DEPARTMENT OF GEOGRAPHY
KAZI NAZRUL UNIVERSITY

ASANSOL 713 340

WEST BENGAL

(www.knu.ac.in)

Preamble:

The purpose of a Learning Outcome-based Curriculum Framework (LOCF) is to change the paradigm of higher education from a teacher-centric to learner-centric curriculum. It is hoped that this paradigmatic change will bring about a significant improvement in the quality of higher education and make the learners both competent and confident to face the challenges of a modern competitive world. The philosophy of this new curriculum framework is pragmatism, to realise that it is not enough for institutions of higher learning to produce good humans and responsible citizens of the country but also to produce employed graduates and postgraduates. After all, it is not prudent to expect an unemployed youth to cherish values like humanity and responsibility towards the nation; he/she first needs to have a productive employment to nourish such values.

LOCF seeks to make higher education in India learner-centric so that graduates and postgraduates not only have a more holistic understanding of their subject but also be able to better serve the humanity with dignity and honour, which can be expected only if they are able to secure productive employment after completing their higher education degrees.

Introduction to Learning Outcome Based Curriculum Framework (LOCF) in Kazi Nazrul University:

Two year Post-Graduate programs in Kazi Nazrul University have been designed as a base for research and application of knowledge. The syllabus and curricula of the post graduate programmes have been developed following the UGC LOCF guidelines and through rigorous academic exercises after consulting eminent academic experts and feedback received from various stakeholders of the University. These two-year programs will enable the students to enhance their learning after under-graduate course and to join the workforce in their respective fields. Kazi Nazrul University has an aim to develop the future generation learners sensitive towards the developmental challenges of the nation with special emphasis on the local developmental needs. The University also aims to foster this future generation of learners with a systematic understanding of global development need. The learning outcome-based curricula of different disciplines reflect the national as well as global sustainable needs listed below in the respective programme and course specific outcomes:

National needs:

- Promote Right to education
- Inculcate ethical and professional values
- Increase national and international visibility;
- leverage institutional strengths through strategic partnerships;
- enlarge the academic community within which to benchmark their activities;
- mobilise internal intellectual resources;
- add important, contemporary learning outcomes to student experience;
- Develop stronger research groups.
- Encourage multidisciplinary
- Promote Cross cultural exchanges
- Preservation of traditional knowledge
- Creating human resource for Economic growth
- Promotion of scientific mind-set and critical thinking

Sustainable development needs:

- Help to eradicate poverty
- Ensuring meal for all
- Promoting good health and well being
- Promoting quality education
- Promoting gender equality
- Initiatives for clean water and sanitization
- Programmes to reduce inequalities
- Develop sustainable cities and communities
- promote decent work and economic growth
- initiate industry-academia collaboration for innovative research
- encourage responsible consumer behaviour
- encourage pro-environment awareness

Program Outcomes (PO)s

The overall program outcome of the LOCF at PG level are to:

- help formulate postgraduate attributes, qualification descriptors, programme learning outcomes and course learning outcomes that are expected to be demonstrated by the holder of a Master's degree;
- enable prospective students, parents, employers and others to understand the nature and level of learning outcomes (knowledge, skills, attitudes and values) or attributes a graduate/postgraduate should be capable of demonstrating on successful completion of MA/MSc/ M.Com/ MBA
- maintain national standards and international comparability of standards to ensure global competitiveness, and to facilitate postgraduate mobility; and
- provide higher education institutions and their stake holders an important point of reference for setting and assessing standards.

Postgraduate Attributes

The postgraduate attributes reflect the particular quality and feature or characteristics of an individual, including the knowledge, skills, attitudes and values that are expected to be acquired by a postgraduate through studies at the higher education institution (HEI) such as a college or university. Such attributes include capabilities that help strengthen one's abilities for widening current knowledge base and skills, gaining new knowledge and skills, undertaking future studies and performing well in a chosen career and playing a constructive role as responsible citizen of the country. The Attributes define the characteristics of a student's university degree programme(s), and describe a set of characteristics/competencies that are designed to be transferable beyond the particular disciplinary area and programme contexts in which they have been developed. Such attributes are fostered through meaningful learning experiences made available through the curriculum, the total college/university experiences and a process of critical and reflective thinking.

The learning outcomes-based curriculum framework is based on the premise that every student is unique. Each student has his/her own characteristics in terms of previous learning levels and experiences, life experiences, learning styles and approaches to future career-related actions. The quality, depth and breadth of the learning experiences made available to the students while at the college/University help develop their characteristic attributes. The postgraduate attributes reflect both disciplinary knowledge and understanding and generic/global skills and competencies that all students in

different academic fields of study should acquire/attain and demonstrate. Some of the desirable attributes which a postgraduate student should demonstrate will include the following:

- ***Disciplinary Knowledge:*** Demonstrate comprehensive knowledge and understanding of one or more disciplines that form a part of a programme of study, and knowledge and skills acquired from interaction with educators and peer group throughout the programme of study.
- ***Communication Skills:*** Express thoughts and ideas effectively in writing and orally, communicate with others using appropriate media, confidently share one's views and express herself/himself, demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.
- ***Critical Thinking:*** Apply analytic thought to a body of knowledge, analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence, identify relevant assumptions or implications, formulate coherent arguments, critically evaluate practices, policies and theories by following scientific approach to knowledge development.
- ***Problem Solving:*** Demonstrate capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge and apply one's learning to real life situations.
- ***Analytical Reasoning****:* Demonstrate the ability to evaluate the reliability and relevance of evidence, identify logical flaws and holes in the arguments of others, analyse and synthesise data from a variety of sources, draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.
- ***Research-related Skills****:* Demonstrate a sense of inquiry and capability for asking relevant/appropriate questions, problematising, synthesising and articulating, demonstrate the ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships, plan, execute and report the results of an experiment or investigation.
- ***Collaboration/Cooperation/Team work****:* Demonstrate ability to work effectively and respectfully with diverse teams, facilitate cooperative or coordinated effort on the part

of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team.

- ***Scientific Reasoning using Quantitative/Qualitative Data****:* Demonstrate the ability to understand cause-and-effect relationships, define problems, apply scientific principles, analyse, interpret and draw conclusions from quantitative/qualitative data, and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective.
- ***Reflective Thinking:*** Demonstrate critical sensibility to lived experiences, with self-awareness and reflexivity of both self and society.
- ***Information/Digital Literacy:*** Demonstrate capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources and to use appropriate software for analysis of data.
- ***Self-Directed Learning:*** Demonstrate ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.
- ***Multicultural Competence:*** Demonstrate knowledge of the values and beliefs of multiple cultures and a global perspective, effectively engage in a multicultural society, interact respectfully with diverse groups.
- ***Moral and Ethical Awareness/Reasoning****:* Demonstrate the ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Demonstrate the ability to identify ethical issues related to one's work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights, appreciate environmental and sustainability issues, and adopt objective, unbiased and truthful actions in all aspects of work.
- ***Community Engagement:*** Demonstrate responsible behaviour and ability to engage in the intellectual life of the educational institution, and participate in community and civic affairs.
- ***Leadership Readiness/Qualities****:* Demonstrate capability for mapping out where one needs to go to "win" as a team or an organization, and set direction, formulate an inspiring vision, build a team who can help achieve the vision, motivate and inspire

team members to engage with that vision, and use management skills to guide people to the right destination, in a smooth and efficient way.

- ***Lifelong Learning****:* Demonstrate the ability to acquire knowledge and skills, including 'learning how to learn' that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.

Structure and Detailed Syllabus of the Post Graduate Courses

Department of Geography

Department of Geography, Kazi Nazrul University was established in 2015. Two Post Graduate Courses in (1) Geography and (2) Geoinformatics are offered at present by the department. Two-year M.Sc. programme in Geography was started in 2015-16 academic year and Geoinformatics in 2017-18 academic year. The thrust areas of the department are on Advance Geomorphology, Environmental Issues in Geography, Urban Geography, Disaster Management along with Photogrammetry, Remote Sensing, Web Mapping and Web GIS and application of Geographic Information System (GIS). The department is equipped with advanced RS and GIS laboratory and seminar library. In this short period of journey, the number of students of the department has increased almost thrice. The Department of Geography aims to promote a balanced sense of theoretical geography and its application in various fields among the students. Both, the students of Geoinformatics and Geography are trained with professional ethics and scientific temper.

Courses offered in the Department

- *M.Sc. in Geography (Two years)*
- *M.Sc. in Geoinformatics (Two years)*

Mission

Department of Geography, Kazi Nazrul University has a mission to develop the future generation Geographers sensitive towards the region-specific issues of the nation with special emphasis on the local developmental issues. The department also aims to foster this future generation of Geographers with a systematic understanding of physical and human geography and equip them with state-of art technology.

Vision

Department of Geography, Kazi Nazrul University envisions to be a global destination for practising Geography and Geoinformatics. Working in collaboration with government, industry and non-governmental developmental organization, the department upholds a vision to apply the knowledge of Geography and technology of Geoinformatics in reducing spatial disparity, promoting equality and social justice.

Programme- specific Outcomes

- *Two years Post-Graduate programme will enable the students with understanding the spatial logic and methodology of geoinformatics. After two years, students will be able to work in the areas of urban and regional planning, disaster management, environmental planning and management and related areas.*
- *Two years Post-Graduate programme in Geoinformatics will enable the students with recent development in the field of Remote Sensing and Geographic Information System. After two years, students will be able to work in the areas mapping and digital cartography, application of GIS in the field urban planning, disaster management, web mapping and web GIS and relate areas (Collaborating with national and international institutes and organizations for research and development).*
- *Two years Post-Graduate programmes will enable to critically analyze the dynamism of the man-nature relationship, environmental sustainability and developmental challenges of the present world.*
- *Two years Post-Graduate programmes have been designed as a base for research and application of Geoinformatics. These two years programme will enable the students to enhance their learning after under-graduate course and to join the workforce in the field of Geography and Geoinformatics.*

Global Needs	MSCGEINC101	MSCGEINC102	MSCGEINC103	MSCGEINC104	MSCGEINC105	MSCGEINC106	MSCGEINC201	MSCGEINC202	MSCGEINC203	MSCGEINC204	MSCGEINC205	MSCGEINC206	MSCGEINMIE201	MSCGEINC301	MSCGEINC302	MSCGEINC303	MSCGEINC304	MSCGEINMJE301	MSCGEINMJE302	MSCGEINMJE303	MSCGEINMJE304	MSCGEINMJE305	MSCGEINMJE306	MSCGEINMJE307	MSCGEINMJE308	MSCGEINMIE301	MSCGEINC401	MSCGEINC402
Systems thinking competency	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Anticipatory competency	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Normative competency					√	√					√	√				√	√	√	√	√	√	√	√	√	√	√	√	√
Strategic competency					√	√					√	√															√	√
Transdisciplinary collaboration competency	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Critical thinking competency	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Creativity competency					√	√					√	√				√	√	√	√	√	√	√	√	√	√	√	√	√
Self-awareness competency					√	√					√	√	√					√	√	√	√	√	√	√	√	√	√	√

National needs	MSCGEINC101	MSCGEINC102	MSCGEINC103	MSCGEINC104	MSCGEINC105	MSCGEINC106	MSCGEINC201	MSCGEINC202	MSCGEINC203	MSCGEINC204	MSCGEINC205	MSCGEINC206	MSCGEINMIE201	MSCGEINC301	MSCGEINC302	MSCGEINC303	MSCGEINC304	MSCGEINMJE301	MSCGEINMJE302	MSCGEINMJE303	MSCGEINMJE304	MSCGEINMJE305	MSCGEINMJE306	MSCGEINMJE307	MSCGEINMJE308	MSCGEINMIE301	MSCGEINC401	MSCGEINC402
Promote Right to education																												
Inculcate ethical and professional values					√	√					√	√				√	√		√		√		√		√		√	√
Increase national and international visibility;	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Leverage institutional strengths through strategic partnerships;	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Enlarge the academic community within which to benchmark their activities;	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Mobilise internal intellectual resources;	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Add important, contemporary learning outcomes to	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√

student experience;																										
Develop stronger research groups.	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Encourage multidisciplinary	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Promote Cross cultural exchanges	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Preservation of traditional knowledge	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Creating human resource for Economic growth	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Promotion of scientific mind-set and critical thinking	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√

Sustainable development needs:	MSCGEINC101	MSCGEINC102	MSCGEINC103	MSCGEINC104	MSCGEINC105	MSCGEINC106	MSCGEINC201	MSCGEINC202	MSCGEINC203	MSCGEINC204	MSCGEINC205	MSCGEINC206	MSCGEINMIE201	MSCGEINC301	MSCGEINC302	MSCGEINC303	MSCGEINC304	MSCGEINMJE301	MSCGEINMJE302	MSCGEINMJE303	MSCGEINMJE304	MSCGEINMJE305	MSCGEINMJE306	MSCGEINMJE307	MSCGEINMJE308	MSCGEINMIE301	MSCGEINC401	MSCGEINC402
Help to eradicate poverty																											√	√
Ensuring meal for all																												
Promoting good health and well being																												
Promoting quality education																												
Promoting gender equality																												
Initiatives for clean water and sanitization																		√						√	√			
Programmes to reduce inequalities																												
Develop sustainable cities and communities																√		√		√	√							

Course Description

Duration of Post Graduate Course of Studies in Geography and will be two years with Semester I, Semester II, Semester III and Semester IV, each of six months leading to Semester I, Semester II, and Semester III and Semester IV examinations in Geography at the end of each semester. Semester I and III comprise ODD SEMESTER and Semester II and IV comprise EVEN SEMESTER of each year. Syllabus for post graduate course in Geography is hereby reframed into Choice Based Credit System (CBCS) in compliance with recent directives from the University Grants Commission (UGC).

Scheme:

Both the course Geography and Geoinformatics consists of 88 credits with at least 20 credits in a semester within the faculty of science. In Semester II and Semester III, students have to choose Minor Elective papers of minimum 4 credits offered by the other Departments or their own Department. There are Major Elective papers in Semester III and Semester IV. The department offers a cluster of Major Elective papers and the students have to choose Major Elective papers according to the norms decided by the Department.

