SHIVAJI UNIVERSITY, KOLHAPUR

Established: 1962

A^{++} Accredited by NAAC (2021) with CGPA 3.52

Structure and Syllabus in Accordance with

National Education Policy - 2020

with Multiple Entry and Multiple Exit

Master of Science (Geoinformatics)

under
Faculty of Science and Technology

(To Be Implemented From Academic Year 2023-24)

INDEX

1. Preamble

Geospatial technology is widely used in various sectors such as agriculture, infrastructure development, finance, mining, disaster management, and more. The Indian government has initiated the National Geospatial Policy, 2020, which aims to enhance the geospatial sector for national development and a prosperous information economy with a citizen-centric approach. As the future of geospatial technology looks promising, there is a growing need to develop skilled human resources with knowledge of geospatial technology. To address this need, Shivaji University has taken the initiative to introduce master program in Geoinformatics.

The Department of Geography at Shivaji University has made the strategic decision to introduce a new program, namely the M.Sc. (Geoinformatics) (Two Years). This step comes in response to the extensive range of applications and numerous employment prospects associated with geospatial technology. The university aims to equip students with the necessary skills and knowledge to excel in this rapidly growing field.

2. Duration

- The course shall be a full time course.
- The duration of course shall be of two years/four semesters.

3. Eligibility for Admission

Graduate in Geology / Physics / Botany / Environmental Sciences / Agriculture / Forestry / Computer Science or B.E / B.Tech in Civil Engineering / Agricultural Engineering / Computer Science / Information Technology and MA or M.Sc. Geography.

4. Medium of Instruction

The medium of instruction will be English.

5. Programme Structure

Structure in Accordance with National Education Policy - 2020
With Multiple Entry and Multiple Exit Options
M.Sc. (Geoinformatics) Part – I (Level-8)

Course Type	Course Code	Teaching Scheme			Examination Scheme					
		Theory and Practical			University Assessment (UA)			Internal Assessment (IA)		
		Lectures (Hours/ week)	Practical (Hours/ week)	Credit	Maximum Marks	Minimum Marks	Exam. Hours:Min	Maximum Marks	Minimum Marks	Exam. Hours
SEMESTER-I (Duration- Six Months)										
Major Mandatory	MMT-101	4	--	4	80	32	3	20	8	1
	MMT-102	4	--	4	80	32	3	20	8	1
	MMPR-103	--	8	4	100	40	5	--	--	--
	MMPR-104	--	4	2	50	20	2:30	--	--	--
Major Elective	MET-105/106	4	--	4	80	32	3	20	8	1
Research Methodology	RM-107	4	--	4	80	32	3	20	8	1
Total (A)		**16**	**12**	**22**	**470**	--	--	**80**	--	--
SEMESTER-II (Duration- Six Months)										
Major Mandatory	MMT-201	4	--	4	80	32	3	20	8	1
	MMT-202	4	--	4	80	32	3	20	8	1
	MMPR-203	--	4	2	50	20	2:30	--	--	--
	MMPR-204	--	8	4	100	40	5	--	--	--
Elective Theory	MET-205/206	4	--	4	80	32	3	20	8	1
OJT	OJT-207	--	8**	4	60	24	3	40	16	*
Total (B)		**12**	**20**	**22**	**450**	--	--	**100**	--	--
Total (A+B)				**44**	**920**	--	--	**180**	--	--

Note(s):

•Student contact hours per week : **28/32** Hours	•Total Marks for M.Sc. : **1100**
•Theory Lectures **60** Minutes Each and Practical Lectures **120** Minutes Each	• Total Credits for M.Sc.: **44** **Level 8:** Semester I & II
•MMT- Major Mandatory Theory •MET- Major Elective Theory •MMPR- Major Mandatory Practical •RM- Research Methodology •FP/OJT- Field Project / On Job Training(**during vacation)	• Theory and Practical examination will be conducted at the end of respective semester. •Practical courses may be divided into sub-sections. •*Duration of practical examination as per respective BOS guidelines. •***Separate passing is mandatory for Theory and Practical examination as well as University and Internal assessment.***
• **Requirement for Entry at Level 8: Completed all requirements of the Bachelor's Degree (Level 7) with above mentioned eligibility criteria (section 3).**	
• **Requirement for Exit after Level 8:** **Students can exit after completion of Level 8 with Post Graduate Diploma in Geoinformatics.**	
• **Entry Option for Level 9: Upon successful completion of the P. G. Diploma in Geoinformatics (Level 8) with a minimum of 44 credits, students are eligible for direct admission to the second year (third semester) of the M.Sc. program in Geoinformatics (Level 9)**	

Structure in Accordance with National Education Policy - 2020
With Multiple Entry and Multiple Exit Options
M.Sc. (Geoinformatics) Part – II (Level-9)

Course Code	Course Number	Teaching Scheme			Examination Scheme					
		Theory and Practical			University Assessment (UA)			Internal Assessment (IA)		
		Lectures (Hours/ week)	Practical (Hours/ week)	Credit	Maximum Marks	Minimum Marks	Exam. Hours	Maximum Marks	Minimum Marks	Exam. Hours
SEMESTER-III (Duration- Six Months)										
Major Mandatory	MMT-301	4	--	4	80	32	3	20	8	1
	MMT-302	4	--	4	80	32	3	20	8	1
	MMPR-303	--	4	2	50	20	2:30	--	--	--
	MMPR-304	--	8	4	100	40	5	--	--	--
Major Elective	MET-305/306	4	--	4	80	32	3	20	8	1
Research Project	RP-307	--	8	4	80	32	4	20	8	*
Total (C)		**12**	**20**	**22**	**470**	**--**	**--**	**80**	**--**	**--**
SEMESTER-IV (Duration- Six Months)										
Major Mandatory	MMT-401	4	--	4	80	32	3	20	8	1
	MMT-402	4	--	4	80	32	3	20	8	1
	MMPR-403	--	8	4	100	40	5	--	--	--
Major Elective	MET-404/405	4	--	4	80	32	3	20	8	1
Research Project	RP-406	--	12	6	120	48	6	30	12	*
Total (D)		**12**	**20**	**22**	**460**	**--**	**--**	**90**	**--**	**--**
Total (C+D)				**88**	**930**	**--**	**--**	**170**	**--**	**--**

Note(s):

•Student contact hours per week : **32** Hours	•Total Marks for M.Sc. : **1100**
•Theory Lectures **60** Minutes Each and Practical Lectures **120** Minutes Each	• Total Credits for M.Sc.: **44** **Level 9:** Semester II & IV
•MMT- Major Mandatory Theory •MET- Major Elective Theory •MMPR- Major Mandatory Practical •RP- Research Project	• Theory and Practical examination will be conducted at the end of respective semester. •Practical courses may be divided into sub-sections. •*Duration of practical examination as per respective BOS guidelines. •#FP/OJT- Field Project / On Job Training (**during vacation) •***Separate passing is mandatory for Theory and Practical examination as well as University and Internal assessment.***
• **Entry Option for Level 9: Upon successful completion of the P. G. Diploma in Geoinformatics (Level 8) with a minimum of 44 credits, students are eligible for direct admission to the second year (third semester) of the M.Sc. program in Geoinformatics (Level 9).**	

6. Programme Outcomes (POs)

1. The M.Sc. graduates will be professionally competent in geospatial professions, with a strong knowledge base, skill set, mindset, and pragmatic wisdom.
2. M.Sc. graduates will have ability of making comprehensive geospatial analysis, interpret spatial problems, and suggest proper solutions by using theoretical, methodological, and instrumental knowledge of geospatial technology.
3. They will have good understanding about proper utilization of natural resources through geospatial knowledge.
4. The graduates will be encouraged in their understanding of moral and social values in daily life in order to develop a culturally and civilized personality.
5. They will be interested in conducting research to address important and emerging societal problems relating to geospatial technology and the environment.

7. Course Codes

Semester	Course Type	Sr. No.	Course Number	Course Title	Course Code
Semester- 1	Major Mandatory	1	MMT-101	Fundamentals and Applications of Remote Sensing	MSU0325MML920G1
		2	MMT-102	Geographical Information System (GIS)	MSU0325MML920G2
		3	MMPR-103	Geographical Information System Lab	MSU0325MMP920G1
		4	MMPR-104	Modern Surveying Lab	MSU0325MMP920G2
	Major Elective	5	MET-105	Fundamentals and Principles of Modern Surveying	MSU0325MEL920G1
		6	MET-106	Statistics for Geospatial Studies	MSU0325MEL920G2
	Research Methodology	7	RM-107	Research Methodology	MSU0325RML920G
Semester- 2	Major Mandatory	1	MMT-201	Photogrammetry and Digital Image Processing	MSU0325MML920H1
		2	MMT-202	Database Management System and Web GIS	MSU0325MML920H2
		3	MMPR-203	Photogrammetry and Digital Image Processing Lab	MSU0325MMP920H1
		4	MMPR-204	DBMS, Web-GIS and Mini Project	MSU0325MMP920H2
	Major Elective	5	MET-205	Geodesy and Digital Cartography	MSU0325MEL920H1
		6	MET-206	Coastal Zone Studies	MSU0325MEL920H2
	OJT	7	OJT-207	Field Project / On Job Training	MSU0325OJP920H
Semester- 3	Major Mandatory	1	MMT-301	Advances in Geospatial Technologies	MSU0325MML920I1
		2	MMT-302	Geospatial Technologies in Natural Disaster Studies	MSU0325MML920I2
		3	MMPR-303	Python Programming Lab	MSU0325MMP920I1
		4	MMPR-304	GIS Programming Lab	MSU0325MMP920I2
	Major Elective	5	MET-305	Python Programming	MSU0325MEL920I1
		6	MET-306	Java Programming	MSU0325MEL920I2
	Research Project	7	RP-307	Research Project-I	MSU0325MMP920I3
Semester- 4	Major Mandatory	1	MMT-401	Geospatial Technology in Climate Change Studies	MSU0325MML920J1
		2	MMT-402	Geospatial Technology for Urban Studies and Regional Planning	MSU0325MML920J2
		3	MMPR-403	Resource Evaluation Lab	MSU0325MMP920J1
	Major Elective	4	MET-404	Hydrology and Watershed Management	MSU0325MEL920J1
		5	MET-405	Environmental Monitoring and Assessment	MSU0325MEL920J2
	Research Project	6	RP-406	Research Project-II	MSU0325MMP920J2

8. Syllabus

M. Sc. Geoinformatics (Part I) (Level-8) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Fundamentals and Applications of Remote Sensing
Course Code: MMT-101 (MSU0325MML920G1)
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand the basic concept and principles of remote sensing.
2. Understand the role of remote sensing and DIP in data collection and analysis.
3. Know the different types of sensor and remote sensing techniques.
4. Understand the use and importance of satellite images and aerial photographs to assess the geographical phenomena.
5. Apply the knowledge of remote sensing in various thematic studies.

