THE UNIVERSITY OF ARIZONA

UNDERGRADUATE EMPHASIS (SUB-PLAN) REQUEST FORM
MAJORS WITH EXISTING EMPHASES (SUB-PLANS)

Requests for the creation of a new emphasis requires approval from the school director/department head (managing administrator), college academic dean, Curricular Affairs, Undergraduate Council (UGC), and College Academic Administrators Council (CAAC). Complete this form (for each proposed emphasis) and submit to the Office of Curricular Affairs, no later than January 31, 2021 to be considered for inclusion in the 2021-2022 Academic Catalog.

I. **Requested by (College & School/Department):** College of Science/Geosciences

II. **Proposer's name, title, email and phone number:** Ananya Mallik, Assistant Professor, mallika@arizona.edu, 401-441-1465

III. **Degree, major and number of students currently enrolled in the major (include dual majors):** Geosciences B.S., 208 as of 10/28/2020

IV. **Total number of students that have completed the major in the past 3 years:** 157 (Fall 2017-Summer 2020)

V. Complete the table below capturing information about your existing major emphases. Add columns as needed.

Name of existing emphasis plan(s)	Geology	Geophysics	Environmental	Earth Systems (ESS)	Earth, Ocean and Climate (EOC)
First term emphasis was offered	Fall 1998	Fall 1998	Fall 1998 Environmental transitioned to ESS in Fall 2008	Fall 2008 ESS ESS transitioned to EOC in Fall 2017	Transitioned from ESS to EOC beginning Fall 2017
Minimum units required to complete major core and emphasis (total)	52	52	68	46	52
Minimum upper division (300 level or above) units required to complete major core and emphasis (total)	No stipulated minimum UPD units, but 27-UPD units designated within Core/Emph curriculum reqs	No stipulated minimum UPD units, but 43-UPD units designated within Core/Emph curriculum reqs	No stipulated minimum UPD units, but 64-UPD units designated within Core/Emph curriculum reqs	No stipulated minimum UPD units, but 30-UPD units designated within Core/Emph curriculum reqs	No stipulated minimum UPD units, but 28-UPD units designated within Core/Emph curriculum reqs
Additional requirements to complete emphasis (supporting coursework*, lecture series, GPA, non-credit workshop)	Tally Math, Chem, Phys, Comp ap if applicable	NA	NA	NA	NA
Number of students enrolled in emphasis	12 Not Available + 1 Geology + 1 Geoph in Fall 1998	12 Not Available + 1 Geology + 1 Geoph in Fall 1998	0 Envr in 1998, but 1 in 1999	8 ESS in Fall 2008	9 ESS + 14 EOC in Fall 2017
Total number of students that have completed emphasis in past 3 years	110	34	0	7	6

*- courses that do not count towards major units and major GPA, but are required for the major

VI. Name of the proposed emphasis: Gem Science

VII. Campus and location offering-indicate the campus(es) and location(s) where this emphasis will be offered.

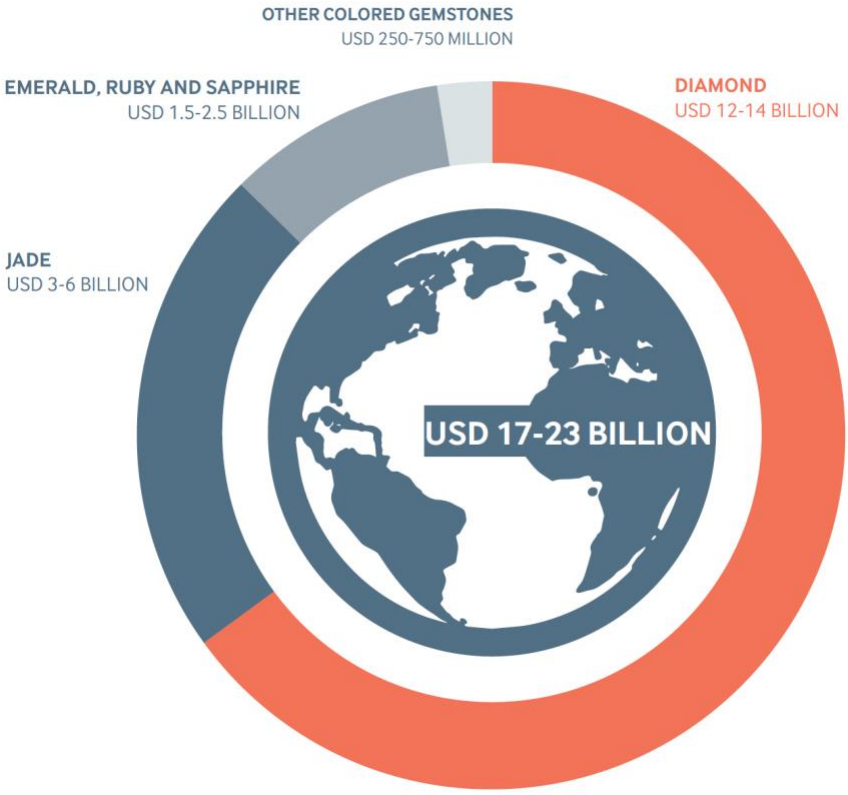
X Main	☐ UA Online	☐ Phoenix Biomedical	☐ Distance (type in location(s) below):

VIII. Provide a rationale for the proposed new emphasis. Survey your current majors to provide evidence of student interest in/demand for the proposed emphasis – attach the survey questions and results at the end of this proposal. Write a short summary of the findings of the survey. Ensure your survey seeks evidence of how the new emphasis will impact existing emphases. You may also include external data (Bureau of Labor Statistics, reports/letters of support from relevant bodies, etc.). Curricular Affairs can provide a job posting/ demand report by skills obtained/outcomes of the proposed emphasis. Please contact Office of Curricular Affairs to request the report for your proposal.

The need for a new track in Gem science, within the Geosciences degree program, is based on: 1) the growing market in gemstone mining, sales and research ; 2) the need for technological expertise in the field.

Growing market in Gemstone

The global gemstone market is approximately $23 billion in the USA and it is expected to grow at a Compound Annual Growth Rate of approximately 5% over 2018-2026 (https://www.futuremarketinsights.com/reports/gemstones-market).



The market is dominated by diamonds; out of a global market of $23 billion, diamonds make up $12-14 billion and jade $3-6 billion. The popularity in colored stones like rubies, emeralds and sapphires, has spiked in recent years and prices have increased 100 percent in the last decade, (https://resourcegovernance.org/sites/default/files/documents/governing-the-gemstone_sector-lessons-from-global-experience.pdf). The combined growth of the gem diamonds and color stones will open new market and job opportunities.

The need for technological expertise

Currently the Gemological Institute of America (GIA) is the only institution in the USA offering a certificate in Gemology which does not require a formal university degree and instead includes mostly vocational classes on diamonds, colored stones and retail jewelry. Whereas these classes provide basic training on how to differentiate gems they do not provide the necessary knowledge to recognize and evaluate natural processes responsible for the physical characteristics of gems which ultimately control their quality and value.

This results in a lack of technological expertise in the field and is the reason behind The RealReal endowment in Gem Science to establish a new track/emphasis in the field of Geosciences.

