

7. Application Review Terms (if applicable session):

Indicate the first term and year in which applications will be opened for admission. Applications will be accepted on a rolling basis after that time.

Note: It is the academic unit's responsibility to display program deadline dates on their website.

Terms	Years	University Late Fee Deadline
<input checked="" type="checkbox"/> Fall (regular)	(year): 2021	July 1st
<input type="checkbox"/> Session B	(year):	October 1st
<input checked="" type="checkbox"/> Spring (regular)	(year): 2022	December 1st
<input type="checkbox"/> Session B	(year):	February 8th
<input type="checkbox"/> Summer (regular)	(year):	May 14th
<input type="checkbox"/> Summer B	(year):	May 14th

Note: Session B is only available for approved online programs.

Program admission deadlines website address: <https://sese.asu.edu/degrees/grad>

8. Curricular Requirements:
Curricular Structure Breakdown for the Academic Catalog:

(To be completed by the Graduate College)

30 credit hours including capstone course (SES 511)

Required Core (5 credit hours)

SES 501 SESE Colloquium (1)

SES 502 Exploring SESE Research (1)

SES 510 Graduate Exploration Project I (3)

Concentration (9 credit hours)

AST 540 Astronomical Instrumentation in Data Analysis (3)

EEE 543 Antenna Analysis and Design (3)

EEE 545 Microwave Circuit Design (3)

EEE 548 Coherent Optics (3)

MAE 503 Finite Elements in Engineering (3)

MAE 557 Exploration Systems Design (3)

EGR 608 Advanced Simulation (3)

Electives or Research (13 credit hours)
Culminating Experience (3 credit hours)

SES 511 Graduate Exploration Project II (3)

Additional Curriculum Information

Students select three courses from the available concentration coursework.

For elective coursework, students will select from the AST, GLG, SES or engineering courses in consultation with their faculty advisor. Six credit hours must be science coursework approved by the faculty advisor. Other courses can be used with academic unit approval.

9. Comprehensive Exams:

Master's Comprehensive Exam (when applicable), please select from the appropriate option.

N/A

10. Allow 400-level courses: ☒ **Yes** ☐ **No**

Note: No more than 6 credit hours of 400-level coursework may be included on a graduate student plan of study.

11. Committee:

Required number of thesis committee members (must be at least 3 including chair or co-chairs): N/A

Required number of non-thesis option committee members (must be a minimum of one): 2

12. Keywords: List all keywords that could be used to search for this program. Keywords should be specific to the proposed program – limit 10 keywords.

Systems engineering, instrumentation, sensors, machine learning, data science, astrophysics, Earth Science

13. Area(s) of Interest
C. Select one (1) primary area of interest from the list below that applies to this program.

- | | |
|--|---|
| <input type="checkbox"/> Architecture & Construction | <input type="checkbox"/> Interdisciplinary Studies |
| <input type="checkbox"/> Arts | <input type="checkbox"/> Law & Justice |
| <input type="checkbox"/> Business | <input type="checkbox"/> Mathematics |
| <input type="checkbox"/> Communication & Media | <input type="checkbox"/> Psychology |
| <input type="checkbox"/> Education & Teaching | <input type="checkbox"/> STEM |
| <input type="checkbox"/> Engineering & Technology | <input checked="" type="checkbox"/> Science |
| <input type="checkbox"/> Entrepreneurship | <input type="checkbox"/> Social and Behavioral Sciences |
| <input type="checkbox"/> Health & Wellness | <input type="checkbox"/> Sustainability |
| <input type="checkbox"/> Humanities | |

D. Select one (1) secondary area of interest from the list below that applies to this program.

- | | |
|--|---|
| <input type="checkbox"/> Architecture & Construction | <input type="checkbox"/> Interdisciplinary Studies |
| <input type="checkbox"/> Arts | <input type="checkbox"/> Law & Justice |
| <input type="checkbox"/> Business | <input type="checkbox"/> Mathematics |
| <input type="checkbox"/> Communications & Media | <input type="checkbox"/> Psychology |
| <input type="checkbox"/> Education & Teaching | <input type="checkbox"/> STEM |
| <input checked="" type="checkbox"/> Engineering & Technology | <input type="checkbox"/> Science |
| <input type="checkbox"/> Entrepreneurship | <input type="checkbox"/> Social and Behavioral Sciences |
| <input type="checkbox"/> Health & Wellness | <input type="checkbox"/> Sustainability |
| <input type="checkbox"/> Humanities | |

14. Contact and Support Information:

Office Location - Building Code & Room: (Search ASU map)	ISTB4 room 795
Campus Telephone Number: (may not be an individual's number)	480-965-5081
Program Email Address: (may not be an individual's email)	seseinfo@asu.edu
Program Website Address: (if one is not yet created, use unit website until one can be established)	https://sese.asu.edu/degrees/grad
Program Director (Name):	Hilairy Hartnett

Program Director (ASURITE):	hhartnet
Program Support Staff (Name):	Becca Dial
Program Support Staff (ASURITE):	rescobar
Admissions Contact (Name):	Becca Dial
Admissions Contact (ASURITE):	rescobar

- 15. Application and iPOS Recommendations:** List the Faculty and Staff who will input admission/POS recommendations to Gportal **and** indicate their approval for Admissions and/or POS:

NAME	ASURITE	ADMSN	POS
Rebecca Polley	polley	Y	Y
Becca Dial	rescobar	Y	Y

**APPENDIX I. C
OPERATIONAL INFORMATION FOR GRADUATE PROGRAMS**

(This information is used to populate the [Graduate Programs Search](#)/catalog website.)

Concentration: Master of Science in Exploration Systems Design (Systems Engineering)

1. **Proposed title of concentration:** Systems Engineering
 2. **Marketing description** *(Optional - 50 words maximum. The marketing description should not repeat content found in the program description.)*
N/A
 3. **Provide a brief program description** *(Catalog type (i.e. will appear in Degree Search) – no more than 150 words. Do not include any admission or curriculum information)*
The exploration systems design systems engineering concentration is a unique combination of science applications and engineering knowledge and skills to create engineering literate scientists and science literate engineers interested in the design, construction and implementation of next generation space missions and large projects. Students in the systems engineering concentration will take a combination of engineering and science courses focused on applications in Earth science, space science and astrophysics. The concentration will train students to design the next generation of large projects and space missions for exploration of the Earth, space and the universe.
 4. **Delivery/Campus Information Options:** On-campus only (ground courses and iCourses)
 5. **Campus(es) where program will be offered:**
ASU Online curriculum consists of courses that have no face-to-face content. iCourses are online courses for students in on-campus programs. iCourses may be included in a program, but may not comprise the entirety of a program. On-campus programs must have some face-to-face content.
Note: Office of the Provost approval is needed for ASU Online delivery option.
☐ ASU Online only (all courses online and managed by ASU Online)
All other campus or location options (please select all that apply):
☐ Downtown Phoenix ☐ Polytechnic ☒ Tempe ☐ West ☐ Other: _____
☐ **Both on-campus and** ☐ ASU Online* - (check applicable campus(es) from options listed above)
- Note: Once students elect a campus or Online option, students will not be able to move between the on-campus and the ASU Online options. Approval from the Office of the University Provost and Philip Regier (Executive Vice Provost and Dean) is required to offer programs through ASU Online. Please complete the ASU Online Offering form in [Curriculum ChangeMaker](#) to begin this request. Prior to completing the online Curriculum ChangeMaker form, please contact EdPlus at edplusprogrammanagement@asu.edu who can provide you with additional information regarding the online request process.*
6. **Admission Requirements:**
Applicants must fulfill the requirements of both the Graduate College and The College of Liberal Arts and Sciences.

Applicants are eligible to apply to the program if they have earned a bachelor's or master's degree in engineering, physical science or related field, from a regionally accredited institution.

Applicants must have a minimum cumulative GPA of 3.00 (scale is 4.00 = "A") in the last 60 hours of their first bachelor's degree program, or applicants must have a minimum cumulative GPA of 3.00 (scale is 4.00 = "A") in an applicable master's degree program.

All applicants must submit:

1. graduate admission application and application fee

2. official transcripts
3. written statement
4. three letters of recommendation
5. proof of English proficiency

Additional Application Information

An applicant whose native language is not English must provide proof of English proficiency regardless of current residency.

