APPLICATION FOR NEW COURSE

1. Submitted by the College of Arts and Sciences Date: 23 February 2009

   Department/Division proposing course: Earth and Environmental Sciences

2. Proposed designation and Bulletin description of this course:

   a. Prefix and Number GLY 626

   b. Title* Gravity and Magnetic Methods

   *If title is longer than 24 characters, offer a sensible title of 24 characters or less: Gravity & Magnetics

   c. Courses must be described by at least one of the categories below. Include number of actual contact hours per week..

   (____) CLINICAL (____) COLLOQUIUM (____) DISCUSSION (____) LABORATORY (3) LECTURE
   (____) INDEPEND. STUDY (____) PRACTICUM (____) RECITATION (____) RESEARCH (____) RESIDENCY
   (____) SEMINAR (____) STUDIO (_____) OTHER – Please explain:

   d. Please choose a grading system: ☒ Letter (A, B, C, etc.) ☐ Pass/Fail

   e. Number of credit hours: 3

   f. Is this course repeatable? YES ☐ NO ☒ If YES, maximum number of credit hours: _____

   g. Course description:

   Theory and practice of the gravity and magnetic methods of geophysical exploration as applied to geological, archeological, environmental, and planetary exploration problems. The course includes principles of instrumentation, surveying, reduction of anomalies, and their interpretation.

   h. Prerequisite(s), if any:

   MA 113, MA 114; PHY 211 and PHY 213 or PHY 231 and PHY 232; or consent of instructor.

   MA 114 and PHY 213 or 232 may be taken concurrently.

   i. Will this course also be offered through Distance Learning? YES ☐ NO ☒

   If YES, please check one of the methods below that reflects how the majority of the course content will be delivered:

   Internet/Web-based ☐ Interactive video ☐ Extended campus ☐

3. Supplementary teaching component: ☒ N/A or ☐ Community-Based Experience ☐ Service Learning ☐ Both

4. To be cross-listed as: N/A
   Prefix and Number

   _____ / _____
   printed name Cross-listing Department Chair signature

5. Requested effective date (term/year): Fall / 2010

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6. Course to be offered (please check all that apply): ☒ Fall ☐ Spring ☐ Summer

7. Will the course be offered every year? ☐ YES ☒ NO
If NO, please explain: Alternate years; generally over a two year period there is likely to be sufficient number of graduate students in geology and geophysics program wanting to take this course.

8. Why is this course needed?
This course is an integral part of graduate geophysics curriculum worldwide. Prior to the arrival of Prof. Ravat, who is an expert in this area, the staff in the department of Earth & Environmental Sciences did not have expertise in this area and therefore the course could not be offered. Gravity and magnetic methods are used widely in solving problems related to geological, archeological, environmental, mining, petroleum, and planetary exploration. All geophysics graduate students and many geology graduate students will take this course.

9. a. By whom will the course be taught? Dhananjay Ravat

b. Are facilities for teaching the course now available? ☒ YES ☐ NO
If NO, what plans have been made for providing them?

10. What yearly enrollment may be reasonably anticipated?
6-7 students every two years

11. a. Will this course serve students primarily within the department? ☒ Yes ☐ No

b. Will it be of interest to a significant number of students outside the department? ☒ YES ☐ NO
If YES, please explain.
The course material is of interest to archeology, civil engineering, and physics students.

12. Will the course serve as a University Studies Program course†? ☐ YES ☒ NO
If YES, under what Area?
†AS OF SPRING 2007, THERE IS A MORATORIUM ON APPROVAL OF NEW COURSES FOR USP.

13. Check the category most applicable to this course:

☒ traditional – offered in corresponding departments at universities elsewhere

☐ relatively new – now being widely established

☐ not yet to be found in many (or any) other universities

14. Is this course applicable to the requirements for at least one degree or certificate at UK? ☐ Yes ☒ No

15. Is this course part of a proposed new program? ☐ YES ☒ NO
If YES, please name:

16. Will adding this course change the degree requirements for ANY program on campus? ☐ YES ☒ NO

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If YES‡, list below the programs that will require this course:

‡In order to change the program(s), a program change form(s) must also be submitted.

17. ☒ The major teaching objectives of the proposed course, syllabus and/or reference list to be used are attached.