The new track in Gem Science within the Geosciences degree program is designed to meet the demands of a growing segment of the jewelry industry and create new and necessary technological expertise in the field.

According to the Bureau of Labor Statistics the employment of geoscientists is projected to grow 5% from 2019 to 2029, faster than the average for all occupations driven by the need for energy, environmental protection, and responsible land and resource management.

According to the American Geosciences Institute (AGI), the employees in Geosciences are aging and a shortfall of all employees is expected. AGI states that "the majority of geoscientists in the workforce are within 15 years of retirement age," and the number of younger employees is only half of the number of those approaching retirement. Moreover, the aging of the workforce represents a potential for a critical loss of technical knowledge, skill and experience. AGI data indicates "about 12% of today's geoscientists are expected to retire by 2018, meaning that net job availability for geoscientists in the United States should have increased between 2008 and 2018 by around 35%".

In a 2013 report on the energy and mining industries (https://www.nap.edu/resource/18250/energy-mining-workforce.pdf), the National Academies of Sciences reports that the current pipeline of students and workers with strong STEM skills will not be adequate to fill the needs of the workforce in these fields. Under pathways to energy and mining careers, the NAS report says that industry-education partnerships have emerged critical to the nation's energy and mining future. Under strategies to address the challenges, they list education initiatives and state "Traditional routes to degrees in higher education do not adequately align curriculum to energy and mining industry requirements, they are increasingly not affordable and accessible and, therefore, do not provide enough qualified STEM-educated workers and professionals to fulfil the nation's energy and mining workforce needs. The goal in addressing the shortfalls of the current education pipeline is to create an education system that can respond to changes in the economy more quickly and produce a more flexible, STEM-competent workforce." Accordingly, we propose to design an interdisciplinary curriculum for Gem Science that provides the needed STEM education to the students but at the same time exposes them to skills that are not traditionally considered a part of STEM (e.g. art as used in jewelry design, retail and consumer science). This would provide students with a holistic approach to applying skills to meet industry demands as well as academic research and be flexible and responsive to changes in economy. The keen interest in this gem emphasis by potential hiring companies in the gem industry such as The Realreal Inc. bolsters the career potential of the graduates of this program. Given the current status of supply and demand in Geosciences workforce and the growing trend in the gem market we expect this new track to attract a significant number of new students into the program thus bringing new revenue to the Department, CoS and U of A.

The new track in Gem Science will be one of its kind in the USA and as such will add value to the U of A educational mission. The department of Geosciences being one of the top programs in the country will add prestige to this new track helping with its popularity and success.

Given the interdisciplinary training of our graduates in gem studies, we expect that they will be employable by multiple sectors such as:

Geology/Earth Science
Materials Science
Optics/Optical Sciences
Fashion Merchandizing
Metal and Jewelry Arts

Market reports on employment potential within the US and within Arizona for the above fields from the National Center for Education Statistics (https://nces.ed.gov/) show that the graduates of our program earn an average salary ($56,908) that is higher than the average living wage in Arizona ($31,450). The projected employment growth (from the Bureau of Labor Statistics) in the various relevant occupations are mostly positive with growths as high as 19%. We expect that the graduates of the gem science emphasis would acquire the skills needed to cater to this growing market.

IX. At minimum, provide two unique learning outcomes for the proposed emphasis. Which courses in the emphasis will Introduce, Practice, and/or Assess the learning outcomes? Use the table below to provide the information. Add rows as needed.

Learning Outcome	Introduced	Practiced	Assessed
Students will be able to identify common gem minerals	(NEW) GEOS 260, Introduction to Gems and Minerals	GEOS 306	GEOS 460
Students will learn scientific techniques to characterize gems	(NEW) GEOS 260, Introduction to Gems and Minerals	MSE 480, GEOS 400	GEOS 460
Students will learn about the geological settings where gems occur to aid in identifying sites of exploration	(NEW) GEOS 260, Introduction to Gems and Minerals	GEOS 356, GEOS 302, GEOS 408, GEOS 446, GEOS 427	(NEW) GEOS 4XX, Petrology of Gems

X. Requirements to meet 40% commonality across emphases. ABOR Policy 2-221-c. Academic Degree Programs Subspecializations requires all undergraduate emphases within a major to share at least 40% curricular commonality across emphases (known as "major core"-courses counting towards major units and major GPA). List the required major core curriculum required of all emphases. Refer to your existing advisement report(s), if needed. Include the prefix, course number, course title and number of units. Add rows as needed.

Requirement Title/Description	Courses (include prefix, number, title, units)	Minimum units needed to satisfy requirement
Supporting Coursework	MATH 125, Calculus I (3) OR MATH 122A, Functions for Calculus (1) AND MATH 122B, First-Semester Calculus (4), MATH 129, Calculus II (3), MATH 223, Vector Calculus (3), CHEM 151, General Chemistry I (4), MSE 110, Solid State Chemistry (4), PHYS 141, Mechanics (4), PHYS 142, Optics Thermodynamics (3)	21
Major Core	1. Computational Ap. Theme options: CSC 110, Introduction to Computer Programming I (4), ECE 175, Computer Programming for Engineering Applications (3), GEOG 330, Introduction to Remote Sensing (3), GEOG 417, Geographic Information Systems for Natural and Social Sciences (3), GEOG 490, Remote Sensing for the Study of Planet Earth (3), GEOS 280, Programming and Data Analysis in the Earth Sciences (3), ISTA 130, Computational Thinking and Doing (3) 2. GEOS 251, Physical Geology (4) 3. GEOS 300, Earth Surface Processes (3) 4. GEOS 302, Stratigraphy and Sedimentation (4) 5. Capstone Theme: Research OR Internship (6)	20
	Total major core upper division units required	**No stipulated minimum UPD criteria, but approximately 13-UPD units designated within Core/Emph curriculum reqs**
	Total major core units required	20

XI. Requirements specific to the proposed emphasis. List the required emphasis core, electives, and any special conditions students must meet to complete the emphasis using the table below. Include the prefix, course

number, course title, and units for each course. Provide email(s)/letter(s) of support from home department head(s) for courses not owned by your department. Highlight and label (NEW) any new courses that must be developed for the emphasis. Add rows as needed.

Note: a proposed emphasis having similar curriculum with other plans (within department, college, or university) may require completion of a comparison chart. Total units required for each emphasis must be equal.