Choice Based Credit System (CBCS)

The CBCS is an effective 'Supply side Initiative' measure evolved as a process of 'Academic Reforms' to sustain the Quality Education that focuses on the learner centric education. It provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill-based courses. It allows students to choose interdisciplinary, intra-disciplinary courses, skill-oriented papers (even from other disciplines according to their learning needs, interests and aptitude) and more flexibility for students). As a result, this not only broadens their horizons but also aims to make students well rounded in all spheres of development. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system.

It is also a cafeteria-type learning system in a semester pattern to foster creativity and innovation that bridges the gap between professional and liberal education to empower the students for meeting the challenges of Globalization with an inbuilt International acceptance of recognition of Degrees. Syllabus for Post Graduate course in Geography and Geoinformatics of Kazi Nazrul University, Asansol is hereby reframed into Choice Based Credit System (CBCS) in compliance with recent directives from the University Grants Commission (UGC). The main objective of this new curriculum is to give the students a holistic understanding of the subject, putting equal weightage to the core content and techniques used in Geography as well as in Geoinformatics.

CBCS SYLLABUS

for

Post Graduate Courses in Geoinformatics

With effect from Academic Session 2022-23

KAZI NAZRUL UNIVERSITY

ASANSOL 713 340

WEST BENGAL

(www.knu.ac.in)

• Semester System: terms and conditions

There shall be regular M.Sc. Course in Geoinformatics of two years duration. There shall be semester system spreading over four semesters, each of six months duration. There shall be 1200 marks in total. There shall be 22 courses (12 theoretical, 10 practical courses including Dissertation, Seminar and Grand Viva) to cover the whole syllabus. 1st to 4th semester contains six, seven, seven and two courses respectively. The Students shall be evaluated by all the teachers regularly by continuous assessment, the marks of which shall be a part of their examination system. The continuous assessment shall be held on the topic (s) included in theoretical as well as practical papers during the semester period. The core course of 100 marks shall require a Dissertation to be submitted by each student. The Dissertation will be evaluated on the basis of internal (60 marks) and end semester (40 marks) examination.

• Continuous Assessment/ Internal Assessment

Continuous assessment for each 'course' would be conducted through a mid-semester test /seminar presentation/ term paper during the semester period on the topics of the courses covered. The marks obtained will be considered for the final award of 20% marks of each theoretical and practical paper (*i.e.* 10). This will be given as *Internal Assessmen*t marks by the concerned teacher (s) during the concerned semester period. Similarly, 20% marks of each practical paper (except the papers with full marks 25 and of 2 Credits) will be given as *viva-voce*. Internal Assessment will be based on written examination /seminar/viva-voce/interaction; the department shall decide the methods of internal assessment.

• Dissertation

A Dissertation (Master's Thesis) on any branch of Geoinformatics will be a comprehensive work based on conceptual aspects, field work and analysis of primary and secondary data in the laboratory. It is to be produced individually by the students and this must be stated clearly in a certificate from the supervisor (s) and concerned Head of the Department of Geography, Kazi Nazrul University.

✧ Semester-wise Course Structure and Credits: M.Sc. in Geoinformatics

Semester	Core Course		Major Elective Course		Minor Elective Course	Total Credit
	Theory	Practical	Theory	Practical		
I	16	4	---	---	---	20
II	10	8	---	---	4	22
III	8	8	4	4	4	28
IV	---	20	---	---	---	20
Total	**36**	**36**	**4**	**4**	**8**	**90**

• **Course Credits** denote the number of teaching hours allocated to the course / week during the semester. One credit is equivalent to one hours of teaching (lecture or tutorial) or two hours of practical work/ field work per week. Actually, assigning of credits is based on the course content and hours of teaching.

• **Core Courses**: Every student will take only core courses in the Semester I and IV. In the Semester II and III students will take core courses along with the other courses.

• **Major Elective Courses (Specialization)**: Student will opt one out of the *Major Electives* in Semester III.

• **Minor Elective Courses (Interdisciplinary Course):** M.Sc. Geoinformatics students will opt two *Minor Elective* courses in the Semester II and Semester III offered by other allied PG Departments or their own department. Out of these Two (2) *Minor Elective* courses, one must be from any of the other disciplines across the Post Graduate courses of study either in 2nd or in 3rd semester.

KAZI NAZRUL UNIVERSITY				FACULTY OF SCIENCE, TECHNOLOGY AND VOCATIONAL STUDIES		DEGREE PROGRAMME: M.SC IN GEOINFORMATICS			WITH EFFECT FROM THE ACADEMIC SESSION: 2022-23								
Abbreviated Degree	Discipline	Abbreviated Degree Programme	Semester	Course Name	Course Type	Course Code	Course Details	L - T - P	Course Credit	Sem Credit	CA Marks		ESE Marks		Total Marks	Sem Marks
											Practical	Theoretical	Practical	Theoretical		
M.SC	GEOINFORMATICS	MSCGEIN	I	Concept of Earth System Science	C	MSCGEINC101	CC-1	4 - 0 - 0	4	20		15		35	50	300
				Fundamentals of Mapping and Mapping Science	C	MSCGEINC102	CC-2	4 - 0 - 0	4			15		35	50	
				Introduction of RS and GIS	C	MSCGEINC103	CC-3	4 - 0 - 0	4			15		35	50	
				Introduction to Surveying and Photogrammetry	C	MSCGEINC104	CC-4	4 - 0 - 0	4			15		35	50	
				Map and Image Interpretation	C	MSCGEINC105	CC-5	0 - 0 - 4	2		30		20		50	
				Computer Fundamentals and Programming	C	MSCGEINC106	CC-6	0 - 0 - 4	2		30		20		50	
			II	Digital Image Processing for Geoinformatics	C	MSCGEINC201	CC-7	4 - 0 - 0	4	22		15		35	50	350
				Statistics and Geostatistics	C	MSCGEINC202	CC-8	4 - 0 - 0	4			15		35	50	
				Introduction to Programming for Geoinformatics and DBMS	C	MSCGEINC203	CC-9	2 - 0 - 0	2			15		35	50	
				Digital Image Processing and Spatial Analysis	C	MSCGEINC204	CC-10	0 - 0 - 8	4		30		20		50	
				Geostatistics and Pilot Project	C	MSCGEINC205	CC-11	0 - 0 - 4	2		30		20		50	
				Programming for Geoinformatics and DBMS	C	MSCGEINC206	CC-12	0 - 0 - 4	2		30		20		50	
				Choose from Pool of Minor Electives	MIE	See Pool	MIEC-1	See Pool	4		See Pool				50	
			III	Research Methodology and Spatial Decision Support System	C	MSCGEINC301	CC-13	4 - 0 - 0	4	28		15		35	50	350
				Advance RS and GIS	C	MSCGEINC302	CC-14	4 - 0 - 0	4			15		35	50	
				Web Mapping and Web GIS	C	MSCGEINC303	CC-15	2 - 0 - 4	4		30		20		50	
				Advance RS & GIS and Theme Specific Case Studies	C	MSCGEINC304	CC-16	0 - 0 - 4	4		30		20		50	
				Geoinformatics in Disaster Management I	Group-A	MSCGEINMJE301	MJEC-1 & MJEC-2	4 - 0 - 0	4X2=8			15		35	50X2=100	
				Geoinformatics in Disaster Management II		MSCGEINMJE302		0 - 0 - 4			30		20			
				Geoinformatics in Urban Planning I	Group-B	MSCGEINMJE303		4 - 0 - 0				15		35		
				Geoinformatics in Urban Planning II		MSCGEINMJE304		0 - 0 - 4			30		20			
				Geoinformatics for Mining and Subsidence I	Group-C	MSCGEINMJE305		4 - 0 - 0				15		35		
				Geoinformatics for Mining and Subsidence II		MSCGEINMJE306		0 - 0 - 4			30		20			
				Geoinformatics in Watershed Management I	Group-D	MSCGEINMJE307		4 - 0 - 0				15		35		
				Geoinformatics in Watershed Management II		MSCGEINMJE308		0 - 0 - 4			30		20			
				Choose from Pool of Minor Electives	MIE	See Pool	MIEC-2	See Pool	4		See Pool				50	
			IV	Dissertation	C	MSCGEINC401	CC-17	2 - 2 - 12	10	20	60		40		100	200
				Seminar and Grand Viva	C	MSCGEINC402	CC-18	2 - 2 - 12	10		60		40		100	
				Total Credit and Marks						**90**						**1200**

Abbreviations: C= Core; CC=Core Course; MJE= Major Elective; MJEC= Major Elective Course; MIE= Minor Elective; MIEC= Minor Elective Course; CA Marks= Continuous Assessment Marks; ESE Marks= End Semester Examination Marks; L= Lecture Hour; T= Tutorial Hour; P= Practical Hour/ Field Work and NA= Not Applicable

Pool of Minor Elective [Offered by the Department of Geoinformatics for all other Departments across faculties]. Student has to choose at least one Minor Elective from other departments except his/her own department.

Discipline	Semester	Course Name	Course Type	Course Code	Course Details	L - T - P	Course Credit	Sem Credit	CA Marks		ESE Marks		Total Marks	Sem Marks
									Practical	Theoretical	Practical	Theoretical		
GEOINFORMATICS	II	Socio Economic Mapping using Geoinformatics	MIE	MSCGEINMIE201	MIEC-1	4 - 0 - 0	4	NA		15		35	50	NA
	III	GIS Project Design and Management	MIE	MSCGEINMIE301	MIEC-2	4 - 0 - 0	4	NA		15		35	50	NA

SYLLABUS

for

M.Sc. in Geoinformatics

(Semester - I)

Semester - I

(MSCGEINC101: Core Course-1, Theoretical)

Concept of Earth System Science

✧ **Full Marks: 50** ✧ **CA+ESE Marks: 15+35**

✧ **Credit: 4** ✧ **L - T – P: 4 - 0 - 0**

✧ **End Sem Exam Duration: 2 Hours**

Course Learning Outcomes:

After the completion of this course, student should be able to:

1. *Understand the concept of different types of rocks that provides genesis and their link to tectonic and geomorphic settings.*
2. *Learn the sedimentary flux: origin, transport and deposition.*
3. *Learn geomorphic and sedimentological processes related to fluvial, coastal, aeolian, and glacial regimes.*
4. *Learn environmental changes and its impact on surface processes and landforms.*

UNIT-1: ROCK TYPE AND LANDFORMS

1.1 Introduction to Rock forming minerals; *Igneous Petrology*: Magma, Form of Igneous bodies, Classification of Igneous Rocks. *Sedimentary Petrology*: Sediments, sedimentation, sedimentary environments, textures and structures of sedimentary rocks. *Metamorphic Petrology*: Definition of metamorphism, agents of metamorphism, kinds of metamorphism, Characteristics of different types of metamorphism Classification of metamorphic rocks (based on the original rock, agent/type of metamorphism).

1.2 Characteristics and impact of Igneous rocks on Landforms with special reference to Granite and Basalt; Landforms on sedimentary rocks. Landform evolution in folded and faulted rock structures.

UNIT-2: EARTH SURFACE PROCESSES

2.1 Introduction to earth surface processes and historical development in concepts, Source of energy, Mass conservation and geomorphic transport laws, Process interaction in shaping the earth surface, Nonlinear and complex behavior of earth systems. *Specific Earth Surface Processes*: Weathering and formation of soils, slope and catchment erosion processes, fluvial, aeolian, glacial, periglacial and coastal processes, and resultant landforms, rates and changes in surface processes.

2.2 Earth system response to external controls; Quantitative modeling of earth surface processes; Analyzing evolutionary trajectory of the landscapes; Surface processes and Natural Hazards; Nonlinear behavior of earth systems and challenges in natural resource managements, Prediction of surface processes.

Continuous Assessment [15 Marks]
(*The department shall decide the methods of internal assessment*)

✧ **Suggested Readings**:

1. Adams, S. and Lambert, D. (2006): *An Illustrated Guide to Science-Earth Science*, New York.
2. Allaby, M. (2009): *Earth Science: A Scientific History of the Solid Earth*, New York.
3. Anderson, R.S. and Anderson, S.P. (2010): *Geomorphology: The Mechanics and Chemistry of Landscapes*, Cambridge University Press, Cambridge.
4. Banerjee-Guha, S. (2004): *Space, Society and Geography*, Rawat, New Delhi.
5. Bloom, A.L. (2002): *Geomorphology: A Systematic Analysis of Late Cenozoic Landforms*, Prentice Hall, Upper Saddle River, New Jersey.
6. Bridge J. and Demicco R. (2008): *Earth Surface Processes, Landforms and Sediment Deposits*, New York.
7. Burbank, D.W. and Anderson, R.S. (2001): *Tectonic Geomorphology*, Blackwell Publishing, USA.
8. Chorley, R., Schumm, S. and Sugden, D.E. (1994): *Geomorphology*, Methuen, London.
9. Chorley, R.J. and Kennedy, B.A. (1971): *Physical Geography: A Systems Approach*, Prentice Hall, Upper Saddle River, New Jersey.
10. Fairbridge, R.W. (1968): *The Encyclopedia of Geomorphology*, Reinhold Book Corporation, New York.
11. Gutierrez, M. (2013): *Geomorphology*, CRC Press, Boca Ranton, Florida.
12. Hamblin, W.K. and Christiansen, E. (2003): *Earth's Dynamic Systems*, Prentice Hall, Upper Saddle River, New Jersey.
13. Harvey, A. (2012): *Introducing Geomorphology: A Guide to Landforms and Processes*, Dunedin Academic Press.
14. Huggett, R.J. (2011): *Fundamentals of Geomorphology*, Routledge, New York.
15. Kale, V.S. and Gupta, A. (2001): Introduction to Geomorphology, Orient Blackswan Ltd., Hyderabad.
16. Kearey, P., Klepeis, K.A. and Vine, F.J. (2009): *Global Tectonics*, 3rd Edition, Wiley-Blackwell, UK.
17. Kusky, T. (2005): *Encyclopedia of Earth Science*, New York.
18. Leeder, M. R. and Pérez-Arlucea, M. (2009): *Physical Processes in Earth and Environmental Sciences*. John Wiley & Sons.
19. Lobeck, A.K. (1939): *Geomorphology (An Introduction to the Study of Landscapes)*, McGraw-Hill Book Company, New York.
20. Ollier, C.D. (1981): *Tectonics and landforms*, Longman Scientific & Technical, London.
21. Rice, R.J. (1988): *Fundamentals of Geomorphology*, 2nd Edition, *Longman Scientific and Technical*, London.
22. Ruhe, R.V. (1982): Geomorphology, Honghton Mifflin Company, Boston.
23. Selby, M.J. (1985): *An Introduction to Geomorphology*, Clarendon, Oxford.

