**Course title:** Programming in Geoinformatics

| **Course code**: NRG 108 | **No. of credits:** 3 | **L-T-P:** 15-5-50 | **Learning hours:** 45 |
|---|---|---|---|

**Pre-requisite course code and title (if any):** NRG 176: Principles of GIS and GNSS, NRG 169: Principles of Remote Sensing, NRG 106: Fundamentals of Computers and Programming

**Department:** Department of Natural and Applied Sciences

| **Course coordinator(s):** Dr. Ayushi Vijhani | **Course instructor(s):** Dr. Adil Masood |
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| **Course type**: Core | **Course offered in:** Semester 2 |
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**Course description**

The course introduces programming required for both GIS and remote sensing analysis to the students. The fundamentals of programming in GIS using Python language. The coding for analysis of remotely sensed dataset will be taught using Google Earth Engine.

**Course objectives**

- To introduce Python programming
- To integrate programming with GIS analysis
- To introduce Google Earth Engine for Image processing

**Course content**

| Module | Topic | L | T | P |
|---|---|---|---|---|
| 1. | Introduction: Automation in GIS, Introduction to Python, variables, object oriented programming, classes | 2 | 1 | |
| 2. | Basics of Python programming: List, loops, decision structures, string manipulation, debugging in Python | 2 | 1 | |
| 3. | GIS Data Access and manipulation with Python: Raster and Vector | 2 | 1 | |
| 4. | GIS analysis using Python | 2 | 1 | |
| 5. | Functions and Modules in Python, Python dictionaries, writing geometries, Batch files, working with map documents | 2 | 1 | |
| 6. | Introduction to Google Earth Engine for image processing | 5 | | |
| | PRACTICALS | | | |
| 1 | Writing first programme in Python | | | 2 |
| 2. | Passing a value to a script as a parameter, reporting spatial reference of feature class, creating buffers | | | 2 |
| 3. | Performing map algebra | | | 2 |
| 4. | Creating a script using multiple GIS operation | | | 2 |
| 5. | Creating and combining list | | | 2 |
| 6. | Working with different types of loop | | | 4 |
| 7. | Looping over records in shapefile in Python | | | 2 |

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|---|---|---|---|---|
| 8. | String manipulation in a shapefile in Python | | | 2 |
| 9. | Debugging a programme | | | 2 |
| 10. | Reading and Writing vector data in Python | | | 4 |
| 11. | Query and updation of vector data using cursor in Python | | | 4 |
| 12 | Raster based analysis in Python | | | 2 |
| 13. | Writing functions and creating modules in Python | | | 4 |
| 14. | Creating dictionary, reading and writing text using Python csv module | | | 2 |
| 15. | Writing geometry of point, polygon and line shapefile | | | 4 |
| 16. | Running python script in batch file, scheduling tasks | | | 2 |
| 17. | Updating map document (mxd file) using Python | | | 2 |
| 18. | Writing first programme in GEE | | | 2 |
| 19 | Display of an image, image computation, spatial reducer using GEE | | | 2 |
| 20. | Creating a composite image, creating profile, vegetation indices creation using GEE | | | 2 |
| | **Total** | **15** | **5** | **50** |

**Evaluation criteria:**

- Assignments : 20% [Every week] (All the learning outcomes)
- Minor test 1 : 20% [End of Module 1 and Module 2] (learning outcome1)
- Minor test 2 : 20% [End of modules 2, 3, and 4] (learning outcome2)
- Major test : 40% [At the end of all the modules] (All the learning outcomes)

**Learning outcomes**

At the end of the course, students will be able to:

- Automate geo processing tasks using Python
- Understand, write, debug and execute python programme
- Write and execute basic image analysis using GEE

**Pedagogical approach**

The course will be delivered through class lectures, lab exercise and tutorials

**Course Reading Materials (* = compulsory readings) Module 1 -5**

1. Gries, P., Campbell, J., and Montojo, J. (2013) Practical Programming: An Introduction to Computer Science Using Python, Pragmatic Programmers.
2. *Zandbergen, Python Scripting for ArcGIS, Esri Press,2013.

**Module 6.**

https://developers.google.com/earth-engine/edu

**Advanced Reading Material**

1. Python official homepage -http://www.python.org/
2. Python document -http://www.python.org/doc/
3. The Python Tutorial - http://docs.python.org/tutorial/ A Byte of Python (an online wikibook) - http://swaroopch.com/notes/Python/ How to think like a computer scientist: learning with Python, 2nd edition by Jeffrey Elkner et. al. - http://openbookproject.net//thinkCSpy/ ArcGIS 10 Desktop Help: Geoprocessing with Python - http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#/What_is_Python/002z000000 01000000/ Geoprocessing Model and Script Tool Gallery - http://blogs.esri.com/Dev/blogs/arcgisdesktop/archive/2010/11/09/Geoprocessing-Model-and-ScriptTool-Gallery.aspx
4. Lutz, M. and Ascher, D. (1999) Learning Python, O'ReillyMedia.
5. Zelle, J. M. (2003) Python Programming: An Introduction to Computer Science, Franklin Beedle
6. &Associates.
7. Tucker (2004) Writing Geoprocessing Scripts in ArcGIS, ESRI Press (availableonline).

**Recommended journals for reference**

1. International Journal of Applied Earth Observation and Geoinformation
2. ISPRS Journal of Photogrammetry and Remote Sensing
3. International Journal of Remote Sensing

**Additional information**

**Student responsibilities**

The students are expected to submit assignments in time and come prepared with readings when provided.

**Course reviewers:**

1. Dr. Kangping Si, Big Data Software Engineer, TiVo Inc., San Jose, USA
2. Mr. Ujaval Gandhi, Google Earth Engine, Hyderabad