7. Application Review Terms (if applicable session):

Indicate the first term and year in which applications will be opened for admission. Applications will be accepted on a rolling basis after that time.

Note: It is the academic unit's responsibility to display program deadline dates on their website.

Terms	Years	University Late Fee Deadline
<input checked="" type="checkbox"/> Fall (regular)	(year): 2021	July 1st
<input type="checkbox"/> Session B	(year):	October 1st
<input checked="" type="checkbox"/> Spring (regular)	(year): 2022	December 1st
<input type="checkbox"/> Session B	(year):	February 8th
<input type="checkbox"/> Summer (regular)	(year):	May 14th
<input type="checkbox"/> Summer B	(year):	May 14th
<i>Note: Session B is only available for approved online programs.</i>		

Program admission deadlines website address: <https://sese.asu.edu/degrees/grad>

8. Curricular Requirements:
Curricular Structure Breakdown for the Academic Catalog:

(To be completed by the Graduate College)

30 credit hours including Capstone Course (SES 511)

Required Core (5 credit hours)

SES 501 SESE Colloquium (1)
SES 502 Exploring SESE Research (1)
SES 510 Graduate Exploration Project I (3)

Concentration (9 credit hours)

IEE 573 Reliability Engineering (3)
MAE 565 Rocket Propulsion (3)
MAE 547 Modeling and Control of Robots (3)
MAE 557 Mechanics of Composite Materials (3)
MAE 587 Radiation Heat Transfer (3)
EGR 530 Principles of Systems Engineering (3)
EGR 608 Advanced Simulation (3)
EGR 611 Complex Engineering Systems (3)

Electives or Research (13 credit hours)
Culminating Experience (3 credit hours)

SES 511 Graduate Exploration Project II (3)

Additional Curriculum Information

Students select three courses from the available concentration coursework.

For elective coursework, students will select from the AST, GLG, SES or engineering courses in consultation with their faculty advisor. Six credit hours must be science coursework approved by the faculty advisor. Other courses can be used with academic unit approval.

9. Comprehensive Exams:

Master's Comprehensive Exam (when applicable), please select from the appropriate option.

N/A

10. Allow 400-level courses: ☒ **Yes** ☐ **No**

Note: No more than 6 credit hours of 400-level coursework may be included on a graduate student plan of study.

11. Committee:

Required number of thesis committee members (must be at least 3 including chair or co-chairs): N/A

Required number of non-thesis option committee members (must be a minimum of one): 2

12. Keywords: List all keywords that could be used to search for this program. Keywords should be specific to the proposed program – limit 10 keywords.

Systems engineering, instrumentation, sensors, machine learning, data science, astrophysics, Earth Science

13. Area(s) of Interest
E. Select one (1) primary area of interest from the list below that applies to this program.

- | | |
|--|---|
| <input type="checkbox"/> Architecture & Construction | <input type="checkbox"/> Interdisciplinary Studies |
| <input type="checkbox"/> Arts | <input type="checkbox"/> Law & Justice |
| <input type="checkbox"/> Business | <input type="checkbox"/> Mathematics |
| <input type="checkbox"/> Communication & Media | <input type="checkbox"/> Psychology |
| <input type="checkbox"/> Education & Teaching | <input type="checkbox"/> STEM |
| <input type="checkbox"/> Engineering & Technology | <input checked="" type="checkbox"/> Science |
| <input type="checkbox"/> Entrepreneurship | <input type="checkbox"/> Social and Behavioral Sciences |
| <input type="checkbox"/> Health & Wellness | <input type="checkbox"/> Sustainability |
| <input type="checkbox"/> Humanities | |

F. Select one (1) secondary area of interest from the list below that applies to this program.

- | | |
|--|---|
| <input type="checkbox"/> Architecture & Construction | <input type="checkbox"/> Interdisciplinary Studies |
| <input type="checkbox"/> Arts | <input type="checkbox"/> Law & Justice |
| <input type="checkbox"/> Business | <input type="checkbox"/> Mathematics |
| <input type="checkbox"/> Communications & Media | <input type="checkbox"/> Psychology |
| <input type="checkbox"/> Education & Teaching | <input type="checkbox"/> STEM |
| <input checked="" type="checkbox"/> Engineering & Technology | <input type="checkbox"/> Science |
| <input type="checkbox"/> Entrepreneurship | <input type="checkbox"/> Social and Behavioral Sciences |
| <input type="checkbox"/> Health & Wellness | <input type="checkbox"/> Sustainability |
| <input type="checkbox"/> Humanities | |

14. Contact and Support Information:

Office Location - Building Code & Room: (Search ASU map)	ISTB4 room 795
Campus Telephone Number: (may not be an individual's number)	480-965-5081

Program Email Address: (may not be an individual's email)	seseinfo@asu.edu
Program Website Address: (if one is not yet created, use unit website until one can be established)	https://sese.asu.edu/degrees/grad
Program Director (Name):	Hilairy Hartnett
Program Director (ASURITE):	hhartnet
Program Support Staff (Name):	Becca Dial
Program Support Staff (ASURITE):	rescobar
Admissions Contact (Name):	Becca Dial
Admissions Contact (ASURITE):	rescobar

- 15. Application and iPOS Recommendations:** List the Faculty and Staff who will input admission/POS recommendations to Gportal **and** indicate their approval for Admissions and/or POS:

NAME	ASURITE	ADMSN	POS
Rebecca Polley	polley	Y	Y
Becca Dial	rescobar	Y	Y

**APPENDIX I. D
OPERATIONAL INFORMATION FOR GRADUATE PROGRAMS**

(This information is used to populate the [Graduate Programs Search](#)/catalog website.)

Concentration: Master of Science in Exploration Systems Design (Sensor Networks)

1. **Proposed title of concentration:** Sensor Networks
2. **Marketing description** *(Optional - 50 words maximum. The marketing description should not repeat content found in the program description.)*
N/A
3. **Provide a brief program description** *(Catalog type (i.e. will appear in Degree Search) – no more than 150 words. Do not include any admission or curriculum information)*

The MS in exploration systems design sensor networks concentration is a unique combination of science applications and engineering knowledge and skills to create engineering literate scientists and science literate engineers interested in the use of robotics, data science and other computational tools applied to science problems in Earth and space sciences. Students in the sensor networks concentration will take a combination of engineering, computer science and science courses focused on applications in Earth science, space science and astrophysics. The concentration will train students to solve the some of the most complex science problems humanity faces using modern computational tools.

4. **Delivery/Campus Information Options:** On-campus only (ground courses and iCourses)

5. **Campus(es) where program will be offered:**

ASU Online curriculum consists of courses that have no face-to-face content. iCourses are online courses for students in on-campus programs. iCourses may be included in a program, but may not comprise the entirety of a program. On-campus programs must have some face-to-face content.

Note: Office of the Provost approval is needed for ASU Online delivery option.

☐ ASU Online only (all courses online and managed by ASU Online)

All other campus or location options (please select all that apply):

☐ Downtown Phoenix ☐ Polytechnic ☒ Tempe ☐ West ☐ Other: _____

☐ **Both on-campus and** ☐ ASU Online* - (check applicable campus(es) from options listed above)

Note: Once students elect a campus or Online option, students will not be able to move between the on-campus and the ASU Online options. Approval from the Office of the University Provost and [Philip Regier](#) (Executive Vice Provost and Dean) is required to offer programs through ASU Online. Please complete the ASU Online Offering form in [Curriculum ChangeMaker](#) to begin this request. Prior to completing the online Curriculum ChangeMaker form, please contact EdPlus at edplusprogrammanagement@asu.edu who can provide you with additional information regarding the online request process.

6. **Admission Requirements:**

Applicants must fulfill the requirements of both the Graduate College and The College of Liberal Arts and Sciences.

Applicants are eligible to apply to the program if they have earned a bachelor's or master's degree in engineering, physical science or related field, from a regionally accredited institution.

Applicants must have a minimum cumulative GPA of 3.00 (scale is 4.00 = "A") in the last 60 hours of their first bachelor's degree program, or applicants must have a minimum cumulative GPA of 3.00 (scale is 4.00 = "A") in an applicable master's degree program.