24. Sparks, B.W. (1972): *Geomorphology*, Longman, London.
25. Summerfield, M.A. (1991): *Global Geomorphology: An Introduction to the Study of Landforms*, John Wiley and Sons Ltd., New York.
26. Thornbury, W.D. (1969): *Principles of Geomorphology*, Wiley Eastern Limited, New Delhi.

Semester - I

(MSCGEINC102: Core Course-2, Theoretical)

Fundamentals of Mapping and Mapping Science

✧ **Full Marks: 50** ✧ **CA+ESE Marks: 15+35**

✧ **Credit: 4** ✧ **L - T – P: 4 - 0 - 0**

✧ **End Sem Exam Duration: 2 Hours**

Course Learning Outcomes:

After the completion of this course, student should be able to:

1. *Understand concept behind conventional and modern map making process.*
2. *Efficiently present qualitative and quantitative data in the form of maps using digital cartographic principles.*

UNIT-1: PRINCIPLES OF CARTOGRAPHY

1.1 Definition, Concept, Types, History of Cartography (Ancient Period to Recent period), Application. Conventional Cartography and Digital Cartography, Cartographical Data Models, Cartography Communication Process, Cartographical Cube, Types of Map, Map scale, Map Numbering System.

1.2 Datum Surface and Coordinate Systems, Transformation. *Geodesy*: Definition, Shape and Size of the Earth, Geoid, reference ellipsoid, Everest Spheroid, WGS 84 and Reference Ellipsoid. *Map Projection*: Properties (Distance, Direction and Angle), Types and Selection of appropriate Map Projection.

UNIT-2: MAPPING SCIENCE

2.1 Data for Mapping, Compilation and Generalization; Map Design and Symbolization; Layout and Map Production and Visualization. Thematic map, Socio-economic map, Weather map, Geological map, Forest map and Agricultural map.

2.2 Mapping of Qualitative and Quantitative data, Bertins cartographic variables and its association with data types. Visualization of Geospatial data -2D and 3D visualization. *Mapping algorithms*: Contouring algorithms, Surface and Sub surface Interpolation algorithms.

Continuous Assessment [15 Mark]
(*The department shall decide the methods of internal assessment*)

✧ **Suggested Readings**:

1. Kraak, M.J. and Ormeling, F. (2004): *Cartography: Visualization of Geospatial Data*. 2nd Edition, Pearson Education.

2. Mailing, D.H. (1973): *Coordinate Systems and Map Projections*, George Phillip &Sons, London.

3. Mishra R.P. and Ramesh, A., (1989): *Fundamentals of Cartography*, Concept, New Delhi.

4. Monmonier, M.S. (1982): *Computer Assisted Cartography: Principles and Prospects*. Prentice Hall, New York.

5. Raisz, E.J. (1962): *Principles of Cartography*, McGraw-Hill.

6. Robinson, A.H., Sale, R.D. and Morrison, J. (1984): *Elements of Cartography*, Wiley, New York.

7. Talukder, S. (2008): *An Introduction to Map Projections*, EBH Publishers (India), Guwahati.

8. Unwin, D.J. and Dawson, J.A. (1985): *Computer Programming in Geography*. Longman, London.

Semester - I

(MSCGEINC103: Core Course-3, Theoretical)

Introduction of RS and GIS

✧ **Full Marks: 50** ✧ **CA+ESE Marks: 15+35**

✧ **Credit: 4** ✧ **L - T – P: 4 - 0 - 0**

✧ **End Sem Exam Duration: 2 Hours**

Course Learning Outcomes:

After completion of this course, students will be able to –

1. *Recognize and explain at a fundamental principle of remote sensing and Satellite System.*
2. *Learn basic computational attributes of remote sensing data acquisition, storage, and processing.*
3. *Learn Interpretation and analysis methods of aerial photographs.*
4. *Know and use main methods to improve, correct and interpret properly Remote Sensing Images.*
5. *Use GIS software to perform different spatial analysis digital analysis of satellite image.*
6. *Understand different application of Remote Sensing and Global Navigation Satellite System.*
7. *Learn digital image enhancement and digital image classifications (supervised and unsupervised) techniques.*

UNIT-1: PHYSICAL BASIS OF REMOTE SENSING (RS) AND SATELLITE SYSTEM

1.1 Physics of Remote Sensing: Electro Magnetic Radiation (EMR), Radiation laws (wavelength-frequency-energy relationship of EMR); Requirements and Stages of Remote Sensing; Satellite Platforms and Sensors: Basics, Kepler's laws, Major-Semi major axis and eccentricity, Velocity, Period, Historical development, Launch Vehicle, Indian scenario.

1.2 Satellite Data Acquisition techniques; Interpretation and analysis of aerial photographs and satellite images; Satellite Sensors: Concept of IFOV, Resolution, Band Combination, FCC and SFCC; Satellite Systems: Whiskbroom Systems (LANDSAT Series), Pushbroom Systems (SPOT, IRS series), Microwave Systems (RADARSAT), Coarse resolution/ Meteorological Satellite systems (NOAA, INSAT), Very high-resolution satellite systems (Quickbird, Cartosat, IKONOS, WorldView series). Referencing scheme of satellite system (path/row calculation). Spectral signature curve.

UNIT-2: FUNDAMENTALS OF GEOGRAPHIC INFORMATION SYSTEM (GIS) AND GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS)

2.1 *Basic Concepts*: Definition of GIS, Components of GIS, Variables: points, lines, polygon, Functionality of GIS, Advantage and Limitation of GIS; *GIS Data:* Spatial and Attribute Data, Information Organization, Data Structures and Data Analysis, Data file and database. *Creating GIS Database*: File organization and formats, Geo-database, Rectification, Digitization and Map Composition.

2.2 *GIS Data Input:* Nature and Source of data, Methods of spatial data capture (Primary and Secondary), digitization and scanning method; Techniques and procedure for digitizing, Errors of Digitization, Attribute data capture; *Data Editing:* Detecting and correcting errors, Re-projection, Transformation and Generalization, Edge matching and Rubber sheeting, Topology. *GNSS*: Principles of GNSS positioning with special reference to GPS; Sources of error in a GNSS system; DGPS and its uses.

Continuous Assessment [15 Marks]
(*The department shall decide the methods of internal assessment*)

✧ **Suggested Readings**:

1. Bhatta, B. (2011): *Global Navigation Satellite Systems: Insights into GPS, GLONASS, Galileo, Compass and Others*, CRC Press.
2. Bhatta, B. (2011): *Remote Sensing and GIS*, 2nd ed., Oxford Univ. Press.
3. Campbell, J.B. (1996): *Introduction to Remote Sensing*, 2nd edition, Taylor and Francis, London.
4. Chaisman, N. (1992): *Exploring Geographical Information Systems*, John Wiley and Sons Inc., New York.
5. Curran, P.J. (1988): *Principles of Remote Sensing*, ELBS Edition, Longman Group Ltd., UK.
6. Heywood, D.I., Cornelius, S. and Carver, S. (2006): *An Introduction to Geographical Information Systems*, Prentice Hall, Upper Saddle River, New Jersey.

7. Jensen, J.R. (2006): *Remote Sensing of the Environment: An Earth Resource Perspective*, Prentice Hall, Upper Saddle River, New Jersey.

8. Joseph, G. (2003*): Fundamental of Remote Sensing*, University Press (India) Pvt. Ltd.

9. Joseph, G. and Jegannathan, C. (2018): *Fundamentals of Remote Sensing*, 3rd ed., Universities Press.

10. Lillesand, T.M. and Kiefer, R. W. (1994): *Remote Sensing and Image Interpretation*, 3rd edition, John Wiley and Sons, New York.

11. Marcolongo, B. and Mantorani, F. (1997): *Photogeology: Remote Sensing Application in Earth Science*, Oxford and IBH Pub. Pvt. Ltd., New Delhi.

12. Martin, D. (1991): *Geographical Information Systems and their Socioeconomic Applications*, London, Routledge.

13. Sabins, F.F. (1997): *Remote Sensing: Principles and Applications*, 3rd edition, W.H. Freeman & Company, New York.

Semester - I

(MSCGEINC104: Core Course-4, Theoretical)

Introduction to Surveying and Photogrammetry

✧ **Full Marks: 50**	✧ **CA+ESE Marks: 15+35**
✧ **Credit: 4**	✧ **L - T – P: 4 - 0 - 0**
✧ **End Sem Exam Duration: 2 Hours**	

Course Learning Outcomes:

After the completion of this course, student should be able to:

1. *Understand basic principles of conventional and advanced survey techniques for precise measurement in field-based studies.*
2. *Understand the concept of surveying using Total Station and GPS.*
3. *Acquire capability for quantitative assessment from aerial photographs.*
4. *Understand automatic and semi-automatic procedures in photogrammetry.*

UNIT-1: INTRODUCTION TO SURVEYING

1.1 Importance of Field Survey, Collection of Ground Truth. Introduction to Conventional field survey techniques: Plane and Geodetic Surveying (Traversing, Triangulation and Levelling), Topographic, Cadastral, Engineering and Hydrographic surveys.

1.2 Chain Survey, Levelling (Simple and Reciprocal Methods) using Dumpy Level, Measurement of Height and Distance (Triangulations Method) by Theodolite, Application of Clinometers. Tacheometric Survey using Total Station. Land Use and Land Cover Mapping using GPS and DGPS Survey.

UNIT-2: PHOTOGRAMMETRY

2.1 Definition and Concepts, Historical Development and Fundamentals of Aerial Photography, Vertical and Oblique Aerial photographs, Orthophotographs, Areal Cameras, Scale, Geometry and Orientation of Aerial Photographs, Distortions, Displacements and their correction. Concept of interior, relative, absolute orientation; object, image measurement, control points, analytical self-calibration, scaling and leveling, analytical procedures; principles of stereoscopic vision, types of stereoscopes, stereoscopic plotting and mapping instruments.

2.2 *Principles of Digital Photogrammetry*: Hardware and software requirements, Image measurement, Orientation procedure, Epipolar geometry, Aerotriangulation, Block adjustment, Satellite stereo images, Mosaics of DTM and ortho images.

Continuous Assessment [15 Marks]
(*The department shall decide the methods of internal assessment*)

✧ **Suggested Readings**:

1. Basak, N.N. (2008): *Surveying and Levelling*, Tata McGraw-Hill Publishing Company Limited, New Delhi. Becker, G.S. (1993): *Human Capital: A Theoretical and Empirical Analysis*, Chicago: University of Chicago Press.

2. Elfic, M.H., Fryer, J.G., Brinkner, R.C. and Wolf, P.R. (1994): *Elementary Surveying*, 8th Edition, Harper Collins Publishers, London.

3. Greve, C. (1996): *Digital Photogrammetry - An Addendum to the Manual of Photogrammetry*. American Society for Photogrammetry and Remote Sensing.

4. Hussain, S.K. and Nagaraj, M.S. (1992): *Text Book of Surveying*, S. Chand & Co. Ltd., New Delhi.

5. Kanetkar, R.P. and Kulkarni, S.V. (1988): *Surveying and Levelling*, Part-I, Vaidyarthi Griha Prakashani, Pune.

6. Kasser, M. and Egels, Y. (2012): *Digital Photogrammetry*, Taylor & Francis.

7. Kochher, C.L. (1993): *A Text Book of Surveying*, S.K. Katariya & Sons, Delhi.

8. Leberl, F. (2008): *Radargrammetry for Image Interpreters*, 2nd Ed., International Institute for Aerial Survey and Earth Sciences, Enschede, The Netherland.

9. Li, Z., Chen, J. and Baltsavias, E. (Eds.). (2008): *Advances in Photogrammetry, Remote Sensing and Spatial Information Sciences: 2008 ISPRS congress book*, Vol. 7, CRC Press.

10. Lo, C.P. and Yeung, A.K. (2002): *Concepts and Techniques of Geographic Information Systems* (pp. 143-191), Prentice Hall, Upper Saddle River, NJ.

11. McGlone, J.C. (2014): *Manual of Photogrammetry*, Seventh Edition, American Society for Photogrammetry and Remote Sensing.

12. Mikail, E.M., Bethel, J.S. and McGlone, J.C. (2011): *Introduction to Modern Photogrammetry*, John Wiley & Sons, Ins.

13. Moffitt, F.H.: (1980) Photogrammetry, 3rd Ed., Harper & Row, NY.

14. Morgan, D. and Falkner, E. (2001): *Aerial Mapping: Methods and Applications*, CRC press.

15. Punmia, B.C. (1985): *Surveying*, Volume II, Standard Book House, Delh Hartshorn, T.A. and Alexander, J.W. (1988): *Economic Geography*, Prentice Hall India, New Delhi.

16. Shepherd, F.A. (1983): *Engineering Surveying*, Edward Arnold, London.

17. Venkatramaiah, C. (1996): *A Textbook of Surveying*, Universities Press/Orient Longman Ltd., Hyderabad.

18. Williams, J.C. (1969): *Simple Photogrammetry: plan-making from small-camera photographs taken in the air, on the ground or underwater*, Academic Press, London.

