



Solapur University, Solapur

Choice Based Credit System (CBCS)

Syllabus

M.Sc. Part I & II Geoinformatics

To be implemented from the year 2016 onwards

School of Earth Sciences

Solapur University, Solapur

M.Sc Geoinformatics

School of Earth Science
Solapur University
M.Sc Geoinformatics (CBCS Syllabus)

Semester	CODE	TITLE OF THE PAPER	Semester Exam			L	T	P	Credit
			Theory	IA	Total				
First		Hard Core							
GIT	HCT1.1	Introduction To Geography (3:1)	70	30	100	4		4	
	HCT1.2	Introduction To Geology	70	30	100	4		4	
	HCT1.3	Geomorphology (2:2)	70	30	100	4		4	
		Soft Core (Any One)							
	SCT1.1	Computer Application In Earth Sciences	70	30	100	4		4	
	SCT1.2	Ocean Sciences (2:2)	70	30	100	4			
		Practical (Hard Core)							
	HCP1.1	Practical HCP1.1	35	15	50		2	6	
	HCP1.2	Practical HCP1.2	35	15	50		2		
	HCP1.3	Practical HCP1.3	35	15	50		2		
		Soft Core (Any One)							
	SCP1.1	Practical SCP1.1	35	15	50		2	2	
	SCP1.2	Practical SCP1.2	35	15	50		2		
		Soft Skill ICT, Scientific English, Tutorial			25		01	1	
		Total For First Semester	420	180	625			25	
Second		Hard Core							
GIT	HCT2.1	Introductions To Remote Sensing (2:2)	70	30	100	4		4	
	HCT2.2	Introduction To GIS And GPS	70	30	100	4		4	
		Soft Core (Any One)							
	SCT2.1	Digital Image Processing	70	30	100	4		4	
	SCT2.2	C++ Programming	70	30	100	4			
		Open Elective (Any One)							
	OET2.1	Climatology	70	30	100	4		4	
	OET2.2	Cartography And Map Analysis	70	30	100	4			
		Practical (Hard Core)							
	HCP2.1	Practical HCP2.1	35	15	50		2	4	
	HCP2.2	Practical HCP2.2	35	15	50		2		
		Practical (Soft Core) (Any One)							

	SCP2.1	Practical SCP2.1	35	15	50			2	2
	SCP2.2	Practical SCP2.2	35	15	50			2	
		Practical Open Elective(Any One)							
	OEP2.1	Practical OEP2.1	35	15	50			2	2
	OEP2.2	Practical OEP2.2	35	15	50			2	
		Soft Skill ICT, Scientific English Tour And Tour Report , Tutorial			25		01		1
		Total For Second Semester	420	180	625				25

*Fieldwork Of 15-21 Days Is Compulsory. The Field Work May Be Stretch Or Divided Into Parts In The Academic Year

Third		Hard Core	Theory	IA	Total				
GIT	HCT3.1	Spatial Analysis	70	30	100	4			4
	HCT3.2	Advanced Techniques In Remote Sensing	70	30	100	4			4
		Soft Core (Any One)							
	SCT3.1	Advanced Techniques In GIS (2:2)	70	30	100	4			4
	SCT3.2	Atmospheric And Planetary Sciences	70	30	100	4			
		Open Elective (Any One)							
	OET3.1	Introduction to Statistical Methods	70	30	100	4			4
	OET3.2	Urban Geography	70	30	100	4			
		Practical (Hard Core)							
	HCP3.1	Practical HCP3.1	35	15	50			2	4
	HCP3.2	Practical HCP3.2	35	15	50			2	
		Practical (Soft Core) (Any One)							
	SCP3.1	Practical SCP3.1	35	15	50			2	2
	SCP3.2	Practical SCP3.2	35	15	50			2	
		Practical Open Elective(Any One)							
	OEP3.1	Practical OEP3.1	35	15	50			2	2
	OEP3.2	Practical OEP3.2	35	15	50			2	
		Soft Skill ICT, Scientific English, Tutorial			25		01		1
		Total For Third Semester	420	180	625				25

Fourth		Hard Core	Theory	IA	Total				
GIT	HCT4.1	Geoinformatics Approach For Natural Resource Management (2:2)	70	30	100	4			4
	HCT4.2	Applications of Rs & GIS In	70	30	100	4			4