Unit I: Introduction and Principles of Remote Sensing **15 Lectures**
Definition and scope of remote sensing; History and development of remote sensing technology; Electromagnetic radiation (EMR) and electromagnetic spectrum; EMR interaction with atmosphere and earth surface; Atmospheric window and spectral reflectance curve; Resolutions in remote sensing; Types of remote sensing; Principles and applications of optical, thermal & microwave remote sensing.

Unit II: Aerial Photography **15 Lectures**
Aerial photographs: types, scale, and resolution; Types of aerial cameras and photographic films; Geometry of aerial photographs; Flight planning; Impact of season, time and topography on aerial photographs; Elements of visual image interpretation; Aerial photos vs. satellite imagery.

Unit III: Satellite Remote Sensing **15 Lectures**
Satellite: types and their characteristics; Types of Sensors; Orbital and sensor characteristics of major earth resource satellites: LANDSAT, Sentinel and IRS; Recent developments of Indian remote sensing satellite programme; Environmental, meteorological and communicational satellites.

Unit IV: Applications of Remote Sensing **15 Lectures**
Geospatial Technology in Urban and Regional planning, Water resource management, Soil resource Management, Agriculture and Crop Monitoring, Forestry and Environment, Land use/ land cover mapping and change detection, Natural hazards assessment.

Seminars, Tutorials, Problem solving session and group discussions on above four units**.**

References:

1. Wolf. P.R., (2014). Elements of Photogrammetry with Application in GIS, McGraw Hill books Co., London.
2. Curran P.J (1985). Principles of Remote Sensing, Longman, London.
3. Lillisand T.M and R.W. Kiefer (1994). Remote Sensing and Image Interpretation (3rd edition). John Wiley & Sons, New York.
4. Sabins F.F Jr. (1987). Remote Sensing: Principles and Interpretation, W.H.Freeman & Co., New York.
5. James B. Campbell, Randolph H. Wynne, Valerie A. Thomas (2022). Introduction to Remote Sensing, Guilford Press, New York
6. Alexey Bunkin and Konstantin Voliak (2001). Laser Remote Sensing of the Ocean, John Wiley and Sons., New York.
7. Gibso, P., and Clare H. Power, (2000). Introductory Remote Sensing: Principles and Concepts, Routledge, London.
8. Hayesm L., (1991). Introduction to Remote Sensing, Taylor and Francis Publication, London.

9. Kumaraswamy, K. (2003). Remote Sensing for Environmental Studies, Department of Geography, Bharathidasan University, Tiruchirappalli. 10. Karl Kraus (2007). Photogrammetry – Geometry from Images and Laser Scans, Walter de Gruyter, Berlin.

Web References:

1. Indian Space Research Organisation (ISRO), India: http://www.isro.org
2. National Remote Sensing Centre (NRSC), India: http://www.nrsc.gov.in
3. National Aeronautics and Space Administration (NASA), USA: http://www.nasa.gov
4. National Oceanic and Atmospheric Administration (NOAA), USA: http://www.noaa.gov
5. United States Geological Survey (USGS), USA: http://www.usgs.gov
6. International Society for Photogrammetry and Remote Sensing (ISPRS): http://www.isprs.org
7. Wikimapia: http://www.wikimapia.org
8. Bhuvan: http://www.bhuvan.nrsc.gov.in

M. Sc. Geoinformatics (Part I) (Level-8) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Geographical Information System (GIS)
Course Code: MMT-102 (MSU0325MML920G2)
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand the Fundamentals of GIS and distinguish various types of GIS data models
2. Familiarization with various data types, editing and storage of spatial and non-spatial data.
3. Create maps to communicate spatial data in a meaningful way to others
4. Visualize multivariate spatial data.

Unit I: Introduction to GIS **10 Lectures**
Definition of Geographical Information System (GIS), History and development of GIS, Components of GIS, GIS operations, Future of GIS.

Unit II: Basics of GIS **20 Lectures**
Types of geographic data; Raster and vector data model: Advantages and disadvantages; Fundamental of data storage: block code, run length code, chain code, quad tree; Spatial data input: Digitization and Conversion; Point, line and polygon; Concept of arc, node and vertices; Digitization errors; Topology: Error and editing.

Unit III: GIS Analysis **20 Lectures**
Vector data analysis: Buffering, Overlay analysis, Network analysis; Raster data analysis; Interpolation techniques in GIS; Terrain analysis: DEM, DSM, DTM and TIN, Viewshed and Watershed Analysis; Types of Queries in GIS.

Unit IV: Data Visualization and Recent Trends **10 Lectures**
GIS and maps; Visualization process; Visualization strategies; Maps dissemination; Process modeling and simulation; Current issues and trends in GIS.

Seminars, Tutorials, Problem solving session and group discussions on above four units**.**

References:

1. Bernhardensen, Tor. 1999. Geographic Information Systems: An Introduction. Toronto: John Wiley & Sons, Inc.
2. Burrough, Peter A. and McDonnell, Rachael A. 1998. Principles of Geographical Information Systems – Spatial Information Systems and Geostatistics. Oxford University Press.
3. Chang, Kang-tsung. 2002. Introduction to Geographic Information Systems. New Delhi: Tata McGraw-Hill Publishing Company Limited.
4. Clarke, Keith C. 2001. Getting Started with Geographic Information Systems (3r d Ed.) (Prent ice Hall Series in Geographic Information Science). Upper Saddle River, New Jersey: Prentice Hall.
5. DeMers, Michael N. 2000. Fundamentals of Geographic Information Systems (2n d Ed.) (Wiley Student Edit ion). New York: John Wiley & Sons, Inc.
6. Foresman, T. (Ed.) 1998. The History of Geographic Information Systems – Perspectives from the Pioneers. Upper Saddle River, NJ: Prentice Hall.

Web References:

1. www.esri.com
2. www.natmo.gov.in
3. www.surveyofindia.gov.in
4. https://gisgeography.com/

M. Sc. Geoinformatics (Part I) (Level-8) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Geographical Information System Lab
Course Code: MMPR-103 (MSU0325MMP920G1)
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Learn the graphical user Interface and tools of GIS software.
2. Apply the knowledge of GIS software in various application fields.
3. Apply Comprehensive knowledge of GIS software for analysis of geographical data and to solve real world problems.
4. Understand the role of GIS as decision support system.
5. Understand and develop the different types of models for GIS spatial analysis.

Exercise of QGIS Software:

1. Interface of QGIS.
2. Working with Projections.
3. Georeferensing: Toposheet and Image Registration.
4. Digitization of Map Data.
5. Satellite Image Browsing Systems
6. Working with WMS Data
7. Making a Map Layout.
8. Data query: Spatial and Attribute.
9. Animating Time Series Data
10. Interpolating Point Data
11. Travel Time Analysis with Uber Movement
12. Service Area Analysis using Open route service
13. Working with Google Earth.

Exercise of ArcGIS and ArcGIS Pro Software:

1. Overview of ArcGIS: Introduction Arc Map, Arc Catalogue And Arc Toolbox.
2. Data Formats in ArcGIS: Import Of Data, Shapefile, Feature Class, Geodatabase, Data Frames, Labeling Features.
3. Georeferencing in ArcGIS: Coordinating System, Datum Conversion, Map Projection, Storing and Viewing Projection Information.
4. Vector Data: Creating New Features, Editing Functions, Digitization, Errors and Creation of Topology.
5. Aspatial Data: Understanding Tables, Field Types, Table Manipulation, Table Relation, Creation of Graphs and Reports.
6. Map Design: Layout and Map Composition.
7. Spatial Analysis-I: Query By Location/Attribute, Buffer and Overlay Analysis.
8. Spatial Analysis-II: Interpolation Methods, Viewshed and Watershed Analysis.
9. Applications: Calculation of Vegetation and Water Indices, Slope and Contour, Network Analysis.
10. Import and Create 3D Model in ArcGIS Pro

References:

1. Adriaans, P., and D. Zantinge. 1996. Data Mining. New York: Addison-Wesley.
2. Bernhardensen, Tor. 1999. Geographic Information Systems: An Introduction. Toronto: John Wiley & Sons, Inc.
3. Bishop, Michael P. and Shroder, John F. (Eds.) 2004. Geographic Information Science and Mountain Geomorphology. Chichester, U.K.: Praxis Publishing (Springer).11
4. Bracken, Ian and Webster, Christopher. 1990. Information Technology in Geography and Planning (Including Principles of GIS). London & New York: Routledge.

5. Burrough, Peter A. and McDonnell, Rachael A. 1998. Principles of Geographical Information Systems – Spatial Information Systems and Geostatistics. Oxford University Press.
6. Buttenfie ld, B.P. and R.P. McMaster 1991. Map Generalization: Making Rules for Knowledge Presentation. New York: Wiley.
7. Chang, Kang-tsung. 2002. Introduction to Geographic Information Systems. New Delhi: Tata McGraw-Hill Publishing Company Limited.
8. Chrisman, N. 1998. "Academic Origins of GIS," In T. Foresman (Ed): The History of Geographic Information Systems. Upper Saddle River, NJ: Prent ice Hall, pp. 33-43.
9. Clarke, Keith C. 2001. Getting Started with Geographic Information Systems (3r d Ed.) (Prent ice Hall Series in Geographic Information Science). Upper Saddle River, New Jersey: Prentice Hall.

Web References:

1. https://docs.qgis.org/2.18/pdf/en/QGIS-2.18-UserGuide-en.pdf
2. https://qgis.org/en/site/
3. https://www.esri.com/en-us/arcgis/about-arcgis/overview
4. http://downloads.esri.com/support/documentation/ao_/698What_is_ArcGis.p

M. Sc. Geoinformatics (Part I) (Level-8) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Modern Surveying Lab
Course Code: MMPR-104 (MSU0325MMP920G2)
Total Credits: 02
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Quantify the Digital Surface Model (DSM), Digital Terrain Model (DTM) and its applications.
2. Prepare topographical map and contour map on an area.
3. Familiar with the GPS and DGPS components, types and applications.
4. Describe the applications of UAV in archaeology, urban mapping and disaster studies.