19. Wolf, P.R. and Dewitt, B.A. (2013): *Elements of Photogrammetry: with Applications in GIS*, 5th Ed., McGraw-Hill.

20. Zorn H.C. (1980): *Introductory Course in Photogrammetry*, 6th Ed., ITC, Netherlands

Semester - I

(MSCGEINC105: Core Course-5, Practical)

Map and Image Interpretation

✧ **Full Marks: 50**	✧ **CA+ESE Marks: 30+20**
✧ **Credit: 2**	✧ **L - T – P: 0 - 0 - 4**
✧ **End Sem Exam Duration: 2 Hours**	

Course Learning Outcomes:

1. *To equip the students to make an understanding of the earth surface characteristics from published map.*
2. *To make a sense of relationship between geological structure and surface relief features.*
3. *To equip the students for better interpretation of the remote sensing images (both satellite images and Aerial photographs).*

UNIT-1: INTERPRETATION OF TOPOGRAPHICAL AND GEOLOGICAL MAP [15 MARKS]

1.1 Mapping and Interpretation of Morphometric aspects (Relative Relief, Dissection Index, Drainage Density and Ruggedness Index), Preparation and Interpretation of Altimetric frequency and Hypsometric Curve from Survey of India 1:50000 topographical maps of plateau region. Demarcation of Drainage Basin and its area calculation (by Graphical or Planimeter Survey Method).

1.2 Stream order (Strahler's and Horton method), Linear, areal and relief aspects of drainage basins, their bivariate and multivariate analysis. Interpretation of Geomorphic Maps of Flood-

prone and Drought-prone areas. Analysis and Interpretation of Geological Maps, Subsurface lithological correlation techniques and its interpretation.

UNIT-2: AERIAL PHOTOGRAPH AND IMAGE INTERPRETATION ` [15Marks]

2.1 Scale measurement of aerial photographs, Distance and area measurement of themes, Aerial-photo interpretation for Terrain Evaluation and thematic mapping, Object height measurements by Parallax bar, Aerial photo mosaicking, Stereo plotting with photogrammetric instruments, Aerial triangulation and photo control. Ortho rectification of Air photos (orthobase), Stereo analysis and Anaglyph generation.

2.2 Calculation of distance and area on plane surface, spherical surface and ellipsoidal surface. Coordinate transformation. Determination of orbital period of a satellite, its velocity and distance from the earth's centre. Visual Satellite Image Interpretation, Elements of image interpretation, development of interpretation keys, Image interpretation for LU/LC and Vegetation mapping.

In the End Semester Examination, students have to answer one compulsory question from the above two Units.

Viva-voce [5 Marks]

Continuous Assessment [30 Marks]

*(*A Project File, comprising one exercise each is to be submitted)*

✧ **Suggested Readings**:

1. Dackombe, R.V. and Gardiner, V. (1983): *Geomorphological Field Manual*, George Allen and Unwin, London.
2. Goudie, A. (1990): *Geomorphological Techniques*, Unwin Hyman, London.
3. Greve, C. (1996): *Digital Photogrammetry - An Addendum to the Manual of Photogrammetry*. American Society for Photogrammetry and Remote Sensing.
4. Maltman, A. (1990): *Geological Maps: An Introduction*, Open University Press, Buckingham.
5. McGlone, J.C. (2014): *Manual of Photogrammetry*, Seventh Edition, American Society for Photogrammetry and Remote Sensing.
6. Morgan, D. and Falkner, E. (2001): *Aerial Mapping: Methods and Applications*, CRC press.
7. Platt, J.I. and Challinor, J. (1956): *Simple Geological Structures (A Series of Notes and Map Exercises)*, Thomas Murby & Co, London.
8. Tamaskar, B.G. and Deshmukh, V.M. (1974): *Geographical Interpretation of Indian Topographical Maps*, Orient Longman Ltd., Bombay.

9. Vaidyanadhan, R. (1968): *Index to a set of sixty Topographic Maps: Illustrating Specified Physiographic Features from India*, Council of Scientific and Industrial Research, Ministry of Education, Government of India.
10. Wolf, P.R. and Dewitt, B.A. (2013): *Elements of Photogrammetry: with Applications in GIS*, 5th Ed., McGraw-Hill.
11. Zorn H.C. (1980): *Introductory Course in Photogrammetry*, 6th Ed., ITC, Netherlands.

Semester - I

(MSCGEINC106: Core Course - 6, Practical)

Computer Fundamentals and Programming

✧ **Full Marks: 50** ✧ **CA+ESE Marks: 30+20**

✧ **Credit: 2** ✧ **L - T – P: 0 - 0 - 4**

✧ **End Sem Exam Duration: 2 Hours**

Course Learning Outcomes:

1. *Students will be familiar with computer hardware and the new trends in operating system and software.*
2. *Students will be able to understand enterprise software.*
3. *Students are exposed to programming languages in terms of working with big data in lesser time, understanding functionality of Matlab and JavaScript languages and to carry out mathematical simulation.*

UNIT-1: FUNDAMENTALS OF COMPUTER [15 Marks]

1.1 Introduction to Computers, Development of Computers, Hardware and Software, Data representation, Conversion of Data. Memory organization, Different Secondary Storage devices and magnetic media devices. *Data representation*: Representation of Characters in Computers, Representation of Integers, Representation of Fractions, Hexadecimal Representation of Numbers, Decimal to Binary Conversion, Error Detecting Codes.

1.2 *Information Technology and Operating System*: Information Technology Infrastructure Hardware, Software and Data related issues, System application software, Enterprise software, Operating System Concepts, Structures, Files, Directories, Process and Memory management.

UNIT-2: PROGRAMMING LANGUAGE [15 Marks]

2.1 *Introduction to Programming*: Basic Concepts, Program constructions - flowcharts, algorithms, pseudo codes, data structures - stacks, queues, linked list etc., approaches to

programming - top-down, bottom-up approach, divide and conquer, modular programming. *MATLAB*: Working with the MATLAB user interface, entering commands and creating variable, analyzing vectors and matrices, working with data files, writing programming with logic and flow control, customizing plots, calculating statistics and best-fit line.

2.2 Introduction to JavaScript, Variables. *Conditionals and Functions*: Booleans, Comparison Operators, Control Flow, Functions. *Scope and Arrays*: Scope, Arrays, Code Challenge: JS Fundamentals. *Loops and Iteration*: Loops, Functions, Iterators. Objects, Errors and Debugging, Handling Events.

In the End Semester Examination, students have to answer one compulsory question from the above two Units.

Viva-voce [5 Marks]
Continuous Assessment [30 Marks]
*(*A Project File, comprising one exercise each is to be submitted)*

✧ **Suggested Readings**:

1. Holland, O. T. and Marchand, P. (2002): Graphics and GUIs with MATLAB, Chapman and Hall/CRC.
2. Rajaraman Y. (1999): *Fundamentals of Computers*, Prentice Hall of India, New Delhi.
3. Scott, M.L. (2009): *Programming Language Pragmatics*, Third Edition, Morgan Kaufmann.
4. Sebesta, R.W. (2008): *Concepts of Programming Languages*, 8/e, Pearson Education.
5. Sebesta, R.W. (2012): *Concepts of Programming Languages*, Tenth Edition, Addison Wesley.
6. Solomon, C. and Breckon, T. (2011): *Fundamentals of Digital Image Processing: A practical approach with examples in Matlab*, John Wiley & Sons.
7. Watt, D.A. (2007): Programming Language Design Concepts, Wiley.

SYLLABUS

for

M.Sc. in Geoinformatics

(Semester - II)

Semester - II

(MSCGEINC201: Core Course-7, Theoretical)

Digital Image Processing for Geoinformatics

✧ **Full Marks: 50** ✧ **CA+ESE Marks: 15+35**

✧ **Credit: 4** ✧ **L - T – P: 4 - 0 - 0**

✧ **End Sem Exam Duration: 2 Hours**

Course Learning Outcomes:

1. *Ability for enhancing and processing digital images.*
2. *Ability to understand the suitability of various satellite images.*
3. *Ability for feature identification and classification from satellite data.*

UNIT-1: INTRODUCTION TO DIGITAL IMAGE PROCESSING (DIP) AND IMAGE ENHANCEMENT TECHNIQUES

1.1 *Introduction*: Definition of Digital Image; Source of Data, Data Formats; Hardware and Software consideration for Digital Image Processing, Satellite Data Encoding and Decoding, Data Loading; Image Restoration, Image Reduction and Magnification. *Pre-Processing of Digital Image*: Sources of Error in Image Data, Atmospheric Correction Methods; Image Rectification and Registration, Resampling Techniques; Radiometric Corrections. *Geometric Corrections of Digital Image.*

1.2 *Image Enhancement Techniques*: Gray Level Thresholding, Level Slicing, Contrast Stretching - Linear and Non-Linear, Density Slicing; Image Filtering (Types and Methods); Multiband Enhancement (Band Ratioing, RGB Transformations, Principal Component Analysis, Image fusion). *Initial Statistics Extraction*: Univariate and Multivariate Image Statistics, Band Correlation.

UNIT-2: DIGITAL IMAGE CLASSIFICATION

2.1 *Thematic Image Classification*: Spectral Pattern Recognition, Spatial Pattern Recognition, Temporal Pattern Recognition, Parametric and Non-Parametric Classifiers, Hard and Soft Classification System, Advantage and Disadvantages of Different Classifiers.

2.2 *Unsupervised classification*: Isodata, K-mean. *Supervised classification Technique*: training sites, classification stage; minimum distance to mean classifier, parallelepiped classifier, maximum likelihood classifier, Mahalanobis Distance. *Advanced Classification Techniques*:

Hybrid Classification, Sub Pixel Classification, Fuzzy Classification; Accuracy Assessment, Signature Statistics, Mathematic Algorithm.

Continuous Assessment [15 Marks]
(*The department shall decide the methods of internal assessment*)

✧ **Suggested Readings**:

1. Bernstein, R. (1978): *Digital Image Processing for Remote Sensing*. IEEE Press, New York.
2. Campbell, J. B. (2002): *Introduction to Remote Sensing*. 5th edition, Taylor and Francis,London.
3. Castleman, K.R. (1996): *Digital Image Processing*. Prentice Hall, New Jersey.
4. Curran, P.J. (1985): *Principles of Remote Sensing*. Longman, London and New York.
5. Deekshatulu, B.L. and Rajan, Y.S. (ed.) (1984): *Remote Sensing*. Indian Academy of Science, Bangalore.
6. Floyd, F. and Sabins, Jr. (1986): *Remote Sensing: Principles and Interpretation*. W.H. Freeman, New York.
7. Gibson, P.J. and Power, C.H. (2000): *Introductory Remote Sensing: Digital Image Processing and Applications*. Routledge, London.
8. Gonzalez, R.C. and Woods, R.E. (1996): *Digital Image Processing*. Pearson, India.
9. Hord, R.M. (1982): *Digital Image Processing of Remotely Sensed Data*. Academic Press, New York.
10. Jain, A.K. (1989): *Fundamentals of Digital Image Processing*. Prentice Hall, New Jersey.
11. Jensen, J.R. (1986): *Introducing Digital Image Processing*. Prentice Hall. New Jersey.
12. Jensen, J.R. (2006): *Remote Sensing of the Environment: An Earth Resource Perspective*. Pearson Education Pvt. Ltd., Delhi.
13. Lillesand, T.M., and Kiefer, R.W. (2007): *Remote Sensing and Image Interpretation*. John Wiley and Sons, New York.
14. Milman, A.S. (1999): *Mathematical Principles of Remote Sensing: Making Inferences from Noisy Data*. Ann Arbor Press, Noida.
15. Richards, J.A. (1999): *Remote Sensing Digital Image Analysis*: *An Introduction*. Springer- Verlag, New York.
16. Schowengerdt, R.A. (1997): *Remote Sensing: Models and Methods for Image Processing*. Academic Press, New York.
17. Sharma, S. (2013): *Fundamentals of Digital Image Processing*. S.K. Kataria and Sons.
18. Siegel, B.S. and Gillespie, A.R. (1980): *Remote Sensing in Geology*. John Wiley and Sons, New York.

Semester - II

(MSCGEINC202: Core Course-8, Theoretical)

Statistics and Geostatistics

✧ **Full Marks: 50**	✧ **CA+ESE Marks: 15+35**
✧ **Credit: 4**	✧ **L - T – P: 4 - 0 - 0**
✧ **End Sem Exam Duration: 2 Hours**	

Course Learning Outcomes:

1. *To equip the students to make use of the statistical procedures in modelling of data in their field of study.*

2. *The students will learn the basic approach in conducting a variogram analysis, including the calculation of experimental variograms and variogram modeling. They will also learn the mathematical and statistical principles behind Kriging, Co-kriging and stochastic simulations as well as how to apply these geostatistical methods in spatial interpolation based on a set of 2D sampled data.*

UNIT-1: FUNDAMENTAL STATISTICAL CONCEPTS

1.1 Meaning, Scope and Importance of Statistics. *Collection of data*: sampling methods, random and systematic method; Sources of data; Organization of data - array, frequency, class intervals, histograms, and distribution. *Presentation of Data*: Tables, Diagrams; Grouped data and ungrouped data, discrete and continuous series; Scales of measurement (nominal, ordinal, interval and ratio); Measures of Central Tendency (mean, median, mode, partition values); Measures of Dispersion (absolute dispersion, relative dispersion, z-scores); Measurement of Shape (skewness and kurtosis).

1.2 Bivariate correlation and regression; Curvilinear regression: Parabolic, geometric and exponential; Standard error of estimation; Time series analysis: Least square and moving average method; Partial and multiple correlations; Multiple regression; Principal component analysis.

UNIT-2: GEOSTATISTICS AND STATISTICAL APPLICATIONS IN GIS

2.1 *Classical Statistics*: Universe, Population and Sample; Concept of Random variable; Probability distributions, *viz.* Normal (Gaussian) and Lognormal distribution. *Concepts of Geostatistics*: Support, Autocorrelation, Random Function, Regionalised variable; Exploratory Data Analysis. *Semi-variogram*: definition, properties, calculation of experimental semivariograms in 1-, 2-, and 3- dimensions; Mathematical models of semi-variogram; Techniques of model fitting, Practical difficulties associated with semi-variography.

2.2 *Extension and Estimation Variance*: definition, formulation, and methods of calculation, viz. method of discretization and use of auxiliary functions. *Surface Modelling*: Spatial

autocorrelation, Role of Interpolation, Methods of Interpolation - Global and Local Deterministic Methods, Moving Averages, Inverse Distance Interpolation, Optimal Interpolation using Geostatistics. *Interpolation by Kriging:* Ordinary Kriging, Block Kriging, Non-Linear Kriging, Stratified Kriging, Co-Kriging, Universal Kriging, Probabilistic Kriging. *Factor and cluster analysis*.

