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UNIVERSITY OF MYSORE

Estd. 1916

VishwavidyanilayaKaryasoudha
Crawford Hall, Mysuru- 570 005

No.AC2(S)/319/2023-24

Dated: 08.11.2023

Notification

Sub:- Modifications in the Syllabus of M.Sc. Geographical Information System (PG) programme with effect from the Academic year 2023-24.

Ref:- 1. Decision of Board of Studies in Geographical Information System (PG) held on 09-02-2023.
2. Decision of the Faculty of Science & Technology meeting held on 15-03-2023.
3. Decision of the Academic Council meeting held on 24-03-2023.

*****

The Board of Studies in Geographical Information System (PG) which met on 09-02-2023 has resolved to recommended and approved the modified syllabus and scheme of Examinations of M.Sc. Geographical Information System (PG) Programme with effect from the academic year 2023-24.

The Faculty of Science & Technology and Academic Council at their meetings held on 15-03-2023 and 24-03-2023 respectively has also approved the above said modified syllabus. Hence, it is hereby notified.

The syllabus contents may be downloaded from the University Website i.e., www.uni-mysore.ac.in.

13/11/2023

Registrar

Registrar
University of Mysore
Mysore

To;

1. The Registrar (Evaluation), University of Mysore, Mysuru.
2. The Chairman, BOS/DOS in Geographical Information System, Manasagangothri, Mysuru.
3. The Dean, Faculty of Science & Technology, DoS in Mathematics, MGM.
4. The Director, PMEB, Manasagangothri, Mysuru.
5. Director, College Development Council , Moulya Bhavan, Manasagangothri, Mysuru.
6. The Deputy Registrar/Assistant Registrar/Superintendent, Administrative Branch and Examination Branch, University of Mysore, Mysuru.
7. The PA to Vice-Chancellor/ Registrar/ Registrar (Evaluation), University of Mysore, Mysuru.
8. Office Copy.

REVISION OF SYLLABUS PERTAINING TO THE
M.Sc. GEOGRAPHICAL INFORMATION SYSTEMS (GIS)
PROGRAMME FOR THE ACADEMIC YEAR, **2023-2024** (ONWARDS)
OFFERED AT THE
CENTRE FOR GEOINFORMATICS TECHNOLOGY,
DOS IN GEOGRAPHY, MGM, UNIVERSITY OF MYSORE, MYSORE

After a detailed discussion (Annexure I, Old/Current Syllabus and Annexure II, Revised Syllabus) has documented and the Board resolved to revise the existing syllabus and made the following changes:

a. The Board resolved to replaced and upgrade the existing **hardcore papers** and introduced new Hard core papers in First, Second and Third Semesters.

b. The Board resolved to replaced and upgrade the existing **softcore papers** and introduced new softcore papers in First, Second and Third Semesters.

c. The Board resolved to update the contents of the existing papers with new concepts and techniques in both theory and practical papers in First, Second and Third Semesters.

For First Semester:

a. The Board ***retained*** the Hard Core "**Principles of Remote Sensing**" and updated the contents.

b. The Board resolved to ***rename*** the hardcore practical paper "**Remote Sensing Analysis and Interpretation**" as **"Practical Remote Sensing"** and updated contents.

c. The Board ***introduced*** the new hardcore practical paper **"Map and Mapping Techniques"** with new content

d. The Board ***introduced*** the new softcore paper **"Earth System and Dynamics"** with new content

e. The Board ***retained*** the softcore "**Fundamentals of Information Technology**" and updated contents.

f. The Board ***shifted the*** hardcore paper "**Principles of Cartography"** to the softcore slot as "**Fundamentals of Cartography**" and updated the contents.

g. The Board ***introduced*** the new softcore paper **"Fundamentals of Statistics"** with new content

For Second Semester:

a. The Board ***retained*** Hardcore "**Principles of GIS**" with 4 credits and updated contents.

b. The Board resolved to ***rename*** existing practical hardcore "**Advanced Geospatial Analysis**" as **"Geospatial Data and Analysis"** (Practical) and updated contents.

c. The Board resolved to ***rename*** existing practical hardcore "**Surveying Technologies and Data Processing**" as **"Advanced Land Surveying Technologies"** and updated contents.

d. The Board ***introduced*** the new softcore paper **"Geoinformatics and Geological Studies"** with new contents.

Dr. RAMU
Course Coordinator, - MSc in GIS
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e. The Board ***shifted*** **"GIS for Water Resource Management"** from third semester to second semester and ***renamed*** as **"Geoinformatics and Water Resource Management** with new updated content

f. The Board ***renamed*** **"GIS for Land Resource Management"** as **"Geoinformatics and Land Resource Management** with new updated content

g. The Board ***introduced*** the new softcore paper **"Geoinformatics and Transportation Management"** with new content

h. The Board ***retained*** Hardcore "**Principles of GIS**" and updated contents.

i. The Board ***shifted*** Open Elective **"Basics of Remote Sensing"** from third semester to second semester with new updated content

For Third Semester:

a. The Board ***retained*** Hard core "**Research Methodology and Project Management**" with 4 credits and updated contents.

b. The Board ***retained*** Hardcore practical "**Programming for GIS**" and updated contents.

c. The Board ***introduced*** the new hardcore practical paper **"Environmental Statistics"** with new content.

d. The Board resolved to ***rename*** the softcore paper "**GIS for Urban Planning and Management**" as "**Geoinformatics and Urban Studies"** and updated contents.

e. The Board ***shifted*** **"GIS for Disaster Management"** from second semester to third semester and ***renamed*** as **"Geoinformatics and Disaster Management** with new updated content.

f. The Board resolved to ***introduce*** the new softcore paper "**Geoinformatics and Marine Studies**" and contents.

g. The Board resolved to rename the softcore paper "**GIS for Sustainability Research**" as **"World and Sustainable Development"** and updated contents.

h. The Board ***shifted*** Open Elective **"Fundamentals of GIS and GPS"** from second semester to third semester and renamed as **"Basics of Geoinformatics"** with new updated content

For Fourth Semester:

a. The Board ***retained*** Hard core "**Internship**" with 4 credits.

b. The Board ***retained*** Hard core "**Major Research Project**" with 8 credits.

Chairman, BOS in GIS 09-02-2022

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Annexure I: Existing/Old Syllabus

CHOICE BASED CREDIT SCHEME (CBCS)

CENTRE FOR GEOINFORMATICS TECHNOLOGY

DOS in Geography, Manasagangothri, University of Mysore, Mysuru – 570006

REVISED SYLLABUS BY SEMESTERS

MASTER OF SCIENCE IN GEOGRAPHICAL INFORMATION SYSTEMS (M.Sc. in GIS)

For students admitted in 2018-19 (Onwards)

I Semester (Credits: 28)

SL. No.	Code	Title of Course	Types HC/SC/OE	Number of Credits			
				L	T	P	Total
1	30941	Principles of Remote Sensing	HC I	3	1	0	4
2	30942	Principles of Cartography	HC II	3	1	0	4
3	Practical	Remote Sensing Analysis and Interpretation	HC III	0	1	3	4
4	30943	Fundamentals of Information Technology	SC I	3	1	0	4
5	30944	GIS for Network Planning and Management	SC II	3	1	0	4
6	30945	Land Use Planning and Land Evaluation	SC III	3	1	0	4
7	30946	Remote Sensing for Coastal Management	SC IV	3	1	0	4
Note: All three Hard Core Courses are compulsory. Among the Four Soft Core courses, students have the option to choose any two Soft Core Courses.							

II Semester (Credits: 28)

SL. No.	Codes	Title of Course	Types HC/SC/OE	Number of Credits			
				L	T	P	Total
1	30951	Principles of GIS	HC IV	3	1	0	4
2	Practical	Advanced Geospatial Analysis	HC V	0	1	3	4
3	Practical	Surveying Technologies and Data Processing	HC VI	0	1	3	4
4	30952	GIS for Disaster Management	SC V	3	1	0	4
5	30953	GIS for Geomorphological Studies	SC VI	3	1	0	4
6	30954	GIS for Land Resource Management	SC VII	3	1	0	4
7	30955	GIS for Demography and Humanities	SC VIII	3	1	0	4
8	30956	Fundamentals of GIS and GPS	OE I	3	1	0	4
Note: All three hard cores are compulsory. Among the Four soft cores, students have the option to choose any two Soft Core Courses. Open Elective Courses are offered for the students from other Department.							

III Semester (Credits: 28)

SL. No.	Codes	Title of Course	Types HC/SC/OE	Number of Credits			
				L	T	P	Total
1	30961	Climate Change and GIS	HC VII	3	1	0	4
2	Practical	Programming for GIS	HC VIII	0	1	3	4
3	30962	Research Methodology and Project Management	HC IX	3	1	0	4
4	30963	GIS for Urban Planning and Management	SC IX	3	1	0	4
5	30964	GIS for Water Resources Management	SC X	3	1	0	4
6	30965	GIS for Environmental Management	SC XI	3	1	0	4
7	30966	GIS for Sustainability Research	SC XII	3	1	0	4
8	30967	Basics of Remote Sensing	OE II	3	1	0	4
Note: All three hard cores are compulsory. Among the Four soft cores, students have the option to choose any two Soft Core Courses. Open Elective Courses are offered for the students from other Department.							