All applicants must submit:

1. graduate admission application and application fee
2. official transcripts

3. written statement
4. three letters of recommendation
5. proof of English proficiency

Additional Application Information

An applicant whose native language is not English must provide proof of English proficiency regardless of current residency.

7. Application Review Terms (if applicable session):

Indicate the first term and year in which applications will be opened for admission. Applications will be accepted on a rolling basis after that time.

Note: It is the academic unit's responsibility to display program deadline dates on their website.

Terms	Years	University Late Fee Deadline
<input checked="" type="checkbox"/> Fall (regular)	(year): 2021	July 1st
<input type="checkbox"/> Session B	(year):	October 1st
<input checked="" type="checkbox"/> Spring (regular)	(year): 2022	December 1st
<input type="checkbox"/> Session B	(year):	February 8th
<input type="checkbox"/> Summer (regular)	(year):	May 14th
<input type="checkbox"/> Summer B	(year):	May 14th
<i>Note: Session B is only available for approved online programs.</i>		

Program admission deadlines website address: <https://sese.asu.edu/degrees/grad>

8. Curricular Requirements:
Curricular Structure Breakdown for the Academic Catalog:

(To be completed by the Graduate College)

30 credit hours including Capstone Course (SES 511)

Required Core (5 credit hours)

SES 501 SESE Colloquium (1)
 SES 502 Exploring SESE Research (1)
 SES 510 Graduate Exploration Project I (3)

Concentration (9 credit hours)

CEN 571 Hardware Acceleration and FPGA Computing (3)
 EEE 507 Multidimensional Signal Processing (3)
 EEE 511 Artificial Neural Computation (3)
 EEE 515 Machine Vision and Pattern Recognition
 EEE 551 Information Theory (3)
 MAE 547 Modeling and Control of Robots (3)

Electives or Research (13 credit hours)
Culminating Experience (3 credit hours)

SES 511 Graduate Exploration Project II (3)

Additional Curriculum Information

Students select three courses from the available concentration coursework.

For elective coursework, students will select from the AST, GLG, SES or engineering courses in consultation with their faculty advisor. Six credit hours must be science coursework approved by the faculty advisor. Other courses can be used with academic unit approval.

9. Comprehensive Exams:

Master's Comprehensive Exam (when applicable), please select from the appropriate option.

N/A

10. Allow 400-level courses: ☒ **Yes** ☐ **No**

Note: No more than 6 credit hours of 400-level coursework may be included on a graduate student plan of study.

11. Committee:

Required number of thesis committee members (must be at least 3 including chair or co-chairs): N/A

Required number of non-thesis option committee members (must be a minimum of one): 2

12. Keywords: List all keywords that could be used to search for this program. Keywords should be specific to the proposed program – limit 10 keywords.

Systems engineering, instrumentation, sensors, machine learning, data science, astrophysics, Earth Science

13. Area(s) of Interest
G. Select one (1) primary area of interest from the list below that applies to this program.

- | | |
|--|---|
| <input type="checkbox"/> Architecture & Construction | <input type="checkbox"/> Interdisciplinary Studies |
| <input type="checkbox"/> Arts | <input type="checkbox"/> Law & Justice |
| <input type="checkbox"/> Business | <input type="checkbox"/> Mathematics |
| <input type="checkbox"/> Communication & Media | <input type="checkbox"/> Psychology |
| <input type="checkbox"/> Education & Teaching | <input type="checkbox"/> STEM |
| <input type="checkbox"/> Engineering & Technology | <input checked="" type="checkbox"/> Science |
| <input type="checkbox"/> Entrepreneurship | <input type="checkbox"/> Social and Behavioral Sciences |
| <input type="checkbox"/> Health & Wellness | <input type="checkbox"/> Sustainability |
| <input type="checkbox"/> Humanities | |

H. Select one (1) secondary area of interest from the list below that applies to this program.

- | | |
|--|---|
| <input type="checkbox"/> Architecture & Construction | <input type="checkbox"/> Interdisciplinary Studies |
| <input type="checkbox"/> Arts | <input type="checkbox"/> Law & Justice |
| <input type="checkbox"/> Business | <input type="checkbox"/> Mathematics |
| <input type="checkbox"/> Communications & Media | <input type="checkbox"/> Psychology |
| <input type="checkbox"/> Education & Teaching | <input type="checkbox"/> STEM |
| <input checked="" type="checkbox"/> Engineering & Technology | <input type="checkbox"/> Science |
| <input type="checkbox"/> Entrepreneurship | <input type="checkbox"/> Social and Behavioral Sciences |
| <input type="checkbox"/> Health & Wellness | <input type="checkbox"/> Sustainability |
| <input type="checkbox"/> Humanities | |

14. Contact and Support Information:

Office Location - Building Code & Room: (Search ASU map)	ISTB4 room 795
Campus Telephone Number: (may not be an individual's number)	480-965-5081
Program Email Address: (may not be an individual's email)	seseinfo@asu.edu
Program Website Address:	https://sese.asu.edu/degrees/grad


(if one is not yet created, use unit website until one can be established)	
Program Director (Name):	Hilairy Hartnett
Program Director (ASURITE):	hhartnet
Program Support Staff (Name):	Becca Dial
Program Support Staff (ASURITE):	rescobar
Admissions Contact (Name):	Becca Dial
Admissions Contact (ASURITE):	rescobar

- 15. Application and iPOS Recommendations:** List the Faculty and Staff who will input admission/POS recommendations to Gportal **and** indicate their approval for Admissions and/or POS:

NAME	ASURITE	ADMSN	POS
Rebecca Polley	polley	Y	Y
Becca Dial	rescobar	Y	Y

APPENDIX II

Assessment Plan



**Arizona State
University**

UOEEO Provisional Approval
Approved: Nov 24 2020

MS in Exploration Systems Design

LM-College of Liberal Arts and Sciences - Natural Sciences

Outcome 1

Students will compose quantitatively answerable, scientifically interesting and reasonably scoped science questions related to Earth and space exploration, and formulate science measurement and technical requirements that answer those questions.

<p>Concepts</p> <p>Students will use the scientific method and knowledge of both foundational knowledge in and the state of the art in Earth and space exploration to analyze potential science questions for quality, importance, feasibility and difficulty, and apply a systems engineering approach to develop requirements that can answer the questions posed.</p>	<p>Competencies</p> <p>Order of magnitude estimation, fundamental background knowledge in Earth science, planetary science and astronomy, searching and understanding existing scientific literature, systems engineering requirements traceability, estimation of technical feasibility.</p>
---	--

Assessment Process

Rubrics will be created by faculty teaching the course each year before each assignment is completed. Rubrics will be reviewed by the SESE graduate committee and associate director for graduate initiatives. Faculty will be responsible for applying rubric to the relevant assignments and recording the data for collection. The SESE academic program office will collect data from the faculty at the end of each semester for use in assessment reports.

<p>Measure 1</p> <p>SESS10 Systems Requirements Review (SRR) presentation and Science Traceability Matrix (STM). In the SRR, students present their science questions, derived measurement requirements and technical engineering requirements to an expert review panel orally. The STM is a document accompanying the SRR that summarizes the science questions and derived requirements in a concise written format.</p>	<p>Performance Criterion 1</p> <p>80% of students achieve mastery based on a faculty designed rubric used to assess the science questions presented in the review and associated written documents.</p>
<p>Measure 2</p> <p>SESS11 Preliminary Design Review (PDR). In the PDR, students orally present their instrument conceptual design and concept of operations to an expert review panel and demonstrate these elements meet the requirements defined earlier in the SRR and STM.</p>	<p>Performance Criterion 2</p> <p>80% of students achieve mastery based on a faculty designed rubric used to assess science measurement and technical requirements presented in the review.</p>

*Last Action: Nov 19 2020 09:38
Last User: Christopher Groppi (cgroppi)*

Outcome 2

Students will collaborate in teams to write presentations and documents that justify their science questions, requirements and experimental design to peers and mentors.

Concepts

The ability to work in teams to succeed in large projects, and convince expert review panels of the validity of a plan and a design are essential to all scientific exploration missions and projects.

Competencies

Scientific writing and oral presentation, teamwork, project management, work breakdown structures.