18. ☐ Check box if course is 400G or 500. If the course is 400G- or 500-level, *you must include a syllabus showing differentiation* for undergraduate and graduate students by (i) requiring additional assignments by the graduate students; and/or (ii) the establishment of different grading criteria in the course for graduate students. (See *SR 3.1.4)*

19. Within the department, who should be contacted for further information about the proposed new course?

Name: Dhananjay Ravat Phone: 257-4726 Email: dhananjay.ravat@uky.edu (preferred)

20. Signatures to report approvals:

25 March 2009	Dhananjay Ravat	/	Dr Ravat
DATE of Approval by Department Faculty	printed name	Reported by Department Chair	signature
Feb 9, 2010	Anna R. K. Bosch	/	ARKBosch
DATE of Approval by College Faculty	printed name	Reported by College Dean	signature
		/	
* DATE of Approval by Undergraduate Council	printed name	Reported by Undergraduate Council Chair	signature
	Jeannine Blackwell	/ 2010.04.19 15:54:59 -04'00'	
* DATE of Approval by Graduate Council	printed name	Reported by Graduate Council Chair	signature
		/	
* DATE of Approval by Health Care Colleges Council (HCCC)	printed name	Reported by Health Care Colleges Council Chair	signature
* DATE of Approval by Senate Council		Reported by Office of the Senate Council	
* DATE of Approval by University Senate		Reported by Office of the Senate Council	

*If applicable, as provided by the *University Senate Rules.* (http://www.uky.edu/USC/New/RulesandRegulationsMain.htm)

GLY 626: Gravity and Magnetic Methods

Time/Place: TR: 11:00 am - 12:15 pm and W: 2:00-2:50 pm (as necessary), Room 203 Slone

Instructor: Prof. D. Ravat **Email: dhananjay.ravat at uky.edu**
Office phone: (859) 257-4726 **Office address: 305 Slone (inside office)**
Preferred method on contact: by e-mail **Office Hours:** MT: 3:30-5:00 p.m.

Overview & *Objectives*:

This course is an introduction to the basic theory and application of the gravity and magnetic methods in geophysics. It is designed for geology and geophysics graduate students as well as other science or engineering students without prior formal instruction in geology or geophysics. *Students who have taken this course will be able to understand the basic theory in gravity and magnetics, collect field data with modern instrumentation, work with basic methods and computer programs for processing and interpretation, and apply these tools to solve geologic, petroleum exploration, mining, archeological, environmental, engineering and planetary geophysics problems that can be addressed by these methods.*

Prerequisites: Consent of the instructor.

Organization: Two class periods each of 75 minutes in length, fieldwork and reports, and homework.

Grade: A- ≥ 80%, B ≥ 70% , C – ≥ 60%, E - < 60% (Even though the grade cutoffs may appear lower compared to other courses, the past experience shows that getting an A will require a lot of hard work because of the number and types of assignments in the course. Getting an A will require completion of all assignments/labs, exams, fieldwork participation, data analysis, interpretation and the report in a manner that shows that the student has excelled in meeting the objectives of the course.)
Two exams – ~50%
Homework and laboratory computer exercises – ~30%
Fieldwork (Supervised): required; minimum two Saturdays and additional as necessary) and a journal publication type written report – ~ 15%
Class Participation – 5%

Students are encouraged to come and talk to me about any difficulties in the course - at least once every couple of weeks. Students are encouraged to discuss with me any difficulties with assignments.

Textbooks: There is really no completely appropriate textbook available for this class. Book #2 is not in print and outdated other than basic principles and basic interpretation, but is very readable and easy to understand. Book #1 below contains the needed information, but is somewhat more mathematical for the purposes of this course. Alternatively, and to a certain extent, one can also learn part of the subject from some of the other introductory geophysics books. A couple of them are recommended below:

1) **(Blakely)** Potential Theory in Gravity & Magnetic Applications by Richard J. Blakely, Cambridge, 1995.
2) **(Nettleton)** Gravity and Magnetics in Oil Prospecting by L.L. Nettleton, McGraw-Hill, 464 p., 1976. (This is not in print, and some of it is now outdated, but this

book contains some of the clearest and best exposition of basic principles and concepts for some of the topics. This is assigned as a supplementary text for aiding comprehension of most concepts.)

3) **(Butler)** Paleomagnetism: Magnetic Domains to Geologic Terranes by R.F. Butler, Electronic Edition, 2004.

Appropriate chapters from other introductory geophysics books:

- Introduction to Applied Geophysics, by H. Robert Burger, Anne F. Sheehan, Craig H. Jones, W. W. Norton & Company, 554 p., 2006.
- Sharma, P.V., Environmental and engineering geophysics, Cambridge University Press, Cambridge, 475p., 1997.

