Core Curriculum Supplement

Academic Unit / Office EAS **Catalog Year of Implementation** 2018-2019

Course (Prefix / Number) GEOL / 1370 **Course Title** Natural Disasters

Core Proposal Request

☒ Add to Core Curriculum ☐ Revise course already in Core Curriculum

	Current Core Categorization (New additions: select N/A for this column)	**Proposed Categorization for Upcoming Core**
Foundational Component Area (required)	N/A (Not currently a Core course)	Life and Physical Sciences (30)
Component Area Option (optional)	N/A (No Component Area Option)	N/A (No Component Area Option)
Category Listing: Single or Double?	N/A (Not currently a Core course)	List under the Foundational Component Area ONLY.

Core Proposal Rationale - Please provide a rationale for including, or continuing to include, this course in the UH Core Curriculum:

The purpose of this course is to inform students about the science of natural disasters by focusing on in-depth analyses of common natural hazards and disasters. Though other courses within the GEOL subject touch upon some basic information about a select few disasters, they are not studied in detail. This course will be organized to focus on the scientific causes of disasters and the geologic background of areas that are susceptible to certain types of disasters.

Core Objectives *(see THECB Core objectives)*

☒ Critical Thinking ☒ Teamwork

☒ Communication ☐ Social Responsibility

☒ Empirical & Quantitative Skills ☐ Personal Responsibility

Please explain how the Core Objectives selected above will be met:

Critical Thinking – Through lectures and graded work, students should be able to look at the geologic setting of an area and determine which natural disasters are likely to occur there. Their understanding of the science behind natural disasters should lead to critical thought about what could make the disaster worse or lessen the effects of, how realistic or accurate predictions are, and make critical decisions based on quantitative data and geologic background of an area for hypothetical disasters.

Communication – Students will practice their written and oral communications skills through written assignments, exams, and a group term paper and presentation.

Empirical & Quantitative Skills – The homework assignments for this course will primarily focus on recorded natural disasters where students will be presented with measurements and data sets in order to answer questions. Students will need to plot data on graphs or interpret already made graphs, perform calculations, and learn how to find scientific data on the internet.

Teamwork – Students will work in groups to complete a term paper and oral presentation about a recent natural disaster. See attached syllabus draft.

When submitting this proposal form, please remember to attach a syllabus, learning objectives, and/or sample lesson(s).

GEOL1370: Natural Disasters – Fall 2018
syllabus rough draft

Course Description
The scientific study of the geology, meteorology, oceanography, and climatology of common natural disasters.

Student Learning Outcomes
By completing this course, students will be able to:

- Demonstrate basic scientific understanding of the causes of natural disasters through reading, written assignments, and lecture.
- Compare and contrast geologic settings and recognize which natural disasters are likely to occur and why.
- Improve critical thinking and quantitative skills through completion of written assignments, such as calculating recurrence intervals for disasters
- Analyze and interpret quantitative data sets to assess natural disaster strength, location, velocity, and/or other characteristics
- Develop and improve communication and teamwork skills through group paper and presentation.

Textbook
Natural Hazards by Edward A. Keller and Duane E. DeVecchio, 4th edition, 2014, ISBN 9780321939968

Exams: There will be 2 non-cumulative exams during the semester and will only cover new material leading up to the exam (i.e. Exam 2 does not have material from exam 1). These exams will assess your scientific knowledge and understanding of natural hazard topics covered in class.
Homework: There will be six (6) homework assignments through the semester.
Group paper and presentation: Each group will need to research a natural disaster event, including the science behind the cause of the disaster, the basic geology of the location and why it is prone to that type of disaster, recurrence interval for that disaster, a description of what happened, and other relevant information. 5-page paper and 10 minute group presentation.

Schedule (dates are modeled after fall 2017 semester)

Week	Date	Topic	Reading
1	8/22	Introduction	Ch. 1
	8/24	Assessing Hazards and Risk **HW 1 – Disaster info on the internet**	Ch. 1
2	8/29	Internal Structure of the Earth	Ch. 2
	8/31	Plate Tectonics	Ch. 2
3	9/5	Earthquakes: Causes, detection, measurements **HW 1 due**	Ch. 3

	9/7	Earthquakes: Causes, detection, measurements **HW 2 - Earthquakes**	Ch. 3
4	9/12	Earthquake hazards, risk, prediction	Ch. 3
	9/14	Case studies: recent and historic earthquakes **HW 2 due**	Ch. 3
5	9/19	Tsunamis	Ch. 4
	9/21	Volcano introduction, types of volcanoes, magma, and eruptions	Ch. 5
6	9/26	Types of volcanoes, magma, and eruptions **HW 3 – Volcanoes**	Ch. 5
	9/28	Volcanic hazards, prediction, benefits	Ch. 5
7	10/3	Case studies: recent and historic volcanic eruptions	Ch. 5
	10/5	**Midterm** **HW 3 due**	Ch. 1-5
8	10/10	Introduction to rivers	Ch. 6
	10/12	River flooding **HW 4 – Flooding recurrence**	Ch. 6
9	10/17	Flooding hazards, mitigation	Ch. 6
	10/19	Case study: Recent flooding **HW 4 due**	Ch. 6
10	10/24	Mass wasting introduction, causes **HW 5 – Mass movement**	Ch. 7
	10/26	Slope stability, hazards, recent events	Ch. 7
11	10/31	Subsidence, dissolution and sinkholes **HW 5 due**	Ch. 8
	11/2	The ocean-atmosphere system	Ch. 9 and 12
12	11/7	Thunderstorms and tornadoes **HW 6 - Weather**	Ch. 9
	11/9	Tropical cyclones (hurricanes)	Ch.
13	11/14	Coastal hazards **HW 6 due**	Ch.
	11/16	Meteorites and impact events	Ch.
14	11/21	Extinctions	Ch.
	11/23	**Thanksgiving – No Class**	
15	11/28	Disaster presentations	
	11/30	Disaster presentations	
16	12/7	**Exam 4 – 8:00am-11:00am**	

Flooding exercise example:

This exercise will introduce you to the techniques that geologists use to predict stream floods as well as experience in working with larger data sets in Excel. You will construct a flood-frequency curve for Buffalo Bayou from data supplied in the excel file on Blackboard. You will rank the discharges, calculate the recurrence interval for each flood, and plot the recurrence intervals against the discharges. Then, you will be able to answer questions about the predicted discharges for large floods and their expected frequency of occurrence.