Requirement Title/Description	Courses (include prefix, number, title, units)	Minimum units needed to satisfy requirement
Emphasis Core	1. GEOS 306, Mineralogy (3) 2. GEOS 356, Petrology (4) 3. (NEW)GEOS 260, Introduction to Gems and Minerals (3) 4. GEOS 400, Introduction to Geochemistry (3) or GEOS 474/574, Geochronology-Thermochronology (3) 5. (NEW)GEOS 4XX, Petrology of Gems (3) 6. MSE 480, Advanced Characterization Methods in Materials Science and Engineering (3)	19
Emphasis Electives/ Approved Emphasis	Complete 13 units from the following list. - GEOS 400, Introduction to Geochemistry (3) or GEOS 474/574 Geochronology-Thermochronology (3) - GEOS 304, Structural Geology (4) - GEOS 446/546, Economic Mineral Deposits (3) - GEOS 408/508, Tectonic Petrology (3) - GEOS 427, Orogenic Systems (3) - MNE/ANTH 201, Nonrenewable Resources and Human Civilizations (3 or 4) - OPTI 201R, Geometrical and Instrumental Optics I (3) - OPTI 202R, Geometrical and Instrumental Optics II (3) - OPTI 201L, Geometrical and Instrumental Optics Lab I (1) - OPTI 202L, Geometrical and Instrumental Optics Lab II (1) - OPTI 210, Physical Optics I (3) - OPTI 330, Physical Optics II (3) - OPTI 340A, Introduction to Optical Design (1) - OPTI 340, Optical Design (3) - OPTI 484/584, Polarized Light and Polarimetry (3) - OPTI 404, Optical Spectroscopy of Materials (3) - OPTI 485/585, Illumination Engg. (3) - ART 237, 3D Modeling (3) - RCSC 214 (future 114), Introduction to Retailing and Consumer Science (3) - RCSC 340 (future 240), Consumer Behavior in Retailing (3) - RCSC 320, Product Development (3) - RCSC 360, Digital Retailing (3) - CHEM 325, Analytical Chemistry (2) - CHEM 326, Analytical Chemistry Lab (2) - CHEM 480A, Physical Chemistry I (3) - CHEM 480B, Physical Chemistry II (3)	13
	Total emphasis upper division units required	**No stipulated min. UPD, but approx. 55-UPD units of options to fulfill emphasis requirements**
	Total major emphasis units required*	32

*** All emphases offered for this major must have the same minimum number of units required**

XIII. Emphasis course/faculty information for existing courses. Complete the table below for all emphasis coursework. You can find information to complete the table using the UA course catalog or UAnalytics (Catalog and Schedule Dashboard> "Printable Course Descriptions by Department" On Demand Report; right side of screen). Provide email(s)/letter(s) of support from home department head(s) for courses not owned by your department. Add rows as needed.

Course prefix and number	Title	Course Description	Typically Offered (F, Sp, Su, W) and Frequency (every year, odd years, etc.)	Home Department	Faculty members available to teach the courses
MATH 125 OR MATH 122A AND B	Calculus I or Functions for Calculus, First-Semester Calculus	Introduction to calculus with an emphasis on understanding and problem solving. Concepts are presented graphically and numerically as well as algebraically. Elementary functions, their properties and uses in modeling; the key concepts of derivative and definite integral; techniques of differentiation, using the derivative to understand the behavior of functions; applications to optimization problems in physics, biology and economics. OR Elementary functions, their properties, and uses in modeling. A graphing calculator is required for this course. We recommend the TI-83 or TI-84 models. Calculators that perform symbolic manipulations, such as the TI-89, NSpire CAS, or HP50g, cannot be used. AND An introduction to first-semester calculus for engineering, science and math students, from rates of change to integration, with an emphasis on understanding, problem solving, and modeling. Topics covered include key concepts of derivative and definite integral, techniques of differentiation, and applications, using algebraic and transcendental functions. A graphing calculator is required for this course. We	Fall and Spring, every year OR Fall, Spring, Summer, every year AND Fall, Spring, Summer, every year	Mathematics Main	Spencer Nelson (MATH 125) Avinash Karamchandani (MATH 125) Darlayne Addabbo (MATH 125) Lisa-Marie Imbert-Gerard (MATH 125) Tonatiuh Sanchez-Vizuet (MATH 125) Stephen Reyes (MATH 125) Donna Krawczyk (MATH 125) Donna Krawczyk (MATH 122A) Tynan Lazarus (MATH 122A) Stephen Reyes (MATH 122A) Debra Wood (MATH 122A) Jocelyn Rios (MATH 122A) Bill Fries (MATH 122B) Jared McBride (MATH 122B) Kevin Childers (MATH 122B) John Awalt (MATH 122B) Jesse Friedbaum (MATH 122B) Samantha Kao (MATH 122B) Janice Takagi (MATH 122B) Ewa Romanowska (MATH 122B) Michael Gilbert (MATH 122B)

		recommend the TI-83 or TI-84 models. Calculators that perform symbolic manipulations, such as the TI-89, NSpire CAS, or HP50g, cannot be used. Examinations are proctored. Except as per University policy on repeating a course, credit will not be given for this course if the student has credit in a higher level math course. Such students may be dropped from the course.			Amber Thrall (MATH 122B) Kyle Priver (MATH 122B) Steven Foster (MATH 122B) Eric Elert (MATH 122B) Ethan O'Brien (MATH 122B) Christian Parkinson (MATH 122B) Weinan Wang (MATH 122B) Alexander Thomson (MATH 122B) Tynan Lazarus (MATH 122B) Stephen Reyes (MATH 122B)
MATH 129	Calculus II	Continuation of MATH 122B or MATH 125. Techniques of symbolic and numerical integration, applications of the definite integral to geometry, physics, economics, and probability; differential equations from a numerical, graphical, and algebraic point of view; modeling using differential equations, approximations by Taylor series. A graphing calculator is required for this course. We recommend the TI-83 or TI-84 models. Calculators that perform symbolic manipulations, such as the TI-89, NSpire CAS, or HP50g, cannot be used. Examinations are proctored.	Fall, Spring, Summer, every year	Mathematics Main	Aaron Ekstrom Gregory Johnson Nicole Fider Kirti Joshi Utkarsh Agarwal Theodore Laetsch Christine Duron Robert Sims Anton Izosimov Leonid Kunyansky Antonio Rubio Ning Hao Douglas Pickrell Debra Wood Jeremy Roberts
MATH 223	Vector Calculus	Math 223 Vector Calculus (4 semester credit hours) The course covers differential and integral calculus of functions of several variables. Topics include vector valued and scalar functions, partial derivatives, directional derivatives, chain rule, local optimization, double and triple integrals, the line integral, Green's theorem, Stokes' theorem and the Divergence theorem. Examinations are proctored.	Fall, Spring, Summer, every year	Mathematics Main	Mariamma Varghese Christopher Jewell May Yeap SungYoon Cho Madhav Kaushish Weihua Liu Ewa Romanowska Donna Krawczyk Aaron Wootton Eun Reeder Lee Swift

