Department of Environmental Sciences and Technology

Course Structure of PG-Diploma in Geoinformatics (Environmental Sciences and Technology)

Academic Session 2021 – 22 onwards

School of Environment and Earth Science

Central University of Punjab

SYLLABUS of PG-DIPLOMA IN GEOINFORMATICS

Scheme of Course

Semester-I: At Central University of Punjab, Bathinda (CUPB)

Paper Code	Course Title	Course Type	Contact Hours			Credit
			L	T	P	C
PGD-GI.601	Principles of Remote Sensing	F	4	0	0	4
PGD-GI.602	GPS and GNSS	CC	2	0	0	2
PGD-GI.603	Introduction to GIS	CC	4	0	0	4
PGD-GI.604	Cartography	CC	2	0	0	2
PGD-GI.605	Photogrammetry	CC	4	0	0	4
PGD-GI.606	Remote Sensing Practical	S	0	0	4	2
PGD-GI.607	GIS Practical	S	0	0	4	2
	Total		**16**	**0**	**8**	**20**

Semester-II: At Punjab Remote Sensing Centre (PRSC), Ludhiana

Paper Code	Course Title	Course Type	Contact Hours			Credit
			L	T	P	C
PGD-GI.611	Seminar	S	0	0	4	2
PGD-GI.612	Skill Based Training- Theory	S	4	0	0	4
PGD-GI.613	Skill Based Training- Practical	S	0	0	4	2
PGD-GI.614	Project Work/ Dissertation/ Industrial Training	S	0	0	24	12
	Total		**4**	**0**	**28**	**20**

L: Lectures T: Tutorial P: Practical C: Credits

Semester-I

Course Title: Principles of Remote Sensing
Paper Code: PGD-GI.601

L	T	P	C
4	0	0	4

Total teaching hours: 60 h

Learning Outcomes

The student will be able to:

- Identify the types of remote sensing
- Describe the characteristics such as Platforms, Scanners and Orbits for satellite
- Enlist steps of digital image processing
- Apply the concept of remote sensing for solving environmental problems

Unit 1 (15 lectures)

History of Remote Sensing; Electromagnetic Radiation (EMR): EMR Spectrum and its properties, Concept of Remote sensing; Atmospheric windows, Interaction of EMR with atmosphere and Earth's Surface; Spectral signatures and response of earth's surface features; Scale and Resolution; Remote Sensing Platforms and Types of Orbits; Sensor classification: Active and Passive, Optical-Mechanical Scanners and Push-broom scanners.

Unit 2 (15 lectures)

Satellites and their characteristics – Geostationary and Sun Synchronous; Polar and Near Polar Orbiting Satellites; Earth Resource Satellite; Weather and Communication Satellites; Space Agencies in India and World; Bhuvan platform and Google Earth.

Unit 3 (15 lectures)

Image; Types of Image - Analogue and Digital; Resolution: Spatial, Spectral, Radiometric and Temporal; False Colour Composite (FCC); Elements of Visual Image Interpretation. Ground Truth Collection; Digital Image Processing- Image Rectification and Restoration, Image Enhancement, Image Transformation, Image Classification- Unsupervised and Supervised Classification, Accuracy Assessment.

Unit 4 (15 lectures)

Thermal Remote Sensing; Microwave Remote Sensing; RADAR; LIDAR; Drones; Applications of Remote Sensing in Environmental Studies.

Suggested Readings:

1. Lillesand, T.M., Keifer, R.W. and Chipman J.W. (2007). Remote Sensing and Image interpretation, Wiley India Pvt Ltd., India.
2. John R. Jensen (2008). Remote Sensing of the Environment (2nd Ed.) Dorling Kindersley India.
3. Basudeb Bhatta (2008). Remote Sensing and GIS, Oxford University Press, USA.

4. Andrew Skidmore, Hendrik Prins (2010). Environmental Modelling with GIS and Remote Sensing, CRC Press.

5. Chang, Kang-taung (2002). Introduction to Geographic Information Systems, Tata McGraw-Hill Publishers, USA. Cracknell, A and Hayes, L. (1990). Remote Sensing Year Book, Taylor and Francis, London.