Assessment Process

Rubrics will be created by faculty teaching the course each year before each assignment is completed. Rubrics will be reviewed by the SESE graduate committee and associate director for graduate initiatives. Faculty will be responsible for applying rubric to the relevant assignments and recording the data for collection. The SESE academic program office will collect data from the faculty at the end of each semester for use in assessment reports.

Measure 1

SES510 Critical Design Review (CDR). The CDR is the final presentation in the course where students orally present the detailed design of their experiment orally to an expert review panel, and demonstrate the design meets all scientific and engineering requirements. The CDR is accompanied by Interface Control Documents that detail the design, operation and requirements compliance of the experiment at the subsystem and system level.

Performance Criterion 1

80% of students achieve mastery based on a faculty designed rubric used to assess the oral and written components of the review in terms of clarity, correctness and completeness.

Measure 2

SES511 Mission Readiness Review (MRR). The MRR is the final oral presentation in SES511 that demonstrates the completed experiment meets all requirements demonstrated through laboratory testing. The review is accompanied by written test reports that detail test results and requirements compliance for all subsystems and the integrated experiment.

Performance Criterion 2

80% of students achieve mastery based on a faculty designed rubric used to assess the oral and written components of the review in terms of clarity, correctness and completeness.

Outcome 3

Students will design and construct an experimental system to meet experiment requirements and develop and employ an integration and test plan to validate their design.



UOEEO Provisional Approval
Approved: Nov 24 2020

Concepts

Systems engineering, mechanical, electrical and/or computer engineering design.

Competencies

Systems engineering planning and verification testing to requirements, computer aided design and manufacturing, electrical and mechanical engineering laboratory skills.

Assessment Process

Rubrics will be created by faculty teaching the course each year before each assignment is completed. Rubrics will be reviewed by the SESE graduate committee and associate director for graduate initiatives. Faculty will be responsible for applying rubric to the relevant assignments and recording the data for collection. The SESE academic program office will collect data from the faculty at the end of each semester for use in assessment reports.

Measure 1

SES510 Interface Control Documents (ICDs). The ICDs are a set of written documents that detail the design and operation of each experiment subsystem and the integrated experiment.

Performance Criterion 1

80% of students achieve mastery based on a faculty designed rubric used to assess the quality, completeness and accuracy of experimental system design as presented in the interface control document package.

Measure 2

SES511 test plan and test reports. The test plan details each test, with pass/fail criteria and demonstrates how each test verifies experiment technical and measurement requirements. The test reports detail the results of each test and compare measured data to pass/fail criteria.

Performance Criterion 2

80% of students achieve mastery based on a faculty designed rubric used to assess ability of the test plan and test reports to validate requirements.

Last Action: Nov 19 2020 09:38
Last User: Christopher Groppi (cgroppi)

MS in Exploration Systems Design (Instrumentation)

UOEEO Status: UOEEO Provisional Approval

08/27/2020 05:45 AM

Mission

The Exploration Systems Design (ESD) instrumentation concentration is a unique combination of science applications and engineering knowledge and skills to create engineering literate scientists and science literate engineers interested in the design, construction and implementation of scientific instrumentation. Students in the ESD instrumentation concentration will take a combination of both graduate level engineering and science courses focused at applications in Earth science, space science and astrophysics. The concentration will train students to design the next generation of in-situ or remote sensing instrumentation for exploration of the Earth, space and the universe.

Goals

The ESD instrumentation concentration is designed to seamlessly fuse the intellectual disciplines of science and engineering by training science literate engineers and engineering literate scientists. The degree is specifically designed to create scientists who understand the implementation of their work and engineers who understand the meaning and motivation of their work. Students with this degree should be able to understand the motivating science in Earth and Space Exploration sufficiently to compose interesting, meaningful and answerable science questions and flow requirements from those questions to define and constrain experimental measurements and technical engineering requirements. Students in this concentration should then be able to design, build and test instrumentation meeting these requirements. At all stages, students will need to work in teams with other scientists and engineers, and be able to communicate their results effectively in both written and oral formats.

Outcome 1

Students will compose quantitatively answerable, scientifically interesting and reasonably scoped science questions related to Earth and space exploration, and formulate science measurement and technical requirements that answer those questions.

Concepts

Students will use the scientific method and knowledge of both foundational knowledge in and the state of the art in Earth and space exploration to analyze potential science questions for quality, importance, feasibility and difficulty, and apply a systems engineering approach to develop requirements that can answer the questions posed.

Competencies

Order of magnitude estimation, fundamental background knowledge in Earth science, planetary science and astronomy, searching and understanding existing scientific literature, systems engineering requirements traceability, estimation of technical feasibility.

Assessment Process: Rubrics will be created by faculty teaching the course each year before each assignment is completed. Rubrics will be reviewed by the SESE graduate committee and associate director for graduate initiatives. Faculty will be responsible for applying rubric to the relevant assignments and recording the data for collection. The SESE academic program office will collect data from the faculty at the end of each semester for use in assessment reports.

Measure 1

SES510 Systems Requirements Review (SRR) presentation and Science Traceability Matrix (STM). In the SRR, students present their science questions, derived measurement requirements and technical

Last Action:
August 26, 2020 2:07 PM

Last User:
Christopher Groppi (cgroppi)

MS in Exploration Systems Design (Instrumentation)

UOEEO Status: UOEEO Provisional Approval

08/27/2020 05:45 AM

engineering requirements to an expert review panel orally. The STM is a document accompanying the SRR that summarizes the science questions and derived requirements in a concise written format.

Performance Criterion 1

80% of students achieve mastery based on a faculty designed rubric used to assess the science questions presented in the review and associated written documents.

Measure 2

SES511 Preliminary Design Review (PDR). In the PDR, students orally present their instrument conceptual design and concept of operations to an expert review panel and demonstrate these elements meet the requirements defined earlier in the SRR and STM.

Performance Criterion 2

80% of students achieve mastery based on a faculty designed rubric used to assess science measurement and technical requirements presented in the review.

Outcome 2

Students will collaborate in teams to write presentations and documents that justify their science questions, requirements and experimental design to peers and mentors.

Concepts

The ability to work in teams to succeed in large projects, and convince expert review panels of the validity of a plan and a design are essential to all scientific exploration missions and projects.

Competencies

Scientific writing and oral presentation, teamwork, project management, work breakdown structures.

Assessment Process: Rubrics will be created by faculty teaching the course each year before each assignment is completed. Rubrics will be reviewed by the SESE graduate committee and associate director for graduate initiatives. Faculty will be responsible for applying rubric to the relevant assignments and recording the data for collection. The SESE academic program office will collect data from the faculty at the end of each semester for use in assessment reports.

Measure 1

SES510 Critical Design Review (CDR). The CDR is the final presentation in the course where students orally present the detailed design of their experiment orally to an expert review panel, and demonstrate the design meets all scientific and engineering requirements. The CDR is accompanied by Interface Control Documents that detail the design, operation and requirements compliance of the experiment at the subsystem and system level.

Performance Criterion 1

80% of students achieve mastery based on a faculty designed rubric used to assess the oral and written components of the review in terms of clarity, correctness and completeness.

Measure 2

SES511 Mission Readiness Review (MRR). The MRR is the final oral presentation in SES511 that demonstrates the completed experiment meets all requirements demonstrated through laboratory testing. The review is accompanied by written test reports that detail test results and requirements compliance for all subsystems and the integrated experiment.

MS in Exploration Systems Design (Instrumentation)

UOEEO Status: UOEEO Provisional Approval

08/27/2020 05:45 AM

Performance Criterion 2

80% of students achieve mastery based on a faculty designed rubric used to assess the oral and written components of the review in terms of clarity, correctness and completeness.

Outcome 3

Students will design and construct instrumentation to meet experiment requirements and develop and employ an integration and test plan to validate their design.

Concepts

Systems engineering, mechanical, electrical and/or computer engineering design.

Competencies

Systems engineering planning and verification testing to requirements, computer aided design and manufacturing, electrical and mechanical engineering laboratory skills.