CHEM 151	General Chemistry I	Integrated lecture-lab course designed to develop a basic understanding of the central principles of chemistry that are useful to explain and predict the properties of chemical substances based on their atomic and molecular structure. Additionally, students will be introduced to modern laboratory techniques and participate in experimental activities that promote the development of basic and advanced science-process skills. The course is designed for students who require a strong foundation in general chemistry, such as science and engineering majors, pre-medical and pre-pharmacy students.	Fall, Spring, Summer, every year	Mathematics Main	Vicente Talanquer Lani Hidalgo Suchithranga Perera Adam Daly Amy Graham
MSE 110	Solid State Chemistry	Fundamental principles of the chemistry of condensed states of matter including metals, polymers, molecular solids and ceramics.	Fall, Spring	Material Sc and Engg	Andrew Wessman Pierre Lucas Andrew Wessman
PHYS 141	Mechanics	A first course in Newtonian mechanics; introduces freshman-level students to the statics and dynamics of point particles, rigid bodies, and fluids. Topics include vector algebra, projectile and circular motion, Newton's Laws, conservation of energy, collisions and conservation of momentum, rotational dynamics and conservation of angular momentum, statics, harmonic oscillators and pendulums, gravitation and Kepler's Laws, fluid statics and dynamics.	Fall, Spring, Summer, every year	Physics	Srinivas Manne Rohit Singh Charles Stafford
PHYS 142	Optics Thermodynamics	A freshman-level course in the fundamental properties of light and heat and related applications such as optical instruments and heat engines; introduces students to the propagation of light and heat. Topics include temperature scales and heat, laws of thermodynamics, basic kinetic theory of gases, heat engines, elementary wave theory and sound, light as an electromagnetic wave,	Fall, Spring, every year	Physics	Alex Burant Sumitendra Mazumdar

		geometrical optics, lenses and mirrors, physical optics, diffraction and interference, optical instruments.			
CSC 110	Introduction to Computer Programming I	An introduction to programming with an emphasis on solving problems drawn from a variety of domains. Topics include basic control and data structures, problem solving strategies, and software development tools and techniques.	Fall, Spring, Summer, every year	Computer Science Main	Benjamin Dicken
GEOS 251	Physical Geology	Introduction to Earth's materials; surface and internal geologic processes; plate tectonics; and geologic time. Includes practical experience in rock and mineral identification, topographic maps, and applied problems in geosciences.	Contact Department	Geosciences	George Gehrels Paul Kapp Mihai Ducea Peter Reiners Mauricio Ibanez-Mejia
GEOS 300	Earth Surface Processes	Introduction to landforms and sediment transport processes in hillslope, fluvial, aeolian, glacial, and coastal environments. Landform development in response to tectonics and climate. Natural hazards occurring on Earth's surface. Quantitative skills and techniques for working with and analyzing data will be emphasized.	Contact Department	Geosciences	Jon Pelletier Luke McGuire
GEOS 302	Principles of Stratigraphy and Sedimentation	Basic principles and methods of stratigraphic and sedimentologic analysis; sedimentation processes and depositional environments, facies relations, stratigraphic analysis and classification, correlation, and dynamics of basin fill.	Contact Department	Geosciences	Andrew Cohen
Capstone theme		Research/Lab experience – apprenticeship or internship at gem and mineral companies, Gemological Institute of America, UA Alfie Norville Gem and Mineral Museum, research labs at UA			
GEOS 306	Mineralogy	Covers principles of crystallography, crystal-chemistry, X-ray diffraction and optical mineralogy. Phase diagrams and phase transitions in the Earth's mantle. Systematic mineralogy. Atomic structure,	Fall, every year	Geosciences	Frank Mazdab

		and physical and optical properties of common rock forming minerals. Identification of minerals and determination of mineral compositions.			
GEOS 356	Petrology	Covers principles of Igneous and Metamorphic petrology; introductory concepts of phase equilibrium, thermodynamics and diffusion kinetics. Emplacement of igneous rocks; distribution, and origins of igneous and metamorphic rocks; rocks in their tectonic settings and implications. Principles of thermometry and barometry. Examination of rocks in hand specimen and thin section; electron microprobe analysis and applications to P-T-t calculations.	Spring, every year	Geosciences	Mihai Ducea, Ananya Mallik
GEOS 400	Introduction to Geochemistry	Covers nuclear systematics and thermodynamics with applications to geologic processes.	Fall, every year	Geosciences	Jay Quade
GEOS 474/574	Geochronology and Thermochronology	This class will familiarize students with principles of geochronology and thermochronology and applications in Earth and planetary sciences. Topics will include radioactive decay and growth, long- and short-lived radioisotope systems, analytical methods, determining dates and rates of a wide variety of events and processes, and the use of radiogenic isotopes as tracers in Earth and planetary processes.	Contact Department	Geosciences	Peter Reiners
MSE 480	Advanced Characterization Methods in Materials Science and Engineering	Covers an introduction, through a combination of lectures and laboratory experiences, to both established and new techniques for microstructural characterization of materials.	Spring, every year	Materials Science and Engineering	Pierre Lucas
GEOS 304	Structural Geology	Description, analysis, and mechanisms of rock deformation. Weekly laboratory assignments	Contact Department	Geosciences	Amanda Hughes

		focused on analysis and construction of geologic maps and cross sections, analysis of deformed rocks, and how rock deformation relates to tectonics.			
GEOS 446/546	Economic Mineral Deposits	Geology of metallic and nonmetallic ore deposits. Economic considerations, processes of formation, methods of study and exploration, and description of geologic aspects and settings of representative worldwide examples.	Contact Department	Geosciences	Mark Barton
GEOS 408/508	Tectonic Petrology	Applications of igneous and metamorphic petrology to the regional tectonic study of continents. Course will have a field trip.	Contact Department	Geosciences	Mihai Ducea
GEOS 427	Orogenic Systems	An analysis of the geology, geophysics, and geochemistry, and the tectonic evolution of selected world mountain systems ranging from currently active belts in both oceanic and continental settings back through Phanerozoic, Proterozoic, and into Archean time.	Contact Department	Geosciences	Susan Beck
MNE/ANTH 201	Nonrenewable Resources and Human Civilizations	Covers the availability and use of nonrenewable resources such as hydrocarbons, coal, metals, stone, and industrial minerals has shaped the development of human societies from the Stone Age to the present, and will continue to affect future humanity. This course explores the uneven natural distribution and varying abundance of nonrenewable resources in the world; how humans have extracted and used them over time; and how nonrenewable resource extraction and use have affected the development of world civilizations. Major themes of this course include resource exhaustion, technological substitution, the geopolitics of resources, and unintended social and environmental side effects of nonrenewable resource extraction and use.	Spring	Mining Engineering	Isabel Barton

OPTI 201R	Geometrical and Instrumental Optics I	Covers basic principles of geometric optics, refraction and reflection, Gaussian optics, paraxial optics, stops and pupils, simple optical instruments.	Fall, every year	Optical Sciences	Michael Nofziger
OPTI 202R	Geometrical and Instrumental Optics II	Covers optical instruments, field and relay lenses, telescopes, microscopes, optical materials, achromatization, illumination, cameras, projectors.	Spring, every year	Optical Sciences	John Greivenkamp
OPTI 201L	Geometrical and Instrumental Optics Lab I	This lab is designed to complement the major topics discussed in OPTI 201R, and it is recommended that these two courses be taken concurrently.	Fall, every year	Optical Sciences	Michael Nofziger
OPTI 202L	Geometrical and Instrumental Optics Lab II	This lab is designed to complement the major topics discussed in OPTI 202R, and it is recommended that these two courses be taken concurrently.	Spring, every year	Optical Sciences	Michael Nofziger
OPTI 210	Physical Optics I	Electromagnetic fields and waves; Fourier series and Fourier transforms; interference and diffraction.	Fall, every year	Optical Sciences	Dan Wilson
OPTI 330	Physical Optics II	Linear system theory, Fourier optics, image formation, interference, optical transfer function.	Spring, every year	Optical Sciences	Amit Ashok
OPTI 340A	Introduction to Optical Design	Use and application of optical design software CODE V.	Fall, every year	Optical Sciences	Yuzuru Takashima
OPTI 340	Optical Design	Use of optical design software, optical materials, aberrations, image evaluation, aberration balancing, design examples	Spring, every year	Optical Sciences	Yuzuru Takashima
OPTI 484/584	Polarized Light and Polarimetry	Polarized light and the Poincare sphere. Polarization in natural scenes and animal vision. Polarization elements: polarizers, retarders, and depolarizers. Jones and Mueller polarization calculus. Polarimetry: measuring the polarization properties of optical elements and materials. Polarization modulators and controllers. Polarization dependent loss and polarization mode	Spring, every year	Optical Sciences	Russell Chipman