		Disaster Management							
	HCT4.3	Web GIS	70	30	100	4			4
		Soft Core (Any One)							
	SCT4.1	Dissertation	70	30	100	4			4
	SCT4.2	Applications Of Rs & Gis In Land Evaluation	70	30	100	4			
		Practical (Hard Core)							
	HCP4.1	Practical HCP4.1	35	15	50			2	6
	HCP4.2	Practical HCP4.2	35	15	50			2	
	HCP4.3	Practical HCP4.3	35	15	50			2	
		Soft Core (Any One)							
	SCP4.1	Practical SCP4.1	35	15	50			2	2
	SCP4.2	Practical SCP4.2	35	15	50			2	
		Soft Skill ICT, Scientific English Tour And Tour Report , Tutorial			25		01		1
		Total for Fourth Semester	420	180	625				25
*Fieldwork of 15-21 days is compulsory. The fieldwork may be stretch or divided into parts in the academic year,									

GIT101: INTRODUCTION TO GEOGRAPHY**(Marks: External 70)****Internal 30**

1	Climatology	Weather and Climate: Atmosphere structure, and composition, Atmosphere and its energy budget- temperature distribution – winds and general circulation-moisture, humidity and Precipitation-climate types – climate and cloud and its type	14
2	Bio-geography	World distribution of plants and animals Ecosystem ,biodiversity & its depletion through nature and man induced causes natures hazard and man-made hazard, soil types and soil profile	14
3	Agriculture and Settlement geography	Major types in India & world agriculture region & patterns, their importance. Rural settlement: pattern & type, Urban settlement: patterns and types and their function, distribution.	14
4	Regional planning & Transport	Region concept in geography, regional hierarchy, concept of planning, regional imbalances in India. Types of Transport mode, Accessibility and connectivity	14

INTERNAL EVALUATION**30 MARKS****(Seminar+Term paper+Test)****Reference Books -**

- Physical Geography, Savinder sing, Prayag Pustak Bhawan, 20-A university road, Allahabad-211002
- Systematic Agricultural Geography, Husain M., Rawet Publication, Jaipur, Delhi
- Location Economic Activity, Hoover E. M., New York, McGraw Hill 1948
- A New Approach to functional Classification of Town, Rafillah. S. M., Geographer, New Dehli
- Climatology, A.K. Barua.

GIT102 INTRODUCTION TO GEOLOGY**(Marks: External 70)****Internal 30**

1	Mineralogy and Classification of Mineral deposits	Definition, physical properties of minerals, brief introduction to rock forming minerals (silica, feldspar, amphibole, mica, garnate, pyroxene). Brief study of Gold, Iron, Copper, Manganese, Lead & Zinc, Bauxite, Coal and Petroleum	14
2	Introduction to Petrology	Definition – Rocks, their general classification into igneous, sedimentary and metamorphic – Forms and Structures of igneous rocks – Textures – Classification of igneous rocks – An outline of classification of sedimentary rocks – Textures and Structures of sedimentary rocks – Definition – agents and kinds of metamorphism – Zones , Grades Textures and Structures of metamorphic rocks.	14
3	Structural Geology	Introduction to Structural geology : Topographic maps – Geologic maps- Outcrops and their trends with Reference to slope and topography – Clinometers compass and its uses – Brief Study of Folds – Faults – Unconformities – Joints	14
4	Engineering Geology	Role of engineering geology in civil construction and mining industry – Various stages of engineering geological investigation for civil engineering projects – Engineering properties of rocks – Brief study of Geological consideration of Dams and Reservoirs – Tunnels	14

INTERNAL EVALUATION**30 MARKS****(seminar+term paper+test)****Reference Books:**

- Introduction to geology, Sohni Sharma, Sharma, Dixit
- Introduction to geology, Santosh Ray
- Engineering Geology, Davis
- Engineering Geology, Parbeen Singh
- Structural geology, M.P.Billings
- Foundation of Structural geology,R.G.Park

GIT103 GEOMORPHOLOGY**(Marks: External 35)****Internal 15**

1	Drainage	Drainage basin and morphometry. Basin demarcation Ordering of streams – Strahler’s and Horton methods
2	Soils	Textural characteristics, study of representative soil profiles
3	Morphometric analysis	Bifurcation ratio, Drainage density, Stream frequency, constant of channel maintenance
4	Landforms & Slope	Identification of landforms on Toposheets, drainage pattern, Relief and slope analysis