IV Semester (Credits: 12)

SL. No.	Codes	Title of Course	Types HC/SC/OE	Number of Credits			
				L	T	P	Total
1		Internship	HC X	0	1	3	4
2		Major Research Project	HC XI	0	2	6	8

Note: Internship and Projects are compulsory for the M.Sc GIS Students.

Note: All course works / programs are compulsory for M.Sc-GIS students.

- **Internships:** Are done in a Government, research and implementation institution and / or a Private, Corporate institution of repute with specialization on the technologies of Cartography, Remote Sensing, Photogrammetry, LiDAR, CAD, GIS and GPS, including Computer work in a prestigious lab. Internship must begin at the first week in the commencement of fourth semester and end with an eight 8-weeks (two months) from the date of joining.
- **Project work:** This is a Major Project of 3 full months or about 12 weeks, on a larger, manageable program of research, requiring a report of 90 pages including maps and diagrams and tables (40 pages) and text (50 pages). Project work begins after the Internship program.

Seminars are a part of Internships and Project work in which seminars have specific purposes. Students make power point presentations on their chosen theme of research for major research project work, outlining the background, rationale and objectives of research, on their chosen Methodology and the rationale behind them and on their Draft Final report at the end of the 20th week of the semester under the guidance and supervision of their tutors/advisors/guides.

Field work and **educational tours** are also compulsory for the students and are conducted by the students with explicit guidance and supervision from the faculty members. They are better performed before the beginning of the second and fourth semesters.

The students are very intensively engaged by the course works of Internship, Project work, seminars, field work and educational tours, with constant monitoring and evaluation of the work carried out by the faculties. Final seminar where the students make their presentations on their Final Project Report of their major research work will be jointly evaluated by two internal examiners / experts.

OPEN ELECTIVES

II SEMESTER

Sl. No	**Codes**	**Course Title**	Number of Credits			
			L	T	P	Total
01		Fundamentals of GIS and GPS	3	1	0	4

III SEMESTER

Sl. No	**Codes**	**Course Title**	Number of Credits			
			L	T	P	Total
01		Basics of Remote Sensing	3	1	0	4

Annexure II: Revised/New Syllabus

CENTRE FOR GEOINFORMATICS TECHNOLOGY

DOS in Geography, Manasagangothri, University of Mysore, Mysuru – 570006

SCHEME BY SEMESTERS
MASTER OF SCIENCE IN GEOGRAPHICAL INFORMATION SYSTEMS (GIS)
For students admitted 2023-24 (Onwards)

I Semester (Minimum Credits: 20)

SL. No.	Code	Title of Course	Types HC/SC/OE	Number of Credits			
				L	T	P	Total
1		Principles of Remote Sensing	HC I	**3**	**1**	**0**	**4**
2	(Practical)	Practical Remote Sensing	HC II	**0**	**1**	**3**	**4**
3	(Practical)	Map and Mapping Techniques	HC III	**0**	**1**	**3**	**4**
4	Any Two	Earth System and Dynamics	SC I	**3**	**1**	**0**	**4**
5		Fundamentals of Information Technology	SC II	**3**	**1**	**0**	**4**
6		Fundamentals of Cartography	SC III	**3**	**1**	**0**	**4**
7		Fundamentals of Statistics	SC IV	**3**	**1**	**0**	**4**
Note: All three Hard Core Courses are compulsory. Among the Four Soft Core courses, students have the option to choose any two Soft Core Courses.							

II Semester (Minimum Credits: 24)

SL. No.	Codes	Title of Course	Types HC/SC/OE	Number of Credits			
				L	T	P	Total
1		Principles of GIS	HC IV	**3**	**1**	**0**	**4**
2	(Practical)	Geospatial Data and Analysis	HC V	**0**	**1**	**3**	**4**
3	(Practical)	Advanced Land Surveying Technologies	HC VI	**0**	**1**	**3**	**4**
4	Any Two	Geoinformatics and Geological Studies	SC V	**3**	**1**	**0**	**4**
5		Geoinformatics and Water Resource Management	SC VI	**3**	**1**	**0**	**4**
6		Geoinformatics and Land Resource Management	SC VII	**3**	**1**	**0**	**4**
7		Geoinformatics and Transportation Management	SC VIII	**3**	**1**	**0**	**4**
8	Open Elective	Basics of Remote Sensing	OE I	**3**	**1**	**0**	**4**
Note: All three hard cores are compulsory. Among the Four soft cores, students have the option to choose any two Soft Core Courses. Open Elective Courses for other disciplines, offered by the department is optional							

III Semester (Minimum Credits: 20)

SL. No.	Codes	Title of Course	Types HC/SC/OE	Number of Credits			
				L	T	P	Total
1		Research Methodology and Project Management	HC VII	**3**	**1**	**0**	**4**
2	(Practical)	Programming for GIS	HC VIII	**0**	**1**	**3**	**4**
3	(Practical)	Environmental Statistics	HC IX	**0**	**1**	**3**	**4**
4	Any Two	Geoinformatics and Urban Studies	SC IX	**3**	**1**	**0**	**4**
5		Geoinformatics and Disaster Management	SC X	**3**	**1**	**0**	**4**
6		Geoinformatics and Marine Studies	SC XI	**3**	**1**	**0**	**4**
7		World and Sustainable Development	SC XII	**3**	**1**	**0**	**4**
8	OE	Basics of Geoinformatics	OE II	**3**	**1**	**0**	**4**
Note: All three hard cores and field works are compulsory. Among the Four soft cores, students have the option to choose any two Soft Core Courses. Open Elective Courses for other disciplines, offered by the department is optional							

CENTRE FOR GEOINFORMATICS TECHNOLOGY

DOS in Geography, Manasagangothri, University of Mysore, Mysuru – 570006

SCHEME BY SEMESTERS
MASTER OF SCIENCE IN GEOGRAPHICAL INFORMATION SYSTEM (GIS)
For students admitted 2023-24 (Onwards)

IV Semester (Minimum Credits: 12)

SL. No.	Codes	Title of Course	Types HC/SC/OE	Number of Credits			
				L	T	P	Total
1		Internship	HC X	**0**	**1**	**3**	**4**
2		Major Research Project	HC XI	**0**	**2**	**6**	**8**
						Total	**12**

Note: All course works / programs are compulsory for M.Sc-GIS students.

- **Internships (Hard Core):** Internships are done in a government, semi-government, NGO's, corporate institution of repute with specialization on the technologies of Cartography, Remote Sensing, GIS and GNSS, CAD, LiDAR, Photogrammetry, Survey and other interdisciplinary institutions. Internship must begin in the first week of fourth semester and should end with eight week of fourth semester.
- **Major Research Project (Hard Core):**
  - This is a major research project of 3 full months or about 12 weeks, on a larger, manageable program of research where students will find suitable topics related to the course and they have to adopt the techniques and technologies which learnt during the course tenure.
  - The outcome of the project is to build a self confidence on students to cope with the future assignment throughout their career. Along with the project report, one publication is compulsory where the publication is the supporting evidences related to the Major Research Project, which may contain the piece of work related to review of literature/ part or whole objectives of the research work.
  - Publication should fulfill the plagiarism criteria met by the University. Student may publish the work in reputed journal/peer-reviewed journal/book chapters to fulfill the criteria.

Seminars are a part of Internships and Project work in which seminars have specific purposes. Students make power point presentations on their chosen theme of research for project work, outlining the background, rationale and objectives of research, on their chosen Methodology and the rationale behind them and on their Draft Final report at the end of the 20^{th} week of the semester (end of June) under the guidance and supervision of their tutors/advisors/guides.

The students are very intensively engaged by the course works of Internship, Project work, seminars, field work and educational tours, with constant monitoring and evaluation of the work carried out by the teachers. Final seminar/ viva voce are conducted, where the students make their presentations on their Final Project Report of their major research work will be jointly evaluated by two internal examiners / experts.

CENTRE FOR GEOINFORMATICS TECHNOLOGY

DOS in Geography, Manasagangothri, University of Mysore, Mysuru – 570006

SCHEME BY SEMESTERS
MASTER OF SCIENCE IN GEOGRAPHICAL INFORMATION SYSTEMS (GIS)
For students admitted 2023-24 (Onwards)

FIRST SEMESTER

FIRST SEMESTER

HARD CORE – I

PAPER: PRINCIPLES OF REMOTE SENSING

Objective: *The objective of this paper is to understand the basic concepts of Remote Sensing and to impart to students the skills necessary for remote sensing analysis and image interpretation so that students acquire transferable and also employable skills in remote sensing. This is a step ahead of the fundamentals in remote sensing.*

Introduction: Definitions, concepts and types of remote sensing, evolution, stages and advantages of remote sensing, spatial data acquisition, electromagnetic spectrum, electromagnetic radiation and wavelength regions; earth coordinate systems; satellites, characteristics and Land/Marine observation satellites; Precision remote sensing – spatial, spectral, radiometric and temporal precision.