		dispersion in fiber optics. Advanced polarization issues in optical devices and systems.			
OPTI 404	Optical Spectroscopy of Materials	The course provides a survey of Optical Spectroscopic Methods and underlying phenomena for the study of materials.	Spring, odd years only	Optical Sciences	Barrett Potter
OPTI 485/585	Illumination Engg.	Fields: Illumination, Nonimaging, and Concentrators; Sources: Incandescent, Fluorescent, LED, HID, Modeling, and Experimental Measurement; Modeling: Ray Tracing, Radiometry and Photometry, Color, Polarization, and Scattering; Theory: Radiometry, Photometry, Étendue, Skew Invariant, and Concentration; Design Methods: Edge Ray, Flow Line, Tailored Edge Ray, Non-Edge Ray, and Imaging; Optics: Reflectors, Lightpipes, Couplers, Films, and Hybrids; Applications: Displays, Automotive, Solar, Sources, and Lighting; Special Topics: Software Modeling, Optimization, Tolerancing, and Rendering.	Spring, every year	Optical Sciences	John Koshel
ART 237	3D Modeling	This course introduces fundamental theories, principles, and practices of 3D digital modeling, rendering, and fabrication. Students are given a thorough overview of 3D modeling techniques and sculptural considerations including: production of organic and geometric surfaces and forms, texturing, lighting, rendering, and physical output. Minimal materials fee for rapid prototyping assignment.	Fall, every year	Art	Joseph Farbrook
RCSC 214 (future 114)	Introduction to Retailing and Consumer Science	This course is designed to give a panoramic view of the many facets of the retailing industry through an exploration of all aspects of the retail planning and management model, strategic planning, consumer behavior and career options. We will focus on the changing nature of retailing today and	Fall, Spring, every year	Retailing and Consumer Science	Felicia Frontain

		the many complex issues facing retailers in the future.			
RCSC 340 (future 240)	Consumer Behavior in Retailing	Study of consumer behavior and the decision making processes involved when individuals or groups select, purchase, use or dispose of products and services to satisfy needs and desires; analysis of quantitative data using SPSS program.	Fall, Spring, every year	Retailing and Consumer Science	Sabrina Helm
RCSC 320	Product Development and Brand Strategies	Uses case studies to examine theories, applications, and scientific aspects of strategic brand management in retailing including building, measuring, and managing brand equity. Students will research, create, organize, and present a new product development concept and its brand strategy	Fall, Spring, every year	Retailing and Consumer Science	Lisette Rice
RCSC 360	Digital Retailing	Survey of digital retailing methods and practices for marketing products and services in direct-to-consumer business models. The course will cover website and mobile design, digital authoring and publishing tools, e-commerce business models, electronic merchandising theory, terminology, resources, and practices. Students will learn about digital commerce via applied learning activities and development of a fully-functional digital store.	Fall, every year	Retailing and Consumer Science	Kathleen Kennedy
CHEM 325	Analytical Chemistry	Principles of modern quantitative analysis, including consideration of stoichiometry, equilibrium principles, treatment of experimental data, titrimetric and photometric analysis, potentiometric analysis, and analytical separation processes.	Fall, Spring, every year	Chemistry and Biochemistry	Michael Marty
CHEM 326	Analytical Chemistry Lab	Experiments in modern quantitative analysis, including statistical analysis of data, acid/base equilibrium, gravimetric analysis, potentiometric analysis, analytical separations, spectroscopy, and mass spectrometry. Emphasis on data reporting and	Fall, Spring, every year	Chemistry and Biochemistry	Brian Zacher

		interpretation. Designed for chemistry majors.			
CHEM 480A	Physical Chemistry I	Fundamental principles of physical chemistry. The course is designed for undergraduate majors in chemistry, chemical engineering, biochemistry and the life sciences, and related majors. Topics covered include properties of solids, liquids, gases; thermodynamics; and chemical kinetics.	Fall, every year	Chemistry and Biochemistry	Ludwik Adamowicz
CHEM 480B	Physical Chemistry II	Fundamental principles of physical chemistry. Course design includes quantum mechanics; atomic and molecular structure; molecular spectroscopy; statistical mechanics and transport.	Fall, Spring, every year	Chemistry and Biochemistry	Ludwik Adamowicz

XIV. Emphasis course/faculty information for NEW courses. Complete the table below. Provide email(s)/letter(s) of support from home department head(s) for courses not owned by your department. Add rows as needed. Add rows as needed.

Course	Title	Course Description	Status*	Anticipated first term offered	Typically Offered (F, Sp, Su, W) and Frequency (every year, odd years, etc.)	Home Dept.	Faculty members available to teach the courses
GEOS 260	Introduction to Gems and Minerals	The course introduces students to the science of gems and minerals – introduction to minerals and gems, understanding gems as materials of geological significance, properties of gems and how to identify them, distinguishing natural and synthetic gems, introduction to gem simulants, and gem fashioning.	S	Fall 2021	F, every year	Geosciences	Ananya Mallik
GEOS 4XX	Petrology of Gems	Covers petrological processes of gem formation in different tectonic settings with the goal of developing exploration sites as well as the importance of	D	Spring 2022	Sp, every year	Geosciences	Ananya Mallik

		gems in academic research					

*In development (D); submitted for approval (S); approved (A)

XIV. Using the table below, list each faculty member who will contribute to the teaching of courses in this emphasis and the teaching FTE they will contribute. Add rows as needed.