Continuous Assessment [15 Marks]

(*The department shall decide the methods of internal assessment*)

✧ **Suggested Readings**:

1. Alvi, Z. (1995): *Statistical Geography: Methods and Applications*. Rawat Pub. New Delhi.
2. Chiles, J.P. (1999): *Geo-statistics: Modelling spatial uncertainty*. Wiley Interscience Publication.
3. Cressie, N. (1991): *Statistics for Spatial Data*. John Wiley and Sons.
4. Isaacs, E.H. and Srivastava, R.M. (1989): *Applied Geostatistics*. Oxford University Press, New York.
5. Kitanidis, P.K. (1997): *Introduction to Geostatistics: Applications in Hydrogeology*. Cambridge University Press.
6. Longley, P. and Batty, M. (*eds.*) (1996): *Spatial Analysis: Modelling in a GIS Environment*. Geoinformation International, Cambridge.
7. Mahmood, A. (2002): *Statistical Methods in Geographical Studies*. Rajesh Publication, New Delhi.
8. Meyer, P.L. (1965): *Introductory Probability and Statistical Applications*. Addison Wesley.
9. Pal, S.K. (1999): *Statistics for Geoscientists*. Concept Publishing Company, New Delhi.
10. Sharma, D.D. (2010): *Geostatistics with applications in Earth Sciences*. Springer.
11. Silk, J. (1979): *Statistical techniques in Geography*. George Allen and Unwin, London.
12. Spiegel, M.R. (1981): *Theory and Problems of Statistics*. Schaum's Outline Series.
13.Volk, W. (1980): *Applied Statistics for Engineers*. Krieger Publishing Company, Huntington, New York.
14.Yang, X.S. (2009): *Introductory Mathematics for Earth Scientists*.Dunedin Academic Press.
15. Wackernagel, H. (2003): *Multivariate Geostatistics*. 3rd edition, Springer-Verlag, Berlin.
16. Walford, N. (1995): *Geographical Data Analysis*. John Wiley and Sons, New York.
17. Walford, N. (2011): *Practical Statistics for Geographers and Earth Scientists*. John Wiley and Sons, New Jersey, USA.
18. Williams, R.B.G. (1984): *Introduction to Statistics for Geographers and Earth Scientists*. Macmillan, London.
19. Wrigley, N. (1985) *Categorical Data Analysis for Geographers and Environmental Scientists*.Longman, Harlow.

Semester - II

(MSCGEINC203: Core Course-9, Theoretical)

Introduction to Programming for Geoinformatics and DBMS

(Database Management System)

✧ **Full Marks: 50** ✧ **CA+ESE Marks: 15+35**

✧ **Credit: 2** ✧ **L - T – P: 2 - 0 - 0**

✧ **End Sem Exam Duration: 2 Hours**

Course Learning Outcomes:

1. *After completion of this course, students will learn basic functionalities of popular programming language (Python, R and C#) of geoinformatics.*
2. *Database management system will teach students how database system works for any types of query building and data storage.*

UNIT-1: PROGRAMMING FOR RS AND GIS

1.1 *Python Programming*: Introduction to Python Programming, Introduction to QGIS Python Programming, QGIS Advanced Python Programming Techniques, Enterprise GIS (Introduction to Enterprise GIS Application, Working with Spatial Databases, Introduction to Web GIS, Publishing the data using GIS Servers, Understanding OGC Web Services, Developing Web GIS Applications, Data Visualization and Analysis)

1.2 Concept of 'R' programming Language and its Basic Characteristics, Packages, Loop Function, Data Loading and statistical analysis, Application of 'R'Programming Language in Geoinformatics, Analysis with Raster Data, Model Building Functions of R for Spatial Data Analysis, Comparison of 'R' Programming Languages with Other Languages for Geospatial Data analysis.

OR

C# .NET: Getting Started with C#, Variables, Conditional Logic, Loops, Debugging your Applications, Understanding Arrays and Lists, String Manipulation, Classes and Objects, Manipulating Files, AutoCAD Development.

UNIT-2: DATABASE MANAGEMENT SYSTEM

2.1: Introduction to Databases and Transactions (Purpose of database systems, view of data, relational databases, database architecture), Database Design, ER-Diagram. Language (Database design and ER Model): overview, ER-Model, Constraints, ER-Diagrams, Codd's rules, Relational Schemas.

2.2 Relational database model: Logical view of data, keys, integrity rules; Relational Database design: features of good relational database design.

Continuous Assessment (Methods of internal assessment is consisting of brief seminar presentation/ group discussion by students)) [15 Marks]

Suggested Readings:

1. Desai, B.C. (1995): *An Introduction to Database Systems*. Galgotia Publications Pvt. Ltd, NewDelhi.
2. Everest, G.C. (2001): *Database Management*. TataMcGraw-Hill, New Delhi.
3. Elmasri, R. and Navathe, S.B. (1994): *Fundamentals of Database Systems*. Benjamin Cummings Pub. Co., Inc. Redwood City, USA.
4. Korth, N.F. and Silberschatz, A. and Sudarshan, S. (2002): *Database Management System Concepts*. 4th edition, McGraw Hill Inc., New Delhi.

Semester - II

(MSCGEINC204: Core Course-10, Practical)

Digital Image Processing and Spatial Analysis

✧ **Full Marks: 50** ✧ **CA+ESE Marks: 30+20**

✧ **Credit: 4** ✧ **L - T – P: 0 - 0 - 8**

✧ **End Sem Exam Duration: 2 Hours**

Course Learning Outcomes:

1. *Deal with increasing sophistication in the rapidly maturing field digital image processing.*
2. *Understand GIS concepts and spatial analysis techniques in an interdisciplinary setting.*
3. *Apply ArcGIS for spatial data preparation, analysis and visualization with sophisticated skills of vector and raster processing.*
4. *Demonstrate proficiency in integrating GIS data analysis with simple statistical analysis.*
5. *Demonstrate ability to conduct a GIS research project in the area of their choice.*

UNIT-1: PRACTICAL IN DIP [15 Marks]

1.1 *Familiarization with image processing system*: Loading of digital data to working environment, preparation of FCC, generation of spectral signature library and analysis of spectral reflectance curves, study of histograms, Image registration (map to image, image to image), reprojection, creating subset/clip and mosaic of digital data. Atmospheric Correction; Image enhancement and filtering of multispectral optical data; Image Fusion; Band ratio, NDVI and NDWI; Principal Component Analysis (PCA).

1.2 *Image classification*: Unsupervised and Supervised, Accuracy assessment, Class separability and contingency matrix, change detection study.

UNIT-2: PRACTICAL IN SPATIAL ANALYSIS [15Marks]

2.1 *Familiarization with GIS softwares*: Geodatabase and working with layers, Geo-referencing and Projection, Editing data (selecting features, simple editing functions, creating new features, modifying, schema changes). Spatial data entry, spatial data editing and topology creation, linking spatial and non-spatial data entry.

2.2 Spatial and non-spatial query and analysis, Overlay Analysis, Buffer Creation and Analysis, Network Analysis. Edge matching/ spatial adjustment, Calculation of area, perimeter and distance. *DEM analysis*: Calculation of slope in degrees and percentages, TIN, Hillshade, Aspect, extraction of drainage network from DEM, catchment demarcation and stream ordering, extraction and mapping of morphometric parameters. *Output map generation*.

In the End Semester Examination, students have to answer one compulsory question from the above two Units.

Viva-voce [5 Marks]
Continuous Assessment [30 Marks]
*(*A Project File, comprising one exercise each is to be submitted)*

Semester - II

(MSCGEINC205: Core Course-11, Practical)

Geostatistics and Pilot Project

✧ **Full Marks: 50** ✧ **CA+ESE Marks: 30+20**
✧ **Credit: 2** ✧ **L - T – P: 0 - 0 - 4**
✧ **End Sem Exam Duration: 2 Hours**

Course Learning Outcomes:

This course aims to give basic knowledge in the specific field of acquisition and processing of numerical data, emphasizing the problems of the representativeness of samples, analytical error, interpretation and presentation of conventional numerical data and georeferenced data.

UNIT-1: PRACTICAL IN STATISTICAL CONCEPTS AND GEOSTATISTICS [15 Marks]

1.1 *Introduction of Statistical Software*; Histogram plotting and estimation of mean, median, mode, skewness and kurtosis; Time series, Scatter plot with regression line, Z-Score, T-test, Correlation, Neighborhood analysis; Fitting of Probability distributions to sample distribution, *viz.* Normal and Lognormal, Chi-squared goodness of fit.

1.2 Principal Component analysis; Spatial autocorrelation; Computation of Semi-variograms in 1-and 2-dimensions; Semi-variogram modeling; Computation of estimation variance; Exercises on kriging.

Continuous Assessment [10 Marks]

UNIT-2: PILOT PROJECT [25 Marks]

Each student is required to undertake a project work after identifying a problem in consultation with internal guide. Execute the work as per the instructions of internal guide while incorporating any of the following activities or combination of activities: (i) *GIS implementation and application*, (ii) *Remote Sensing application*. After the project work is completed, students shall submit project report both in **print form** and **digital form (pdf)** based on the results obtained. The size of the project report may be between **40 and 50 pages**, which are not inclusive of scripts and other appendices. To enhance the presentation and communication skills of a student, each student has to present the project work carried out by him/her in front of the examiners (internal and external) using audio visual methods. On completion of study of this pilot project, students would have a sound knowledge about the GIS/ Remote Sensing and its applications.

Evaluation of Project Report: **20 Marks**

Seminar Presentation: **5 Marks**

Semester - II

(MSCGEINC206: Core Course-12, Practical)

Programming for Geoinformatics and DBMS (Database Management System)

✧ **Full Marks: 50** ✧ **CA+ESE Marks: 30+20**

✧ **Credit: 2** ✧ **L - T – P: 0 - 0 - 4**

✧ **End Sem Exam Duration: 2 Hours**

Course Learning Outcomes:

1. *This course will teach students how to process big spatial data in programming languages (MATLAB, R, C#).*
2. *Students will learn to write code in different programming languages for spatial data analysis which will help them for better understanding of the background process of GIS tools.*
3. *DBMS part will help the students to understand how DBMS works and how existing database can be manipulated for fulfilling their objectives of work.*

UNIT-1: PROGRAMMING FOR RS AND GIS [15 Marks]

1.1 *Programming for RS and GIS*: *MATLAB recipes for Geoinformatics*: Image processing through MATLAB (Basic programme to understand MATLAB, Programme to display and enhance a map, Rectifying and Referencing Images; Image Stitching, NDVI from Images, Simple programme to remove cloud cover in MATLAB); Digital Elevation Model (DEM) Analysis (Analysis of digital elevation models (DEMs) using Topo Toolbox).

1.2 GIS using Python Programming, Visual Studio IDE, C# .NET programming language, AutoCAD .NET Programming.

OR/AND

Familiarizing with 'R' Programming Language, Download and Installation of Required Packages, Geospatial Data Import, Band Compositing, Subset of Satellite images, Preparation of Biophysical Indices from Satellite Bands (NDVI, NDWI, NDBI, NDMI), Land Use Classification from Satellite Image, Simple Model Building and Prediction Using Geospatial Data.

UNIT-2: DATABASE MANAGEMENT SYSTEM [15 Marks]

2.1: Introduction to Databases and Transactions (Purpose of database systems, view of data, relational databases, database architecture), Database Design, ER-Diagram. Language (Database design and ER Model): overview, ER-Model, Constraints, ER-Diagrams, Codd's rules, Relational Schemas.

2.2 Relational database model: Logical view of data, keys, integrity rules; Relational Database design: features of good relational database design.

In the End Semester Examination, students have to answer one compulsory question from the above two Units.

Viva-voce [5 Marks]
Continuous Assessment [30 Marks]
*(*A Project File, comprising one exercise each is to be submitted)*

Suggested Readings:

1. Desai, B.C. (1995): *An Introduction to Database Systems*. Galgotia Publications Pvt. Ltd, NewDelhi.
2. Everest, G.C. (2001): *Database Management*. TataMcGraw-Hill, New Delhi.
3. Elmasri, R. and Navathe, S.B. (1994): *Fundamentals of Database Systems*. BenjaminCummings Pub. Co., Inc. Redwood City, USA.
4. Korth, N.F. and Silberschatz, A. and Sudarshan, S. (2002): *Database Management System Concepts*. 4th edition, McGraw Hill Inc., New Delhi.

Semester - II

(MSCGEINMIE201: Minor Elective-1, Theoretical)

Socio Economic Mapping using Geoinformatics

✧ **Full Marks: 50** ✧ **CA+ESE Marks: 15+35**

✧ **Credit: 4** ✧ **L - T – P: 4 - 0 - 0**

✧ **End Sem Exam Duration: 2 Hours**

Course Learning Outcomes:

1. *This course enables students to understand the applicability of computer system for socio-economic mapping and its recent trends.*
2. *Students will learn how to convert attribute data into spatial data for visualization of different socio-economic aspects.*

UNIT-1: CONCEPT OF THEMATIC MAPPING

1.1 Introduction and Significance of Computer Mapping. Colour schemes *versus* Black and White/ Grayscale; graduated symbols; dot density; symbolizing types of features; Linking data to geography; extracting data from the map; site selection *vs* site planning; data suitability.
1.2 General and Thematic maps; Concept of Thematic Cartography; Types of thematic maps (qualitative and quantitative). Methods of Representing socio-economic data using GIS: Chorochromatic and Choroschematic maps; Choropleth maps; Isopleths methods; Diagrammatic maps/Cartograms; Dot maps; Flow line maps; Statistical surfaces. Application of Remote Sensing in Thematic mapping (Forest cover mapping; Crop type mapping, Disaster mapping; Urban land use mapping, Mapping of mining areas).

UNIT-2: MAPPING OF SOCIOECONOMIC DATA

2.1 *Mapping socio-economic data*: Dot maps, Density maps (colour and grey scale patterns); Choropleth Mapping, Chorochromatic Mapping.
2.2 *Thematic mapping using Remote Sensing*: Forest cover mapping, urban land use mapping, mapping of mining areas.