Remote Sensing Technologies: Thermal Remote Sensing – Thermal radiation principles; Passive and Active Microwave Remote Sensing; RADAR – definition, development, wavelengths, polarimetry, airborne and space borne SLRs and their components; LiDAR – principles, components, accuracy, spectral characteristics of laser and error analysis.

Digital Image Processing: Image processing systems, data formats of digital image, resolutions of remote sensing products; pre-processing, image enhancement , Image transformation and image classification, multispectral images, Visual Image Interpretation, elements of visual interpretation, interpretation keys; generating thematic maps; remote sensing products, thermal and radar image interpretation.

Applications of Remote Sensing: Applications of remote sensing in agriculture (crop-yield estimation, agroforestry, moisture), forestry (vegetation index, biomass, biodiversity/species estimation, forest fires), oceans and coastal monitoring (sea surface temperatures, oil spills, flood, other glacial studies), Urban sprawl analysis, land degradation, desertification and monitoring atmosphere components, applications of thermal remote sensing in geology, hydrogeology mineral exploration, lithological mapping and urban heat budgeting

Reference:

1. Remote Sensing and GIS, Second Edition (2011), Bhatta, B.
2. Introduction to Remote Sensing and Image Interpretation (2003); Lillesand T.M.
3. Remote sensing and image interpretation(2015); Chipman, Jonathan W., Kiefer, Ralph W., Lillesand
4. Introduction to Remote Sensing, Fifth Edition (2011); James B. Campbell, Randolph H. Wynne

HARD CORE – II (PRACTICAL)

PAPER: PRACTICAL REMOTE SENSING

Objective: *To make the students well versed in handling of remotely sensed imageries along with the standard software products and to make them to apply various methods to solve the earth related problems and issues in sustainable development.*

Data Acquisition: Obtaining multi-spectral data, microwave data, thermal data from various satellites sensors like IRS, Landsat, SPOT, MODIS Terra/Aqua, NOAA; obtaining elevation data from Cartosat - I, SRTM, ASTER-GDEM, Topographical Maps and GEBCO, study of histograms and layer information's.

Data Preprocessing: Atmospheric Correction – Haze Removal - Image enhancement - contrast manipulation, density slicing, and color coding, image rectification: noise removal, radiometric correction, spatial correction, spectral correction, pan sharpening; geometric correction; image registration, subset, mosaic of side lap and overlap images.

Classification and Delineation: Determination of land use classes and various classification scheme; Unsupervised – K Means, ISODATA; Supervised classification – training sets, Parametric and Non-Parametric rules; Object based classification; Accuracy assessment – Confusion matrix, Kappa – coefficient, thematic mapping.

Modelling – Change Detection, terrain modelling and analysis, indices modelling - DVI, NDVI, SAVI, MSI, NDBI, NDWI; building of model using model maker – Tasseled Cap Transformation (Brightness, Wetness and Greenness), land surface temperature.

References

1. Remote Sensing and GIS, Second Edition (2011), Bhatta, B.
2. Introduction to Remote Sensing and Image Interpretation (2003); Lillesand T.M.
3. Remote sensing and image interpretation(2015); Chipman, Jonathan W., Kiefer, Ralph W., Lillesand
4. Introduction to Remote Sensing, Fifth Edition (2011); James B. Campbell, Randolph H. Wynne
5. Practical handbook of remote sensing, First Edition (2016) - Lavender, Andrew, Lavender, Samantha
6. Introductory Digital Image Processing: A Remote Sensing Perspective, Fourth Edition(2015) - John R. Jensen
7. Image processing and GIS for remote sensing : techniques and applications; Second Edition(2016) - Liu, Jian-Guo, Mason, Philippa J

HARD CORE - III (PRACTICAL)

PAPER: MAPS AND MAPPING TECHNIQUES

Objective*: Students will learn the concepts of maps through various mapping techniques adapted using the cartographic skills and students will effectively use the maps for representing and solving of various geographical problems.*

Cartographic Exercises: Map appreciation and conventional signs: thematic, topographic and atlas maps and appreciation; Map reading, interpretation, use of compass, Brunton compass transit, toposheet scaling and generalization; field data collections for various themes.

Relief Mapping and Climatic Diagrams: Relative relief and slope maps; Drainage Basin and morphometric analysis; hypsometric analysis; Climograph and climatograph, rainfall variability and intensity maps, temperature and rainfall profiles, dispersion and deviation graph, aridity and water balance.

Thematic Mapping: Color schemes, generalization, symbols, index of concentration and diversification; Dot density maps, graduated color, graduated symbol, grayscale patterns, rate maps – pie chart, bar chart, stacked bar

Network and Map Analysis: transport network analysis, flow maps, flow density maps, cluster maps, location representation of tourism and facilities; point and line patterns analysis; cartograms and 3D maps.

Textbooks

1. Monkhouse, F.J. and Wilkinson, H.R. 1976: Maps and Diagrams, Methuen, London.
2. Worthington, B.D.R. and Robert Gent 1975: Techniques in Map Analysis, Ebenezer Baylis, USA.
3. Tomlin, C.D. 1990: Geographic Information Systems and Cartographic Modelling, Prentice Hall, Englewood Cliff, New Jersey.
4. Anson, R.W. (Ed) 1984: Basic Cartography for Students and Technicians, Volume 2, International Cartograhic Association, Elsevier Applied Science, London.
5. Dorling, D. and David Fairbairn 1997: Mapping: Map of representing the world, Addisson Wesley Longman Ltd., U.K.

SOFT CORE - I

PAPER: EARTH SYSTEM AND DYNAMICS

Objective: *To make students to acquire the knowledge in various physical, chemical and biological properties of the Earth system to enhance the deep insight and to develop experiences on basic geological, geochemical, geophysical and analytical modeling skills to solve earth related problems and prospects.*

Earth System Dynamics: Origin of Earth and its forms, plate tectonics, continental drift theory, Process of atmosphere, hydrosphere, biosphere, lithosphere, and its interaction. Study on Physical Geography of World, India and Karnataka. Study on interaction of socio-ecological system, Human and Environment, ecological and environmental dynamics over space and time.

Issues in Earth System: Global warming, greenhouse effect, carbon cycle, nitrogen cycle, water cycle, ozone depletion, floods, droughts, weather variations, sea level rise, changing ecosystems, snow / glaciers melting and impact of pollutions.

Climate Change: The physical science of climate system and change, concepts, causes, effects, measures, climate change; Land – Climate interactions and climatic zones of world and India; Climate change and linkages with energy, emerging diseases, community response.

Geoinformatics Applications: Concepts of hazards, risks and vulnerability; Climate projections and their uncertainties; Tsunami, floods, droughts, earth quake and weather variations, ecosystems changes, and snow/glaciers melting, energy studies, health and diseases studies and other case studies.

References

1. Climate Change: A Multidisciplinary Approach- Burroughs, W.J.
2. Earth's Dynamic Systems; Tenth Edition (2003) - W. Kenneth Hamblin, Eric H. Christiansen
3. Earth's Evolving Systems. The History of Planet Earth; Second Edition(2016) - Ronald E. Martin
4. Understanding Earth; Seventh Edition(2014) - John Grotzinger, Thomas H. Jordan
5. Earth System Science in the Anthropocene: Emerging Issues and Problems; First Edition(2006) - Eckart Ehlers, Thomas Krafft (Eds.)
6. Earth System Science: From Biogeochemical Cycles to Global Change: Second Edition(2000)- Michael C. Jacobson, Robert J. Charlson, Henning Rodhe and Gordon H. Orians (Eds.)
7. Climate Systems: Interactive Forces of Global Warming: First Edition(2009) - Julie Kerr Casper
8. Global Warming - A Very Short Introduction: First Edition(2005) – Mark Maslin
9. Encyclopedia of Weather and Climate: Second Edition(2007) - Michael Allaby, Richard Garratt
10. Weather and Climate Extremes in a Changing Climate: First Edition(2008) - Thomas R. Karl

SOFT CORE - II

PAPER: FUNDAMENTALS OF INFORMATION TECHNOLOGY

Objectives: *Information Technology is a turnkey solutions in the current world of technology which intending to the automation of manual task. So that, this paper teaches basics of computer science and information technology as a bridge course to the interdisciplinary students.*

Basics of Computer Systems: Basics of computer, Characteristics of computers, Limitations of computers; Evolution of computers, Classification of Computers, Types of Microcomputers Distributed Computer; System Components, Input devices, Output devices, Computer Memory, Central Processing Unit, Mother Board; Number Systems and Boolean algebra; Software's and Operating Systems Concepts.