Course(s)	Name	Department	Rank	Degree	Faculty/% effort
MATH 125	Spencer Nelson	Mathematics	Graduate Assistant	BA/BSc minimum	0.4
MATH 125	Avinash Karamchandani	Mathematics	Postdoctoral Research Associate I	PhD	0.4
MATH 125	Darlayne Addabbo	Mathematics	Postdoctoral Research Associate I	PhD	0.4
MATH 125	Lisa-Marie Imbert-Gerard	Mathematics	Associate Professor	PhD	0.4
MATH 125	Tonatiuh Sanchez-Vizuet	Mathematics	Assistant Professor	PhD	0.4
MATH 125	Stephen Reyes	Mathematics	Instructor	PhD	0.133
MATH 122B	Stephen Reyes	Mathematics	Instructor	PhD	0.133
MATH 122A	Stephen Reyes	Mathematics	Instructor	PhD	0.133
MATH 125	Donna Krawczyk	Mathematics	Senior Lecturer	PhD	0.133
MATH 122A	Donna Krawczyk	Mathematics	Senior Lecturer	PhD	0.133
MATH 223	Donna Krawczyk	Mathematics	Senior Lecturer	PhD	0.133
MATH 122A	Tynan Lazarus	Mathematics	Instructor	PhD	0.2
MATH 122B	Tynan Lazarus	Mathematics	Instructor	PhD	0.2
MATH 122A	Debra Wood	Mathematics	Senior Lecturer	PhD	0.2
MATH 129	Debra Wood	Mathematics	Senior Lecturer	PhD	0.2
MATH 122A	Jocelyn Rios	Mathematics	Graduate Assistant	BA/BSc minimum	0.4
MATH 122B	Bill Fries	Mathematics	Graduate Assistant	BA/BSc minimum	0.4
MATH 122B	Jared McBride	Mathematics	Graduate Assistant	BA/BSc minimum	0.4
MATH 122B	Kevin Childers	Mathematics	Postdoctoral Research Associate I	PhD	0.4
MATH 122B	John Awalt	Mathematics	Instructor	PhD	0.4
MATH 122B	Jesse Friedbaum	Mathematics	Graduate Assistant	BA/BSc minimum	0.4

MATH 122B	Samantha Kao	Mathematics	Instructor	PhD	0.4
MATH 122B	Janice Takagi	Mathematics	Instructor	PhD	0.4
MATH 122B	Ewa Romanowska	Mathematics	Senior Lecturer	PhD	0.2
MATH 223	Ewa Romanowska	Mathematics	Senior Lecturer	PhD	0.2
MATH 122B	Michael Gilbert	Mathematics	Instructor	PhD	0.4
MATH 122B	Amber Thrall	Mathematics	Graduate Assistant	BA/BSc minimum	0.4
MATH 122B	Kyle Priver	Mathematics	Graduate Assistant	BA/BSc minimum	0.4
MATH 122B	Steven Foster	Mathematics	Lecturer	PhD	0.4
MATH 122B	Eric Elert	Mathematics	Graduate Associate	BA/BSc minimum	0.4
MATH 122B	Ethan O'Brien	Mathematics	Postdoctoral Research Associate I	PhD	0.4
MATH 122B	Christian Parkinson	Mathematics	Postdoctoral Research Associate I	PhD	0.4
MATH 122B	Weinan Wang	Mathematics	Postdoctoral Research Associate I	PhD	0.4
MATH 122B	Alexander Thomson	Mathematics	Instructor	PhD	0.4
MATH 129	Aaron Ekstrom	Mathematics	Lecturer	PhD	0.4
MATH 129	Gregory Johnson	Mathematics	Graduate Assistant	BA/BSc minimum	0.4
MATH 129	Nicole Fider	Mathematics	Postdoctoral Research Associate I	PhD	0.4
MATH 129	Kirti Joshi	Mathematics	Associate Professor	PhD	0.4
MATH 129	Utkarsh Agarwal	Mathematics	Graduate Associate	BA/BSc minimum	0.4
MATH 129	Theodore Laetsch	Mathematics	Associate Professor	PhD	0.4
MATH 129	Christina Duron	Mathematics	Postdoctoral Research Associate I	PhD	0.4
MATH 129	Robert Sims	Mathematics	Associate Professor	PhD	0.4
MATH 129	Anton Izosimov	Mathematics	Assistant Professor	PhD	0.4
MATH 129	Leonid Kunyansky	Mathematics	Professor	PhD	0.4
MATH 129	Antonio Rubio	Mathematics	Instructor	PhD	0.4

MATH 129	Ning Hao	Mathematics	Associate Professor	PhD	0.4
MATH 129	Douglas Pickrell	Mathematics	Associate Professor	PhD	0.4
MATH 129	Jeremy Roberts	Mathematics	Graduate Assistant	BA/BSc minimum	0.4
MATH 223	Mariamma Varghese	Mathematics	Senior Lecturer	PhD	0.4
MATH 223	Christopher Jewell	Mathematics	Instructor	PhD	0.4
MATH 223	May Yeap	Mathematics	Lecturer	PhD	0.4
MATH 223	SungYoon Cho	Mathematics	Postdoctoral Research Associate I	PhD	0.4
MATH 223	Madhav Kaushish	Mathematics	Graduate Assistant	BA/BSc minimum	0.4
MATH 223	Weihua Liu	Mathematics	Postdoctoral Research Associate I	PhD	0.4
MATH 223	Aaron Wootton	Mathematics	Visiting Professor	PhD	0.4
MATH 223	Eun Reeder	Mathematics	Instructor	PhD	0.4
MATH 223	Lee Swift	Mathematics	Graduate Associate	PhD	0.4
CHEM 151	Vicente Talanquer	Chemistry and Biochemistry	Distinguished Professor	PhD	0.4
CHEM 151	Lani Hidalgo	Chemistry and Biochemistry	Lecturer	PhD	0.4
CHEM 151	Suchithranga Perera	Chemistry and Biochemistry	Instructor	PhD	0.4
CHEM 151	Adam Daly	Chemistry and Biochemistry	Assistant Professor of Practice	PhD	0.4
CHEM 151	Amy Graham	Chemistry and Biochemistry	Lecturer and Faculty Fellow	PhD	0.4
MSE 110	Andrew Wessman	Material Science and Engineering	Assistant Professor	PhD	0.4
MSE 110	Pierre Lucas	Material Science and Engineering	Professor	PhD	0.2
MSE 480	Pierre Lucas	Material Science and Engineering	Professor	PhD	0.2
PHYS 141	Srinivas Manne	Physics	Associate Professor	PhD	0.4
PHYS 141	Rohit Singh	Physics	Laboratory manager	PhD	0.4
PHYS 141	Charles Stafford	Physics	Professor	PhD	0.4