Theodolite and Total Station:

1. Field survey with theodolite
2. Field survey with total station

GPS and DGPS:

1. GPS: Basic functions, Waypoint demarcation and Area Calculation through GPS
2. GPS: Transfer data in GIS software
3. DGPS: Basic functions, Selection of reference station for calibration and Point data collection (GCPs)
4. DGPS: DGPS and GIS data integration and output preparation

Drone/UAV:

1. Flight planning
2. Assemble and calibration
3. Flying for data collection
4. Data processing for generation of DEM, point cloud and Orthophoto

References:

1. R.Subramanian "Surveying and leveling" 2nd edition, 2013, Oxford university press, New Delhi.
2. Dr. A.M. Chandra, "Plane Surveying", 2007, New Age International (P) Ltd., New Delhi.
3. Dr. A.M. Chandra, "Higher Surveying", 2006, New Age International (P) Ltd., New Delhi.
4. Dr. B.C. Punamia, "Surveying Vol. I and II", 2016, Laxmi Publishers, New Delhi
5. S.K. Duggal, "Surveying, Vol. I, II and III", 2009, Tata Mcgraw Hill, New Delhi.
6. B. Bhatta, "Remote Sensing and GIS", Oxford University Press, New Delhi.
7. Dr. A.M. Chandra, "Remote Sensing and GIS", Narosa Publishers, New Delhi.
8. Sateesh Gopi, R. Sathikumar, and N. Madhu, "Advanced Surveying", Pearson Education India, 2007.
9. "GPS Satellite Surveying", Alfred Leick 3rd Edition, John Wiley and Sons 2004.
10. Global Navigation Satellite Systems by G. S. Rao 2010 Tata McGraw Hill Education Pvt Ltd.
11. "GPS Theory, Algorithms and Applications Guocheng Xu," Springer-Verlag, 2003.
12. Unmanned Aerial Remote Sensing: UAS for Environmental Applications 1st Edition, David R. Green (Editor) 2020

Web References:

1. https://cpe.leica-geosystems.com/si/blog/post/what-is-a-total-station-how-it-works.html
2. https://ellipsis-drive.com/blog/drones-and-their-impact-on-gis-mapping/
3. https://en.wikipedia.org/wiki/Differential_GPS
4. https://opendronemap.org/
5. https://www.mapmyindia.com/solutions/drones/

M. Sc. Geoinformatics (Part I) (Level-8) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Fundamentals and Principles of Modern Surveying
Course Code: MET-105 (MSU0325MEL920G1)
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand principles and methods of surveying, including traditional and advanced techniques.
2. Use Total Station for data processing and analysis in surveys.
3. Apply GPS and DGPS for mapping, navigation, and accurate surveys.
4. Utilize drone/UAV technology for data capturing and post-processing.
5. Minimize errors and ensure precision in survey measurements using appropriate units.

Unit I: Introduction to Surveying **15 Lectures**
Introduction and principles of surveying; Classification of surveying, Survey methods: traditional and advanced, Nature of surveying work: field work and office work, Sources and types of errors, Units of measurements.

Unit II: Surveying with Total Station **15 Lectures**
Introduction to total station: Principle and function, REM, RDM, Use of total station for data processing and analysis; Electronic distance measurement survey; Area measurement survey; Height measurement survey; Survey data post processing; Survey data applications.

Unit III: Surveying with GPS and DGPS **15 Lectures**
Introduction to GPS; GPS satellite system; GPS segments; Sources of GPS errors; Differential GPS: Principle, concepts and function, Duel and single frequency DGPS, RTK and Static Surveys; Application of GPS and DGPS in surveying, mapping and navigation.

Unit IV: Surveying with Drone/UAV Technology **15 Lectures**
Introduction to drones; History of UAVs; Types of Drones; Working principle; Components; Photogrammetry and data capturing process; Post processing of UAV data; Data products; Applications.

Seminars, Tutorials, Problem solving session and group discussions on above four units**.**

References:

1. R.Subramanian "Surveying and leveling" 2 ndedition, 2013, Oxford university press, New Delhi.
2. Dr. A.M. Chandra, "Plane Surveying", 2007, New Age International (P) Ltd., New Delhi.
3. Dr. B.C. Punamia, "Surveying Vol. I and II", 2016, Laxmi Publishers, New Delhi
4. Dr. A.M. Chandra, "Remote Sensing and GIS", Narosa Publishers, New Delhi.
5. Sateesh Gopi, R. Sathikumar, and N. Madhu, "Advanced Surveying", Pearson Education India, 2007.
6. Global Navigation Satellite Systems by G. S. Rao 2010 Tata McGraw Hill Education Pvt Ltd.
7. "GPS Theory, Algorithms and Applications Guocheng Xu," Springer-Verlag, 2003.
8. Unmanned Aerial Remote Sensing: UAS for Environmental Applications 1st Edition, David R. Green (Editor) 2020
9. Barry Kavanagh & Tom Mastin, "Surveying Principles and Applications", Pearson, 2018.

Web References:

1. https://cpe.leica-geosystems.com/si/blog/post/what-is-a-total-station-how-it-works.html
2. https://ellipsis-drive.com/blog/drones-and-their-impact-on-gis-mapping/
3. https://en.wikipedia.org/wiki/Differential_GPS
4. https://opendronemap.org/

M. Sc. Geoinformatics (Part I) (Level-8) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Statistics for Geospatial Studies
Course Code: MET-106 (MSU0325MEL920G2)
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Students will frame problems using multiple mathematical and statistical representations of relevant structures and relationships and solve using standard techniques.
2. Demonstrate knowledge of the properties of parametric, semi-parametric and nonparametric testing procedures
3. Interpreting and communicating the results of a statistical analysis
4. Recognize the importance and value of mathematical and statistical thinking, training, and approach to problem solving, on a diverse variety of disciplines

Unit I: Introduction **20 Lectures**
Statistical Methods for Geography; Scientific method and mathematical notation; Descriptive Statistics; Measures of central tendency: Mean, Median, and Mode; Measures of Dispersion: Range, Variance, Standard Deviation, z-score, Skewness, Kurtosis and Histograms.

Unit II: Probability **20 Lectures**
Probability Concepts; Discrete Probability Distributions: Uniform, Binomial and Poisson Distributions; Continuous Probability Distributions; Probability Models; Central Limit Theorem and Confidence Intervals.

Unit III: Hypothesis Testing and Sampling **10 Lectures**
Sources of Data; Sampling; Hypothesis Testing: z-test and t-test; Analysis of Variance (ANOVA).

Unit IV: Correlation and Regression **10 Lectures**
Covariance; Pearson's Correlation Coefficient; Spearman's Rank Correlation Coefficient; Correlation and Geographic Problems; Regression Analysis.

Seminars, Tutorials, Problem solving session and group discussions on above four units**.**

References:

1. Rogerson, P. A. (2001) Statistical Methods for Geography, Sage Publications, New Delhi.
2. Pal, S. K. (1998) Statistics for Geoscientists, Tata McGraw Hill, New Delhi.
3. Hammond, P. and McCullagh, P. S., (1978) Quantitative Techniques in Geography: An Introduction, Oxford University Press, New York.
4. Gareth James (2013). An Introduction to Statistical Learning: with Applications in R, Springer Science & Business Media.
5. George A. Morgan (2011). IBM SPSS for Introductory Statistics, Taylor & Francis.
6. Ajai, S. G. and Sanjaya, S.G. (2009) Statistical Methods for Practice and Research, Sage Publications, New Delhi.
7. Lyman Ott (2015). An Introduction to Statistical Methods and Data Analysis, Cengage Learning.
8. Ding-Geng (Din) Chen, Karl E. Peace (2021) Applied Meta-Analysis with R and Stata.

Web References:

1. https://machinelearningmastery.com/
2. https://www.hackerrank.com/domains/ai/machine-learning
3. https://newonlinecourses.science.psu.edu/stat857/node
4. http://www.unc.edu/courses/2006spring/geog/090/001

M. Sc. Geoinformatics (Part I) (Level-8) (Semester I)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Research Methodology
Course Code: RM-107 (MSU0325RML920G)
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand the meaning, significance, and types of research.
2. Develop understanding of the basic framework of research process.
3. Demonstrate knowledge of various data collection techniques.
4. Develop skills in thesis writing and effective presentation of research findings.

Unit I: Introduction **15 Lectures**
Basics of Research; Research problem; Research design; Hypothesis; Qualitative and Doctrinal Methods in Research; Quantitative Methods in Research.

Unit II: Sampling and Research Types **15 Lectures**
Quantitative Research; Qualitative Research; Sampling; Measurement; Scaling; Reliability and Validity.

Unit III: Method of Data Collection **15 Lectures**
Methods of Data Collection; Primary and Secondary Data; Tools and Techniques of Data Collection; Data Analysis; Survey Method; Data Processing.

Unit IV: Thesis Writing **15 Lectures**
Report Writing; Research Ethics; Research Proposal; Review of Literature; Presentation of Research; Citation Patterns; Plagiarism.

Seminars, Tutorials, Problem solving session and group discussions on above four units**.**

References:

1. Basil Gomez, John Paul Jones., (2010). Research Methods in Geography: A Critical Introduction, John Wiley & Sons, New York.
2. Daniel Montello, Paul Sutton, (2006). An Introduction to Scientific Research Methods in Geography, SAGE.
3. Ron Iphofen (2018). The SAGE Handbook of Qualitative Research Ethics, SAGE.
4. Paige Baltzan (2016). Business Driven Information Systems, McGraw Hill Education, New York.
6. David L. Olson (2015). Information Systems Project Management, Business Expert Press, New York.

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2. http://sdeuoc.ac.in/sites/default/files/sde_videos/190459.pdf
3. https://ccsuniversity.ac.in/bridge-library/pdf/Research-Methodology-CR-Kothari.pdf
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M. Sc. Geoinformatics (Part I) (Level-8) (Semester II)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Photogrammetry and Digital Image Processing
Course Code: MMT-201 (MSU0325MML920H1)
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Acquire knowledge on the Development of Digital Photogrammetry, DIP and its Software and Hardware components.
2. Understand the concepts of Stereo image analysis include interior orientation, exterior orientation and aerial triangulation.
3. Understand planning and processing of photogrammetric and Image processing data.
4. Classify satellite images using classification techniques and carry out accuracy assessment.