Programming and DBMS: Problem solving techniques with Algorithms, Flowcharts, Pseudo codes; Translators-Assemblers, Compilers, Interpreters; Machine Code - Assembly Language - High Level Languages - Systematic Programming - Object-Oriented Programming; Database Management Systems: Introduction, databases, database management system - structure, types of DBMS; application of DBMS.

Information Technology: Information, Quality of Information, Information Processing, IT components, role, benefits, Information privacy, security and reliability in using computer systems and the internet; issues and responsibilities in internet usage; legal issues in IT; Green IT, global perspectives of computing issues; Current trends in IT industries, emerging technologies and applications.

Data Communication and Networking: Communication, Communication Process, Data Representation, Data Transmission speed, Communication Types (modes), Data Transmission Medias, Modem and its working, characteristics, Types of Networks, topologies, Network Protocols and security in network; Internet- History, services, browsers, uses, emerging technologies and applications.

Reference:

1. Basics of Computer Science – First Edition(2007) - Rajiv Khanna
2. Algorithm Design: Foundations, Analysis and Internet Examples; First Edition(2001) - Michael T. Goodrich
3. Computer Networking: A Top-Down Approach; Seventh Edition (2017) - Kurose James F.
4. Data Communications and Networking; Fifth Edition(2013) - Behrouz A. Forouzan
5. Fundamentals of Database Systems; Sixth Edition(2010) - Ramez Elmasri, Shamkant B. Navathe
6. Using Information Technology; Ninth Edition(2010) - Brian Williams, Stacey Sawyer
7. Principles of Information Security; Fourth Edition(2011) - Michael E. Whitman, Herbert J. Mattord
8. Encyclopedia of information science and technology; First Edition(2005) - Mehdi Khosrow-Pour

SOFT CORE-III

PAPER: FUNDAMENTALS OF CARTOGRAPHY

Objective: *To enable the students to learn the fundamental techniques and skills in Cartography to prepare various kinds of maps for representation of the real world.*

Introduction: Definition, concepts, types, history, applications, conventional cartography and digital cartography, cartographic communication process, cartographical cube, types of map and functions, measurement of variable, map scale, map numbering system and map making.

Geodesy and Projections: Geodesy – definition, types, shape and size of Earth, geoid, reference ellipsoid, and geometry of ellipsoid; Map projections, local and global datum; Coordinate systems- Geographical coordinate systems, projected coordinate systems, vertical coordinate systems; global, regional and local models in coordinate systems.

Cartographic abstraction and symbolization: Cartographical data models, classification, simplification, Base maps, thematic maps, Choropleth map, Socioeconomic map, Water resources map, Geologic map, Forest map, Agriculture map, Water resource map, Water quality map, Soil map, Map for hot spots manipulation; map composition, cartographic elements, symbolization of features – point, line and area.

Map perceptions and design: Objectives, functions, scope of design, perceptual consideration, graphic communications, control of map design and design planning, design excellence, principles of cartographic designs, cartographic generalization, atlases and hypermaps; Mapping Algorithms - Contouring algorithms, Surfaces and surface interpolation algorithms; 3D Visualization with stereo anaglyph images.

References

1. Elements of Cartography; Sixth Edition (2009) - Arthur H. Robinson, Joel L. Morrison
2. Fundamentals of Cartography; First Edition (2002) - Misra, R.P. and Ramesh A.
3. Cartography: Visualization of Geospatial Data; Third Edition (2010) - Menno-Jan Kraak, Ferjan Ormeling
4. Cartography: The Ideal and Its History; First Edition (2019) - Matthew H. Edney
5. GIS Cartography: A Guide to Effective Map Design; Second Edition (2014) - Gretchen N. Peterson
6. Principles of Map Design; First Edition (2010) - Judith A. Tyner
7. Mapping: A Critical Introduction to Cartography and GIS (Critical Introductions to Geography); First Edition (2010) - Jeremy W. Crampton
8. Cartographies of Time: A History of the Timeline; First Edition (2010) - Anthony Grafton, Daniel Rosenberg
9. Datums and Map Projections: For Remote Sensing, GIS and Surveying; First Edition (2000) - Jonathan C. Iliffe
10. Map Projections: Theory and Applications; Second Edition (2018) - Frederick Pearson II

SOFT CORE- IV

PAPER NAME: FUNDAMENTALS OF STATISTICS

Objective: *To expose the students on the basic concepts of statistics and to make them familiar with various types of data required for analysis and Student's will able to deal with numerical and quantitative issues related to geography and environmental aspects.*

Basic Statistics: Concepts, Origin, Development, Functions, Importance, Limitation and misuses of statistics; Data sampling and designs, data collection, methods, data types, data classification, data tabulation; diagrams and graphical representations.

Descriptive Statistics: Variables, frequency table, Mean, median, mode, summation; Measures of dispersion, range, quartile, average and standard deviation; Measures of inequality- Gini's coefficient and Lorenz curve; histogram, skewness and kurtosis; Data intervals-natural breaks and equal value;

Bivariate Statistics: Scatter diagram, fitting of linear, quadratic, geometric and exponential curves. Product moment correlation coefficient and its properties. Coefficient of determination. Spearman's rank correlation coefficient. Concept of regression. Properties of regression coefficients.

Design of Experiments: Formulation of Hypotheses, test procedures and ANOVA tables; Case studies from Socio-Economic Data, Environmental Data; Time Series Models: Components of Time series, moving averages and trends. Trend Analysis – parametric and non-parametric methods.

References:

1. Statistical Methods in Geographical Studies: Student Edition(1999); Aslam Mahmood
2. Fundamentals of Mathematical Statistics (A Modern Approach); First Edition (2014) - S.C Guptha and V.K.Kapoor.
3. Fundamentals of Statistics; First Edition(2018) D.N. Elhance
4. Statistics; Ninth Edition(2009) - Robert S. Witte and John S. Witte

CENTRE FOR GEOINFORMATICS TECHNOLOGY

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SCHEME BY SEMESTERS
MASTER OF SCIENCE IN GEOGRAPHICAL INFORMATION SYSTEMS (GIS)
For students admitted 2023-24 (Onwards)

SECOND SEMESTER

SECOND SEMESTER

HARD CORE - IV

PAPER: PRINCIPLES OF GIS

Objective: *To make students to learn the core ethics and principles of geographical information systems used to represent the real world and to develop various layers of information required to integrate and solve the earth related problems.*

Introduction: Concepts, history and development of GIS, components of GIS, applications of GIS; Coordinate Systems –datum's, latitudes, longitudes, Geographical Coordinate Systems, WGS84, Projected Coordinate System and UTM; Geospatial data - data input-existing GIS data, creating new data; Query: Spatial and Non Spatial data query, Boolean algebra.

Data Models and Management: Data format: Raster and Vector data formats; Spatial Data Models –Vector and Raster data models, Non- Spatial Data Models, Topology models, Grid model, TIN model, Network model, applications; Data collection, capture and Geo processing: Sources, input methods, editing, re-projection, geometric transformation, map scale, precision and accuracy.

GIS Modelling and analysis: Basic elements of GIS modeling; Coupling-Loose, Tight coupling; Vector data analysis: buffering, overlay; raster data analysis– local operations, neighborhood operations, zonal operations; terrain mapping and analysis- DEM and TIN, contour, hill shading, slope and aspect; Spatial interpolation: elements, sampling schemes, global-local methods, comparison of spatial interpolation methods;

GNSS and RNSS: definition, history, components; types, working principles and application of GPS, GLONASS, GALILEO, COMPASS; system segmentation – control segment, user segment, space segment, types of receivers; GNSS: different GNSS, GNSS Augmentation; RNSS - IRNSS, WAAS, EGNOS, MSAS, QZSS, SNAS, SDCM and WAGE; advantages and disadvantages; Role of DGPS and RTK receivers for surveying applications.

References:

1. An Introduction to Geographical Information Systems, Third Edition(2006) - Ian Heywood
2. Geographic Information Science and Systems; Fourth Edition(2015) Paul A. Longley, Michael F. Goodchild
3. Introduction to Geographic Information Systems, Ninth Edition(2019); Kang-tsung Chang
4. Basic GIS coordinates, CRC Press(2017); Jan Van Sickle
5. GIS Fundamentals: A First Text on Geographic Information Systems, Fifth Edition(2016) - Paul Bolstad

HARD CORE - V (PRACTICAL)

PAPER: GEOSPATIAL DATA AND ANALYSIS

Objective: *To make students to learn hands-on experience in handling software's to develop the geographical information based on the methods and methodologies used to create data from scratch to enhance the represent, analysis and interpret the real world problems.*

Data capture and Management: Scanning of hardcopy maps, georeferencing and projection, data encoding; data uncertainties; feature and geodatabase creation (point, line and area), digitization, topology, annotations; attribute data – joining, editing and integration, field calculation, spatial and non-spatial queries; symbolization and thematic mapping.