**INTERNAL EVALUATION
(seminar+term paper+test)****30 MARKS****Reference Books :**

- Fundamental of Geomorphology, R.J. Rice
- Geomorphology, R.J. Chorley, S.A.Schumm, D.E. Sugden
- Principle of geomorphology, W.D. Thornbury

GIT104: COMPUTER APPLICATION IN EARTH SCIENCES**(Marks: External 70)****Internal 30**

1	Basics of computers and its components	An introduction to computers, development of computers, Hardware and Software. Operating systems, Input devices to the computers, Storage devices, central processing unit, Computer output devices	14
2	Database Management system: concept	Advantage of DBMS conceptual & implementation models. Hierarchical, network & Relational Models, RDBMS: components, concept, database schema, table relationship –one to one, one to many, many to many database design.	14
3	SQL	Normalization data, definition & manipulation using SQL. SQL – query processing, operation on tables, Union, intersection, product, natural join, integrity constraints, database security, role of data base Administrator	14
4	Application of Computer in Earth Sciences	Examples for Geoinformatics applications in image processing, Geological applications mineral exploration, mapping, exploration Geographical applications related mapping of settlement, agricultures and Environmental applications in biodiversity, wildlife, forestry, Land use land cover.	14

**INTERNAL EVALUATION
(seminar+term paper+test)****30 MARKS**

Reference Books :-

- Principles of GIS for Land Resources Assessment by P.A. Burrough, Oxford : Science publications, 1986.
- Geographic Information Systems – An introduction by Tor Bernhardsen, John Wiley and Sons, Inc, New York, 2002.
- GIS – A computing Perspective by Micheal F. Worboys, Taylor & Francis, 1995
- Introduction to computer and operating system – sharada sahasrabudhe ,pune
- Elmasri R. and Navathe S.B., “**Fundamentals of Database Systems**”, Benjamin/Cummings Publishing Co. Inc.(Addison-Wesley world student series), 2002
- Trembley J.P. and Sirenson P.G., “An Introduction to Data Structures with Applications”, Tata McGraw-Hill.
- Date C.J., “An Introduction to Database Systems”, Vol-I, Addison-Wesley.
- A.Silberschatz, H.F.Korth and S.Sudarshan, “Database System Concepts”, McGraw-Hill International Editions, Computer Science Serie

GIT104: OCEAN SCIENCES

(Marks: External 70)

Internal 30

1	Nature and scope	Define, Nature, concept, Scope of ocean sciences.	14
2	Heat budget of ocean	Heat budget of ocean- Distribution of temperature and salinity	14
3	Ocean Currents	Circulation factors affecting ocean currents, currents in Atlantic, Pacific and Indian ocean. EL Nino and LA Nina	14
4	Marine deposits and coral reefs	Ocean basin topography - slope, abyssal plain. ocean deeps, ridges, coral reefs, island and ocean deposits. Ocean as a house of Minerals, Food resources and Hydrological cycle	14

INTERNAL EVALUATION

30 MARKS

(Seminar+Term paper+Test)

Reference Books :-

- Physical Geography, Savinder sing, Prayag Pustak Bhawan, 20-A university road, Allahabad-211002
- Negi B. S. (1994-85): Climatology and oceanography, Kedarnath Ramnath Meerat, New Delhi.
- Siddhartha K (1999): Oceanography A brief Introduction. Kaisalya Pub. New Delhi.
- Joseph W & Howard P: Introduction to Oceanography, McGraw Hill Lognkusha, Ltd New Delhi.
- Sharma R. C. (1970): Oceanography for Geographers, Chaitanya Publishing House, Allahabad.

- Peter K. W. (1970): Oceanography: An Introduction to to the marine environment, John Wiley & Sons Inc. New York.

PRACTICAL 105 (INTRODUCTION TO GEOGRAPHY + INTRODUCTION TO GEOLOGY)

INTRODUCTION TO GEOGRAPHY

(Marks: External 35)

Internal 15

1	Study of Natural resources	Water, Forest, Minerals, Soil,
2	Study of human resources	Transportation, settlement, agriculture, industries, education facility, cultural places, population
3	Quantitative Methods	Semi average method, least square method.
4	Advanced techniques	Nearest neighbor techniques, nelson methods of town classification, accessibility of transport network, crop combination method
5	Climatic Data	Wind Rose diagram, Line Graph.