Unit I: Fundamentals of Photogrammetry **15 Lectures**
Definition; Photogrammetry System; Source of photogrammetry information; Projection in Photogrammetry; Scale and coverage; Image coordinate system; Relief displacement; Parallax and stereo; Image overlap; Image Geometry; platforms.

Unit II: Digital Photogrammetry **15 Lectures**
Sensor model (Interior Orientation); platform model (Exterior Orientation); Resection and Intersection; Relative and Absolute orientation; Orthophotography; Feature extraction and object recognition; Close range photogrammetry: camera instrument, software and Applications.

Unit III: Introduction to Digital Image Processing **15 Lectures**
Digital image: Introduction and data formats; Introduction to image processing; Image processing system characteristics; Initial statistical extraction: histograms, univariate and multivariate statistics; Image Pre-processing: Introduction; Radiometric correction; Atmospheric correction; Geometric correction.

Unit IV: Image Enhancement and Image Classification **15 Lectures**
Contrast enhancement: linear and non-linear; Spatial feature enhancement: spatial filtering, edge enhancement; band rationing, resolution merge. Supervised classification: classification algorithm and training site selection; unsupervised classification; Classification accuracy assessment.

Seminars, Tutorials, Problem solving session and group discussions on above four units**.**

References:

1. Karl Kraus (2007) Photogrammetry – Geometry from Images and Laser Scans, Walter de Gruyter, Berlin.
2. Wilfried Linder (2003) Digital Photogrammetry: Theory and Applications, Springer – Verlag, Berlin Heidelberg.
3. Wolf. P.R., (1974). Elements of Photogrammetry, McGraw Hill books Co., London.
4. Yves Egels, Michel Kasser (2002) Digital Photogrammetry, Taylor & Francis Group, London, UK.
5. Zhilin Li (2008) Advances in Photogrammetry, Remote Sensing and Spatial Information Sciences, CRC Press, Taylor & Francis Group, London, UK.
6. S.K. Ghosh (2013). Digital Image Processing, Narosa, India
7. Chris McGlone J. (2013). Manual of Photogrammetry, American Society for Photogrammetry and Remote Sensing (ASPRS), USA.
8. Francesco Mancini Riccardo Salvini (2020) Applications of Photogrammetry for Environmental Research, ISPRS, MDPI
9. Rainer Sandau (2010). Digital Airborne Camera: Introduction and Technology, Springer Science & Business Media.
10. Jensen, J. R., (2006). Introductory Digital Image Processing: A Remote Sensing Perspective, 3rd

Edition, Prentice-Hall Inc., New Jersey.
11. Campbell, J. B. and Wynne, R.H., (2011). Introduction to Remote Sensing, 5th Edition, The Guilford Press, New York.
12. Pierre Soille (2013). Morphological Image Analysis: Principles and Applications, Springer Science & Business Media.
13. Wilhelm Burger (2010). Principles of Digital Image Processing: Core Algorithms, Springer Science & Business Media.
14. Jude Hemant (2020). Artificial Intelligence Techniques for Satellite Image Analysis Remote Sensing and Digital Image Processing, Springer, India.

Web References:

1. https://uwescience.github.io/sat-image-analysis/resources.html
2. https://agisoft.freshdesk.com/support/solutions/articles/31000153729-satellite-imageryprocessing
3. https://www.esa.int/SPECIALS/Eduspace_EN/SEMHA60P0WF_0.html
4. https://engineering.purdue.edu/~bouman/ece637/
6. www.isprs.org
7. www.hexagongeospatial.com

M. Sc. Geoinformatics (Part I) (Level-8) (Semester II)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Database Management System and Web GIS
Course Code: MMT-202 (MSU0325MML920H2)
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Demonstrate organizational skills in file and database management.
2. Clarify the concepts and components of DBMS and entity modeling.
3. Understand web mapping and hosting principles.
4. Develop skill in data warehousing and indexing, Metadata Concepts and Design.
5. Differentiate web application and hosting platforms.

Unit I: Introduction to DBMS **15 Lectures**

File system vs DBMS – Database Management Systems – Database Architectures, Introduction to data, database, spatial database; Data Storage types , Database Structure Models; Types of Database management system; Normalization; Relational Database Management System, Spatial Relationships; Spatial model and techniques; Spatial-Entity, Data management using SQL.

Unit II: Introduction to RDBMS **15 Lectures**

Data constraint-primary key, foreign key, unique key, null, not null, Normalization, default key etc. SQL: Introduction to SQL, Features of SQL, Basic data types, SQL statements/commands, DDL,DML, DCL, Set operations in SQL, order by and group by clause like, between, in, like, view and join command Nested queries, Sorting , SQL functions: MAX, MIN SORT, COUNT, AVERAGE, Numeric, String, Date Functions, Type conversion functions.

Unit III: Fundamentals of Web-GIS **20 Lectures**

What is Web, Network and Internet; Introduction to Web Mapping; Web-GIS Data Formats, Web-GIS architectures and Tires, Dynamic and Static Web Mapping; Open Geospatial Consortium (OGC) and its specifications; what is Web GIS Service, OGC specifications for GIS web services (WMS, WFS, WCS, WPS, SLD etc.) Google Earth and Bhuvan; Open Source GIS.

Unit IV: Web-GIS Applications **10 Lectures**

Application of Web-GIS in e-Government; Application of Web GIS in e-Business; 3D Web-GIS; Internet mapping; Mobile GIS; Online GIS Analytics.

Seminars, Tutorials, Problem solving session and group discussions on above four units**.**

References:

1. Cartwright, W., Peterson, M. P., and Gartner G. (Eds) (2007), Multimedia Cartography, Springer, Berlin.
2. Kraak, M., and Ormeling, F., (2003). Cartography: Visualization of Geospatial Data, Pearson Education, New Delhi.
3. Kropla B., (2005). Beginning MapServer Open-Source GIS Development, Apress, New York.
4. Pinde Fu and Jiulin Sun, (2010). Web GIS: Principles and applications, ESRI Inc.,U.S.
5. Pinde Fu (2020). Getting to Know Web GIS, ESRI Inc.,U.S.
6. Tyler Mitchell (2015). Web Mapping Illustrated: Using Open Source GIS Toolkits, O′Reilly; 1ed.

Web References:

1. http://mapserver.gis.umn.edu
2. http://postgis.org/home
3. https://earthengine.google.com/

M. Sc. Geoinformatics (Part I) (Level-8) (Semester II)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Photogrammetry and Digital Image Processing Lab
Course Code: MMPR-203 (MSU0325MMP920H1)
Total Credits: 02
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Can easily handle the advance photogrammetry and DIP software.
2. To apply photogrammetry & Digital Image Processing technique to generate geospatial data.
3. Can perform various corrections like geometric, contrast, atmospheric etc. and apply filters to improve the image classification.
4. Can apply the knowledge of Photogrammetry and DIP in various thematic studies and problem solving.

Practical in Photogrammetry:

1. Introduction to Photogrammetry suite
2. Aerial Triangulation and Control Point Extraction
3. Close Range Photogrammetry
4. Digital Surface Model (DSM) and Digital Terrain Model (DTM) Generation
5. Orthophoto Generation

Practical in DIP:

1. Introduction to DIP software
2. Loading of image data, study of histogram and layer stacking
3. Image Rectification and Registration: Image to map, Image to image
4. Extracting area of Interest and Mosaicking
5. Image Enhancement Techniques: Contrast enhancement-linear and nonlinear
6. Spatial filtering- low and high frequency, edge enhancement
7. Resolution merges.
8. Supervised Classification
9. Unsupervised classification
10. Accuracy assessment

References:

1. Lillesand, T.M., Kiefer, R.W., and Chipman, J.W. 2004. Remote Sensing and Image Interpretation (5th Ed.). Wiley. (Wiley Student Edition).
2. Miller, V.C. 1961. Photogeology. New York: McGraw-Hill, Book Company, Inc.
3. Moffit, H.F., and Edward, M.M., 1980. Photogrammetry, Harperand Row Publishers, New York.
4. Panda, B.C. 2005. Remote Sensing – Principles and Applications. New Delhi: Viva Books Private Limited.8
5. Rampal, K.K. 1999. Handbook of Aerial Photography and Interpretation. New Delhi: Concept Publishing Company.
6. Rashid, S.M. (Ed.) 1993. Remote Sensing in Geography. Delhi: Manak Publications, Pvt. Ltd.
7. Reddy, M.A. 2006. Textbook of Remote Sensing and geographical Information Systems. Hyderabad: B.S. Publications.
8. Sabins F.F Jr.1987, Remote Sensing: Principles and Interpretation, W.H.Freeman & Co., New York.

Web References:

1. www.hexagongeospatial.com
2. www.nrsc.gov.in
3. https://bhuvan.nrsc.gov.in/
4. https://www.e-education.psu.edu/geog862/node/1407

M. Sc. Geoinformatics (Part I) (Level-8) (Semester II)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: DBMS, Web-GIS and Mini Project
Course Code: MMPR-204 (MSU0325MMP920H2)
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Learn fundamentals of Web GIS and Familiar with Geo server.
2. Publish and share dynamics map using Geo-server.
3. Learn basic ethics of research.
4. Handle and analyze real world geospatial problems through mini project.

DBMS:

1. Design a Database and create required tables. For e.g. Bank, College Database
2. Apply the constraints like Primary Key, Foreign key, NOT NULL to the tables
3. Write a SQL statement for implementing ALTER, UPDATE and DELETE
4. Write the queries to implement the joins
5. Write the query for implementing the following functions: MAX (), MIN (), AVG (), COUNT (), SORT ()
6. Write the query to implement the concept of Integrity constrains
7. Write the query to create the views
8. Perform the various operations for demonstrating the insertion, updation and deletion using the referential integrity constraints

Web-GIS with ArcGIS Online:

1. Introduction to ArcGIS Online
2. Creating Web Maps
3. WebGIS Applications with AppBuilder
4. Spatial Analysis in ArcGIS Online
5. Sharing and Collaboration
6. WebGIS and 3D Visualization

Mini Project:

Prepare a mini project based on GIS techniques

Web References:

1. https://geoserver.org/
2. https://en.wikipedia.org/wiki/GeoServer
3. https://www.osgeo.org/projects/geoserver/
4. https://www.geosolutionsgroup.com/technologies/geoserver/
5. https://github.com/geoserver/.