Geoprocessing and Modelling: Vector- raster manipulation and analysis; proximity analysis; Topographical modelling, 3D visualization and analysis; Sampling and Spatial Interpolation, accuracy assessment of interpolation techniques; Drainage Basin and Morphometric analysis, network analysis;

Spatial Statistical Modeling: Identification of Central feature, directional distribution, mean center, median center, linear directional mean, standard distance, hot-spot analysis, correlation, raster calculator and Boolean operation. Exploring spatial relations using Ordinary least square (OLS), Geographical weighted regression (GWR), spatial autocorrelation;

GNSS/GPS Survey: Collection of Ground Control Points (GCP), precision, vertical and horizontal accuracy of collection; Waypoints, tracks, and transformation of GNSS/GPS data into GIS; Ground Truth Verification (GTV) of GPS data; Mobile based survey using Open data kit (form building, XML generation, data collection, and mapping)

References:

1. An Introduction to Geographical Information Systems, Third Edition(2006) - Ian Heywood
2. Geographic Information Science and Systems; Fourth Edition(2015) Paul A. Longley, Michael F. Goodchild
3. Introduction to Geographic Information Systems, Ninth Edition(2019); Kang-tsung Chang
4. Basic GIS coordinates, CRC Press(2017); Jan Van Sickle
5. GIS Fundamentals: A First Text on Geographic Information Systems, Fifth Edition(2016) - Paul Bolstad
6. Applied GIS and Spatial Analysis; Firs Edition(2003) - John Stillwell, Graham Clarke
7. Statistical methods for spatial data analysis; First Edition(2005) - Oliver Schabenberger, Carol A. Gotway
8. Spatial Statistics; First Edition(2004) - Brian D. Ripley
9. Exploratory analysis of spatial and temporal data: a systematic approach: First Edition(2006) - Natalia Andrienko

HARD CORE - VI (PRACTICAL)

PAPER: ADVANCED LAND SURVEYING TECHNOLOGIES

Objectives: *To make students to learn basic principles of surveying, to handle various survey instruments, gathering of survey data, and processing of it, for better planning and maintenance of required applications.*

Basics of Surveying: Operating of Handheld GPS, D-GPS, Total Station, Airborne Laser Scanning (ALS), and Terrestrial Laser Scanning (TLS) devices, LiDAR Derived Products, Aerial Photography using Drone Techniques and Orthophoto with Seam line Generation/Mosaicking.

CAD and GIS: Acquiring survey data, Data interoperability, Data warehousing, Feature alignment, Scaling, Layer Generations, Layer Editing, Block referencing, Coordinate geometry, Drawing cleanup, Topology checking, Quality Audit, Feature Data analysis, symbolizations, thematic map generations, Map books, data archival and other case studies.

LiDAR data capture and processing: Fleet Planning, Automation, LiDAR Data Acquisition, Data conversion, LAS file compression, coloring, classification of ground, air points, Vegetation's, Buildings, Low Points and Water bodies; Generations of Digital Terrain Models (DTM), Digital Surface Model (DSM), Delineation of Features, Vectorizing Features and other case studies.

Photogrammetry and 3D modeling: Unmanned Aerial Systems, Ground based Systems, Camera calibrations, Acquisition of Vertical and Horizontal Images, Conversion of Images, Generation of Tie points, building mesh textures, draping images, scaling model and aligning 3D models to real-world locations and other case studies.

Reference:

1. Aerial Photogrammetry and Image Interpretation; Third Edition(2012) - David P. Paine, James D. Kiser
2. Close Range Photogrammetry: Principles, Techniques and Applications: First edition(2011)- Thomas Luhman
3. Digital Image Processing: A Remote Sensing Perspective; Fourth Edition (2015) - Jensen, John R.
4. Geoinformation: Remote Sensing, Photogrammetry and GIS; First Edition(2003) - Gottfried Konecny
5. Topographic Laser Ranging and Scanning: Principles and Processing; Second Edition(2018) - Jie Shan, Charles K.Toth
6. Field Guide to Lidar: First Edition(2015) - Paul McManamon

SOFT CORE - V

PAPER: GEOINFORMATICS AND GEOLOGICAL STUDIES.

Objective: *To make students to learn the essential properties of Earth's components and tends to develop an understanding of the Earth through the study of complex geosystems that interact across a wide range of spatial and temporal scales. At the end students are expected to apply acquired skills to solve Earth science problems.*

Introduction: Disciplines, role of geology, geomorphology, identification of natural hazards - Soil erosion by water and wind, river floods, Slope instability, ground surface subsidence, volcanoes and earthquakes, management of landslides and coastal geomorphological studies.

Geological Mapping: Geological survey, geologic mapping and cartographic standards for different scale, mapping geological structures – fold, faults, joints and lineaments, lithological mapping, fracture analysis, Landforms – Deltaic, fluvial, coastal, glacial, tectonic, volcanic, karst/lakes; landslide hazard zonation and others applications.

Geological Resources Exploration: Mineral resources exploration, mineral mapping and mineral resources information system, mineral prospect zonation, mapping mining area, encroachment mapping, EIA for land, water and air quality in Mining areas; GIS in mine remediation and mine reclamation, oil and gas exploration.

Ground Water Resources: Groundwater potential assessment, groundwater prospect zones mapping, modeling, planning and management, forecasting, site selection of artificial recharge by using RS and GIS, quality mapping, ground and surface water interactions, fluorosis, nitrate pollution and heavy metal contamination.

Reference:

1. Engineering Geomorphology - Theory and Practice; First Edition (2007) - Fookes, P.G., Lee, E.M., Griffiths, J.S.
2. Geoinformatics in Applied Geomorphology; First Edition (2011) - Siddan Anbazhagan, S.K. Subramanian, XIAOJUN YANG
3. Geologic Maps: A Practical Guide to Preparation and Interpretation; Third Edition (2017) - Edgar W. Spencer
4. Basic Geological Mapping: Fourth Edition (2004) - John W. Barnes, Richard J. Lisle
5. Geological Structures and Maps: A Practical Guide, 3rd edition (Geological Structures and Maps); Richard J Lisle
6. Geomorphological Mapping: Methods and Applications; First Edition(2011) - Mike J. Smith, Paolo Paron and James S. Griffiths (Eds.)

SOFT CORE - VI

PAPER: GEOINFORMATICS AND WATER RESOURCES MANAGEMENT

Objective: *To enable the students to use remote sensing and geographical information systems to learn the integrated water resource and its management for better sustainability of the earth system.*

Introduction: Hydrology – definition and its importance, hydrological cycle, water budgeting, water demand estimation, surface water bodies, water content in ocean, sea, ice, lakes, dams, tanks, rivers and groundwater; Water resource scenario in India and Karnataka, RS and GIS applications in water resources development and management.

Oceanographic studies: Definition, concepts and importance of ocean, ocean resources, ocean process, satellite and sensors for ocean studies, sea ice monitoring, estimation of wind velocity and direction, sea surface temperature, turbidity, salinity, ocean color, phytoplankton and seaweed mapping, potential fishing zones, suspended sediment and bathymetry mapping.

Meteorology, Glaciology and Surface Fresh Water: Rainfall mapping, potential and actual evapo-transpiration, atmospheric water content, cloud mapping, rain forecasting, water quality parameters, cyclone forecasting; Glaciology: monitoring of snow melt and snow formation, snowmelt runoff estimation, estimation of damages; Surface Fresh Water: river diversion studies, site suitability for surface storages and hydro-electric power plants, storage yield analysis and reservoir sizing.

Irrigation and Watershed: Mapping and monitoring of catchment and command areas, land irrigability mapping, agriculture water demand estimation for different crops, tank information system, soil moisture estimation, wetland mapping, siltation mapping; Watershed: delineation, morphometric analysis, rainfall-surface runoff model, reservoir sedimentation, water-harvesting structures, watershed development planning, mapping of drought prone areas.

References:

1. GIS for Water Resources and Watershed Management, First Edition(2002)- John G Lyon
2. Geographic Information Systems in Water Resources Engineering, First Edition(2008)- Lynn E.Johnson
3. Managing Water, Soil and Waste Resources to Achieve Sustainable Development Goals; First Edition (2018) - Stephan Hülsmann, Reza Ardakanian
4. Water resources systems analysis; First Edition(2003) - Mohammad Karamouz, Ferenc Szidarovszky, Banafsheh Zahraie
5. Integrated Water Resources Management in Practice Better Water Management for Development, First Edition(2009)- Roberto Lenton, Mike Muller
6. Enhancing Participation And Governance in Water Resources Management: Conventional Approaches And Information Technology; First Edition(2006)- Libor Jansky, Juha I. Uitto
7. Hydrology and water resource management : breakthroughs in research and practice; First Edition(2008)- Information Resources Management Association

SOFT CORE - VII

PAPER: GEOINFORMATICS AND LAND RESOURCE MANAGEMENT

Objective: *To develop the skills in utilization of technologies of remote sensing, GIS and GPS, in Land Resource, Planning and Management to establish the sustainability across global, regional and local scales.*

Geological and Geo-technical studies: Mineral resources exploration, mineral mapping and mineral resources information system, mapping mining area, encroachment mapping, GIS in mine remediation and mine reclamation, oil and gas exploration, site suitability for dams, atomic power plants.