Assessment Process: Rubrics will be created by faculty teaching the course each year before each assignment is completed. Rubrics will be reviewed by the SESE graduate committee and associate director for graduate initiatives. Faculty will be responsible for applying rubric to the relevant assignments and recording the data for collection. The SESE academic program office will collect data from the faculty at the end of each semester for use in assessment reports.

Measure 1

SES510 Interface Control Documents (ICDs). The ICDs are a set of written documents that detail the design and operation of each experiment subsystem and the integrated experiment.

Performance Criterion 1

80% of students achieve mastery based on a faculty designed rubric used to assess the quality, completeness and accuracy of instrument design as presented in the interface control document package.

Measure 2

SES511 test plan and test reports. The test plan details each test, with pass/fail criteria and demonstrates how each test verifies experiment technical and measurement requirements. The test reports detail the results of each test and compare measured data to pass/fail criteria.

Performance Criterion 2

80% of students achieve mastery based on a faculty designed rubric used to assess ability of the test plan and test reports to validate requirements.

MS in Exploration Systems Design (Systems Engineering)

UOEEO Status: UOEEO Provisional Approval

08/28/2020 05:20 AM

Mission

The Exploration Systems Design (ESD) systems engineering concentration is a unique combination of science applications and engineering knowledge and skills to create engineering literate scientists and science literate engineers interested in the design, construction and implementation next generation space missions and large projects. Students in the ESD systems engineering concentration will take a combination of both graduate level engineering and science courses focused at applications in Earth science, space science and astrophysics. The concentration will train students to design the next generation of large projects and space missions for exploration of the Earth, space and the universe.

Goals

The ESD systems engineering concentration is designed to seamlessly fuse the intellectual disciplines of science and engineering by training science literate engineers and engineering literate scientists. The degree is specifically designed to create scientists who understand the implementation of their work and engineers who understand the meaning and motivation of their work. Students with this degree should be able to understand the motivating science in Earth and Space Exploration sufficiently to compose interesting, meaningful and answerable science questions and flow requirements from those questions to define and constrain experimental measurements and technical engineering requirements. Students in this concentration should then be able to plan, justify and facilitate a project schedule and budget for experiment design, fabrication, integration and test. At all stages, students will need to work in teams with other scientists and engineers, and be able to communicate their results effectively in both written and oral formats.

Outcome 1

Students will compose quantitatively answerable, scientifically interesting and reasonably scoped science questions related to Earth and space exploration, and formulate science measurement and technical requirements that answer those questions.

Concepts

Students will use the scientific method and knowledge of both foundational knowledge in and the state of the art in Earth and space exploration to analyze potential science questions for quality, importance, feasibility and difficulty, and apply a systems engineering approach to develop requirements that can answer the questions posed.

Competencies

Order of magnitude estimation, fundamental background knowledge in Earth science, planetary science and astronomy, searching and understanding existing scientific literature, systems engineering requirements traceability, estimation of technical feasibility.

Assessment Process: Rubrics will be created by faculty teaching the course each year before each assignment is completed. Rubrics will be reviewed by the SESE graduate committee and associate director for graduate initiatives. Faculty will be responsible for applying rubric to the relevant assignments and recording the data for collection. The SESE academic program office will collect data from the faculty at the end of each semester for use in assessment reports.

Measure 1

SES10 Systems Requirements Review (SRR) presentation and Science Traceability Matrix (STM). In the SRR, students present their science questions, derived measurement requirements and technical

MS in Exploration Systems Design (Systems Engineering)

UOEEO Status: UOEEO Provisional Approval

08/28/2020 05:20 AM

engineering requirements to an expert review panel orally. The STM is a document accompanying the SRR that summarizes the science questions and derived requirements in a concise written format.

Performance Criterion 1

80% of students achieve mastery based on a faculty designed rubric used to assess the science questions presented in the review and associated written documents.

Measure 2

SES511 Preliminary Design Review (PDR). In the PDR, students orally present their instrument conceptual design and concept of operations to an expert review panel and demonstrate these elements meet the requirements defined earlier in the SRR and STM.

Performance Criterion 2

80% of students achieve mastery based on a faculty designed rubric used to assess science measurement and technical requirements presented in the review.

Outcome 2

Students will collaborate in teams to write presentations and documents that justify their science questions, requirements and experimental design to peers and mentors.

Concepts

The ability to work in teams to succeed in large projects, and convince expert review panels of the validity of a plan and a design are essential to all scientific exploration missions and projects.

Competencies

Scientific writing and oral presentation, teamwork, project management, work breakdown structures.

Assessment Process: Rubrics will be created by faculty teaching the course each year before each assignment is completed. Rubrics will be reviewed by the SESE graduate committee and associate director for graduate initiatives. Faculty will be responsible for applying rubric to the relevant assignments and recording the data for collection. The SESE academic program office will collect data from the faculty at the end of each semester for use in assessment reports.

Measure 1

SES510 Critical Design Review (CDR). The CDR is the final presentation in the course where students orally present the detailed design of their experiment orally to an expert review panel, and demonstrate the design meets all scientific and engineering requirements. The CDR is accompanied by Interface Control Documents that detail the design, operation and requirements compliance of the experiment at the subsystem and system level.

Performance Criterion 1

80% of students achieve mastery based on a faculty designed rubric used to assess the oral and written components of the review in terms of clarity, correctness and completeness.

Measure 2

SES511 Mission Readiness Review (MRR). The MRR is the final oral presentation in SES511 that demonstrates the completed experiment meets all requirements demonstrated through laboratory testing. The review is accompanied by written test reports that detail test results and requirements compliance for all subsystems and the integrated experiment.

MS in Exploration Systems Design (Systems Engineering)

UOEEE Status: UOEEE Provisional Approval

08/28/2020 05:20 AM

Performance Criterion 2

80% of students achieve mastery based on a faculty designed rubric used to assess the oral and written components of the review in terms of clarity, correctness and completeness.

Outcome 3

Students will plan, justify and facilitate a project schedule and budget for experiment design, fabrication, integration and test.

Concepts

Systems engineering design approach and project management.

Competencies

Work breakdown structures, Science traceability matrices, Gantt charts, project schedules, test plans, project budget management, requirement verification

Assessment Process: Rubrics will be created by faculty teaching the course each year before each assignment is completed. Rubrics will be reviewed by the SESE graduate committee and associate director for graduate initiatives. Faculty will be responsible for applying rubric to the relevant assignments and recording the data for collection. The SESE academic program office will collect data from the faculty at the end of each semester for use in assessment reports.

Measure 1

SES510 Interface Control Documents (ICDs) The ICDs are a set of written documents that detail the design and operation of each experiment subsystem and the integrated experiment. These documents contain the complete plan for fabrication and integration of the entire experiment, and also include the overall project schedule and budget.

Performance Criterion 1

80% of students achieve mastery based on a faculty designed rubric used to assess the validity, completeness and accuracy of project scheduling, test planning and budgeting.

Measure 2

SES511 test plan and test reports. The test plan details each test, with pass/fail criteria and demonstrates how each test verifies experiment technical and measurement requirements. The test reports detail the results of each test and compare measured data to pass/fail criteria.

Performance Criterion 2

80% of students achieve mastery based on a faculty designed rubric used to assess the validity, completeness and accuracy of the project test plan and test reports and their ability to verify project requirements.

MS in Exploration Systems Design (Sensor Networks)

UOEEE Status: UOEEE Provisional Approval

08/28/2020 05:26 AM

Goals

The ESD sensor networks concentration is designed to seamlessly fuse the intellectual disciplines of science and engineering by training science literate engineers and engineering literate scientists. The degree is specifically designed to create scientists who understand the implementation of their work and engineers who understand the meaning and motivation of their work. Students with this degree should be able to understand the motivating science in Earth and Space Exploration sufficiently to compose interesting, meaningful and answerable science questions and flow requirements from those questions to define and constrain experimental measurements and technical engineering requirements. Students in this concentration should then be able to design and construct command and control, user interface and data handling and processing systems, integrate them with the experiment and validate their performance through testing. At all stages, students will need to work in teams with other scientists and engineers, and be able to communicate their results effectively in both written and oral formats.

Outcome 1

Students will compose quantitatively answerable, scientifically interesting and reasonably scoped science questions related to Earth and space exploration, and formulate science measurement and technical requirements that answer those questions.