M. Sc. Geoinformatics (Part I) (Level-8) (Semester II)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Geodesy and Digital Cartography
Course Code: MET-205 (MSU0325MEL920H1)
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand about geodesy, scale, projection systems and its principles and application.
2. Acquaint with data sources and methods of data collection
3. Get familiarize about generalization and symbolization of various levels of data.
4. Acquire knowledge on the usage of conventional sings, symbols, colors and patterns.
5. Get to know about the modern techniques of map production.

Unit I: Concept of Geodesy **10 Lectures**
Definition and fundamentals of geodesy; Spherical, ellipsoid and geoid shape of the earth; Grid and Graticule, Datums: Horizontal vs. Vertical.

Unit II: Map Projections **10 Lectures**
General principles of map projections, Classification, Choice of projections; Cartesian vs. Geodetic coordinate systems; WGS 84 and UTM projection system.

Unit III: Fundamentals of Cartography **20 Lectures**
History and Development of Cartography; Sources of cartographic data; Indexing of SOI toposheet; Scale: types and importance; Definition and classification of map; Elements of map; Map Design and its principles, Cartographic methods and techniques for preparation of maps and diagrams.

Unit IV: Digital Cartography **20 Lectures**
Concept of Digital Cartography, Digital Cartography: its comparisons with conventional cartography and GIS; Spatial and attribute database, Concept of base map, Symbolization, Generalization and Visualization; Colour system, Modern techniques of map production: animation, simulation, web maps and AI. VR in cartography.

Seminars, Tutorials, Problem solving session and group discussions on above four units**.**

References:

1. Dorling, D. and Fairborn, D. (1997): Mapping. Ways of Representing the World. Longman, Harlow.
2. Griffith, D. A. and Amehein (1997): Statistical Analysis for Geographers. Prentice Hall, Englewood Cliffs, New Jersey.
3. Strahler, A.N. (1971): The Earth Sciences. Harper and Row Publishers; New York.
4. Kraak M.J. (2010) Cartography: Visualization of Geospatial Data (3rd ed.), Pearson Edu. Ltd.
5. Tom Herring, "Geodesy Elsevier,2009,
6. Schwarze, V.S. Geodesy: The challenge of the 3rd millennium, Springer verlag, 2002.
7. James R.Smith, "Introduction to Geodesy", John wiley & Sons Inc. 1997
9. Dent, B.D.(1999): Cartography- Thematic Map Design, 5th Edition, WCB Mc Grew Hill, Boston.

Web References:

1. www.natmo.gov.in
2. www.surveyofindia.gov.in
3. www.gsi.gov.in
4. www.nbsslup.icar.gov.in
5. https://oceanservice.noaa.gov/podcast/jan18/nop12-geodesy.html

M. Sc. Geoinformatics (Part I) (Level-8) (Semester II)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Coastal Zone Studies
Course Code: MET-206 (MSU0325MEL920H2)
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. To gain knowledge on Coastal zone, Coastal zone regulations, Beach profile, Surf zone and off shore.
2. To gain knowledge on Coastal waters, Estuaries, Wet lands and Lagoons, Living resources and Non-living resources.
3. To gain knowledge on Wave classification, Wave pressure, Wave energy and Wave Decay.
4. To Students can gain knowledge on Oceanographic Applications.

Unit I: Coastal Zone **15 Lectures**
Coastal zone; Coastal zone regulations; Beach profile, Surf zone, Off shore, Coastal waters , Estuaries, Wet lands and Lagoons; Living resources, Non-living resources.

Unit II: Wave Dynamics **15 Lectures**
Wave classification; Airy's Linear Wave theory; Deep water waves, Shallow water waves, Wave pressure, Wave energy, Wave Decay; Reflection, Refraction and Diffraction of waves, Breaking of waves, Wave force on structures, Vertical, Sloping and stepped barriers, Force on piles.

Unit III: Coastal Processes **10 Lectures**
Erosion and depositional shore features; Methods of protection; Littoral currents, Coastal aquifers; Sea water intrusion; Impact of sewage disposal in seas.

Unit IV: Oceanographic Applications **20 Lectures**
Use of Microwave data; CZCS studies; chlorophyll production index; various sensors used for coastal application; physical oceanographic parameter estimation; sea surface temperature; significant wave height; wind speed and direction; Oceanic Circulation, Tidal Variation, Sea Level Rise, Coastal Bathymetry.

Seminars, Tutorials, Problem solving session and group discussions on above four units**.**

References:

1. Richard Sylvester, "Coastal Engineering, Volume I and II", Elsevier Scientific Publishing Co., 1999. Quinn, A.D., "Design & Construction of Ports and Marine Structures", McGraw-Hill Book Co., 1999.
2. Ed. A.T. Ippen, "Coastline Hydrodynamics", McGraw-Hill Inc., New York, 1993.
3. Dwivedi, S.N., Natarajan, R and Ramachandran, S., "Coastal Zone Management in Tamil Nadu".

M. Sc. Geoinformatics (Part I) (Level-8) (Semester II)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Field Project / On Job Training
Course Code: OJT-207 (MSU0325OJP920H)
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Improve their professional skills related to their employability.
2. Carry out field project on their own.
3. Effectively manage the assigned workload and complete given tusk.
4. Learn new concept and improve their knowledgebase.
5. Do team work and manage on job practical difficulties.

Duration:
One month during vacation

Joining Report of On Job Training:
Students are expected to join for their on job training with prior intimation to the department. They are expected to carry out work under the guidance of job supervisor.

On Job Training Placement:
Students can join any institution/ corporation/ industry as per their choice but within the scope of the subject area.

Total Contact Hours: 120 Hrs.

Note (s):

1. Students need to submit report of their work in prescribed format.
2. Internal assessment while on job training will be done by the job supervisor and need to be forwarded to the Department/ University.

M. Sc. Geoinformatics (Part II) (Level-9) (Semester III)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Advances in Geospatial Technologies
Course Code: MMT-301 (MSU0325MML920I1)
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Explore the Airborne Laser Terrain Mapping (ALTM) and Principles of laser altimetry, Components: GPS, IMU, LASER and data formats.
2. Familiar with the UAV components, types and applications.
3. Describe the applications of UAV in archaeology, urban mapping and disaster studies
4. Apply the Multi-criteria Decision Analysis, classification and Spatial Multi-criteria Decision Analysis in GIS projects.

Unit I: Advances in Microwave Remote Sensing **15 Lectures**
Basic and advanced processing techniques: Interferometry of Synthetic Aperture Radar (InSAR), differential InSAR or polarimetric InSAR; Applications of active and passive microwave remote sensing data in areas of geology, Hydrology, Agriculture and environmental sciences, etc.

Unit II: Air Borne Laser Terrain Mapping (LiDAR) **20 Lectures**
Introduction to laser ranging; Principle of LiDAR; System components; Range measurements; LiDAR error sources, Accuracy and applications; Advantages of ALTM; Integration of LiDAR technology with GIS mapping; UAV-based LiDAR survey: mapping of urban areas, building 3D city models, monitoring infrastructure projects, mining etc.

Unit III: Geo-spatial Modelling and Time Series Analysis **15 Lectures**
General suitability and multicriteria modelling; Geographically weighted analysis; Land cover change modelling; AHP, FR and artificial intelligence for GIS; Introduction of time series analysis; Advantages and difficulties in time-series satellite data; Time-composite techniques.

Unit IV: Cloud Computing in GIS **10 Lectures**
GeoAI; GeoGTP Tools; Introduction of Cloud Computing; Cloud Computing in GIS; Introduction to ETL and GIS ETL Tools.

Seminars, Tutorials, Problem solving session and group discussions on above four units**.**

References:

1. Wolf. P.R., (2014). Elements of Photogrammetry with Application in GIS, McGraw Hill books Co., London.
2. Curran P.J (1985). Principles of Remote Sensing, Longman, London.
3. Lillisand T.M and R.W. Kiefer (1994). Remote Sensing and Image Interpretation (3rd edition). John Wiley & Sons, New York.
4. James B. Campbell, Randolph H. Wynne, Valerie A. Thomas (2022). Introduction to Remote Sensing, Guilford Press, New York
5. Alexey Bunkin and Konstantin Voliak (2001). Laser Remote Sensing of the Ocean, John Wiley and Sons., New York.
6. Hayesm L., (1991). Introduction to Remote Sensing, Taylor and Francis Publication, London.

Web References:

1. www.rst.gsfc.nasa.gov
2. www.ccrs.nrcan.gc.ca/resource/tutor/fundam/index_e.php
3. http://www.nrsc.gov.in / www.isro.org / http://iirs.gov.in

M. Sc. Geoinformatics (Part II) (Level-9) (Semester III)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Geospatial Technologies in Natural Disaster Studies
Course Code: MMT-302 (MSU0325MML920I2)
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Acquire knowledge about hazards, disasters and catastrophes and also Disaster Management
2. Discover the causes and effects of Cyclone, Flood hazards, Drought, Landslide and Desertification with GIS case studies
3. Learn about preparation of GIS based parameters and layers for analysis
4. Help government agencies to form necessary action plans and strategies to mitigate disaster.

Unit I: Disasters and Geospatial Technology **15 Lectures**
Types of Natural Disasters with most well-known Indian examples; Causes and effects; Disaster Management and overview of mitigation strategy; Role of Geospatial technology in disaster management.

Unit II: Cyclones and Flooding **15 Lectures**
Cyclone: Origin and types; effects on land and sea; damage assessment; Flooding: Topography, land use and flooding; GIS based parameters and layers; flood prone area analysis and management; risk assessment; GIS case studies for cyclones and floods.

Unit III: Drought and Desertification **15 Lectures**
Drought: Types, factors influencing drought; vegetation index; soil erosion; delimiting drought prone areas; short term and long-term effects; Desertification: Processes; GIS based management strategies; GIS case studies for drought and desertification.

Unit IV: Landslide Disaster **15 Lectures**
Landslide: Inventory, types and influencing factors; major disasters of the world and India; effect of climate change on landslide intensity and frequency; Role of geospatial technology in landslide susceptibility and risk mapping.