Applications in soil: Soil and Land Use Surveys, Soil classification, soil irritability, soil erosion mapping, soil salinity, soil alkalinity, surface soil moisture estimation, runoff and sediment yield estimation, desertification mapping, soil fertility mapping, agro-land suitability assessment, soil capability and loss assessment, locational and climatic advantages, settlements and demographic pressure estimation.

Forest and Ecology: RS and GIS for forest cover mapping, change detection and monitoring, estimation of biomass, carbon sequestration, Wildlife ecology: wildlife tracking, protected areas, wildlife habitat selection, rangeland applications, forest fire surveillance and forecasting, forest burnt area mapping, fire spread modeling, re-vegetation, biodiversity characterization, deforestation/ afforestation/encroachment mapping and monitoring, impact assessment of mining in forest.

Application in agriculture: Agro-climatic zonation, site suitability for agricultural and horticulture crops, crop acreage estimation, RS based yield model, crop norm violation, RS basis for crop insurance claim, damage assessment due to cyclone, drought, flood and forewarning, crop stress detection, precision agriculture.

Reference:

1. Remote Sensing Handbook: Volume 2 - Land Resources Monitoring, Modeling, and Mapping with Remote Sensing; First Edition (2016) - Thenkabail, Prasad Srinivasa
2. Land Use and Society: Geography, Law, and Public Policy; First Edition (2014) - Prof. Rutherford H. Platt (auth.)
3. Land-Use Planning for Sustainable Development- Second Edition(2013), Silberstein, M.A., Jane
4. Soil Mapping and Process Modeling for Sustainable Land Use Management; First Edition (2017) - Paulo Pereira, Erik Brevik
5. Remote Sensing of Landscapes with Spectral Images: A Physical Modeling Approach: First Edition (2006) - John B. Adams, Alan R. Gillespie
6. Digital Soil Mapping: An Introductory Perspective; First Edition (2006) - P. Lagacherie, A.B. McBratney and M. Voltz (Eds.)
7. Practical Ecology for Geography and Biology: Survey, mapping and data analysis; First Edition (1985), D. D. Gilbertson, M. Kent, F. B. Pyatt (auth.)

SOFT CORE - VIII

PAPER: GEOINFORMATICS AND TRANSPORT MANAGEMENT

Objective: *To make students to learn geography of networks and implication of network models for adaptation, implementation and management of various transport networks ranging from ground-to-air.*

Transport Systems: Introduction, advantages of road-rail-air-water-metros transport, principal function of administrative, traffic, secretarial and engineering divisions, chain of responsibility, and forms of ownership by state, municipality, public body and private undertakings; Role of Intelligent Transport Systems and examples from various metro cities

Transport Planning and Analysis: Transport Planning and Its Scope – Components of planning, Urban and Rural Transport Systems, Airport Air Traffic Management, Harbor and Port Management, Railway monitoring and management, travel mode and forecast, Modal Split Analysis, implication of land use systems in planning.

Network Model and Theory: Nature and utility of network data models, basic representations of node and link tables, layer-based and object-oriented approaches to network analysis; Applications of network theory, web applications of social networks, graphs – socio-grams, connections, distances and measures of power and prestige, applications of social networks in geographical information systems applications.

GIS for Transportation (GIS-T): Network nodes and links and their structures, basic structural properties, measures and indices (detour, network intensity, PI, Eta, Theta, Beta, Alpha and Gamma indices), connectivity and total accessibility; Data representation, analysis and modeling (multi-dimensional GIS-T models), Applications and problems – travelling salesman problem, vehicle routing problem, facility location problems and spatial interaction models.

Textbooks

1. Rodrique, Jean-Paul, Comtois, C. and Slack, B. (2009): The Geography of Transport Systems, New York: Routledge.
2. Scott, John (1991): Social Network Analysis: A Handbook, London: Sage.

References

1. Intelligent Transportation Systems: Functional Design for Effective Traffic Management; Second Edition (2016)- Robert Gordon
2. Traffic Engineering; Fourth Edition (2010) - Roger Roess, Elena Prassas, William McShane
3. Transportation and Traffic Theory; First Edition (1999) - A. Ceder
4. Transportation Systems Analysis: Models and Applications; Second Edition (2009)-Ennio Cascetta
5. Traffic Flow Dynamics: Data, Models and Simulation, First Edition (2013) - Martin Treiber, Arne Kesting
6. The Geography of Transport Systems, First Edition(2006) - Jean-Paul Rodrigue, Claude Comtois, Brian Slack
7. The Geography of Transport Systems, Third Edition(20133) - Jean-Paul Rodrigue, Claude Comtois, Brian Slack
8. Geographical Information and Urban Transport Systems; First Edition(2011) – Arnaud Banos

OPEN ELECTIVE - I:

PAPER: BASICS OF REMOTE SENSING

Objective: *To make interdisciplinary students to understand the basic concepts of Remote Sensing and to impart the necessary skills for remote sensing analysis and interpretation.*

Introduction: Definitions, concepts and types of remote sensing, evolution and stages of remote sensing, advantages of remote sensing, spatial data acquisition, Electromagnetic spectrum, types and platforms of sensors.

Digital Image Processing: digital image, data formats of digital image, pre-processing, image classification, elements of visual interpretation, interpretation keys, generating thematic maps.

Remote Sensing Technologies: Thermal Remote Sensing, spatial, passive and Active Microwave Remote Sensing; RADAR – definition, development, components; LiDAR – principles, components, accuracy.

Applications of Remote Sensing: Applications of remote sensing in agriculture, forestry, oceans and coastal monitoring, geology, hydrogeology and urban heat budgeting; list of various satellite missions for earth applications.

References

1. Remote Sensing and GIS, Second Edition (2011), Bhatta, B.
2. Introduction to Remote Sensing and Image Interpretation (2003); Lillesand T.M.
3. Remote sensing and image interpretation(2015); Chipman, Jonathan W., Kiefer, Ralph W., Lillesand
4. Introduction to Remote Sensing, Fifth Edition (2011); James B. Campbell, Randolph H. Wynne
5. Practical handbook of remote sensing, First Edition (2016) - Lavender, Andrew, Lavender, Samantha
6. Introductory Digital Image Processing: A Remote Sensing Perspective, Fourth Edition(2015) - John R. Jensen
7. Image processing and GIS for remote sensing : techniques and applications; Second Edition(2016) - Liu, Jian-Guo, Mason, Philippa J

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SCHEME BY SEMESTERS
MASTER OF SCIENCE IN GEOGRAPHICAL INFORMATION SYSTEMS (GIS)
For students admitted 2023-24 (Onwards)

THIRD SEMESTER

THIRD SEMESTER

HARD CORE - VII

PAPER: RESEARCH METHODOLOGYAND PROJECT MANAGEMENT

Objectives: *To make students to experience the range of quantitative and qualitative research methods to develop academic writings. To expose students to compete with corporate sectors to address the growing complexities of corporate projects and to incorporate students to learn the key project management tools and techniques for better project management.*

Basics of Research: Research: Meaning, definition, objectives, characteristics, types, steps involved in Research, Research ethics, motivations, approaches, significance, research and scientific methods, research process, criteria of good research, research problem, research questions, statement of problems, objectives formulation, Research design and review of literature

Qualitative and Quantitative Research: Research methods versus methodology, Qualitative Research, quantitative research, mixed research methods; Sampling schemes and methods, data collection and types, Hypothesis, testing of hypothesis, limitations of the tests of hypothesis. Interpretation of Results, charting, tabulation, documenting – reports, thesis, journals and its structure.

Business Strategies and Project Management: Corporate Projects, Project Management(PM), Program Management, Portfolio Management, PM Framework, PM Skills, Interpersonal Skills Management, PM Methodologies, Organizational System, Project Life Cycle and its Phases, PM Process, Procurement Process, Contracting, Strategic Planning and use of PERT/CPM, Scope of a Project, Project Charter; Resource Levelling, Communication Planning, Project Status Reporting.

Risk, Quality, Budget and Time Management: Work breakdown structure (WBS), Activity Sequencing and Network Diagrams, Gantt Charts for Time Management; Project Cost Estimation and Tracking, Management, Project Resources, Cost Control and Earned Value Management(EVM); Quality Planning, Assurance, and Control; Project Risk and Change Management; Integration management and Final Deliverables. Case studies of GIS and other related projects.