*** See also the selected books reference list ***

Tentative Lecture/Laboratory Schedule:

Week	Topic	Reading and Homework (HW) (additional reading will be announced as necessary)
1	Introduction to Gravity and Magnetics	Blakely: Ch. 1 *Nettleton*: Ch. 1 & 2 **HW**: San Luis Obispo Map Sheet interpretation
2	Fundamentals of the gravity method	Nabighian et al. (2005a) Blakely: Ch. 3 *Nettleton:* Ch. 3
3	Acquisition and Reduction of Gravity Data	Blakely: Ch. 7 (pp.128-142) *Nettleton*: Ch. 4 & 5 **Gravity Fieldwork (Saturday)**
4	Different types of gravity anomalies, their significance and utility	Blakely: Ch. 7 (pp. 142-153) Li and Götze (2001) *Nettleton*: Ch. 7 **HW**: Anomaly reduction & calculations
5	Rock densities; Ambiguity in potential fields; Forward Modeling **LAB:** Gravity anomaly forward modeling using Computer Programs GM-SYS/Geosoft Oasis-Montaj	**HW:** Ambiguity Blakely: pp. 182-195
6	Techniques in gravity interpretation (Isolation, Preliminary interpretation)	*Nettleton*: Ch. 8 **HW:** Simple Interpretation
7	Geophysical Inversion of Gravity Data **Exam 1 Gravity**	Blakely: Ch. 10
8	Fundamentals of the magnetic method, Similarities and Differences between the gravity and magnetic methods	Blakely: Ch. 8, Butler: Ch. 1 Nabighian et al. (2005b) *Nettleton*: Ch. 10, 11, & 12
9	Basics of Rock Magnetism	Butler: Ch. 2 *Nettleton:* Ch. 14
10	Acquisition and Reduction of Magnetic Data – Modern practice	*Nettleton*: Ch. 13 [for basic and early field methods]

		Magnetics Fieldwork (Saturday)
11	Introduction to Signal Processing in Geophysics **LAB:** Potential field data filtering using OASIS-Montaj software Package	Blakely: Ch. 12 *Nettleton*: Ch. 6 [for *early* methods]
12	Interpretation of Magnetic Anomalies	*Nettleton*: Ch. 15
13	Combined Gravity And Magnetic Analysis and Interpretation	*Will be assigned*
14	Class project: Problem resolution with the methods, discussion, and interpretation of class project data	
15	Modern Magnetic Source Interpretation Methods: Euler, Tilt-Depth, Curie Temperature Depth Determination Methods of Magnetic Interpretation	*Will be assigned*
16	**Exam 2 Magnetics (Finals Week)**	--

SELECTED BOOKS, COLLECTIONS, AND REFERENCES ON INTRODUCTORY GRAVITY AND MAGNETICS IN GEOPHYSICS

* Blakely, R.J., 1995, Potential Theory in Gravity and Magnetic Applications, Cambridge Univ. Press, Cambridge, 300pp. (G&M)

Butler, R.F., 2004, Paleomagnetism: Magnetic Domains to Geologic Terranes, Electronic Edition. (M)

Dehlinger, Peter, 1978, Marine Gravity, Elsevier Scientific Pub. Co., New York, 322 p. (G)

* Gibson, R.I. and Millegan, P.S., editors, 1998, Geologic Application of Gravity and Magnetics: Case Histories, SEG Geophysical References Series, No. 8, AAPG studies in Geology #43, Published jointly by the SEG and AAPG. (G&M - collection of useful articles illustrating the concepts)

Grant, F.S., and G.F. West, 1965, Interpretation Theory in Applied Geophysics, McGraw-Hill Education, 583p. (G&M)

Hinze, W.J. (Ed.), 1985, The utility of the regional gravity and magnetic anomaly maps, Soc. Exploration Geophys., 454p. (G&M - collection of papers with useful concepts)

Li, X. and H.-J. Götze, 2001, Ellipsoid, geoid, gravity, geodesy, and geophysics, Geophysics, 66, 1660-1668. (G)

Li, X. and H.-J. Götze, 2002, Errata to Li and Götze, 2001, Geophysics, 67, p.997; DOI 10.1190/1.1489656 031203. (G)

Nabighian, M. N., M. E. Ander, V. J. S. Grauch, R. O. Hansen, T. R. LaFehr, Y. Li, W. C. Pearson, J. W. Peirce, J. D. Phillips, and M. E. Ruder, 2005a, Historical development of the gravity method in exploration, Geophysics, 70, p. 63ND–89ND, DOI: 10.1190/1.2133785. (G)