Seminars, Tutorials, Problem solving session and group discussions on above four units**.**

References:

1. Holechek, J. L., R. A. Cole, J. T. Fisher, and R. Valdez (2003) Natural Resources: Ecology, Economics and Policy (2nd Edition). Prentice Hall Education.
2. Lilesand and Keifer (2000): Introduction to remote sensing and Image Interpretation; John Willy & sons Ltd., New York.
3. Colin W. Mitchell (1991) Land Evaluation, Longman scientific& Technical, co published with John Wiley & sons Inc, New York.
4. Kevin H. Deal (2020) Wildlife and Natural Resource Management 4th Ed, atithibooks, New Delhi
5. Ramkumar, Mu, (2009) Geological Hazards: Causes, Consequences and Methods of Containment, New India Publishing Agency, New Delhi.
6. Brian Tomaszewski (2020) Geographic Information Systems (GIS) for Disaster Management, Routledge, U.K.
7. Lyon, J.G (2003) GIS for Water Resources and Watershed Management. T & F, New York.

Web References:

1. www.esri.com/en-us/industries/natural-resources/overview
2. https://bhuvan-app1.nrsc.gov.in/disaster/disaster.php
3. https://bhuvan-app1.nrsc.gov.in/bhuvandisaster/

M. Sc. Geoinformatics (Part II) (Level-9) (Semester III)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Python Programming Lab
Course Code: MMPR-303 (MSU0325MMP920I1)
Total Credits: 02
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Write Python programs proficiently using different editors and IDEs.
2. Utilize variables, operators, and data types effectively for data manipulation.
3. Implement conditional statements and looping constructs to control program flow.
4. Apply Object-Oriented Programming principles to design and create classes and objects.
5. Demonstrate file handling skills and implement error handling techniques in Python programs.

Python Programming Lab:

1. Working with python editors and using IDEs
2. Variables and operators
3. Data types: number, string, list, tuple, dictionary and set
4. Conditional statements
5. Looping statements
6. Functions
7. OOP: Class, Object, Abstraction, Inheritance, Constructor, Polymorphism, Incapsulation
8. File Handling (I/O)
9. Debugging and error handling in python.
10. Case study

References:

1. John Jelle (2016) Python Programming: An Introduction to Computer Science, Franklen Beedle.
2. Paul A. Zandbergen (2020) Python Scripting for ArcGIS Pro, ESRI Press.

Web References:

1. https://www.python.org/about/gettingstarted/
2. https://www.w3schools.com/python/
3. https://nptel.ac.in/courses/106106212

M. Sc. Geoinformatics (Part II) (Level-9) (Semester III)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: GIS Programming Lab
Course Code: MMPR-304 (MSU0325MMP920I2)
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Produce basic Python code that is functional and extendable.
2. Undertake basic geoprocessing tasks by using Python code and the arcpy library.
3. Package code into usable Python Toolboxes that will be available to users via ArcToolbox.
4. Perform map designing using Python scripting.

Programming for GIS Analysis:

1. Import Arcpy and ArcGIS environment setting
2. Geoprocessing using python scripting (Clip, Split by Attributes, Buffer).
3. Exploring spatial data using python (Checking, Describing, and Listing data).
4. Manipulating spatial and tabular data using Python
5. Working with geometries using python.
6. Working with rasters using python.
7. Network analysis with python
8. Map scripting and map designing using python.
9. GIS software tool development-getting to know libraries
10. GIS software tool development- tool integration
11. Case study

References:

1. Paul A. Zandbergen (2020) Python Scripting for ArcGIS Pro, ESRI Press.
2. Paul A. Zandbergen (2020) Advanced Python Scripting for ArcGIS Pro, ESRI Press.
3. Eric Pimpler (2015). Programming ArcGIS with Python Cookbook, Packt Publishing Limited; 2nd edition.
4. Laura Tateosian (2018). Python For ArcGIS. Springer.
5. Silas Toms, and Dara O'Beirne (2017). ArcPy and ArcGIS -: Automating ArcGIS for Desktop and ArcGIS Online with Python, Packt Publishing Limited; 2nd edition.

Web References:

1. https://pro.arcgis.com/en/pro-app/latest/arcpy/get-started/installing-python-for-arcgis-pro.htm
2. https://www.esri.com/training/catalog/60db423e8b20f13a5ac9cc09/working-with-raster-data-using-python/

M. Sc. Geoinformatics (Part II) (Level-9) (Semester III)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Python Programming
Course Code: MET-305 (MSU0325MEL920I1)
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Learn basics of Python.
2. Develop console application in python.
3. Develop database application in python.
4. Apply python in geospatial analysis.

Unit I: Introduction of Programming and Python **15 Lectures**

Language, Programming Language, Introduction to ASCII, Programming Language Types, Introduction and History, Variables and data types in python; Perform computations and create logical statements using Python's operators: Arithmetic, Assignment, Comparison, Logical, Identity, list, tuple and string operations.

Unit II: Python Decision Making and Loops **15 Lectures**

Write conditional statements using If statement, if ...else statement, elif statement and Boolean expressions, While loop, For loop, Nested Loop, Infinite loop, Break statement, Continue statement, Pass statement, Use for and while loops along with useful built-in functions to iterate over and manipulate lists, sets, and dictionaries.

Unit III: Python File Operations and Modules **15 Lectures**

An introduction to file I/O, use text files, use binary files, Handle a single exception, Illustrative programs, Exercises. Importing own module as well as external modules, Programming using functions, modules and external packages, Understanding Libraries, Data Frames and Basic operations with data frames.

Unit IV: Python for GIS **15 Lectures**

Importing ArcPy, Geoprocessing with Python, use of built-in tools, setting environments, tool messages, working with vectors and its geometries, raster data handling, batch processing, Map automations, working with toolbox; Introduction to GDAL, Geopandas, NumPy.

Seminars, Tutorials, Problem solving session and group discussions on above four units**.**

References:

1. Paul A. Zandbergen (2020) Python Scripting for ArcGIS Pro, ESRI Press.
2. Paul A. Zandbergen (2020) Advanced Python Scripting for ArcGIS Pro, ESRI Press.
3. Eric Pimpler (2015). Programming ArcGIS with Python Cookbook, Packt Publishing Limited; 2nd edition.
4. Laura Tateosian (2018). Python For ArcGIS. Springer.
5. Silas Toms, and Dara O'Beirne (2017). ArcPy and ArcGIS -: Automating ArcGIS for Desktop and ArcGIS Online with Python, Packt Publishing Limited; 2nd edition.

Web References:

1. https://pro.arcgis.com/en/pro-app/latest/arcpy/get-started/installing-python-for-arcgis-pro.htm
2. https://www.esri.com/en-us/arcgis/products/arcgis-python-libraries/overview
3. https://www.esri.com/training/catalog/60db423e8b20f13a5ac9cc09/working-with-raster-data-using-python/

M. Sc. Geoinformatics (Part II) (Level-9) (Semester III)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Java Programming
Course Code: MET-306 (MSU0325MEL920I2)
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Analyze a software development problem and express its essence succinctly and precisely
2. Implement a module so that it executes efficiently and correctly
3. Devise appropriate module specifications and express them informally in terms of pre- and post-conditions
4. Express representation invariants, understand their impact on efficiency and ease of implementation, and implement them as runtime assertions.

Unit I: Object-Oriented Programming – Fundamentals **15 Lectures**
Review of OOP; Objects and classes in Java; defining classes; methods, access specifies, static members, constructors, finalize method, Arrays, Strings, Packages, Java Doc comments.

Unit II: Object-Oriented Programming – Inheritance **15 Lectures**
Inheritance, class hierarchy, polymorphism, dynamic binding, final keyword, abstract classes, the Object class, Reflection, interfaces, object cloning, inner classes, proxies.

Unit III: Event-Driven Programming **15 Lectures**
Graphics programming; Frame, Components, working with 2D shapes, Using color, fonts, and images, Basics of event handling, event handlers, adapter classes, actions, mouse events; AWT event hierarchy, introduction to Swing, Model-View, Controller design pattern, buttons, layout management, Swing Components.

Unit IV: Generic Programming **15 Lectures**
Motivation for generic programming, generic classes, generic methods, generic code and virtual machine, inheritance and generics, reflection and generics, exceptions, exception hierarchy, throwing and catching exceptions, Stack Trace Elements, assertions, logging.

Seminars, Tutorials, Problem solving session and group discussions on above four units**.**

References:

1. Cay S. Horstmann and Gary Cornell, "Core Java: Volume I – Fundamentals", Eighth Edition, Sun Microsystems Press, 2008.
2. C. Thomas Wu, "An introduction to Object-oriented programming with Java", Fourth Edition, Tata McGraw-Hill Publishing company Ltd., 2006.
3. Marty Stepp, CS 106A: Programming Methodology, Stanford University, 2017sp

Web References:

1. https://www.computerscienceonline.org/cutting-edge/java/
2. http://www.learnjavaonline.org/
3. http://www.programming-simplified.com/index.html

M. Sc. Geoinformatics (Part II) (Level-9) (Semester III)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Research Project-I
Course Code: RP-307 (MSU0325MMP920I3)
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Identify spatial problems and research questions suitable for GIS analysis.
2. Apply spatial analysis techniques to extract meaningful information.
3. Create visually compelling maps to communicate analysis results.
4. Gain proficiency in using GIS software (e.g., ArcGIS, QGIS).

Duration: Entire semester (Six month)

Groupwise Student Allocation: Students will be allocated into groups for the project work**.**

Presentation: Students are required to present their project findings in a structured format.

Total Contact Hours: 120 Hrs.

M. Sc. Geoinformatics (Part II) (Level-9) (Semester IV)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Geospatial Technology in Climate Change Studies
Course Code: MMT-401 (MSU0325MML920J1)
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand and explain the differences between weather and climate, local to global climatic variations, and Elnino vs. Lanino
2. Quantify relationship between ecosystems (forest, agriculture) and rainfall, temperature, and map/model the impact of global warming on these systems using RS & GIS.
3. Learn the relationship between climate and urban issue
4. Describe global policies, and link them with local, regional and national developmental initiatives and generate report.

Unit I: Overview Climate Studies **15 Lectures**
Fundamentals of Weather and Climate; Greenhouse effect and Global Warming; Local, Regional, Continental and global weather Pattern; Weather variations and associated effects, Elnino, LaNino, Southern Oscillation, Drought and Flood Scenario.

Unit II: Effect of Climate Change on Agriculture and Forest **15 Lectures**
Food security, Drought monitoring and forecast; Climate change impact on agriculture economy; Time-Series Satellite data; Phenology of Vegetation; Global changes in phenology; Forest Fire and climate change.