Continuous Assessment [15 Marks]
(*Methods of internal assessment is consisting of brief seminar presentation/ group discussion by students*)

✧ **Suggested Readings**:

1. Kraak, M.J. and Ormeling, F. (2004): *Cartography: Visualization of Geospatial Data*. 2nd Edition, Pearson Education.
2. Monmonier, M.S. (1982): *Computer Assisted Cartography: Principles and Prospects*. Prentice Hall, New York.
3. Unwin, D.J. and Dawson, J.A. (1985): *Computer Programming in Geography*. Longman,London..

SYLLABUS

for

M.Sc. in Geoinformatics

(Semester - III)

Semester - III

(MSCGEINC301: Core Course-13, Theoretical)

Research Methodology and Spatial Decision Support System

✧ **Full Marks: 50**	✧ **CA+ESE Marks: 15+35**
✧ **Credit: 4**	✧ **L - T – P: 4 - 0 - 0**
✧ **End Sem Exam Duration: 2 Hours**	

Course Learning Outcomes:

1. *Students are exposed to the research concepts in terms of identifying the research problems, collecting relevant data pertaining to the problem, to carry out the research and writing research paper/ thesis/ dissertation.*
2. *Students will learn how to take decision from large numbers of alternatives in a spatial domain.*

UNIT-1: RESEARCH METHODOLOGY

1.1 Concepts and Significance of Research in Geoinformatics, Objectives and Types of Research, Approaches to Research in Geoinformatics. Identification of a Research Problem, Research Questions and Hypothesis Building. *Research Design*: Need for Research Design, Important Concepts, Different Research Design. Qualitative and Quantitative research methods, Scaling Techniques, Sampling Design.

1.2 *Statistical Inference for Research:* Concepts and Procedure concerning testing of Hypothesis, Chi-square Test, Variance and Co-variance analysis, Concept of Standard Error. *Model Calibration and Validation*. *Project:* Definition and Characteristics of Project, Project Objectives and Functions, Classification of Projects, Preparation of Research Projects and Writing of Reports, Critical Writing, Ethical Issues in Research.

UNIT-2: SPATIAL DECISION SUPPORT SYSTEM

2.1 *GIS and Decision Support Systems*: Concept and characteristics of Decision Support Systems (DSS), Spatial Decision Support Systems (SDSS) and GIS. *Multicriteria Decision Analysis (MCDA)*: Elements and Structure of MCDA, Multi-objective and Multi-attribute analysis.

2.2 *Spatial Multicriteria Decision Analysis (SMDA*): Framework of SMDA, Evaluation Criteria and GIS, Decision Alternatives and Constraints. *Criterion Weighting and Decision Rules*: Estimation of Weights- Ranking, Rating, Pairwise Comparison and Trade-off analysis method; Decision Rules-Simple Additive Weighting method and Analytic Hierarchy Process.

Continuous Assessment [15 Marks]
(*The department shall decide the methods of internal assessment*)

✧ Suggested Readings:

1. Ahuja, R. (2001): *Research Methodology*, Rawat Publication, Kolkata.
2. Angus, R.B., Gundersen, N.A. and Cullinane, T.P. (1999): *Planning, Performing and controlling Projects: Principles and Applications* (3rd Edition), Prentice Hall.
3. Beri, G.C. (2000): *Marketing Research*, Tata McGraw-Hill Publishing Company Limited, New Delhi.
4. Bonczek, R.H., Holsapple, C.W. and Whinston, A.B. (1981): *Foundations of Decision Support Systems*, Academic Press, New York.
5. Cooper, D.R. (1998): *Business Research Methods*, McGraw-Hill International Editions, New Delhi.
6. Cooper, D.R. and Schindler, R.S. (2000): *Business Research Methods*, Tata McGraw Hill Publishing Company Limited, New Delhi.
7. Harper, C., and Marcus, R. (2007): *Research for Development: A Practical Guide*, Vistaar Publication, New Delhi.
8. Huxold, W.E. and Levinsohn A.G. (1995): *Managing Geographic Information Projects*, Oxford University Press.
9. Kerzner, H. (2000): *Project Management: A System Approach to Planning, Scheduling, and Controlling*, 7th Edition. John Willey & Sons.
10. Kothari, C.R. (2009): *Research Methodology: Methods and Techniques*, New Age International Publishers, Kolkata.
11. Krishnaswamy, O.R (2002): *Methodology of Research in Social Sciences*, Himalaya Publishing House, Bombay.
12. Malczewski, J. (1999): *GIS and Multicriteria Decision Analysis*, John Willey and Sons, New York.
13. Mishra, R.C. and Soota, T. (2005): *Modern Project Management*, New Age International Ltd.
14. Murthy, C. (2009): *Research Methodology*, Vrinda Publications Ltd.
15. Sekaran, U. (2000): *Research Methods for Business*, John Wiley and Sons lnc, New York.
16. Shajahan, S. (2006): *Research Methods for Management* (Text and Cases), Jaico Publishing House, New Delhi.
17. Sprague, R.H. (1980): A framework for the development of decision support systems Management Information Sciences, *Quarterly* 4:1-26.
18. Sprague, R.H. and Carlson, E.D. (1982): *Building Effective Decision Support Systems*, Prentice-Hall, Englewood Cliffs NJ.
19. Sprague, R.H. and Carlson, E.D. (1982): *Source for DSS development model, Building Effective Decision Support Systems*, Prentice-Hall, Englewood Cliffs NJ.
20. Vijayalakshmi, G. and Sivapragasam, C. (2009): *Research Methods: Tips and Techniques*, MJP Publishers, Chennai.

Semester - III

(MSCGEINC302: Core Course-14, Theoretical)

Advance RS and GIS

✧ **Full Marks: 50** ✧ **CA+ESE Marks: 15+35**

✧ **Credit: 4** ✧ **L - T – P: 4 - 0 - 0**

✧ **End Sem Exam Duration: 2 Hours**

Course Learning Outcomes:

1. *Students will develop knowledge about the various thermal and microwave sensors operating in space*
2. *Ability to apply thermal infrared models for various applications in the field of civil engineering.*
3. *Ability to use microwave data for the analysis of various problems in land and water.*

UNIT-1: RECENT ADVANCES IN REMOTE SENSING

1.1 *Thermal Remote Sensing*: Thermal radiation principles, Factors affecting Thermal Imagery, Thermal process and properties, Thermal image and types of available data products, Applications of Thermal Remote Sensing. *Microwave Remote Sensing*: Introduction- Concept and principle, backscattering, aircraft radar system, Passive and Active microwave sensors, RADAR definition and basics, SAR concepts, SLAR- Imaging Geometry, Applications of microwave Remote Sensing.

1.2 *Hyperspectral Remote Sensing*: Concepts, data collection systems, calibration techniques, airborne and space-borne Hyperspectral sensors, applications. *LiDAR*: Principles, components of LiDAR system, LiDAR applications.

UNIT-2: ADVANCED GIS

2.1 Recent trends in GIScience: Interoperability and Web GIS (Concept and Applications); Mobile GIS (Concept and principle of Mobile GIS, ArcGIS Mobile, Characteristics of Mobile GIS, Advantages of Mobile GIS and its applications). Benefits of Multidimensional GIScience.

2.2 Emerging Branches and Future Trends of GIScience: Hydro-Informatics, Weather-Informatics, Biodiversity-Informatics and Socio-Informatics. Location Based Services and GIS, Cloud GIS, Visualizing a Three-dimensional Reality, GIScience Challenges

Continuous Assessment [15 Marks]
(*The department shall decide the methods of internal assessment*)

✧ Suggested Readings:

1. Bonham Carter, G.F (1994): *GIS for Geoscientists: Modeling with GIS*, Pergamon Publications.
2. Borengasser, M., Watkins, R. and Hungate, W.S. (2007): *Hyperspectral Remote Sensing: Principles and Applications*, CRC Press.
3. Campbell J.B. (2002): *Introduction to Remote Sensing*, 3rd Ed., The Guilford Press
4. Chaisman, N. (1992): *Exploring Geographical Information Systems*, John Wiley and Sons Inc., New York.
5. Chang, C.I. (2006): *Hyperspectral Data Exploitation: Theory and Applications*, Wiley & Sons Ltd.
6. Cracknell A.P. (Ed.) (1981): *Remote Sensing in Meteorology, Oceanography and Hydrology*, Ellis Horwood Limited, Chichester.
7. DeMers, M.N. (1997): *Fundamentals of Geographic Information System*, Wiley, New York.
8. Ghassem, A. (1989): *Theory and Applications of Optical Remote Sensing*, John Wiley and Sons, New York.
9. Grahn, H.F. and Geladi, P. (Eds.) (2007): *Techniques and Applications of Hyperspectral Image Analysis*, Wiley & Sons Ltd.
10. Henderson F.M. and Lewis A.J. (1998): *Imaging Radar* (Manual of Remote Sensing, Volume 2), 3rd Ed., Wiley.
11. Humhold. W.E. (1991): *An Introduction to Urban Geographic Information Systems*, Oxford University Press, New York.
12. Kalacska, M. and Sanchez-Azofeifa, A. (2008): *Hyperspectral Remote Sensing of Tropical and Subtropical Forests*, CRC Press.
13. Laurini, R. and Thompson, D. (1992): *Fundamentals of Spatial Information Systems*, Academy Press, London.
14. Lee, J.S. and Pottier, E. (2009): *Polarimetric Radar Imaging: From Basics to Applications*, CRC Press.
15. Mac Donald, A. (1999): *Building a Geodatabase*, ESRI Press, Redlands CA.
16. Maguire, D.J., Goodchild, M.F. and Rhind, D.W. (Eds.) (1991): *Geographical Information Systems: Principles and Applications*, Longman Scientific and Technical.
17. Martin, D. (1991): *Geographical Information Systems and their Socioeconomic Applications*, Routledge, London.
18. Masser, I. and Blakemore, M. (Eds.) (1991): *Handling Geographical Information: Methodology and Potential Applications*, Longman Pub Group
19. Massonnet, D. and Souyris, J.C. (2008): *Imaging with Synthetic Aperture Radar*, CRC Press, 2008.
20. Maune, D.F. and Bethesda, M.D. (2nd Ed.) (2007): *American Society for Photogrammetry and Remote Sensing*.

21. Silberschats, A. and Korth, H.F. (1998): *Database System Concepts*, 3rd Edition, TMH.
22. Skolnik, M.I. (2001): *Introduction to Radar Systems*, McGraw-Hill.
23. Ulaby, F.T., Moore, R.K. and Fung, A.K. (1986): *Microwave Remote Sensing: Active and Passive*, Vol. 1, 2 and 3 Addison-Wesley Publication Company.
24. Woodhouse, I.H. (2004): *Introduction to Microwave Remote Sensing*, CRC.

Semester - III

(MSCGEINC303: Core Course-15, Practical)

Web Mapping and Web GIS

✧ **Full Marks: 50** ✧ **CA+ESE Marks: 30+20**

✧ **Credit: 4** ✧ **L - T – P: 2 - 0 - 4**

✧ **End Sem Exam Duration: 2 Hours**

Course Learning Outcomes:

1. *Critically assess the organizational benefits and challenges of developing Web GIS applications.*
2. *Explain the difference between Web GIS, geospatial web services, mashups, mobile GIS solutions, geoportals, and how these are applicable to e-business and e-government.*
3. *Evaluate current technologies or architectures that support Web GIS.*
4. *Design and implement an independent Web GIS application.*

UNIT-1: INTRODUCTION TO WEB GIS AND GEOPORTALS [30 Marks]

1.1 *Concept of Web GIS*: Introduction, Limitation of Desktop GIS, GIS from Desktop to Internet, explanation of varying terminology, classification of web maps, components of Web GIS, potential of Web GIS, Web GIS technology: proprietary versus open source. *Computer networking*: Introduction, types of networks: LAN and WAN, structure of network: client-server and P2P, network topology and media. Internet: Introduction, Internet services, How Internet works, TCP/IP model. World Wide Web (Web), Web components, Web based client-server architecture. *Web server configuration and web page design*: HTML basics, headings, paragraphs, lists, links, images, tables, forms *etc.* Web GIS architecture and evolution of technology: strategy of Web GIS - server and client side, architecture of static and dynamic Web GIS.

1.2 *GIS web services*: Open Geospatial Consortium (OGC) Standards, Web Map Server (WMS), Web Feature server (WFS) *etc.*, use Map server as a WMS client. Geoportals: Concept, uses, functions, architectures, applications, challenges and prospects; Web page design principles, HTML, XML, data formats, helper applications, Java, databases and the Web

application of Internet services to GIS, Internet GIS software, interoperability issues and Open GIS (GSDI and NSDI). *Geospatial Mashups*.

UNIT-2: WEB MAPPING AND WEB GIS [20 Marks]

2.1 Mobile mapping using Note Pad and Tough Pad if possible. Use of GPS in Mobile mapping and processing the same data in GIS Platform.

2.2 Generation of Web map in ArcGIS platform using existing data. Building the web: HTML, CSS, and JavaScript; setting up a Modern Web Development Environment: Javascript and JQuery Programming; Publishing Maps using Geoserver and Introduction to OpenLayers.

In the End Semester Examination, students have to answer one compulsory question from unit 2 of 15 marks

Viva-voce [5 Marks]

Continuous Assessment on the basis of Unit 1 [30 Marks]

✧ Suggested Readings:

1. Burrough P.A. (1980): Principles of Geographical Information System for Land Resources Assessment, Oxford Publications.
2. Chang, K. (2008): Introduction to Geographical Information System, Fourth Edition, Tata McGraw Hill.
3. Deitel Nieto, H.M. *et al.* (2003): *Internet and World Wide Web - How to program*, Second Edition, Prentice Hall of India, New Delhi.
4. Ford, A. and Dixon, T. (1996): *Spinning the Web*, 2/e. International Thomson Computer Press.
5. Fu, P. and Sun, J. (2010): *Web GIS: Principles and applications*, ESRI.
6. Powell, T.A. (2003): *The Complete Reference - Web Design*, Tata McGraw Hill Publishing Company, New Delhi.
7. Ramalho, J.A. (2000): *Advanced HTML 4.0 with DHTML*, BPB Publications, New Delhi.