Mode of Transaction: Lecture, power point, demonstration, case study, co-operative learning, group discussion, e-learning, google meet, zoom

Evaluation criteria:
Continuous Assessment: **25 marks**
Mid Semester Test-1: Subjective Type Test: **25 marks**
End Semester Exam I: Subjective Type Test: **35 marks**
End Semester Exam II: Based on Objective Type Tests: **15 marks**
Total Marks: **100**

Course Title: GPS and GNSS

Paper Code: PGD-GI.602

L	T	P	C
2	0	0	2

Total teaching hours: 30 h

Learning Outcomes

The student will be able to:

- Identify geospatial tools- remote sensing, GIS and GPS
- Apply the concept of remote sensing and GIS for solving environmental problems
- Describe the history of Space Programme in India
- Enlist international and Indian space agencies

Unit 1 (08 lectures)

Fundamentals of GPS; History of GPS; Components of global positioning system; Working Principle of GPS; Satellite positioning; Factors affecting GPS accuracy; GPS surveying methods and accuracy; Introduction to DGPS, Wide area augmentation system (WAAS)

Unit 2 (08 lectures)

Navigational systems of the world- NAVSTAR, GLONASS, GALILEO, Bei Dou: History and Development

Unit 3 (07 lectures)

Navigational systems of India - IRNSS; GAGAN

Unit 4 (07 lectures)

Applications of GNSS and IRNSS, Case Studies

Suggested Readings

1. Jan Van Sickle (2008). GPS for Land Surveyors. CRC Press, London
2. B. Hofmann-Wellenhof, H. Lichtenegger, J. Collins (2013). GPS- Global Positioning System: Theory and Practice. Springer India

Mode of Transaction: Lecture, power point, demonstration, case study, co-operative learning, group discussion, e-learning, google meet, zoom

Evaluation criteria:

Continuous Assessment: **25 marks**
Mid Semester Test-1: Subjective Type Test: **25 marks**
End Semester Exam I: Subjective Type Test: **35 marks**
End Semester Exam II: Based on Objective Type Tests: **15 marks**
Total Marks: **100**

Course Title: Introduction to GIS

Paper Code: PGD-GI.603

L	T	P	C
4	0	0	4

Total teaching hours: 60 h

Learning Outcomes

The student will be able to:

- Identify spatial and attribute data of GIS
- Enlist projection system of GIS
- Apply the concept of GIS for solving environmental problems

Unit 1 (12 lectures)

Overview; History and Concepts of GIS; Concept of space and time**;** Data types- map, attributes; Spatial and non-spatial data

Unit 2 (18 lectures)

Elements of GIS; Data structures in GIS: Raster and Vector data, Hierarchical, Network and relational data, Geo-relational and object-oriented vector data structure; Vector and Raster based analysis; Overlays operations; Map algebra; Grid based operations; Buffering; Network Analysis; Terrain Analysis; Spatial analysis; Topology; GIS database; Georeferencing; Linking spatial and non-spatial data.

Unit 3 (15 lectures)

Map Projections; Spheroid; Geoid; Coordinate systems; Distortions in map projections; Examples of map projections - Polyconic, Mercator, UTM projections

Unit 4 (15 lectures)

Opensource GIS, Applications of GIS; Case Studies

Suggested Readings

1. Bonham, Carter G.F. (1995): Information Systems for Geoscientists – Modelling with GIS. Pergamon, Oxford.
2. Burrough, P.A. and McDonnell, R. (1998): Principles of Geographic Information Systems. Oxford University Press, Oxford.
3. Chang, K.T. (2003): Introduction to Geographic Information Systems. Tata McGraw Hill Publications Company, New Delhi.
4. Chauniyal, D. D. (2004): Remote Sensing and Geographic Information Systems. (in Hindi). Sharda Pustak Bhawan, Allahabad.

Mode of Transaction: Lecture, power point, demonstration, case study, co-operative learning, group discussion, e-learning, google meet, zoom

Evaluation criteria:
Continuous Assessment: **25 marks**
Mid Semester Test-1: Subjective Type Test: **25 marks**
End Semester Exam I: Subjective Type Test: **35 marks**
End Semester Exam II: Based on Objective Type Tests: **15 marks**
Total Marks: **100**

Course Title: Cartography

Paper Code: PGD-GI.604

L	T	P	C
2	0	0	2

Total teaching hours: 30 h

Learning Outcomes

The student will be able to:

- Recognize the elements of cartographic representation, and how maps work.
- Use digital cartographic methods for exploring, critiquing, confirming and presenting geographical relationships.
- Develop the proficiency in graphical literacy, geo-visualisation and map modelling.

Unit 1 (08 lectures)

Map; Map Features; Map Design; Categories of maps; Cartographic design; Map Scale: Horizontal and vertical; Scale factor; Topographical Maps; Thematic Map.

Unit 2 (07 lectures)

Digital Cartography; Concept of Digital Cartography, Advantages and Disadvantages of Digital Cartography; Advances in cartographic practice

Unit 3 (08 lectures)

Digital Mapping: Cartographic Design Issues, Concept of Visual Variables, Map Lettering, Map Compilation, Generalization, Map Composition, Multivariate and Dynamic Mapping, Map Production

Unit 4 . (07 lectures)

Visualization of 2D and 3D geospatial data; Advances in Cartographic Practice

Suggested Readings

1. Keates, J.S. (1998). Cartographic Design and Production, Longman, London.
2. Misra, R.P. and Ramesh, A. (1989). Fundamental of Cartography, Concept Publishing Company, New Delhi.
3. Monkhouse, F.J. (1994). Maps and Diagrams, Methuen and Co., London.
4. Robinson, A.H. et al. (1992). Elements of Cartography, John Willy & Sons, New York, 6th edition.