Concepts

Students will use the scientific method and knowledge of both foundational knowledge in and the state of the art in Earth and space exploration to analyze potential science questions for quality, importance, feasibility and difficulty, and apply a systems engineering approach to develop requirements that can answer the questions posed.

Assessment Process: Rubrics will be created by faculty teaching the course each year before each assignment is completed. Rubrics will be reviewed by the SESE graduate committee and associate director for graduate initiatives. Faculty will be responsible for applying rubric to the relevant assignments and recording the data for collection. The SESE academic program office will collect data from the faculty at the end of each semester for use in assessment reports.

Measure 1

SES510 Systems Requirements Review (SRR) presentation and Science Traceability Matrix (STM). In the SRR, students present their science questions, derived measurement requirements and technical engineering requirements to an expert review panel orally. The STM is a document accompanying the SRR that summarizes the science questions and derived requirements in a concise written format.

Performance Criterion 1

80% of students achieve mastery based on a faculty designed rubric used to assess the science questions presented in the review and associated written documents.

Measure 2

Last Action:
August 27, 2020 4:36 PM

Last User:
Christopher Groppi (cgroppi)

MS in Exploration Systems Design (Sensor Networks)

UOEEO Status: UOEEO Provisional Approval

08/28/2020 05:26 AM

SES511 Preliminary Design Review (PDR). In the PDR, students orally present their instrument conceptual design and concept of operations to an expert review panel and demonstrate these elements meet the requirements defined earlier in the SRR and STM.

Performance Criterion 2

80% of students achieve mastery based on a faculty designed rubric used to assess science measurement and technical requirements presented in the review.

Outcome 2

Students will collaborate in teams to write presentations and documents that justify their science questions, requirements and experimental design to peers and mentors.

Concepts

The ability to work in teams to succeed in large projects, and convince expert review panels of the validity of a plan and a design are essential to all scientific exploration missions and projects.

Competencies

Scientific writing and oral presentation, teamwork, project management, work breakdown structures.

Assessment Process: Rubrics will be created by faculty teaching the course each year before each assignment is completed. Rubrics will be reviewed by the SESE graduate committee and associate director for graduate initiatives. Faculty will be responsible for applying rubric to the relevant assignments and recording the data for collection. The SESE academic program office will collect data from the faculty at the end of each semester for use in assessment reports.

Measure 1

SES510 Critical Design Review (CDR). The CDR is the final presentation in the course where students orally present the detailed design of their experiment orally to an expert review panel, and demonstrate the design meets all scientific and engineering requirements. The CDR is accompanied by Interface Control Documents that detail the design, operation and requirements compliance of the experiment at the subsystem and system level.

Performance Criterion 1

80% of students achieve mastery based on a faculty designed rubric used to assess the oral and written components of the review in terms of clarity, correctness and completeness.

Measure 2

SES511 Mission Readiness Review (MRR). The MRR is the final oral presentation in SES511 that demonstrates the completed experiment meets all requirements demonstrated through laboratory testing. The review is accompanied by written test reports that detail test results and requirements compliance for all subsystems and the integrated experiment.

Performance Criterion 2

80% of students achieve mastery based on a faculty designed rubric used to assess the oral and written components of the review in terms of clarity, correctness and completeness.

Outcome 3

MS in Exploration Systems Design (Sensor Networks)

UOEEO Status: UOEEO Provisional Approval

08/28/2020 05:26 AM

Students will design and construct command and control, user interface and data handling and processing systems, integrate them with the experiment and validate their performance through testing.

Concepts

Software, firmware and hardware engineering, systems engineering based design and testing, hardware-computer interfacing, data acquisition, processing and analysis.

Competencies

Programming for computers, embedded systems and microcontrollers, data analysis mathematical and computational tools, statistical analysis, real time computing

Assessment Process: Rubrics will be created by faculty teaching the course each year before each assignment is completed. Rubrics will be reviewed by the SESE graduate committee and associate director for graduate initiatives. Faculty will be responsible for applying rubric to the relevant assignments and recording the data for collection. The SESE academic program office will collect data from the faculty at the end of each semester for use in assessment reports.

Measure 1

SES510 Interface Control Documents (ICDs). The ICDs are a set of written documents that detail the design and operation of each experiment subsystem and the integrated experiment, including all command and control, user interface, data handling and processing subsystems.

Performance Criterion 1

80% of students achieve mastery based on a faculty designed rubric used to assess the design and validation plan for software and firmware systems.

Measure 2

SES511 test plan and test reports. The test plan details each test, with pass/fail criteria and demonstrates how each test verifies experiment technical and measurement requirements. The test reports detail the results of each test and compare measured data to pass/fail criteria.

Performance Criterion 2

80% of students achieve mastery based on a faculty designed rubric used to assess the ability of the test plan and test results to validate the performance of software and firmware systems.

APPENDIX III

Statements of Collaboration and Impact

The College of Liberal Arts and Sciences – Official Submission

From: [Kimberly Castillo](#)
To: curriculumplanning@asu.edu
Cc: [Fabio Milner](#); [Kyle Rader](#); [Jenny Smith](#)
Subject: New Prog- MS Exploration Sys Design
Date: Tuesday, October 13, 2020 8:27:19 AM
Attachments: [image003.png](#)
[SESE- MS ESD_FINAL2.pdf](#)
[SESE- MS ESD_FINAL2.docx](#)

Please see attached proposal for MS Exploration Systems Design. Let me know if anything else is needed, thanks!

Best,

Kim Castillo

Academic Success Analyst, Graduate Initiatives

Office of the Dean

The College of Liberal Arts & Sciences

P: 480-965-0044 | E: Kimberly.E.Castillo@asu.edu



Fulton Schools of Engineering

From: [Fabio Milner](#)
To: [James Collofello](#)
Cc: [Kimberly Castillo](#)
Subject: Re: M5 ESD - courses impact letter
Date: Monday, November 16, 2020 10:59:56 AM
Attachments: [image003.png](#)
[image004.png](#)

Thanks for your prompt response and your support, Jim.

Best,
Fabio

On Nov 16, 2020, at 10:39, James Collofello
<JAMES.COLLOFELLO@asu.edu> wrote:

The Fulton Schools of Engineering is supportive of this new proposal and the use of our courses in the degree.

jim

James S. Collofello
Vice Dean for Academic and Student Affairs
Professor of Computer Science and Engineering
School of Computing Informatics and Decision Systems Engineering
Ira A. Fulton Schools of Engineering
Arizona State University

[image002.png](#)
[image003.png](#)

Thanks for the prompt response and for the support, Jim.

Best,
Fabio

Fabio Augusto Milner, PhD

Associate Dean of Graduate Initiatives

Assistant Director, SA Levin MCMS Center

College of Liberal Arts and Sciences

Director of Mathematics for STEM Education

School of Mathematical and Statistical Sciences

Arizona State University



Armstrong Hall, Office 285

P: 480/965-5877 | F: 480/965-2110

milner@asu.edu

URL: <https://clas.asu.edu/content/fabio-milner>

From: James Collofello <JAMES.COLLOFELLO@asu.edu>

Date: Monday, August 24, 2020 at 18:30

To: Fabio Milner <milner@asu.edu>

Subject: RE: MS Exploration Systems Design- impact statements

The Fulton Schools of Engineering has reviewed the proposed MS Degree in Exploration Systems and Design as well as the new SES 510 and SES 511 courses and does not have any concerns. The program might consider using some of our Engineering Management courses to complement the current offerings.

jim

College of Global Futures

From: [Christopher Boone](#)
To: [Fabio Milner](#)
Cc: [Kimberly Castillo](#)
Subject: RE: MS in Exploration Systems Design - GC Review
Date: Monday, November 16, 2020 9:54:10 AM
Attachments: [image001.png](#)
[image004.png](#)

The College of Global Futures is happy to support this proposal.

Christopher Boone
Dean, College of Global Futures
Professor, School of Sustainability



<https://collegeofglobalfutures.asu.edu/>
PO Box 875502, Tempe, AZ 85287-5502
Executive Assistant: Lorraine.Protocollo@asu.edu
480-965-2236

The College of Global Futures embraces ASU's mission as being a comprehensive public research university, measured not by whom it excludes, but rather by whom it includes and how they succeed; advancing research and discovery of public value; and assuming fundamental responsibility for the economic, social, cultural and overall health of the communities it serves. We support and foster a culture of inclusiveness, tolerance, and respect that promotes equal opportunity and diversity among faculty, staff, and students and through our engagement with diverse communities within and beyond the University.