Introduction: It is normal for streams to flood, however damage is often considerable in populated areas. Damage caused by stream flooding amounts to several billion dollars annually in the United States. In fact, the flooding from May 2015 caused about $1 billion worth of damage in Texas alone. These losses can be prevented if buildings are constructed outside the flood plain, or if dikes, artificial levees, retention ponds, and other drainage-control modifications are built to control flooding. Either solution requires that planners be able to predict the recurrence interval and discharge of stream floods. If this information is known, then geographic restrictions can be placed on construction inside flood plains, or flood-control structures can be built to the proper height to protect property already existing inside flood plains. A stream's flood discharge is simply the amount of water, measured in cubic feet per second (cfs) that passes a point on the stream during a flood. This amount is far greater than the normal stream discharge. For Buffalo Bayou, the normal discharge is between 100 and 200 cfs (lower during extended dry periods). The highest recorded discharge was ~40,000 cfs.

A stream's flood frequency is given by the stream's flood recurrence interval, which is defined as the average interval of time, in years, a flood of a given discharge or larger will occur. For example, a flood having a recurrence interval of 10 years is one that has a 10% chance of occurring in any year. A flood having a recurrence interval of 100 years has a 1% chance of occurring in any year; a flood of this magnitude is called a 100-year flood, and would occur, on average when measured over many centuries, about once every 100 years. It is important to calculate the predicted discharge of a 100-year flood for any stream on whose floodplain structures will be built since planners usually use this number as a reasonable limit for flood plain management. The reasoning is as follows: It is reasonable and prudent to allow construction in areas that will only be flooded, on average, about once every 100 years Another way to state this is the following: There is only a 1% chance each year that structures will be damaged or destroyed if constructed on a 100-year floodplain, and this chance is a reasonable and prudent level of risk that is acceptable to governments and insurance companies. Of course, it would be even better to place structures outside of even this 100-year floodplain, but this is often not practical, especially in urban conditions.

Calculations of flood frequency (recurrence interval) can be made in a systematic manner if records of the annual peak floods of a stream have been kept. Since a flood can vary greatly at different points along a stream as the flood moves downstream, "annual peak flood" refers to the peak discharge for each year at a recording station, and a major stream would have several recording stations. In our problem, we will consider only a single recording station over a period of 70 years. The recurrence interval **R** for a flood of a given discharge is calculated by the following equation:

$$R = (N + 1)/m$$

in which **m** is the rank of the annual peak stream discharge and **N** is the number of years of record. In our problem, N = 70.

What you need to do:

1. Head to our Blackboard page, under "Homework" download the file called "Buffalo Bayou Peak Discharges.xlsx. This file contains yearly peak discharge measurements for Buffalo Bayou, taken from USGS gauge 08074000 at the intersection of Shepherd Dr. and Allen Pkwy/Kirby Dr. The first column is the date of the peak discharge that year, and the second column is the discharge measurement in cubic feet per second (cfs).
2. Assign a ranking for each of the 70 peak discharge measurements (in order of 1 to 70 [1=highest discharge, 70=lowest discharge]). This ranking can be easily done in Excel by sorting the discharge data (be sure to check "Expand the selection" when prompted so you keep the date with the associated discharge). Enter the value in the "Rank" column. If you are a more advanced Excel user, you can use the "RANK" function.
3. Calculate the recurrence interval (**R**) for each of the years on record using the equation above. **N** is the number of years on record (70 years) and **m** is the ranking you assigned to that particular year. Enter this in the "Recurrence Interval" column. Enter this equation once and copy it to the remaining cells.
4. If all goes well the graph on the right-hand side should automatically populate. Please note the axes are on logarithmic scales. If this didn't work for some reason, you will need to create the graph yourself (very easy). Create a scatter plot with recurrence interval as your x-axis and peak discharge as your y-axis. Change both axes to a logarithmic scale; this will help interpreting the data and answering the questions.
5. Now you need to calculate the annual exceedance probability (**P**), this will tell you the probability (in % chance) of an event of equal size can occur in a given year.
6. Answer the questions related to the graph you just made. Download the file Buffalo Bayou Flooding HW.docx to find a copy of this instruction sheet and the questions on the last page of the document. **Paste a copy of your graph below the questions you answer on the next page.**
7. **Turn in your question answers and graph on Blackboard by the end of [date here]**.

Answer the following questions based on the recurrence interval graph you made for Buffalo Bayou.

1. What would be the discharge during a 20-year flood?

2. If we are to assume the highest discharge point from 1935 is accurate, estimate the discharge during a 100-year flood. (Hint: follow the trend)

3. What is the recurrence interval for a flood with a discharge of 15,000 cfs?

4. What is the recurrence interval of the flooding experienced during April of last year?

5. What is the probability that a flooding event like May 2015 can occur each year?

[Insert you graph here]