Mode of Transaction: Lecture, power point, demonstration, case study, co-operative learning, group discussion, e-learning, google meet, zoom

Evaluation criteria:

Continuous Assessment: **25 marks**
Mid Semester Test-1: Subjective Type Test: **25 marks**
End Semester Exam I: Subjective Type Test: **35 marks**
End Semester Exam II: Based on Objective Type Tests: **15 marks**
Total Marks: **100**

Course Title: Photogrammetry

Paper Code: PGD-GI.605

L	T	P	C
4	0	0	4

Total teaching hours: 60 h

Learning Outcomes

The student will be able to:

- Adapt the current knowledge to emerging applications of photogrammetry and UAV technology.
- Develop the techniques, skills and modern tools of photogrammetry to solve technical photogrammetric problems in environmental sciences and other trans-disciplinary subjects.

Unit 1 (15 lectures)

History and Fundamentals of aerial photography; Early Developments in Aerial Photography; Photogrammetry: Definition and Categories; Surveying and Mapping.

Unit 2 (15 lectures)

Aerial photos: Types, Scale, Resolution; Geometric properties of aerial photos; Vertical and Oblique aerial photography; Scale; Interpretation keys and their types; Aerial mosaics; Multi-spectral aerial photographs; Ground control for mapping from aerial photos; Rectification methods in aerial photos.

Unit 3 (15 lectures)

Historical Background of Photogrammetry; Measurements of object height and length; Stereo-Photogrammetry: Stereovision and Stereoscopes, Relief displacement; Parallax; Digital photogrammetry; Triangulation; Mapping; Orthorectification; Digital Photogrammetry; Mathematics and Programming to RS and Photogrammetry.

Unit 4 (15 lectures)

Applications of Aerial photo interpretation in general resource evaluation; Geomorphic studies and mapping. Land use/Land cover mapping; Applications and limitation of Aerial Photography; Problems of Aerial Photogrammetry; Applications of Photogrammetry.

Suggested Readings

1. Deekshatulu, B.L. and Rajan, Y.S. (ed.) (1984): Remote Sensing. Indian Academy of Science, Bangalore
2. Hallert, B. (1960): Photogrammetry. McGraw Hill Book Company. Inc. New York
3. Leuder, D.R. (1959): Aerial Photographic Interpretation: Principles and Application, McGraw Hill, New York
4. Jensen, John R. (2000). Remote sensing of the Environment – An Earth Resource Perspective, Pearson Education
5. Lillesand, T.M. and Kiefer, R.W. (2000): Remote Sensing and Image Interpretation. 4th Ed. John Wiley and Sons, New York

Transaction mode: Lecture, Demonstration, Problem solving, Tutorial, Seminar, Local field visit discussion. Tools used: PPT, video, animation movie, WhatsApp and Expert's Video Conferencing lectures from various national & international organizations.

Evaluation criteria:
Continuous Assessment: **25 marks**
Mid Semester Test-1: Subjective Type Test: **25 marks**
End Semester Exam I: Subjective Type Test: **35 marks**
End Semester Exam II: Based on Objective Type Tests: **15 marks**
Total Marks: **100**

Course Title: Remote Sensing Practical

Paper Code:PGD-GI.606

L	T	P	C
0	0	4	2

Total Practical hours: 60 h

Learning Outcomes

The students will be able to:

- Design various experiments for familiarization with satellite images, mapping and layout.
- Apply remote sensing software for image interpretation
- Develop the analytical skills for pre-processing, image classification and post-processing

1. Visual Image Interpretation
2. Procuring/downloading satellite data
3. Preparation of Thematic Maps
4. Creation of subset from satellite data
5. Mosaic of Image
6. Unsupervised Classification
7. Supervised Classification and Accuracy Assessment
8. Land use Land Cover Mapping-Area calculation under different LULC
9. Google Earth
10. Bhuvan

Suggested readings

1. Kennedy, M. (2013). *Introducing geographic information systems with ArcGIS: A workbook approach to learning GIS,* Wiley & Sons Publications.
2. Kennedy, M. (2010). *The Global positioning system and ArcGIS*. Crc Press.
3. Jensen, John R. (2000). *Remote sensing of the Environment – An Earth Resource Perspective*, Pearson Education
4. Lillesand, T.M. and Kiefer, R.W. (2000): *Remote Sensing and Image Interpretation*. 4th Ed. John Wiley and Sons, New York
5. Websites-ESRI, NASA