Nabighian, M. N., V. J. S. Grauch, R. O. Hansen, T. R. LaFehr, Y. Li, J. W. Peirce, J. D. Phillips, and M. E. Ruder, 2005b, The historical development of the magnetic method in exploration, Geophysics, 70, p. 33ND-61ND. DOI: 10.1190/1.2133784. (M)

Merrill, R.T., and M.W. McElhinny,1983, The Earth's Magnetic Field: Its history, origin, and planetary perspective, Academic Press, 401p. (M)

Nettleton, L.L., 1971, Elementary Gravity and Magnetics for Geologists and Seismologists, SEG Mono., No. 1, 121 p. (G&M)

* Nettleton, L.L., 1976, Gravity and Magnetics in Oil Prospecting, McGraw-Hill, 464 p. (G&M)

Parkinson, W.D., 1983, Introduction to Geomagnetism, Elsevier, 433p. (M)

Telford, W.M., L.P. Geldart, R.E. Sheriff, and D.A. Keys, 1985?, Applied Geophysics, Cambridge Univ. Press. (G&M & other topics)

Vacquier, V., N.C. Steenland, R.G. Henderson, and I. Zietz 1951, Interpretation of Aeromagnetic Maps, Geological Society of America, Memoir 47, 151p. (M)

Course Policy on Academic Accommodations due to disability: If you have a documented disability that requires academic accommodations, please see me as soon as possible during scheduled office hours. In order to receive accommodations in this course, you must provide me with a Letter of Accommodation from the Disability Resource Center (Room 2, Alumni Gym, 257-2754, email address jkarnes@email.uky.edu) for coordination of campus disability services available to students with disabilities.

Course Policy for Attendance:
Attendance is required and class participation grade will serve as a reflection of the attendance. Excused absences will be given at instructor's discretion only with proof as defined by S.R. 5.2.4.2. [http://www.uky.edu/Ombud/policies.php S.R. 5.2.4.2 defines the acceptable reasons for excused absences.]
For further information see http://www.uky.edu/StudentAffairs/Code/part2.html 5.2.4 – Academic Standards

Attendance and Completion of Assignments 5.2.4.1
Excused absences: 5.2.4.2 – see for definitions
Make-up opportunities:
The instructor shall give the student an opportunity to make up the work and/or the exam missed during an excused absence…" implies the student shall not be penalized for the excused absence.
Verification of absences:
Students missing work due to an excused absence bear the responsibility of informing the instructor about their excused absence within one week following the period of the excused absence (except where prior notification is required), and of making up the missed work.

Course Policy for Submission of Assignments:
Assignments must be neatly typed or hand-written (as appropriate for the assignment), clearly labeled, the arguments and reasons must be well-articulated and complete. Deadlines for assignments will be specified when the assignments are given (generally, within one or two weeks, as appropriate for the assignment).

Course Policy on Academic Integrity:
All assignments, projects, and exercises completed by students for this class should be the product of the personal efforts of the individual(s) whose name(s) appear on the corresponding assignment. Even a slightly modified single sentence from any resource (even with citation) can be considered plagiarism. If you are not sure if something constitutes plagiarism, ask your professors ahead of time! Misrepresenting others' work as one's own in the form of cheating or plagiarism is unethical and will lead to those penalties outlined in the University Senate Rules (6.3.1 & 6.3.2) at the following website: http://www.uky.edu/USC/New/rules_regulations/index.htm. The Ombud site also has information on plagiarism found at http://www.uky.edu/Ombud.

Course Policy on Classroom civility and decorum:
The university, college and department has a commitment to respect the dignity of all and to value differences among members of our academic community. There exists the role of discussion and debate in academic discovery and the right of all to respectfully disagree from time-to-time. Students clearly have the right to take reasoned exception and to voice opinions contrary to those offered by the instructor and/or other students (S.R. 6.1.2). Equally, a faculty member has the right -- and the responsibility -- to ensure that all academic discourse occurs in a context characterized by respect and civility. Obviously, the accepted level of civility would not include attacks of a personal nature or statements denigrating another on the basis of race, sex, religion, sexual orientation, age, national/regional origin or other such irrelevant factors.

Course Policy for Group work & student collaboration:
Other than fieldwork, there is no group work involved in the course. All assignments and labs must be done independently. Students should discuss with the professor directly any difficulties with assignments.