From: Fabio Milner <milner@asu.edu>
Sent: Monday, November 16, 2020 9:06 AM
To: Christopher Boone <Christopher.G.Boone@asu.edu>
Cc: Fabio Milner <milner@asu.edu>; Kimberly Castillo <Kimberly.E.Castillo@asu.edu>
Subject: MS in Exploration Systems Design - GC Review
Importance: High

Dear Chris,

The School of Earth and Space Exploration is preparing to launch a MS degree in Exploration Systems Design. As part of the proposal process, we would like to request a letter of support/impact from College of Global Futures. Please find the proposal attached here for your review. Since they are requesting program support, this statement needs to come from our dean-to-dean communication.

Would you please review the attached materials and provide a statement of impact/support in regards to the proposed program being supported by your college.

If you need any additional materials to assist with your review please let me know.

If possible, we'd like to request your review and statement by the **Mon., Nov. 23**. If this would not be possible please let me know.

College of Integrative Sciences and Arts

From: [Duane Roen](#)
To: [Fabio Milner](#)
Cc: [Kimberly Castillo](#)
Subject: RE: MS in Exploration Systems Design - GC Review
Date: Monday, November 16, 2020 6:56:36 PM

Fabio,

CISA is happy to support your proposal for an MS degree in Exploration Systems Design.

Please let me know if CISA can do anything else to be helpful.

Best,
Duane

Duane Roen
Dean, College of Integrative Sciences and Arts
Vice Provost, Polytechnic campus
Arizona State University
Mail Code: 2780
7271 E Sonoran Arroyo Mall
Mesa, AZ 85212-6415
P: 480-727-1415

From: Fabio Milner <milner@asu.edu>

Sent: Monday, November 16, 2020 9:08 AM

To: Duane Roen <Duane.Roen@asu.edu>

Cc: Fabio Milner <milner@asu.edu>; Kimberly Castillo <Kimberly.E.Castillo@asu.edu>

Subject: MS in Exploration Systems Design - GC Review

Importance: High

Dear Duane,

The School of Earth and Space Exploration is preparing to launch a MS degree in Exploration Systems Design. As part of the proposal process, we would like to request a letter of support/impact from College of Integrative Sciences and Arts. Please find the proposal attached here for your review. Since they are requesting program support, this statement needs to come from our dean-to-dean communication.

Would you please review the attached materials and provide a statement of impact/support in regards to the proposed program being supported by your college.

If you need any additional materials to assist with your review please let me know.

If possible, we'd like to request your review and statement by the **Mon., Nov. 23**. If this would not be possible please let me know.

Thunderbird School of Global Management

From: [Sanjeev Khagram \(Dean\)](#)
To: [Fabio Milner](#)
Cc: [Kimberly Castillo](#); [Nancy Gonzales \(Dean\)](#)
Subject: Re: MS in Exploration Systems Design - GC Review
Date: Wednesday, November 18, 2020 11:08:21 AM
Attachments: [image004.png](#)
[image005.png](#)
[image006.png](#)

Dear Fabio,

Thunderbird enthusiastically supports this new degree!

Dr. Sanjeev Khagram

CEO, Director General & Dean |

Foundation Professor of Global Leadership |

Thunderbird School of Global Management

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Dear Sanjeev,

The School of Earth and Space Exploration is preparing to launch a MS degree in Exploration Systems Design. As part of the proposal process, we would like to request a letter of support/impact from Thunderbird School of Global Management. Please find the proposal attached here for your review. Since they are requesting program support, this statement needs to come from our dean-to-dean communication.

Would you please review the attached materials and provide a statement of impact/support in regards to the proposed program being supported by your college.

If you need any additional materials to assist with your review please let me know.

If possible, we'd like to request your review and statement by the **Mon., Nov. 23**. If this would not be possible please let me know.

W. P. Carey School of Business

From: "Amy Hillman (DEAN)" <AMY.HILLMAN@asu.edu>
Date: November 16, 2020 at 12:49:49 PM MST
To: "Nancy Gonzales (Dean)" <nancy.gonzales@asu.edu>
Subject: Re: MS in Exploration Systems Design - GC Review

Hello Nancy,

The W. P. Carey School of Business has no objections to your new MS in Exploration Systems Design.

Best of luck with it,
Amy

From: Nancy Gonzales (Dean) <nancy.gonzales@asu.edu>

Date: Monday, November 16, 2020 at 10:07 AM

To: Amy Hillman (DEAN) <AMY.HILLMAN@asu.edu>

Subject: FW: MS in Exploration Systems Design - GC Review

Dear Amy,

I have another request for an impact statement.

The School of Earth and Space Exploration is preparing to launch a MS degree in Exploration Systems Design. As part of the proposal process, we would like to request a letter of support/impact from W.P. Carey School of Business. Please find the proposal attached here for your review.

Would you please review the attached materials and provide a statement of impact/support in regards to the proposed program being supported by your college.

If you need any additional materials to assist with your review please let me know.

If possible, we'd like to request your review and statement by the **Mon., Nov. 23**.

Thank you,

Nancy

Herberger Institute for Design and the Arts

From: [Stephani Etheridge Woodson](#)
To: [Fabio Milner](#)
Cc: [Kimberly Castillo](#)
Subject: Re: MS in Exploration Systems Design - GC Review
Date: Monday, November 30, 2020 2:55:54 PM
Attachments: [image001.png](#)
[image002.png](#)

Apologies for the delay, the Herberger Institute for Design and the Arts has no concerns with this degree nor its overlap with our current degrees.

with appreciation, Stephani

Stephani Etheridge Woodson
Interim Associate Dean of Students
Herberger Institute for Design and the Arts
The FDT Evelyn Smith Professor | School of Music, Dance and Theatre
Director, Design and Arts Corps | herbergerinstitute.asu.edu/design-and-arts-corps
She/Her/Hers

From: Fabio Milner <milner@asu.edu>
Date: Monday, November 16, 2020 at 9:17 AM
To: Stephani Etheridge Woodson <swoodson@asu.edu>
Cc: Fabio Milner <milner@asu.edu>, Kimberly Castillo <Kimberly.E.Castillo@asu.edu>
Subject: MS in Exploration Systems Design - GC Review

Dear Stephani,

The School of Earth and Space Exploration is preparing to launch a MS degree in Exploration Systems Design. As part of the proposal process, we would like to request a letter of support/impact from Herberger Institute for Design and the Arts. Please find the proposal attached here for your review. Since they are requesting program support, this statement needs to come from dean-to-dean communication.

Would you please review the attached materials and provide a statement of impact/support in regards to the proposed program being supported by your college.

If you need any additional materials to assist with your review please let me know.

If possible, we'd like to request your review and statement by the **Mon., Nov. 23**. If this would not

Sandra Day O'Connor College of Law

From: [Tamara Herrera](#)
To: [Fabio Milner](#)
Cc: [Kimberly Castillo](#)
Subject: RE: MS in Exploration Systems Design - GC Review
Date: Thursday, November 19, 2020 12:44:36 PM
Attachments: [image002.png](#)

Hello Fabio,

The College of Law has reviewed the attached proposal for an MS degree in Exploration Systems Design and supports this proposal.

Please let us know if you need anything additional.

Tamara

Dear Tamara,

The School of Earth and Space Exploration is preparing to launch a MS degree in Exploration Systems Design. As part of the proposal process, we would like to request a letter of support/impact from Sandra Day O'Connor College of Law. Please find the proposal attached here for your review. Since they are requesting program support, this statement needs to come from dean-to-dean communication.

Would you please review the attached materials and provide a statement of impact/support in regards to the proposed program being supported by your college.

If you need any additional materials to assist with your review please let me know.

If possible, we'd like to request your review and statement by the **Mon., Nov. 23**. If this would not be possible please let me know.