Mode of Transaction: Lecture, demonstration, Experimentation, Tutorial, Problem solving, Self-learning, E-tutoring

Tools: Google meet, Google Classroom, Swayam, e-PG Pathshala, YouTube, Slide share, Google Apps, Websites- NASA, ESRI

Evaluation criteria:

1. Continuous Assessment: **10 Marks**
2. End Semester Exam: Subjective Type Test (**40 Marks)** (30 Marks practical performance and 10 Marks viva)

Total Marks: 50

Course Title: GIS Practical

Paper Code: PGD-GI.607

L	T	P	C
0	0	4	2

Total Practical hours: 60 h

Learning Outcomes

The student will be able to:

- Design various experiments for familiarization with GIS
- Apply GIS software for image presentation
- Develop the analytical skills for satellite images using GIS software

1. Georeferencing
2. Creation of Shape Files, Layers
3. Digitization of Points, Lines and Polygons
4. Adding Attributes
5. Conversions and Topology
6. Spatial Analysis
7. Network Analysis
8. Layout
9. Map Composition
10. Finding geographical coordinates using GPS

Suggested readings

1. Kennedy, M. (2013). *Introducing geographic information systems with ArcGIS: A workbook approach to learning GIS,* Wiley & Sons Publications.
2. Kennedy, M. (2010). *The Global positioning system and ArcGIS*. Crc Press.
3. Jensen, John R. (2000). *Remote sensing of the Environment – An Earth Resource Perspective*, Pearson Education
4. Lillesand, T.M. and Kiefer, R.W. (2000): *Remote Sensing and Image Interpretation*. 4th Ed. John Wiley and Sons, New York
5. Websites-ESRI, NASA

Mode of Transaction: Lecture, demonstration, Experimentation, Tutorial, Problem solving, Self-learning, E-tutoring

Tools: Google meet, Google Classroom, Swayam, e-PG Pathshala, YouTube, Slide share, Google Apps, Websites- NASA, ESRI

Evaluation criteria:

Continuous Assessment: **10 Marks**

End Semester Exam: Subjective Type Test (**40 Marks)** (30 Marks practical performance and 10 Marks viva)

Total Marks: 50

Semester-II

Course Title: Seminar

Paper Code: PGD-GI.611

L	T	P	C
0	0	4	2

Total Practical hours: 60 h

Evaluation Criteria:

- The originality and quality of the content
- Quality of presentation

Supervisor **(50 Marks)**:
External expert, HoD and senior-most faculty of the department **(50 Marks)**:
Report: 30 Marks
Presentation: 10 Marks
Final viva-voce: 10 Marks
Total Marks: **100 Marks**

Course Title: Skill Based Training- Theory

Paper Code: PGD-GI.612

L	T	P	C
4	0	0	4

Total Teaching hours: 60 h

Skill Based Training- Theory: Compulsory Training (Agri-informatics/ Disaster Management/ Environment/ Geoinformatics/ Geology/ Land use and Soil Resource Assessment/ Urban and Regional Planning/Water Resources)

Evaluation Criteria:

Continuous Assessment: **25 marks**
Mid Semester Test-1: Subjective Type Test: **25 marks**
End Semester Exam I: Subjective Type Test: **35 marks**
End Semester Exam II: Based on Objective Type Tests: **15 marks**
Total Marks: **100**

Course Title: Skill Based Training- Practical

Paper Code: PGD-GI.613

L	T	P	C
0	0	4	2

Total Practical hours: 60 h

Skill Based Training- Practical: Compulsory Practical Training (Agri-informatics/ Disaster Management/ Environment/ Geoinformatics/ Geology/ Land use and Soil Resource Assessment/ Urban and Regional Planning/Water Resources)

Evaluation Criteria:

- Assignments
- Presentation Skills

Supervisor **(50 Marks)**
External expert, HoD and senior-most faculty of the department **(50 Marks)**
Report: 30 Marks
Presentation: 10 Marks
Final viva-voce: 10 Marks
Total Marks: **100 Marks**

Course Title: Project Work/Dissertation/Industrial Training

Paper Code:PGD-GI.614

L	T	P	C
0	0	24	12

Total Practical hours: 24 x 15 h

Project Evaluation criteria

- Relevance, need and clarity in the objectives
- The originality and quality of the content
- Quality of presentation
- Subject knowledge and presentation viva
- Time line of completion of project
- Continues evaluation by the supervisor
- Mid-term evaluation
- Dissertation report
- Presentation, final viva-voce)

Supervisor **(50 Marks)**:
External expert, HoD and senior-most faculty of the department **(50 Marks)**
Report: 30 Marks
Presentation: 10 Marks
Final viva-voce: 10 Marks
Total Marks: **100 Marks**