Unit III: Effect of Climate Change on Urban Area **15 Lectures**
The physical structure and composition of urban areas; Urbanization process, and growth trend, problems of urbanization; Climate change impact on urban area; Urban Heat Island; Application of LST in analyzing Urban Heat Island effect.

Unit IV: Global Policies for Climate Change Mitigation **15 Lectures**
United Nations Framework Convention on Climate Change (UNFCCC); Kyoto Protocol; Intergovernmental Panel on Climate Change (IPCC); Reducing Emissions from Deforestation and forest Degradation (REDD); Convention of Biological Diversity (CBD); Committee on World Food Security.

Seminars, Tutorials, Problem solving session and group discussions on above four units**.**

References:

1. ECA (Economics of Climate Adaptation) (2009). Shaping climate resilient development: a framework for decision making. ClimateWorks Foundation, Global Environment Facility, European Commission, McKinsey & Company, The Rockefeller Foundation, Standard Chartered Bank and Swiss Re. 164pp.
2. FAO (2015). Booklet on FAO‟s work on Climate Change. Job Number 15165.
3. FAO (2016). Planning, implementing and evaluating Climate-Smart Agriculture in Smallholder Farming Systems. Job Number 15805. Report under Mitigation of Climate Change in Agriculture (MICCA) Programme of FAO. ISBN: 978925109305.
4. IPCC (2014). IPCC Assessment Report. UNFCCC.
5. Kulkarni, A., I.M. Bahuguna, B.P. Rathore, S.K. Singh, S.S. Randhawa, R.K. Sood and
S. Dhar (2007). Glacial retreat in Himalaya using Indian Remote Sensing satellite data. Current Science, Vol. 92, No. 1.
6. Lal, M., T. Nozawa, S. Emori, H. Harasawa, K. Taka, A. Abe-Ouchi, T. Nakajima, T. Takemura and A. Numaguti (2001). Future climate change: Implications for Indian summer monsoon and its variability. Current Science, Vol. 81, No. 9, 10.

7. Milly, P.C.D., R.T. Wetherald, K.A. Dunne and T.L. Delworth (2002). Increasing risk of great floods in a changing climate. Nature Vol 415: 514–517.
8. Rees, H.G. and D.N. Collins (2006). Regional differences in response of flow in glacier-fed Himalayan rivers to climatic warming. Hydrological Processes, 20 (10). 2157–2169. 10.5002/hyp.6209.
9. Schmidhuber, J. and F. Tubiello (2007). Global food security under climate change. PNAS 104 (50) 19703–19708.
10. Tubiello, F. and G. Fischer (2007). Reducing climate change impacts on agriculture: Global and regional effects of mitigation, 2000–2080 Technological Forecasting & Social Change 74 1030–1056.
11. USDA (ed Walsh, M) (2008). The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity in the United States. U.S. Climate Change Science Program Synthesis and Assessment Product 4.3.
12. WWF (2005). An Overview of Glaciers, Glacier Retreat, and Subsequent Impacts in Nepal, India and China. Kathmandu. Nepal.
13. World Bank (2010). Economics of Adaptation to Climate Change: Synthesis Report. Washington DC. 100pp.

Web References:

1. https://www.ipcc.ch/report/ar6/wg2/
2. https://education.nationalgeographic.org/resource/explore-climate-change-through-gis/

M. Sc. Geoinformatics (Part II) (Level-9) (Semester IV)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Geospatial Technology for Urban Studies and Regional planning
Course Code: MMT-402 (MSU0325MML920J2)
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand urban morphology, hierarchy, and urbanization processes.
2. Apply conceptual models and urban indicators for monitoring urban processes.
3. To understand the concepts in regional planning and its application
4. To study different methods in order to compute regional development
5. To acquire a comprehensive understanding of Geoinformatics approaches employed in the context of regional planning.

Unit I: Concepts in Urban Studies **15 Lectures**

Urban morphology, Urban hierarchy; urbanization processes conceptual modeling of urban processes; urban indicators and monitoring, urban information system; Land use/Land cover mapping, change detection ; Land suitability analysis; Plan formulation, Regional, Master and detailed development, Use of remote sensing and GIS in plan preparation, Urban information system; case studies.

Unit II: Urban Management **15 Lectures**

Network Analysis; Traffic and parking studies; Accident analysis, Solid waste management; Urban heat Island and LST; Fringe Dynamic; Urban sprawl and growth modeling , Virtual 3D city modeling and applications; case studies.

Unit III: Concepts in Regional Planning **15 Lectures**

Region: concept, types and hierarchy of regions; planning, concept and types, planning region: concept and characteristics of a planning region, Delineation of planning region, Indicators for measuring development, Development; meaning, Growth versus development, Measurement of regional development; policies and experiences of regional planning in India.

Unit IV: Regional Planning and Geoinformatics **15 Lectures**

GIS Based Decision making Process, spatial data infrastructure and spatial information system, Applications in planning, population estimation, identification of illegal encampments, sources of pollution etc. Spatial resolution related to level of Planning, Use of remote sensing and GIS in detecting urban heat islands.

Seminars, Tutorials, Problem solving session and group discussions on above four units**.**

References:

1. Juliana Maantay, John Ziegler, John Pickles, GIS for the Urban Environment, Esri Press 2006.
2. Allan Brimicombe, GIS Environmental Modeling and Engineering, CRC; 1 edition 2003.
3. Paul Longley, Michael Batty, Spatial Analysis: Modeling in a GIS Environment Wiley,1997.
4. Michael F. Goodchild, Louis T. Steyaert , Bradley O. Parks, Carol Johnston, David Maidment, Michael Crane , Sandi Glendinning, GIS and Environmental Modeling: Progress and Research Issues (Hardcover) by,Publisher: Wiley; 1 edition, 1996.
5. Roland Fletcher, The Limits of Settlement Growth: A Theoretical Outline (New Studies in Archaeology) (First edition), Cambridge University Press; 2007.

M. Sc. Geoinformatics (Part II) (Level-9) (Semester IV)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Resource Evaluation Lab
Course Code: MMPR-403 (MSU0325MMP920J1)
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Acquire knowledge in spatial data collection and manipulation.
2. Integrate multiple layers and assign weightages according to attributes.
3. Perform layer based analysis to derive accurate results.
4. Assess flood and its possible impact on natural and man-made resources.

Resource Evaluation Lab:

1. Change detection analysis
2. Watershed delineation and prioritization
3. Analysis of urban heat island
4. Trend analysis (Rainfall & Temperature)
5. Site suitability analysis
6. Analysis of groundwater potential zone
7. Analytical hierarchy process for flood susceptibility mapping
8. Frequency ratio model for landslide susceptibility mapping
9. Drought monitoring and assessment
10. Forest fire modelling
11. Soil erosion modelling
12. Flood modelling in HEC-RAS

References:

1. Lyon, J.G, (2003) GIS for Water Resource and Watershed Management, T &F, New York.
2. Haywood. L, Comelius. S and S. Carver (1988). An Introduction to Geographical Information Systems, Addison Wiley Longmont, New York.
3. Lillisand T.M and R.W. Kiefer (1994). Remote Sensing and Image Interpretation (3rd edition). John Wiley & Sons, New York.
4. Sabins F.F Jr. (1987). Remote Sensing: Principles and Interpretation, W.H.Freeman & Co., New York.
5. Burrough P.A (1986) Principles of Geographical Information System for Land Resources Assessment, Clarendon Press, Oxford.
6. Burrough P A and McDonnell [2000] Principles of Geographical Information Systems, Oxford University Press, London.
7. Lo.C.P., Yeung. K.W. Albert (2002) Concepts and Techniques of Geographic Information Systems, Prentice-Hall of India, New Delhi.
8. Monkhouse, F.J. and Wilkinson, H.R. (1994) Maps and Diagrams, Methuen, London.
9. Sarkar A. K. (1997) Practical Geography: A Systematic Approach, Oriental Longman, Calcutta.
10. Michael Law (2021) Getting to Know ArcGIS Pro 2.8 Fourth Edition, ESRI Press, U.S.A

Web References:

1. www.esri.com
2. www.nrsc.gov.in
3. www.bhuvan.nrsc.gov.in
4. www.arcgis.com
5. www.nbsslup.icar.gov.in

M. Sc. Geoinformatics (Part II) (Level-9) (Semester IV)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Hydrology and Watershed Management
Course Code: MET-404 (MSU0325MEL920J1)
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand the concepts of watershed management and its effect on land, water and ecosystem resources
2. Develop control and mitigation techniques for watershed problems
3. Suggest technical measures for soil erosion control both due to water and wind
4. Assess the current status of the watershed at field, by taking up accurate investigation measures and conduct survey
5. Suggest drought control measures, water conservation structures, including design

Unit I: Introduction **10 Lectures**

Hydrology as emerging discipline of earth science; Water budget equation; World water balance; Global Fresh water resources; Hydrological cycle: Man's intervention in hydrological cycle.

Unit II: Hydrological Cycle **15 Lectures**

Major components of hydrological cycle: precipitation, evapotranspiration, infiltration, surface and ground water runoff; Hydrograph and Unit hydrograph; Stream flow measurement: Measurement of stage and velocity, Stage discharge relationship, Rating curve; Factor affecting on runoff, basin yield, Rainfall Runoff relationship.

Unit III: Watershed Management **15 Lectures**

Watershed management: concept and history of watershed management, Watershed characterization, Classifications: Land Capability, Land Suitability, Land Use Land Cover, Integrated watershed management; Principles of soil erosion- causes of soil erosion, types of soil erosion, Methods of soil conservation, Soil erosion models.

Unit IV: Watershed Modeling **20 Lectures**

Rainwater harvesting: Potential and Methods, Water resources models; Rainfall runoff modelling; Groundwater modeling; Water quality modeling; Flood inundation mapping and modelling; Drought monitoring; Cropping pattern change analysis; Site selection for artificial recharge; Reservoir sedimentation; Use of RS and GIS in watershed Management.