Reference:

1. A Guide to the Project Management Body of Knowledge PMBO: Sixth Edition(2017)– Project Management Institute(PMI)
2. Geospatial Technology Project Management - Open Courseware, Penn State University
3. Information Technology Project Management, Eigth Edition(2016)- Kathy Schwalbe
4. Research Methodology: Methods and Techniques Revised Edition (2009) - Kothari, C. R.

HARD CORE – VIII (PRACTICAL)

PAPER: PROGRAMMING FOR GIS

Objective: *To develop deep insights among the students to acquire programing skills in the geospatial domain and to make students to familiarize with various programming concepts and code blocks to automate the day to day workflow adapted in geospatial academia and industries.*

Introduction to programming: Programming concepts, problem-solving techniques, Programming Language vs. Presentation Language with examples; Command Line and GUI based programming; Language translators; Coding, Error handling, Role of Programming in Geomatics.

Python Programming: Introduction to Python, Installing Python 2.7 Interpreter, importing various libraries, working with numbers, variables, writing statements, strings, lists, use of python objects, functions, methods, paths, built-in modules, external modules, controlling flow with conditional statements, looping structures, getting user input, commenting scripts and error handling.

Python for Geomatics: Geoprocessing with Python, Importing ArcPy, 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, model builders and development of Graphical User Interfaces(GUI), development of python addins for ArcMap.

Programming for WebGIS: Basics of HTML, CSS and JavaScript for WebGIS Programming; Introduction to Leaflet JavaScript API, Geoserver, OpenLayers. Working with Leaflet, Installation of Geoserver, Creating Snippet codes, Configuring Bootstraps, code deployment and hosting in local/cloud servers, Physical Server Setups, Domain Purchasing, working with cPanel, URL Redirections, Leech protection.

Reference:

1. ArcPy and ArcGIS – Geospatial Analysis with Python; First Edition(2015) - Silas Toms
2. Getting to Know ArcGIS: Model Builder; Second Edition(2010) - David W. Allen, ESRI
3. Getting to Know WebGIS: First Edition(2015) - Pinde Fu, ESRI
4. Learning PHP, MySQL, JavaScript and CSS; Second Edition(2012) - Robin Nixon
5. Learning Python; Fifth Edition(2013) - Mark Lutz
6. OpenLayers Cookbook; ; First Edition(2012) - Antonio Santiago Perez
7. Programming ArcGIS 10.1 with Python Cookbook; ; First Edition(2013) -Eric Pimpler
8. Python for Informatics; First Edition(2009) - Charles Severance
9. Python Geospatial Development; Second Edition(2013)- Erik Westra
10. Python Scripting for ArcGIS; ; First Edition(2013)-Paul A. Zandbergen, , ESRI

HARD CORE - IX (PRACTICAL)

PAPER: ENVIRONMENTAL STATISTICS

Objective: To enhance the students to learn hands-on experience in statistics, specifically in the field of environmental science and technologies. To make students to develop techniques and procedures in designing of environmental projects for various analysis and interpretation of environmental data to draw the meaningful conclusions in various aspects at the end.

Environmental Statistics using Python/R: Concepts of uni-variate data, multivariate data, distributions, commercial and open source software's of statistics, inter-comparision SPSS, R and Python, Installing the statistical libraries and working with variables, vectors, plots, import-export of data, directories, statistical notations, sampling methods.

Descriptive statistics using Python/R: histograms, measures of centre, measure of variation, dispersions, correlations, hypothesis design and testing, one and two way ANOVA, linear and non-linear regression, residuals, coefficient of determination, Principle Component Analysis (PCA), data standardisation, factor analysis, discriminant analysis, cluster analysis.

Time Series Modelling using Python/R: Time dependent data, modelling, moving variance, markov chain, anomaly detection, LAG detection, parametric and non-parametric trend detection, periodicity analysis, change point detection, forecasting with ARMA and ARIMA Models, handling grid data and case studies.

R Package / Python and GIS: Spatial Data in R/Python, Data frames, coordinate systems, SpatialPoints, SpatialLines, SpatialPolygons, Spatial Data Import-Export, Visualising and Analysing Spatial Data-Point Pattern, Interpolation, Model Diagnostics, Autocorrelations and Case Studies.

References:

1. Applied Statistics for Environmental Science With R; First Edition(2019)- Abbas F. M. Alkarkhi and Wasin A. A. Alqaraghuli,
2. Data analysis and statistics for Geography, Environmental Science, and Engineering, First Edition(2013)- Miguel F. Acevedo,
3. Applied Spatial Data Analysis with R; First Edition(2008)- Roger S. Bivand, Edzer J. Pebesma, Virgilio Gómez-Rubio
4. Spatial Modeling in GIS and R for Earth and Environmental Sciences; First Edition(2019) - Hamid Reza Pourghasemi, Candan Gokceoglu
5. Using R and RStudio for Data Management, Statistical Analysis and Graphics; First edition(2015)- Nicholas J. Horton, Ken Kleinman

SOFT CORE - IX

PAPER: GEOINFOMATICS AND URBAN STUDIES

Objective: *To make students to implement the remote sensing, GIS and GPS techniques to understand the urban spatial structure and its implication for efficient planning and management of urban areas.*

Urban Planning and Mapping: Importance and types of plans, urban and regional planning, land use and land cover mapping, GIS data modeling for urban design, urban infrastructure, site selection for urban development, site suitability analysis for utilities and civic amenities; Urban mapping: physical structure and composition of urban areas, urbanization process, growth trend, problems of urbanization, urban sprawl and types; interventions in planning and management.

Utility Management: GIS applications in Automated Mapping (AM) and Facility Management (FM), road network, water lines and sewerage pipelines, power supply lines, telecom applications; Integrated modelling of AM/FM; Demand estimation and forecasting with respect to urban outgrowth.

Demography and Urban Governance: Population distribution map by age, gender, education, occupation, socio-economic grouping, health criteria index, crime maps; Urban governance: mapping administrative boundaries, city base map generation, comprehensive plans, strategic plans, land use forecasting, point of interest (POI) maps, asset mapping, revenue collection systems and management; Internet of Things (IoT) and sensor based applications.

Urban Ecology Applications: Air quality indexing and mapping, monitoring atmospheric haze, smoke, toxic gas movement and prediction of vulnerable zones, noise pollution zonation, natural resources inventory and management, vegetation, soil, surface water and groundwater conservation, site suitability for groundwater recharging, rain water harvesting and solid water management; Urban area heat budgeting and management.

References

1. Applied Remote Sensing for Urban Planning, Governance and Sustainability; First Edition (2007) - Netzband M., Stefanov W., Redman C.
2. Remote Sensing of Urban and Suburban Areas; First Edition (2010) - Maik Netzband, Carsten Jürgens (auth.), Tarek Rashed, Carsten Jürgens (eds.)
3. Remote sensing and urban analysis; First Edition (2010) - Jean-Paul Donnay, Michael John Barnsley
4. Urban Remote Sensing; Second Edition(2018) - Gamba, Paolo E., Quattrochi, Dale, Weng, Qihao

SOFT CORE - X

PAPER: GEOINFOMATICS AND DISASTER MANAGEMENT

Objective: *To develop the ideas among the students to learn various kinds of calamities in the world and to create students to make use of advanced geospatial technologies used for mapping, impact assessment, forewarning, preparedness and mitigation of adverse effects over any regions of the world.*

Introduction: Definition, types of disasters, importance of RS and GIS for disaster management, forecast, forewarning system, disaster preparedness with respect to different disaster, Spatial Data infrastructure(SDI) to facilitate Disaster Management, GIS based Decision support system(DSS) for disaster management, satellite surveillance for disaster mitigation.

Drought and Forest Fire: Drought types, causes, mitigation measures, delineation of drought vulnerable areas, drought monitoring, GIS based drought analysis, desertification factors, monitoring vegetative biomes and biomass; Forest fire, fire management using GIS prototypes, risk zonation mapping and forecasting system.

Earthquake, volcanoes, landslides and soil erosion: Causes, types, effects and mitigation measures, RS and GIS in earthquake prediction and post-quake rehabilitation, GIS for earthquake disaster management, mapping tectonic lineament; Volcano: RS of geothermal field, mapping lava flows, volcano hazard management; Landslides: RS and GIS for zonation, monitoring and management; Soil erosion: RS and GIS for soil erosion and sediment estimation;

Flood, Cyclone and Tsunami: Flood types- flash and riverine floods, snowmelt floods, ice jams and mud flows, causes and mitigation measures, flooding potential zonation mapping, flood hazard assessment, ice cover monitoring and its role in flooding; Cyclone: cyclone monitoring using INSAT, ERS-1, NOAA and DMSP satellites, RS and GIS in hurricane mapping and mitigation, damage assessment, warning; Tsunami: types, causes, RS and GIS for warning, damage assessment and rehabilitation.