PHYS 142	Alex Burant	Physics	Lecturer	PhD	0.4
PHYS 142	Sumitendra Mazumdar	Physics	Professor	PhD	0.4
CSC 110	Benjamin Dicken	Computer Science	Lecturer	MS	0.4
GEOS 251	George Gehrels	Physical Geology	Professor	PhD	0.4
GEOS 251	Paul Kapp	Geosciences	Professor	PhD	0.2
GEOS 304	Paul Kapp	Geosciences	Professor	PhD	0.2
GEOS 356	Mihai Ducea	Geosciences	Professor	PhD	0.132
GEOS 408/508	Mihai Ducea	Geosciences	Professor	PhD	0.132
GEOS 251	Mihai Ducea	Geosciences	Professor	PhD	0.132
GEOS 400/500	Peter Reiners	Geosciences	Professor	PhD	0.132
GEOS 251	Peter Reiners	Geosciences	Professor	PhD	0.132
GEOS 474/574	Peter Reiners	Geosciences	Professor	PhD	0.132
GEOS 251	Mauricio Ibanez-Mejia	Geosciences	Assistant Professor	PhD	0.4
GEOS 300	Luke McGuire	Geosciences	Assistant Professor	PhD	0.2
GEOS 300	Jon Pelletier	Geosciences	Professor	PhD	0.2
GEOS 302	Andrew Cohen	Geosciences	Professor	PhD	0.4
GEOS 306	Frank Mazdab	Geosciences	Research Scientist	PhD	0.4
GEOS 356	Ananya Mallik	Geosciences	Assistant Professor	PhD	0.132
GEOS 260	Ananya Mallik	Geosciences	Assistant Professor	PhD	0.132
GEOS 4XX	Ananya Mallik	Geosciences	Assistant Professor	PhD	0.132
GEOS 400	Jay Quade	Geosciences	Professor	PhD	0.4
GEOS 304	Amanda Hughes	Geosciences	Assistant Professor of Practice	PhD	0.4
GEOS 446/546	Mark Barton	Geosciences	Professor	PhD	0.4
GEOS 427	Susan Beck	Geosciences	Professor	PhD	0.4
MNE/ANTH 201	Isabel Fay Barton	Mining and Geological Engineering	Assistant Professor	PhD	0.4
OPTI 201R	Michael Nofziger	Optical Sciences	Professor	PhD	0.132
OPTI 201L	Michael Nofziger	Optical Sciences	Professor	PhD	0.132
OPTI 202L	Michael Nofziger	Optical Sciences	Professor	PhD	0.132
OPTI 202R	John Greivenkamp	Optical Sciences	Professor	PhD	0.4
OPTI 210	Dalziel Wilson	Optical Sciences	Assistant Professor	PhD	0.4
OPTI 330	Amit Ashok	Optical Sciences	Associate professor	PhD	0.4
OPTI 340A	Yuzuru Takashima	Optical Sciences	Associate professor	PhD	0.2

OPTI 340	Yuzuru Takashima	Optical Sciences	Associate professor	PhD	0.2
OPTI 484/584	Russell Chipman	Optical Sciences	Professor	PhD	0.4
OPTI 404	Barrett Potter	Optical Sciences	Professor	PhD	0.4
OPTI 485/585	John Koshel	Optical Sciences	Professor	PhD	0.4
ART 237	Joseph Farbrook	School of Art	Associate Professor	PhD	0.4
RSCS 214 (future 114)	Felicia Frontain	Retailing and Consumer Science	Assistant Professor of Practice	PhD	0.4
RCSC 340 (future 240)	Sabrina Helm	Retailing and Consumer Science	Associate professor	PhD	0.4
RCSC 320	Lisette Rice	Retailing and Consumer Science	Professor of Practice	PhD	0.4
RCSC 360	Kathleen Kennedy	Retailing and Consumer Science	Associate Professor of Practice	PhD	0.4
CHEM 325	Michael Marty	Chemistry & Biochemistry	Assistant Professor	PhD	0.4
CHEM 326	Brian Zacher	Chemistry & Biochemistry	Instructor	PhD	0.4
CHEM 480A	Ludwik Adamowicz	Chemistry & Biochemistry	Professor	PhD	0.2
CHEM 480B	Ludwik Adamowicz	Chemistry & Biochemistry	Professor	PhD	0.2

XV. **Special conditions for admission to/declaration of this emphasis** – explain in detail the criteria to declare this emphasis, including GPA requirements, completion of courses prior to declaration, application process, interviews, etc. These conditions must be approved by faculty governance to be enforced.

- None for new freshmen or transfers to UA to declare. However, minimum 2.0 GPA for a current UA student to change into our major.

XVI. **Emphasis productivity** – provide a detailed plan in the case the emphasis does not attract the number of anticipated students and/or the new courses have low enrollments. Will emphasis courses continue to be offered as described in Section XIII and XIV or will students be offered alternative courses from outside the emphasis as substitutions? Is the department/school/college committed to offering the courses regardless of the emphasis productivity?

- We anticipate substantial enrollment in the emphasis (about 15 students per year). The student enrollment in the courses will not have an impact on the course offerings. All courses, except for the two new ones in Geosciences, are currently being offered outside of the emphasis and would continue to do so. The Geosciences department is committed to offering the two new courses regardless of the emphasis productivity.

XVII. **Do you want the emphasis name to appear on the transcript? ☒ Yes ☐ No**

XVIII. **Do you want the emphasis name to appear on the diploma? ☒ Yes ☐ No**

XIX. **Anticipated semester and year to launch the proposed emphasis:** Fall 2021

XX. **Number of new faculty hires required to deliver the emphasis: None (Ananya Mallik was recently hired as endowed chair of this emphasis)**

XXI. **Budgetary impact**– indicate new resources needed and source of funding to implement the proposed emphasis. If reallocating resources, indicate where resources will be taken from and the impact this will have on the students/faculty/program/unit.

- No resources are needed at this time but when and if the track will grow significantly, additional advising and teaching resources may be needed according to increased enrollment and additional revenue.

Decision process for approval will include:
1) efficiency of course offerings.
2) course offerings are appropriate and match the expertise of the faculty.
3) evidence of sufficient student demand.
3) no major conflict with existing programs.

XXII. Required signatures

Managing Unit Administrator (print name and title): Barbara Carrapa, Professor and Department Head of Geosciences

Managing Administrator's Signature: Barbara Carrapa Date: 01/14/2021

Managing Unit Administrator (print name and title): _____

Managing Administrator's Signature: _____ Date: _____

Dean (print name and title): Rebecca L. Gomez, Interim Associate Dean of Student Academic Success, CoS

Dean's Signature: _____ Date: 1/14/21

Dean (printed name and title): _____

Dean's Signature: _____ Date: _____

All programs that will be offered through distance learning and/or fully online must include the following signature. The signature of approval does not indicate a commitment to invest in this program. Any potential investment agreement is a separate process.

Joel Hauff, Associate Vice President Academic Initiatives and Student Success and Executive Director for Online and Distance Education Administration

Signature: _____ Date: _____

Note: In some situations, signatures of more than one unit head and/or college dean may be required.

For use by Curricular Affairs:

Committee	Approval date
Academic Programs Subcommittee	
Undergraduate Council	
College Academic Administrators Council	

☐ Create approval memo
☐ Send memo to college/dept and acad_org listserv
☐ Create emphasis code in UAccess, including secondary major emphasis code
☐ Upload approval memo and proposal documents to UAccess
☐ Notify acad_org of the plan code creation
☐ Notify ADVIP team, include proposers

THE UNIVERSITY OF ARIZONA
COLLEGE OF FINE ARTS
School of Art

SCHOOL OF ART
Art Building #2
1031 N. Olive Rd.
PO Box 210002
Tucson, AZ 85721-0002
Ofc: 520-621-7000
Fax: 520-621-2353
http://art.arizona.edu

M E M O

To: Curricular Affairs, Academic Administration
From: Colin Blakely, Director, School of Art
Date: October 2, 2020
Re: Gem Science Concentration

I am happy to offer approval for the inclusion of ART 237 3D Modeling in the Gem Science concentration of the Geosciences major. Please don't hesitate to contact me for additional information. We are excited to work with the Department of Geosciences on this program!