Semester - III

(MSCGEINC304: Core Course-16, Practical)

Advance RS & GIS and Theme Specific Case Studies

✧ **Full Marks: 50** ✧ **CA+ESE Marks: 30+20**

✧ **Credit: 4** ✧ **L - T – P: 0 - 0 - 4**

✧ **End Sem Exam Duration: 2 Hours**

Course Learning Outcomes:

1. *Students will be familiar with the new trends in algorithm design such as the joint use of spatial and spectral information.*
2. *Ability to deal with the increasing sophistication in the rapidly maturing field digital image processing.*
3. *Ability to create, edit and document geospatial datasets.*
4. *Ability to develop and document a conceptual design of a geospatial database for a specific application problem.*
5. *Ability to develop custom build GIS applications.*
6. *The course opens the opportunity for students to have interaction with the stakeholders who run industries to cater the need of RS and GIS software-based activities.*
7. *Learn the work culture, technicalities and business strategies through their involvement in project work.*
8. *Develop the skill in terms of presenting the research findings and writing scientific report.*

UNIT-1: ADVANCE RS AND GIS: APPLICATIONS [25 Marks]

1.1 Processing of Thermal Infrared data (Example: Landsat 7, Landsat 8 and ASTER Level1T Infrared data); Calculation of brightness temperature and land surface temperature; Calculation of NDWI; Establishing relation between NDWI and Land Surface temperature. Downloading free Hyperspectral data and complete processing these for generation of spectral curve and image classes.

1.2 Introduction to a GPS and initial setting, creating codes and attribute table for GPS receiver, point data collection using GPS with different datum, line data collection using GPS and measurements, GPS data collection for area calculation, Post processing of the GPS data, Creating attribute table in GPS pro software and export functions, integrating GPS and GIS for output preparation.

In the End Semester Examination, students have to answer one compulsory question from unit 1 of 15 marks

Continuous Assessment [10 Marks]

(The department shall decide the methods of internal assessment)

UNIT-2: THEME SPECIFIC CASE STUDIES
(Field based/ Outreach/ Internship Programme) [25 Marks]

Students may carry out their *field based/ outreach/ internship project* in an industry or any reputed academic/ research institutes. The project aims at giving the student an opportunity to participate and work in a substantive project activity. Typically, the project helps the student to learn about work culture, business processes, technologies, marketing strategies, *etc.* Each Candidate has to spend at least 2 weeks in an industry/ educational institution/ business house /IT industry, where GIS/ Remote Sensing/ GPS or a combination of these above is the main activity which may also include marketing of such products. Under the institute project, the student takes up a research topic or participates in an institute project under the guidance of a faculty or project coordinator. At the end of the field-based project/ outreach/ internship, the candidate has to produce an experience certificate and a written report (may be between **20 and 25 pages)** to the department for the evaluation. They will present the same in front of the examiners (internal and external) during the final examination which will be based on their overall learning experiences/ skills during the program.

Evaluation of Project Report: **20Marks**

Seminar Presentation: **5 Marks**

Continuous Assessment (Evaluation of Project Report) [20 Marks]

Semester - III

(MSCGEINMJE301: Major Elective-1, Theoretical)

Geoinformatics in Disaster Management I

✧ **Full Marks: 50** ✧ **CA+ESE Marks: 15+35**

✧ **Credit: 4** ✧ **L - T – P: 4 - 0 - 0**

✧ **End Sem Exam Duration: 2 Hours**

Course Learning Outcomes:

1. Understand the concepts of disaster management.

2. Understand the application of RS, GIS and GPS tools for disaster management and mitigation.

UNIT-1: CONCEPT OF DISASTER, HAZARD AND VULNERABILITY

1.1 Conceptualizing hazard, disaster, risk, vulnerability; classification of hazards; Natural, quasi-natural and manmade disaster; disaster induced loss in India; 3R of disaster management (Rehabilitation, reconstruction and recovery).

1.2 Concept of disaster management; Indian disaster management authorities (Role of government, NGOs, international cooperation); Peoples participation in disaster management; Emergency management system; Early warning system; Role of geoinformatics in different stages of disaster management.

UNIT-2: APPLICATION OF GEOINFORMATICS IN HAZARD AND DISASTER MANAGEMENT `

2.1 Application of geoinformatics in geological and hydro-meteorological hazards: Landslide, Flood and Cyclone.

2.2 Application of geoinformatics in environmental hazard management: Deforestation, Forest fire and soil erosion; Identification of suitable modelling approaches for different hazard studies.

Continuous Assessment [15 Marks]

(*The department shall decide the methods of internal assessment*)

✧ **Suggested Readings**:

1. Clague, J.J. and Stead, D. (Eds.) (2012): *Landslides: types, mechanisms and modeling*, Cambridge University Press.

2. Dewan, A. (2013): *Floods in a megacity: geospatial techniques in assessing hazards, risk and vulnerability* (p. 199), Springer, Dordrecht.
3. Engman, E.T. and Gurney, R.J. (1991): *Remote sensing in hydrology*, Chapman and Hall, London.
4. Glade, T., Anderson, M.G. and Crozier, M.J. (Eds.) (2006): *Landslide hazard and risk*, John Wiley & Sons.
5. Plaza, A.J. and Chang, C.I. (Eds.) (2007): *High performance computing in remote sensing*, CRC Press.
6. Schultz, G.A. and Engman, E.T. (Eds.). (2012): *Remote sensing in hydrology and water management*, Springer Science & Business Media.
7. Skidmore, A. (Ed.) (2003): *Environmental modelling with GIS and remote sensing*, CRC Press.
8. Thenkabail, P.S. (Ed.). (2015): *Remote sensing of water resources, disasters, and urban studies*, CRC Press.
9. Townshend, J.R., Hardy, J.R., Justice, C.O., Williams, D.F., Mitchell, C.W., Cook, A. and Hancock, P. (1981): *Terrain analysis and remote sensing*.
10. Wadge, G. (1994): *Natural hazards and remote sensing*, Proceedings sponsored by the Natural Environment Research Council and National Remote Sensing Centre Limited.
11. Wulder, M.A. and Franklin, S.E. (Eds.) (2012): *Remote sensing of forest environments: concepts and case studies*, Springer Science & Business Media.

Semester - III

(MSCGEINMJE302: Major Elective-2, Practical)

Geoinformatics in Disaster Management II

✧ **Full Marks: 50**	✧ **CA+ESE Marks: 30+20**
✧ **Credit: 4**	✧ **L - T – P: 0 - 0 - 4**
✧ **End Sem Exam Duration: 2 Hours**	

Course Learning Outcomes:

1. *Acquire knowledge about Hazard mapping techniques and mitigation methods.*
2. *Understand the application of RS, GIS and GPS tools for disaster management and mitigation.*

Generation of Case Studies (Compulsory Field Study): Based on primary or secondary data, case studies to be generated on respective themes (related to disaster management), validation of the output based on post field data, output generation and finalization.

To carry out project work on a problem related to disaster management based on Remote Sensing and GIS application, the student may work in the available infrastructures of their own institution with various image processing and GIS softwares. The project is for addressing spatial data gathering, data mining, and/ or raster / vector analysis and modelling. All data analysis and survey related to project shall necessarily present in a series of thematic maps. With the report, the student demonstrates the ability to formulate and solve a scientific problem and to document the work in publishable form. The student has to develop research questions in the application of geoinformatics for disaster management, apply and develop methods to solve problems, independent scientific and technical writing and self-motivated research. After the completion of the project work, students shall submit project report both in **print form** and **digital form (pdf)** based on the results obtained. The size of the project report may be between **40 and 50 pages**, which are not inclusive of scripts and other appendices. To enhance the presentation and communication skills of a student, each student has to present the project work carried out by him/her in front of the examiners (internal and external) using audio visual methods.

Evaluation of Project Report based on case studies: 3**0Marks (***Continuous Assessment)*

Seminar Presentation and Viva Voce: **20 Marks (***ESE***)**

Semester - III

(MSCGEINMJE303: Major Elective-1, Theoretical)

Geoinformatics in Urban Planning I

✧ **Full Marks: 50** ✧ **CA+ESE Marks: 15+35**

✧ **Credit: 4** ✧ **L - T – P: 4 - 0 - 0**

✧ **End Sem Exam Duration: 2 Hours**

Course Learning Outcomes:

1. *The students will learn basic concept of Urban and its related terms with basic characteristics.*
2. *After completing this course, students will be able to understand the applicability of geoinformatics for identification and assessment of the urban environmental problems.*

UNIT-1: CONCEPT OF URBAN, URBANIZATION AND URBANISM

1.1 Concept of Urban: Definition of urban from traditional to contemporary concept; Urbanization and urbanism; Scenario of Indian urbanization; concept of core-urban, peri-urban, sub-urban, urban fringe and urban agglomeration.

1.2 Population Growth and Cities; Globalization and cities; Classification of cities (according to census of India); concept of world cities, global cities, metropolitan cities, metropolis with example from world and India.

UNIT-2: EMERGING URBAN ISSUES AND APPLICATION OF GEOINFORMATICS

2.1 Role of remote sensing data for identifying urban areas; Capturing urbanization trend from remote sensing data; Future prediction of urbanization through geoinformatics techniques; Advantages and limitations of remote sensing data for urban studies.

2.2 Application of geoinformatics for urban problem studies- urban micro climate (UHI), urban air quality (Aerosol optical depth and trace gases), Ground water depletion and contamination, urban agricultural land loss, urban hydrology.

Continuous Assessment [15 Marks]

(*The department shall decide the methods of internal assessment*)

✧ **Suggested Readings**:

1. Acharya, S.S., Sen, S., Punia, M. and Reddy, S. (Eds.) (2017): *Marginalization in Globalizing Delhi: Issues of Land, Livelihoods and Health*, Springer India.
2. Baghdadi, N. and Zribi, M. (2016): *Land Surface Remote Sensing in Urban and Coastal Areas*, Elsevier.

3. Bhatta, B. (2010): *Analysis of Urban Growth and Sprawl from Remote Sensing Data*, Springer, New York.
4. Bhatta, B. (2012): *Urban growth analysis and remote sensing: a case study of Kolkata, India (1980-2010)*, Springer, Science & Business Media.
5. Donnay, J.P., Barnsley, M.J. and Longley, P.A. (Eds.) (2014): *Remote sensing and urban analysis: GISDATA 9*, CRC Press.
6. Geertman, S., Toppen, F. and Stillwell, J. (2013): *Planning support systems for sustainable urban development*, Heidelberg: Springer, New York.
7. Gillies, R.R. and Temesgen, B. (2000): *Thermal Remote Sensing in Land surface Processes*.
8. Hall, T. (2005): *Urban Geography, 3rd edition*, Routledge, New York.
9. Netzband, M., Stefanov, W.L. and Redman, C. (Eds.) (2007): *Applied remote sensing for urban planning, governance and sustainability*, Springer Science & Business Media.
10. Pacione, M. (2013): *Urban geography: A global perspective*, Routledge, New York.
11. Thenkabail, P.S. (Ed.) (2015): *Remote sensing of water resources, disasters, and urban studies*, CRC Press.
12. Zhang, H., Weng, Q., Lin, H. and Zhang, Y. (2015): *Remote sensing of impervious surfaces in tropical and subtropical areas*, CRC Press.

Semester - III

(MSCGEINMJE304: Major Elective-2, Practical)

Geoinformatics in Urban Planning II

✧ **Full Marks: 50**	✧ **CA+ESE Marks: 30+20**
✧ **Credit: 4**	✧ **L - T – P: 0 - 0 - 4**
✧ **End Sem Exam Duration: 2 Hours**	

Course Learning Outcomes:

1. *Learn the tools and methods of mapping the urban neighbourhood through primary survey.*
2. *Enhance the knowledge of using satellite data for spatial analysis of urban areas.*
3. *Understand the applicability of geoinformatics for identification and assessment of the urban environmental problems.*

GENERATION OF CASE STUDIES (Compulsory Field Study): Based on primary or secondary data, case studies to be generated on respective themes (related to urban planning), validation of the output based on post field data, output generation and finalization.

To carry out project work on a problem related to urban planning based on Remote Sensing and GIS application, the student may work in the available infrastructures of their own institution with various image processing and GIS software. The project is for addressing spatial data gathering, data mining, and/ or raster/ vector analysis and modelling. All data analysis and survey related to project shall necessarily present in a series of thematic maps. With this report,

the student demonstrates the ability to formulate and solve a scientific problem and to document the work in publishable form. The student has to develop research questions in the application of geoinformatics for urban planning, apply and develop methods to solve problems, independent scientific and technical writing and self-motivated research. After the completion of the project work, students shall submit project report both in **print form** and **digital form (pdf)** based on the results obtained. The size of the project report may be between **40 and 50 pages**, which are not inclusive of scripts and other appendices. To enhance the presentation and communication skills of a student, each student has to present the project work carried out by him/her in front of the examiners (internal and external) using audio visual methods.

Evaluation of Project Report based on case studies: 3**0Marks (***Continuous Assessment)*

Seminar Presentation and Viva Voce: **20 Marks (***ESE***)**

Semester - III

(MSCGEINMJE305: Major Elective-1, Theoretical)

Geoinformatics in Mining and Subsidence I

✧ **Full Marks: 50**	✧ **CA+ESE Marks: 15+35**
✧ **Credit: 4**	✧ **L - T – P: 4 - 0 - 0**
✧ **End Sem Exam Duration: 2 Hours**	

Course Learning Outcomes:

1. The students will learn basic concept of mines, their characteristic and related hazards especially subsidence hazard.

2. After completing this course, students will be able to understand the applicability of geoinformatics for mine area identification and mining hazard assessment.

UNIT-1: CONCEPT OF MINES AND MINING HAZARDS

1.1 Concept of mines and its types, Basic characteristics of mining areas; Concept of mining hazards and types of mining hazards (Land subsidence, Mine flooding *etc.*), causes of mining hazards; Basic requirements of mining hazard mapping.