Seminars, Tutorials, Problem solving session and group discussions on above four units**.**

References:

1. Allam, Gamal Ibrahim Y., Decision Support System for Integrated Watershed Management, Colorado State University, 1994.
2. Am. Soc. Of Agri. Engr., Hydrologic Modeling of Small Hydrologic Modeling of Small Watersheds, Am. Soc. Agri. Eng., Michigan, 1982.
3. American Soc. of Civil Engr., Watershed Management, American Soc. of Civil Eng, ,ineers, New York, 1975.
4. Black Peter E., Watershed Hydrology, Prentice Hall, London, 1991.
5. Bedient, Philip B. and Huber, Wayne Charles 2002. Hydrology and Floodplain Analysis. Prentice Hall, Englewood Cliffs NJ.
6. Bilas, Ram., Rural Water Resource Utilization and Planning. Concept Publishing Company, New Delhi. 1988.
7. Chow, VenTe.,. Handbook of Applied Hydrology: A Compendium of Water Resources Technology.McGrawHill,NewYork, 1964.

8. Chow, VenTe; Maidment, David R. and Mays, Larry W., Applied Hydrology. McGraw-Hill, New York, 1988.
9. Fetter, C. W., Applied Hydrogeology. Pearson Education, San Francisco, 2001.
10. GopalIyer, K.,□& Roy U.N., (Eds.), Watershed Management & Sustainable Development, Kanishka Publishers, , New Delhi, 2005.
11. Heathcote, I.W., Integrated Watershed Management Integrated Watershed Management- Principles and Practice, Jown Wiley□& Sons, London, 1998.
12. Paul A. Debarry., Watershed, Processes,□ Assessment & Management, Wiley London 2004 Wiley, London, 2004.

Web References:

1. https://dep.wv.gov/wwe/watershed/pages/watershed_management.aspx
2. https://www.frontiersin.org/research-topics/36217/hydrological-connectivity-and-sustainable-watershed-management-in-a-changing-environment#articles
3. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/watershed-management

M. Sc. Geoinformatics (Part II) (Level-9) (Semester IV)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Environmental Monitoring and Assessment
Course Code: MET-405 (MSU0325MEL920J2)
Total Credits: 04
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand environmental quality and its deterioration due to human impact.
2. Learn methods for environmental monitoring and assessment.
3. Comprehend the significance and steps of Environmental Impact Assessment (EIA).
4. Explore specific environmental issues: thermal pollution, oil pollution, and electronic waste (e-waste).
5. Understand the applications of remote sensing in environmental studies.

Unit I: Environmental Monitoring **15 Lectures**

What is environmental quality? Quality of environment for life on earth and man; Advantages of Environmental Monitoring, Deterioration of environmental quality with reference to anthropogenic impact; Methods of assessment of environmental quality; Short term studies/ surveys; Rapid assessment; Continuous short and long term monitoring

Unit II: Environmental Impact Assessment (EIA) **15 Lectures**

Need of EIA; Scope and objectives; Types of environmental impacts; Steps involved in conducting the EIA Studies; Environmental Impact Assessment techniques- Ad-hoc method, checklist method, overlay mapping method, network method, simulation and modeling technique, matrix method, and system diagram technique; Merits and Demerits of EIA studies.

Unit III: Thermal pollution, Oil Pollution and Electronic waste (E-waste) **15 Lectures**

Definition and sources, Chemical and biological effects of thermal pollution, Effect of thermal pollution; Thermal pollution from power plants and their control. Oil pollution and marine ecology, sources of oil pollution, factors effecting fate of oil after spillage movement, remote sensing in water quality monitoring. Sources and types and constituents of E-wastes and its environmental consequences.

Unit IV: Remote sensing and its applications in Environmental Monitoring **15 Lectures**

Application of remote sensing in environmental studies: land use mapping, forest survey, habitat analysis, water management, drought monitoring and flood studies, wetland survey; rainfall estimation, pollution studies, soil conservation, watershed management and vegetation mapping.

Seminars, Tutorials, Problem solving session and group discussions on above four units**.**

References:

1. Environmental Impact Assessment: Practical Solutions to Recurrent Problems, D. P. Lawrence
2. Environmental Impact Analysis Handbook: J. G. Rau and D. C. Wooten;
3. Environmental Impact Assessment, L. W. Canter,
4. Methods of Environmental Impact Assessment, P. Morris and R. Therivel

M. Sc. Geoinformatics (Part II) (Level-9) (Semester IV)
(NEP-2020)
(Introduced from Academic Year 2023-24)

Title of Course: Research Project-II
Course Code: RP-406 (MSU0325MMP920J2)
Total Credits: 06
Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Carry out a substantial research based project.
2. Demonstrate capacity to lead and manage change through collaboration with others.
3. Demonstrate and understanding of the ethical issues associated with practitioner research.
4. Analyze data and synthesize research findings.

Duration: Entire semester (Six month)

Individual Allocation: Each student will be assigned a dedicated teacher to guide them through their project work.

Presentation: Students are required to present their project findings in a structured format.

Total Contact Hours: 120 Hrs.

9. Scheme of Teaching

Course Type	Course Code	Teaching Scheme		
		Theory and Practical		
		Lectures (Hours/ week)	Practical (Hours/ week)	Credit
SEMESTER-I				
Major Mandatory	MMT-101	4	--	4
	MMT-102	4	--	4
	MMPR-103	--	8	4
	MMPR-104	--	4	2
Major Elective	MET-105/106	4	--	4
Research Methodology	RM-107	4	--	4
Total (A)		**16**	**12**	**22**
SEMESTER-II				
Major Mandatory	MMT-201	4	--	4
	MMT-202	4	--	4
	MMPR-203	--	4	2
	MMPR-204	--	8	4
Elective Theory	MET-205/206	4	--	4
OJT	OJT-207	--	8**	4
Total (B)		**12**	**20**	**22**
SEMESTER-III				
Major Mandatory	MMT-301	4	--	4
	MMT-302	4	--	4
	MMPR-303	--	4	2
	MMPR-304	--	8	4
Major Elective	MET-305/306	4	--	4
Research Project	RP-307	--	8	4
Total (C)		**12**	**20**	**22**
SEMESTER-IV				
Major Mandatory	MMT-401	4	--	4
	MMT-402	4	--	4
	MMPR-403	--	8	4
Major Elective	MET-404/405	4	--	4
Research Project	RP-406	--	12	6
Total (D)		**12**	**20**	**22**
Total (A+B+C+D)				**88**

10. Examination Pattern

Course Type	Course Code	Examination Scheme					
		University Assessment (UA)			Internal Assessment (IA)		
		Maximum Marks	Minimum Marks	Exam. Hours:Mi	Maximum Marks	Minimum Marks	Exam. Hours
SEMESTER-I							
Major Mandatory	MMT-101	80	32	3	20	8	1
	MMT-102	80	32	3	20	8	1
	MMPR-103	100	40	5	--	--	--
	MMPR-104	50	20	2:30	--	--	--
Major Elective	MET-105/106	80	32	3	20	8	1
Research Methodology	RM-107	80	32	3	20	8	1
Total (A)		**470**	--	--	**80**	--	--
SEMESTER-II							
Major Mandatory	MMT-201	80	32	3	20	8	1
	MMT-202	80	32	3	20	8	1
	MMPR-203	50	20	2:30	--	--	--
	MMPR-204	100	40	5	--	--	--
Elective Theory	MET-205/206	80	32	3	20	8	1
OJT	OJT-207	60	24	3	40	16	*
Total (B)		**450**	--	--	**100**	--	--
SEMESTER-III							
Major Mandatory	MMT-301	80	32	3	20	8	1
	MMT-302	80	32	3	20	8	1
	MMPR-303	50	20	2:30	--	--	--
	MMPR-304	100	40	5	--	--	--
Major Elective	MET-305/306	80	32	3	20	8	1
Research Project	RP-307	80	32	4	20	8	*
Total (C)		**470**	--	--	**80**	--	--
SEMESTER-IV							
Major Mandatory	MMT-401	80	32	3	20	8	1
	MMT-402	80	32	3	20	8	1
	MMPR-403	100	40	5	--	--	--
Major Elective	MET-404/405	80	32	3	20	8	1
Research Project	RP-406	120	48	6	30	12	*
Total (D)		**460**	--	--	**90**	--	--
Total (A+B+C+D)		**1850**	--	--	**350**	--	--

Theory:

For theory courses, such as MMT-101, MMT-102, etc., the examination pattern is as follows:
Maximum Marks: 80
Minimum Marks: 32
Examination Duration: 3 hours
Internal Assessment (IA):
Maximum Marks: 20
Minimum Marks: 8
Examination Duration: 1 hour

Practical:

Practical courses typically involve hands-on exercises and may not have only traditional written examination. However, if they do, the pattern would be specified for each practical course individually. For example, MMPR-104, MMPR-105, and others may have their own examination patterns.

On Job Training (OJT):

OJT-207, which stands for On-the-Job Training, has the following examination pattern:
University Assessment (UA):
Maximum Marks: 60
Minimum Marks: 24
Examination Duration: 3 hours
Internal Assessment (IA):
Maximum Marks: 40
Minimum Marks: 16

Research Methodology:

The research methodology course, RM-206, has the following examination pattern:
University Assessment (UA):
Maximum Marks: 80
Minimum Marks: 32
Examination Duration: 3 hours
Internal Assessment (IA):
Maximum Marks: 20
Minimum Marks: 8
Examination Duration: 1 hour

11. Nature of Question Paper and Scheme of Marking

There will be four questions in the question paper each carrying 20 marks. All questions shall be compulsory,

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SHIVAJI UNIVERSITY, KOLHAPUR
M.Sc. (Geoinformatics) (Two Years)
SEMESTER-I/II/III/IV EXAMINATION, YYYY
Theory

PAPER No.----- Paper Title----------

Day and Date :------ **Total Marks: 80** **Duration : 03 Hours**

Instructions: 1) All questions are compulsory.

2) All questions carry equal marks.

Q. No. 1: Multiple Choice Questions (2 Marks Each) Marks **16**

Q. No. 2: Short Answer (Any Four out of Five) Marks **16**

Q. No. 3: Short Notes (Any Two out of Three) Marks **16**

Q. No. 4: Descriptive Answer (Any Two out of Four) Marks **32**

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SHIVAJI UNIVERSITY, KOLHAPUR
M.Sc. Geoinformatics (Two Years)
SEMESTER-I/II EXAMINATION, YYYY
Practical

PAPER No.----- Paper Title----------

Day and Date :------ **Total Marks: 80** **Duration: 03 Hours**

Instructions: 1) All questions are compulsory.

2) All questions carry equal marks.

Q. No. 1: Marks **20**

Q. No. 2: Marks **20**

Q. No. 3: Marks **20**

Q. No. 4: Marks **20**

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12. Equivalence of courses

Not Applicable