Sincerely,

Colin Blakely
Director
cblakely@arizona.edu

THE UNIVERSITY OF ARIZONA
COLLEGE OF SCIENCE
COLLEGE OF MEDICINE TUCSON
Chemistry
& Biochemistry

October 12, 2020

Dear Program Approval Committee,

The Department of Chemistry and Biochemistry wholeheartedly supports the establishment of a Gem Science emphasis option in the Geosciences program. We welcome their students in the upper-level chemistry elective courses in the program, including CHEM 325, CHEM 326, CHEM 480A, and CHEM 480B. These courses can easily accommodate the Geosciences students for the foreseeable future.

Sincerely,

Dee Belle-Oudry

Associate Head for Academic Affairs

JAMES C. WYANT
COLLEGE OF OPTICAL SCIENCES
Meinel Building
1630 E. University Blvd.
PO Box 210094
Tucson, AZ 85721-0094

Ofc: 520-626-6992
Fax: 520-626-4358

10 November 2020

Dear Prof. Ananya Mallik:

I am writing this letter in support of using Optical Sciences courses in the novel undergraduate Gem Sciences track in the Geosciences B.S. From our discussions, there are a number of courses that you have recognized that may prove useful in this sub-plan. Here is a listing of those course along with the details (note that I added OPTI 340A and OPTI 340 since the material in such is used to model the path of light through gemstones):

OPTI 201R	Geometrical & Instrumental Optics	Nofziger	Fall	3 units
OPTI 201L	Geometrical & Instrumental Optics Lab	Nofziger	Fall	1 unit
OPTI 202R	Geometrical & Instrumental Optics II	Greivenkamp	Spring	3 units
OPTI 202L	Geometrical & Instrumental Optics Lab II	Nofziger	Spring	1 unit
OPTI 210	Physical Optics	Wilson*	Spring	3 units
OPTI 330	Physical Optics II	Ashok	Spring	3 units
OPTI 340A	Introduction to Optical Design	Takashima	Fall	1 unit
OPTI 340	Optical Design	Takashima	Spring	3 units
OPTI 404	Optical Spectroscopy of Materials**	Potter	Spring	3 units
OPTI 484	Polarized Light and Polarimetry+	Chipman	Spring	3 units
OPTI 485	Illumination Engineering+	Koshel	Spring	3 units

* Dal Wilson is taking over the instruction of OPTI 210 Spring 2020 from Miroslav Kolesik.
** OPTI 404 is cross listed from the Department of Materials Science & Engineering course MSE 404 – likely you will be required to obtain their support since they own this course.
+ OPTI 484 and OPTI 485 convene with graduate versions of the course (584 and 585), which are also approved for your students.

Note that we have many other courses, which you can review at

https://www.optics.arizona.edu/academics/courses.

In addition to the courses listed above, we are open to students in your Gem Sciences track taking any of these additional courses. In Optical Sciences we are currently updating the prerequisites for our courses, especially the undergraduate ones. Also note, core 300- and 400-level courses typically require advanced standing in Engineering, but we are also looking into these requirements. We plan on having these updates in place for the Fall

JAMES C. WYANT
COLLEGE OF OPTICAL SCIENCES
Meinel Building
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Fax: 520-626-4358

2021 semester. Thus, all courses will have adjusted prerequisites and other requirements within the next nine months; however, some of the courses may still have prerequisites that cannot be removed. These prerequisites may include courses from other departments, especially Mathematics and Physics. In conclusion, after our update of course requirements, additional requirements may still be in place. We will inform you of updates as they happen.

We look forward to meeting and teaching your students in the Gem Sciences track. As we have discussed a number of faculty members in the Wyant College of Optical Sciences have been doing work in this field – from modeling with ray tracing, to analyzing with multiphoton microscopes developed in graduate-student research, to using gem materials in research, and to measuring optical properties of such materials. Your undergraduate students will be a welcome addition to the optics classroom. If you have any questions, do not hesitate to contact me.

Cheers,

R. John Koshel
Associate Dean, Undergraduate Affairs and Professor
jkoshel@optics.arizona.edu
520.621.6357

THE UNIVERSITY OF ARIZONA
COLLEGE OF ENGINEERING
Department of Materials Science and Engineering

Sept. 22, 2020

To: Ananya Mallik
Assistant Professor
Office: GS 538
Department of Geosciences
University of Arizona
1040 E 4th Street
Tucson, AZ 85721-0077

From: Pierre A. Deymier
Head and Professor
Department of Materials Science and Engineering
University of Arizona
Tucson AZ 85721

Re: MSE 480 (Advanced Characterization Methods) as requirement for the undergraduate emphasis on Gem Science within the Geosciences major.

The Department of Materials Science and Engineering (MSE) strongly supports the inclusion of MSE480 in your Gem Science emphasis. For your students, we will override the advance engineering standing (which is currently a requirement). Also, we welcome your students in MSE110 (Solid State Chemistry) which is a prerequisite for MSE480.
We are looking forward supporting your program and further cooperation between Geosciences and MSE.

THE UNIVERSITY OF ARIZONA
COLLEGE OF ENGINEERING
Mining & Geological Engineering

Lowell Institute for Mineral Resources

1235 E James E. Rogers Way
P.O. Box 210012
Tucson / AZ / 85721-0012
(P) 520.621.6063
(F) 520.621.8330
http://mge.arizona.edu
http://minerals.arizona.edu

Wednesday September 29, 2020

Subject: Gem Science Track Proposal

Dear Professor Mallik,

It gives me pleasure to provide this letter of support for your proposed undergraduate emphasis on Gem Science and the inclusion of Professor Isabel Barton's MNE 201 – Nonrenewable Resources and Human Civilizations course as one of the approved options/electives. I think the Gem Science emphasis will be well received by students in all colleges on campus. Please let me know if I can help in way.

Sincerely,

Moe Momayez, PhD
Associate Professor and Interim Department Head
David & Edith Lowell Chair in Mining and Geological Engineering
The University of Arizona
moe.momayez@arizona.edu
520-621-6580

Retailing and Consumer Science
Norton School of Family and Consumer Sciences
The University of Arizona
McClelland Park
650 North Park Avenue, Suite 406
Tucson, Arizona 85721

November 12, 2020

Dr. Barbara Carrapa
Professor and Department Head
Dept. of Geosciences, University of Arizona
1040 E. 4th Street Tucson, AZ 85721,

Rebecca Gomez
Interim Associate Dean, Student Academic Success
College of Sciences

Re.: Inclusion of RCSC Courses in Gem Sciences Emphasis/Track

Dear Dr. Carrapa and Dr. Gomez,

This memo is to grant permission for including the course(s) listed below from the Norton School of Family and Consumer Sciences in the proposed curriculum for an undergraduate track/emphasis in Gem sciences within the Geosciences major. The RCSC Faculty agree to give regular access to these course(s) until withdrawn in writing to students in the proposed Geosciences - Gem Science track:

- RCSC 214 (RCSC114 in future course modification)– Introduction to Retailing and Consumer Science
- RCSC 340 (RCSC240 in future course modification) – Consumer Behavior in Retailing
- RCSC 320 – Product Development
- RCSC 360 – Digital Retailing

We look forward to having these students in our courses alongside our RCSC majors and minors.

Sincerely,

Scott Hessell
Program Chair, Retailing and Consumer Science
2020-2021