College of Health Solutions

From: Deborah Helitzer (Dean) <Deborah.Helitzer@asu.edu>
Sent: Tuesday, December 1, 2020 2:21 PM
To: Nancy Gonzales (Dean) <nancy.gonzales@asu.edu>
Subject: Re: MS in Exploration Systems Design - Graduate College Review

Nancy – The College of Health Solutions is pleased to provide its support for the MS in Exploration Systems Design. In fact, we see this as a terrific opportunity to work more closely with BHSE graduate programs to produce “health literate engineers” and “engineering literate health scientists”.

Dear Deborah,

The School of Earth and Space Exploration is preparing to launch a MS degree in Exploration Systems Design. As part of the proposal process, we would like to request a letter of support/impact from College of Health Solutions. Please find the proposal attached here for your review.

Would you please review the attached materials and provide a statement of impact/support in regards to the proposed program being supported by your college?
If you need any additional materials to assist with your review please let me know.

Thanks much. I hope you are doing well and had a nice Thanksgiving.

Nancy

New College of Interdisciplinary Arts and Sciences

From: Patricia Friedrich <Patricia.Friedrich@asu.edu>
Date: Tuesday, December 8, 2020 at 15:01
To: Fabio Milner <milner@asu.edu>
Subject: Re: MS in Exploration Systems Design - Graduate College Review
Resent-From: <milner@asu.edu>

Dear Fabio:

Thank you so much for your patience. New College is in support of the degree and hopeful to work together especially through MNS where appropriate and helpful.

Thank you so much, Patty

Patricia Friedrich, PhD
She, Her, Hers

Associate Dean of Academic Programs and Faculty Affairs,
New College of Interdisciplinary Arts and Sciences
Professor of Sociolinguistics,
School of Social and Behavioral Sciences



Arizona State University
P. O. Box 37100
4701 W. Thunderbird Rd. Mail Code 3051
Phoenix, AZ, USA 85069-7100
voice 602 543-6046

From: Fabio Milner <milner@asu.edu>
Date: Monday, November 16, 2020 at 09:19
To: Patricia Friedrich <Patricia.Friedrich@asu.edu>
Cc: Fabio Milner <milner@asu.edu>, Kimberly Castillo <Kimberly.E.Castillo@asu.edu>
Subject: MS in Exploration Systems Design - Graduate College Review

Dear Patty,

The School of Earth and Space Exploration is preparing to launch a MS degree in Exploration Systems

Design. As part of the proposal process, we would like to request a letter of support/impact from New College of Interdisciplinary Arts and Sciences. Please find the proposal attached here for your review. Since they are requesting program support, this statement needs to come from dean-to-dean communication.

Would you please review the attached materials and provide a statement of impact/support in regards to the proposed program being supported by your college.

If you need any additional materials to assist with your review please let me know.

If possible, we'd like to request your review and statement by the **Mon., Nov. 23**. If this would not be possible please let me know.

Thanks, and best wishes,
Fabio

Fabio Augusto Milner, PhD

Associate Dean of Graduate Initiatives

Assistant Director, SA Levin MCMS Center

[The College of Liberal Arts and Sciences](#)

Director of Mathematics for STEM Education

[School of Mathematical and Statistical Sciences](#)

[Arizona State University](#)



Armstrong Hall, Office 214

P: 480/965-5877 | F: 480/965-2110

milner@asu.edu

URL: <https://thecollege.asu.edu/content/fabio-milner>

Mary Lou Fulton Teachers College

From: "Carole Basile (Dean)" <Carole.Basile@asu.edu>
Date: Monday, November 16, 2020 at 09:20
To: Fabio Milner <milner@asu.edu>
Subject: Re: MS in Exploration Systems Design - Graduate College Review

Fabio,

The MLFTC has no concerns with this program. It appears to be a much needed addition and wish you the best in execution.

cb

Carole G. Basile
Dean
Arizona State University
Mary Lou Fulton Teachers College
[P.O. Box 871811, Tempe, AZ 85281-1811](#)
O: 480.965.3463 | M: 480.310.6887

On Nov 16, 2020, at 9:15 AM, Fabio Milner <milner@asu.edu> wrote:

Dear Carole,

The School of Earth and Space Exploration is preparing to launch a MS degree in Exploration Systems Design. As part of the proposal process, we would like to request a letter of support/impact from Mary Lou Fulton Teachers College. Please find the proposal attached here for your review. Since they are requesting program support, this statement needs to come from dean-to-dean communication.

Would you please review the attached materials and provide a statement of impact/support in regards to the proposed program being supported by your college.

If you need any additional materials to assist with your review please let me know.

If possible, we'd like to request your review and statement by the **Mon., Nov. 23**. If this would not be possible please let me know.

Best,
Fabio

Watts College of Public Service & Community Solutions

From: [William Terrill](#)
To: [Fabio Milner](#)
Cc: [William Terrill](#); [Kimberly Castillo](#)
Subject: Re: MS in Exploration Systems Design - Graduate College Review
Date: Friday, November 20, 2020 4:15:30 PM
Attachments: [image001.png](#)

Hi Fabio,

The Watts College is supportive of your MS degree in Exploration Systems Design.

Best wishes for your program,
Bill

William Terrill, PhD

On Mon, Nov 16, 2020 at 9:23 AM Fabio Milner <milner@asu.edu> wrote:

Dear Bill,

The School of Earth and Space Exploration is preparing to launch a MS degree in Exploration Systems Design. As part of the proposal process, we would like to request a letter of support/impact from New College of Interdisciplinary Arts and Sciences. Please find the proposal attached here for your review. Since they are requesting program support, this statement needs to come from dean-to-dean communication.

Would you please review the attached materials and provide a statement of impact/support in regards to the proposed program being supported by your college.

If you need any additional materials to assist with your review please let me know.

If possible, we'd like to request your review and statement by the **Mon., Nov. 23**. If this

(NEW GRADUATE INITIATIVES)
PROPOSAL PROCEDURES CHECKLIST

Academic units should adhere to the following procedures when requesting new curricular initiatives (degrees, concentrations or certificates).

- ☒ **Obtain the required approval from the Office of the Provost to move the initiative forward for internal ASU governance reviews/approvals.** Please see the academic strategic plan website at: <https://provost.asu.edu/curriculum-development>.
- ☒ **Submit any new courses that will be required for the new curricular program to the Curriculum ChangeMaker online course approval system for review and approval.**
 - Additional information can be found at the Provost's Office Curriculum Development website: [Courses link](#)
 - For questions regarding proposing new courses, send an email to: courses@asu.edu
- ☒ **Prepare the applicable proposal template and operational appendix for the proposed initiative.**
- ☒ **Obtain letters or memos of support or collaboration (if applicable).**
 - when resources (faculty or courses) from another academic unit will be utilized
 - when other academic units or degree programs may be impacted by the proposed request
 - if the program will have an online delivery option support will be required from the Provost's office and ASU Online. *(Please complete the ASU Online Offering form in [Curriculum ChangeMaker](#) to begin this request.)*
- ☒ **Obtain the internal reviews/approvals of the academic unit.**
 - internal faculty governance review committee(s)
 - academic unit head (e.g. Department Chair or School Director)
 - academic unit Dean or their designee (will submit approved proposal to the curriculumplanning@asu.edu email account for further ASU internal governance reviews (as applicable, University Graduate Council, CAPC and Senate)

Additional Recommendations

All new graduate programs require specific processes and procedures to maintain a successful degree program. Below are items that the Graduate College strongly recommends that academic units establish after the program is approved for implementation.

- ☒ **Establish satisfactory academic progress policies, processes and guidelines** – Check within the proposing academic unit and/or college to see if there are existing academic progress policies and processes in place. If none have been established, please go to http://graduate.asu.edu/faculty_staff/policies and scroll down to the **academic progress review and remediation processes** (for faculty and staff) section to locate the reference tool and samples for establishing these procedures.
- ☒ **Establish a Graduate Student Handbook for the new degree program** – Students need to know the specific requirements and milestones they must meet throughout their degree program. A Graduate Student Handbook, provided to students when they are admitted to the degree program and published on the website for the new degree, gives students this information. To be included in the handbook are the unit/college satisfactory academic progress policies, current degree program requirements (outlined in the approved proposal) and a link to the Graduate Policies and Procedures website: http://graduate.asu.edu/faculty_staff/policies.