1.2 Subsidence: theories of subsidence, factors affecting subsidence, prediction and measurement of subsidence. Damage and prevention of damage due to subsidence. Rock bursts and Bumps: causes, occurrence and control; Impact of surface mining on land resources.

UNIT-2: APPLICATION OF GEOINFORMATICS IN MINING AND MINING HAZARDS

2.1 Application of Remote Sensing and Geographical Information System in mine mapping and mining hazard mapping; Identification of probable mining sites through Remote Sensing and GIS; Application of Geoinformatics in underground Coal mines to assist Operational Management and safety.

2.2 Mapping of mining areas to identify the overburden and land degradation; Impact assessment of road construction and site identification for setting of mining industries; Data sources for mining hazard assessment and mining disaster management; Sustainable mining hazard management through Geoinformatics.

Continuous Assessment [15 Marks]

(*The department shall decide the methods of internal assessment*)

✧ **Suggested Readings**:

1. Bhatta, B. (2011): *Remote Sensing and GIS*. Second Edition, Oxford Univ. Press.

2. Deshmukh, D.J. (1994): *Elements of Mining Technology*. Vol. I, Vidyaseva Prakashan, Nagpur.

3. Hartman, H.L. (1999): *Introduction to Mining Engineering*. Second Edition, John Wiley and Sons.

4. Jenson, J.R. (2000): *Remote Sensing of the environment - An Earth Resource Perspective*. Prentice Hall Inc.

5. Singh, T.N. (1992): *Underground Winning of Coal*. Oxford and IBH, New Delhi

Semester - III

(MSCGEINMJE306: Major Elective-2, Practical)

Geoinformatics in Mining and Subsidence II

✧ **Full Marks: 50** ✧ **CA+ESE Marks: 30+20**

✧ **Credit: 4** ✧ **L - T – P: 0 - 0 - 4**

✧ **End Sem Exam Duration: 2 Hours**

Course Learning Outcomes:

1. *Learn the tools and methods of mapping the Mining areas and subsidence zone through primary survey.*
2. *Enhance the knowledge of using satellite data for spatial analysis of urban areas.*
3. *Understand the applicability of geoinformatics for identification and assessment of the Mining areas and subsidence zone related problems.*

GENERATION OF CASE STUDIES (Compulsory Field Study): Based on primary or secondary data, case studies to be generated on respective themes (related to urban planning), validation of the output based on post field data, output generation and finalization.

To carry out project work on a problem related to Mining and subsidence based on Remote Sensing and GIS application, the student may work in the available infrastructures of their own institution with various image processing and GIS software. The project is for addressing spatial data gathering, data mining, and/ or raster/ vector analysis and modelling. All data analysis and survey related to project shall necessarily present in a series of thematic maps. With this report, the student demonstrates the ability to formulate and solve a scientific problem and to document the work in publishable form. The student has to develop research questions in the application of geoinformatics for urban planning, apply and develop methods to solve problems, independent scientific and technical writing and self-motivated research. After the completion of the project work, students shall submit project report both in **print form** and **digital form (pdf)** based on the results obtained. The size of the project report may be between **40 and 50 pages**, which are not inclusive of scripts and other appendices. To enhance the presentation and communication skills of a student, each student has to present the project work carried out by him/her in front of the examiners (internal and external) using audio visual methods.

Evaluation of Project Report based on case studies: 3**0Marks (***Continuous Assessment)*

Seminar Presentation and Viva Voce: **20 Marks (***ESE***)**

Semester - III

(MSCGEINMJE307: Major Elective-1, Theoretical)

Geoinformatics in Watershed Management I

✧ **Full Marks: 50**	✧ **CA+ESE Marks: 15+35**
✧ **Credit: 4**	✧ **L - T – P: 4 - 0 - 0**
✧ **End Sem Exam Duration: 2 Hours**	

Course Learning Outcomes:

1. At the completion of the course, the students will be able to understand the basics of watershed management, watershed management practices in arid and semiarid regions and watershed conservation planning and management.

2. Students will obtain the knowledge of the application of RS, GIS, DEM and GPS in various domains of watershed management including rainfall-runoff modeling, ground water modeling, and integrated watershed management.

UNIT-1: INTRODUCTION AND BASIC CONCEPTS OF WATERSHED MANAGEMENT

1.1 Concept of watershed; Watershed characterization, delineation and codification; Watershed management: Introduction, Philosophy, Role of Remote Sensing in watershed conservation, planning and management; Different stakeholders and their relative importance.

1.2 Sustainable integrated watershed management, natural resources management, agricultural practices, integrated farming, Soil erosion and conservation; Watershed Management Practices in Arid and Semiarid Regions, Case studies, short term and long term strategic planning.

UNIT-2: APPLICATION OF GEOINFORMATICS IN WATERSHED MANAGEMENT `

2.1 GIS as a watershed tool for developing a watershed management plan, GIS delineation of watershed, Development of a watershed management plan, people participation, preparation of action plan, administrative requirement; Geoinformatics approach for watershed prioritization.

2.2 Applications of Digital Elevation Models (DEMs) in water resources; Erosion, erodibility and sediment yield modeling; Geoinformatics based runoff and hydrological modeling; subsurface flows and groundwater flow modeling; Application of remote sensing in hydro-geomorphological interpretation for ground water exploration.

Continuous Assessment [15 Marks]

(*The department shall decide the methods of internal assessment*)

✧ **Suggested Readings**:

1. Awange, J. and Kyalo Kiema, J.B. (2013): *Environmental Geoinformatics: Monitoring and Management*. Springer.
2. Gupta, R.K. and Chander, S. (2008): *Principles of Geoinformatics*. 5th Edition, Jain Brothers.
3. Murthy, J.V.S. (2017): *Watershed Management*. Second Edition, New Age International (P) Ltd., New Delhi.
4. John G. Lyon (2002): *GIS for Water Resource and Watershed Management*. First Edition, CRC Press.
5. Murthy, J.V.S. (1994): *Watershed Management in India*. Wiley Eastern Ltd., New Delhi.
6. Schultz, G.A. and Engman, E.T. (2000): *Remote Sensing in Hydrology and Water Management*. Springer-Verlag, Berlin, Germany.
7. *Space Technology Applications for Sustainable Developments at Watersheds*, Technical Report, ISRO-HQ-TR-104-95, ISRO, Bangalore.
8. Todd, D.K.., (2005): *Groundwater Hydrology*. Second Edition, John Wiley & Sons, New York.
9. Zhu, X. (2016): *GIS for Environmental Applications: A practical approach*. First Edition Routledge.

Semester - III

(MSCGEINMJE308: Major Elective-2, Practical)

Geoinformatics in Watershed Management II

✧ **Full Marks: 50** ✧ **CA+ESE Marks: 30+20**

✧ **Credit: 4** ✧ **L - T – P: 0 - 0 - 4**

✧ **End Sem Exam Duration: 2 Hours**

Course Learning Outcomes:

1. *Learn the tools and methods of mapping the watershed through primary survey.*
2. *Enhance the knowledge of using satellite data for spatial analysis of urban areas.*
3. *Understand the applicability of geoinformatics for identification and assessment of the watershed area related problems.*

GENERATION OF CASE STUDIES (Compulsory Field Study): Based on primary or secondary data, case studies to be generated on respective themes (related to watershed management), validation of the output based on post field data, output generation and finalization.

To carry out project work on a problem related to urban planning based on Remote Sensing and GIS application, the student may work in the available infrastructures of their own institution with various image processing and GIS softwares. The project is for addressing spatial data gathering, data mining, and/ or raster/ vector analysis and modelling. All data analysis and survey related to project shall necessarily present in a series of thematic maps. With this report,

the student demonstrates the ability to formulate and solve a scientific problem and to document the work in publishable form. The student has to develop research questions in the application of geoinformatics for urban planning, apply and develop methods to solve problems, independent scientific and technical writing and self-motivated research. After the completion of the project work, students shall submit project report both in **print form** and **digital form (pdf)** based on the results obtained. The size of the project report may be between **40 and 50 pages**, which are not inclusive of scripts and other appendices. To enhance the presentation and communication skills of a student, each student has to present the project work carried out by him/her in front of the examiners (internal and external) using audio visual methods.

Evaluation of Project Report based on case studies: 3**0Marks (***Continuous Assessment)*

Seminar Presentation and Viva Voce: **20 Marks (***ESE***)**

Semester - III

(MSCGEINMIE301: Minor Elective-2, Theoretical)

GIS Project Design and Management

✧ **Full Marks: 50**	✧ **CA+ESE Marks: 15+35**
✧ **Credit: 4**	✧ **L - T – P: 4 - 0 - 0**
✧ **End Sem Exam Duration: 2 Hours**	

Course Learning Outcomes:

1. *Deepen in the capture, manipulation, analysis and representation of data.*
2. *Have the experience of working as a team member on an actual GIS project.*
3. *Be able to design a GIS project.*
4. *Develop and demonstrate competence in using GIS techniques in a substantive application.*

UNIT-1: GIS BASED PROJECT DESIGN

1.1 Concepts and Significance of GIS based project design, Considerations for GIS based project design, History of GIS based projects, Sources of GIS based projects, Recent trends of GIS based project selection and design, Future direction of GIS based project design,and limitations of GIS based project design.

1.2 *Types of GIS based projects*: Land use projects; Hydrological projects; Morphological projects; other GIS based projects.Identification of problems of regional and local level, geographic data sources and natures of data, selection of data layers, quality assurance of data, hypotheses and models, formulation of research schemes.

UNIT-2: GIS BASED PROJECT MANAGEMENT

2.1 *GIS based project data preparation*: Consideration for data selection (scale consideration, Quality consideration); Data standardization: Boolean techniques; Maximum minimum techniques; Fuzzy techniques; Sampling techniques (Random sampling, Stratified sampling, Quota sampling);conversion from discrete to continuous data, interpolation techniques, distance calculation and other techniques.

2.2 *GIS based project management:* Objective selection, Data collection, Methodology selection for different types of GIS based project: Landslide project, Flood analysis, Land use change analysis; Calibration and validation of the result; Analysis of the result, Report writing and publication process.

Continuous Assessment [15 Marks]

(*The department shall decide the methods of internal assessment*)

1. Bhatta, B. (2011): *Global Navigation Satellite Systems: Insights into GPS, GLONASS, Galileo, Compass and Others*, CRC Press.
2. Bhatta, B. (2011): *Remote Sensing and GIS*, 2nd ed., Oxford Univ. Press.
3. Campbell, J.B. (1996): *Introduction to Remote Sensing*, 2nd edition, Taylor and Francis, London.
4. Chaisman, N. (1992): *Exploring Geographical Information Systems*, John Wiley and Sons Inc., New York.
5. Curran, P.J. (1988): *Principles of Remote Sensing*, ELBS Edition, Longman Group Ltd., UK.
6. Heywood, D.I., Cornelius, S. and Carver, S. (2006): *An Introduction to Geographical Information Systems*, Prentice Hall, Upper Saddle River, New Jersey.
7. Jensen, J.R. (2006): *Remote Sensing of the Environment: An Earth Resource Perspective*, Prentice Hall, Upper Saddle River, New Jersey.
8. Joseph, G. (2003*): Fundamental of Remote Sensing*, University Press (India) Pvt. Ltd.
9. Joseph, G. and Jegannathan, C. (2018): *Fundamentals of Remote Sensing*, 3rd ed., Universities Press.
10. Lillesand, T.M. and Kiefer, R. W. (1994): *Remote Sensing and Image Interpretation*, 3rd edition, John Wiley and Sons, New York.
11. Marcolongo, B. and Mantorani, F. (1997): *Photogeology: Remote Sensing Application in Earth Science*, Oxford and IBH Pub. Pvt. Ltd., New Delhi.
12. Martin, D. (1991): *Geographical Information Systems and their Socioeconomic Applications*, London, Routledge.
13. Sabins, F.F. (1997): *Remote Sensing: Principles and Applications*, 3rd edition, W.H. Freeman & Company, New York.

SYLLABUS

for

M.Sc. in Geoinformatics

(Semester - IV)

Semester - IV

(MSCGEINC401: Core Course - 17)

Dissertation

✧ **Full Marks: 100** ✧ **CA+ESE Marks: 60+40**
✧ **Credit: 10** ✧ **L - T – P: 2 - 2 - 12**

Course Learning Outcomes:

1. *Learn the skill in finding and drafting a research problem.*
2. *Become familiar with the scientific terminologies and concepts needed for conducting a scientific research.*
3. *Develop the skill of scientific writing and proficiency in presenting the research outcome.*

Dissertation work of the fourth semester will be supervised by the departmental teachers. Each student is required to undertake a project work after identifying a problem in consultation with internal guide. Execute the work as per the instructions of internal guide.

Dissertation consisting of relevance of the problem to be studied and its aims and objectives, methodology adopted to study such problem.

CHAPTER SCHEME

- *Problem Definition*
- *Objective*
- *Review of Literature*
- *Database and Methodology*
- *Result and Discussion*

After the completion of project work, student shall submit project report both in print form and digital form (pdf) based on the results obtained.

The Dissertation will be evaluated on the basis of internal (60 marks) and end semester (40 marks) examination.

Semester - IV

(MSCGEINC402: Core Course-18)

Seminar and Grand Viva

✧ **Full Marks: 100** ✧ **CA+ESE Marks: 60+40**
✧ **Credit: 10** ✧ **L - T – P: 2 - 2 - 12**

Course Learning Outcomes:

1. Learn the process to review the research articles and relevant materials towards developing the research writing.
2. Inhibit the quality of writing the research project.
3. Develop the skill of presentation and involvement in seminar activities.

Seminar and Grand viva will be based on the overall understanding of the subject in front of External and Internal Examiner.

MARKS DISTRIBUTION FOR SEMINAR AND GRAND VIVA

The project report will be assessed through Viva 50 marks. Rest 50 marks will be assessed through assignment and presentation. Literature review related to his/her dissertation has to be submitted for this assignment. The student has to review at least 10 International/ National/ Regional books/ journals/ published and unpublished reports/ Ph.D. theses.

The viva for project report and assignment will be evaluated through internal (30 marks each) and end semester (20 marks each) examination.