Reference:

1. Geographic Information Systems (GIS) for Disaster Management, First Edition(2014) -Tomaszewski, Brian
2. Disaster Management Handbook (Public Administration and Public Policy) - First Edition(2008) - Jack Pinkowski
3. Disaster Management and Preparedness, First Edition(2001), Larry R. Collins
4. Natural Disasters: Prevention, Risk Factors and Management; First Edition(2012) -Biljana Raskovic, Svetomir Mrdja
5. Policing in Natural Disasters: Stress, Resilience, and the Challenges of Emergency Management, First Edition(2019) - Terri M. Adams, Leigh R. Anderson

SOFT CORE - XI

PAPER: GEOINFOMATICS AND MARINE STUDIES

Objective: *To familiarize the students about the fundamentals of ocean, sea and coastal process and to make students to learn the applicability of geospatial applications in the field of Marine Management.*

Marine Process: Definition, importance of marine study, geomorphology and structures of the ocean floor and plain; continental shelf, slope, ridges and rise; Physical properties of sea water-distribution of temperature, salinity, density and oxygen in space and time. Oceanic circulation, upwelling and sinking, waves, wave characteristics, wave generated currents, catastrophic waves, tides, tidal forces, littoral drift, ocean resource, utilization, extraction techniques.

Coastal Dynamics: Beach, coast and shore - beach features, coastal hydrodynamics, estuarial dynamics, inland waters, hydrodynamics of pollution dispersion, Modeling of suspended sediments; Coastal erosion, Shore line change dynamics, Coastal engineering for protection works; Breakwaters - Types and factors determining selection and stability of breakwaters. Sand bypassing and artificial beach nourishment - latest technologies in shore protection techniques.

Coastal Zone Management: Introduction, Environmental impacts of coastal developments, major issues/ problems, spatial maps on coastal resources, coastal aquifer modeling, wetland classification, coastal vegetation mapping; Mapping of shore line changes, coastal interactions, coastal regulation zone mapping, creation of CZIS, Integrated Coastal Zone Management(ICZM) model concepts and case studies, resolving conflict on resources utilization

Remote Sensing Applications: Use of satellite data in coastal application, chlorophyll production index, physical oceanographic parameter estimation, sea surface temperature, Suspended sediments, Salinity Mapping, significant wave height, wind speed and directions, coastal bathymetry and sea level rise. Estuaries, Intertidal zones, potential fishing zones and other related case studies.

Reference:

1. GIS in oceanography & Fisheries , First Edition(2002)- Vasilis D. Valavanis
2. Introduction to Coastal Engineering and Management; First Edition(1999) J. William Kamphuis
3. Integrated Coastal and Ocean Management: Concepts and Practices; First Edition(1998) - Biliana Cicin-Sain, Robert Knecht
4. Science, Information, and Policy Interface for Effective Coastal and Ocean Management; First Edition(2016) - Bertrum H. MacDonald
5. Remote Sensing of Coastal Environments (Remote Sensing Applications Series) - First Edition(2009) - Yeqiao Wang
6. Remote sensing of aquatic coastal ecosystem processes, First Edition(2006), laurie l. Richardson, ellsworth f. Ledrew

SOFT CORE - XII

PAPER: WORLD AND SUSTAINABLE DEVELOPMENT

Objective: To make students to think the world in the view of sustainability and to enhance the skills among the students to solve issues and implication related to sustainable development of the world.

Sustainability Development: Sustainability, meaning, concept, roles, elements-Environmental, Social and Economic Sustainability; intergenerational justice of sustainability; Integration of Scientific and Traditional knowledge, Global, Regional and local issues and initiatives on Sustainable Development; Sustainable Development Goals (SDGs) – UN Agenda 21 and Indian Context- SDG Index 2.0; Role of Cooperatives in sustainable development;

Social and Economic Dimensions: International cooperation on sustainable development in under-developed, developing and developed countries with its regional policies; Combating poverty and measures; identification of consumption patterns and dynamics; Demographic transitions and sustainability; Protecting and promoting human health conditions, Promoting sustainable human settlement development; Integrating environment and development in decision-making with case studies.

Environmental Dimensions: Conservation and Management of Resources, Protection of the atmosphere, integrated approach to the planning and management of land and water resource; promoting sustainable agriculture and rural development; Conservation of biological diversity, Protection of the quality and supply of freshwater resources, development of environmentally feasible management of hazardous wastes, solid wastes and sewage-related issues and radioactive wastes with case studies.

Implementing Sustainability: Role of young generations in sustainable development, Recognizing and strengthening the role of indigenous people and their communities, Strengthening the role of NGO's and associated partners for sustainable development, Local authorities' initiatives in support of Agenda 21, strengthening the role of farmers, workers, trade unions, business, industry, scientific and technological community through technology, cooperation and capacity-building; Promoting education, public awareness and training for sustainable development.

Reference:

1. GIS for Sustainable Development, First Edition(2005)- Michele Campagna
2. The Age of Sustainable Development, First Edition(2015)- Jeffrey D. Sachs, Ki-moon Ban
3. An introduction to sustainable development, First Edition(2007)- Peter P. Rogers, Kazi F. Jalal, John A. Boyd
4. The Economics of Sustainable Development, First Edition(2005)-Sisay Asefa
5. The Goals of Sustainable Development : Responsibility and Governance, First Edition(2018)-Crowther, David, Moyeen, Abdul, Seifi, Shahla

OPEN ELECTIVE – II

PAPER: BASICS OF GEOINFORMATICS

Objective: *To make students to learn the core ethics and principles of geographical information systems used to represent the real world and to develop various layers of information required to integrate and solve the earth related problems.*

Introduction: Earth System science, traditional mapping techniques, Earth Coordinate Systems - Geographical Coordinate Systems, Projected Coordinate System; Definitions, History and development and components of Geoinformatics; GIS, Remote Sensing, Photogrammetry, LiDAR, CAD and its applications.

Data Models and Management: Data format: Raster and Vector data formats; Spatial Data Models –Vector and Raster data models, Non- Spatial Data Models, TIN model, input methods, editing, map scale, precision and accuracy.

GIS Modelling and analysis: Basic elements of GIS modeling; terrain mapping and analysis-DEM and TIN, contour, hill shading, slope and aspect, Spatial interpolation: kriging method, IDW, spline, trend, natural neighbor, Vector data analysis: buffering and overlay.

GPS and GNSS: definition, history, components; types and application of GPS, GLONASS, GALILEO, COMPASS; system segmentation – control segment, user segment, space segment, types of receivers; DGPS; GNSS: different GNSS, IRNSS - advantages and disadvantages.

References:

1. An Introduction to Geographical Information Systems, Third Edition(2006) - Ian Heywood
2. Geographic Information Science and Systems; Fourth Edition(2015) Paul A. Longley, Michael F. Goodchild
3. Introduction to Geographic Information Systems, Ninth Edition(2019); Kang-tsung Chang
4. Basic GIS coordinates, CRC Press(2017); Jan Van Sickle
5. GIS Fundamentals: A First Text on Geographic Information Systems, Fifth Edition(2016) - Paul Bolstad

CENTRE FOR GEOINFORMATICS TECHNOLOGY

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SCHEME BY SEMESTERS
MASTER OF SCIENCE IN GEOGRAPHICAL INFORMATION SYSTEMS (GIS)
For students admitted 2023-24 (Onwards)

FOURTH SEMESTER

FOURTH SEMESTER

HARD CORE – X

PAPER: INTERNSHIP

- **Internships (Hard Core):** Internships are done in a government, semi-government, NGO's, corporate institution of repute with specialization on the technologies of Cartography, Remote Sensing, GIS and GNSS, CAD, LiDAR, Photogrammetry, Survey and other interdisciplinary institutions. Internship must begin in the first week of fourth semester and should end with eight week of fourth semester.

HARD CORE - XI

PAPER: MAJOR RESEARCH PROJECT

- **Major Research Project (Hard Core):**
  - This is a major research project of 3 full months or about 12 weeks, on a larger, manageable program of research where students will find suitable topics related to the course and they have to adopt the techniques and technologies which learnt during the course tenure.
  - The outcome of the project is to build a self confidence on students to cope with the future assignment throughout their career. Along with the project report, one publication is compulsory where the publication is the supporting evidences related to the Major Research Project, which may contain the piece of work related to review of literature/ part or whole objectives of the research work.
  - Publication should fulfill the plagiarism criteria met by the University. Student may publish the work in reputed journal/peer-reviewed journal/book chapters to fulfill the criteria.

Seminars are a part of Internships and Project work in which seminars have specific purposes. Students make power point presentations on their chosen theme of research for project work, outlining the background, rationale and objectives of research, on their chosen Methodology and the rationale behind them and on their Draft Final report at the end of the 20^{th} week of the semester (end of June) under the guidance and supervision of their tutors/advisors/guides.

The students are very intensively engaged by the course works of Internship, Project work, seminars, field work and educational tours, with constant monitoring and evaluation of the work carried out by the teachers. Final seminar/ viva voce are conducted, where the students make their presentations on their Final Project Report of their major research work will be jointly evaluated by two internal examiners / experts.