INTRODUCTION TO GEOLOGY

(Marks: External 35)

Internal

1	Identification and description of Megascopic minerals (rock forming, Industrial and Ore)
2	Study of structural maps – surface inclined.
3	Identification and description of Megascopic rocks.
4	Study of common rocks with reference to their utility in engineering projects.
5	Preparation and interpretation of hydrogeological maps.

INTERNAL EVALUATION

30 MARKS

(viva-voce+journal + data evaluation)

PRACTICAL 106 (COMPUTER APPLICATION IN EARTH SCIENCE+ GEOMORPHOLOGY / OCEAN SCIENCES)

COMPUTER APPLICATION IN EARTH SCIENCE

(Marks: External 35)

Internal 15

1	MS -Word	Report, typing, files and ppt
2	MS-Access	Database management system
3	MS-excel	Line, Bar, Pie, Scatter,

GEOMORPHOLOGY

(Marks: External 35)

Internal 15

1	Drainage	Drainage basin and morphometry. Basin demarcation Ordering of streams – Strahler’s and Horton methods
2	Soils	Textural characteristics, study of representative soil profiles
3	Morphometric analysis	Bifurcation ratio, Drainage density, Stream frequency, constant of channel maintenance
4	Landforms & Slope	Identification of landforms on Toposheets, drainage pattern, Relief and slope analysis

OCEAN SCIENCES

(Marks: External 35)

Internal 15

1	Analysis of Physical properties of sea water
2	General guidelines for identification of phytoplankton and zooplankton
3	Study of coastal landforms
4	Case study of Oil spill
5	Study of Oceanic fossils

GIT 201 INTRODUCTIONS TO REMOTE SENSING

Marks: External 70

Internal 30

1	Fundamental of Remote Sensing and Aerial photography	Introduction, Principles of Remote Sensing, History, Stages of Remote Sensing, Remote Sensing In India, Types of Remote Sensing, Types of Resolution: Spectral, Spatial, Temporal, Radiometric, Spectral Signature: Vegetation, Water, Soil Introduction , History, Examples of Aerial Photography, Uses of Aerial Photography, Flying Condition of AP, Aerial Camera, Types of Camera, Marginal Information, Types of AP, Spatial Resolution, Overlapping Stereo Photography, Films, Problems, Problem Associated with Film and Camera, Aerial Photograph Vs Map Scale, Stereoscopic Parallax	14
2	Electromagnetic radiation	Electro Magnetic Radiation, Electro Magnetic Spectrum, Energy Interaction with the Atmosphere, Energy Interaction with the Earth Surface.	14
3	Platform, Orbit and sensors	Types of platform: Ground Based, Airborne, Spaceborne Platform, Types of sensor and cameras, processes of sensor & its characteristics, Whiskbroom and Pushbroom cameras	14
4	Techniques of Interpretation	Element of Image Interpretation: : Tone, Color, Texture, Pattern, Shape, Size and associated features Aerial Photo Interpretation, Satellite Image Interpretation,	14

INTERNAL EVALUATION**30 MARKS****(seminar+term paper+test)****Reference Books :**

- Fundamentals of Remote Sensing: George Joseph
- Remote Sensing and Image Interpretation: Lillesand & Keifer.
- Manual of Remote Sensing: ASP Falls Church Virginia USA.
- Physical aspects of Remote Sensing: PJ Curran.
- Remote Sensing Principles and Interpretation: F.F. Sabins.
- Introduction to Remote Sensing: J.B. Campbell.
- Remote sensing Models and methods for image processing by Robert A. Schowengerdt, second edition, 1997, Academic Press.

GIT 202 INTRODUCTION TO GEOGRAPHICAL INFORMATION SYSTEM AND GPS**Marks: External 70****Internal 30**

1	Introduction to GIS	Introduction, Definition, History, Objectives of GIS, components of GIS, various applications of GIS in areas related to earth sciences.	14
2	Geographical Data	Types of Geographical Data: Raster Data Model, Vector Data Model, GIS Tasks: Input, Manipulation, Management, Query, Analysis and Visualization	14
3	How GIS Works and Concept of Topology	Layer, Geographic Reference, Types of data: Spatial Data, Non Spatial Data, Level of Measurement: Nominal, Ordinal, Interval, Ratio Definition, Advantages of Topology, Concept of Arc, Node and Vertices, Connectivity, Containment, Contiguity.	14
4	Global Positioning System (GPS)	Main segments, nature and sources of errors in GPS signals, differential GPS.	14

**INTERNAL EVALUATION
(Seminar+Term paper+Test)****30 MARKS****Reference Books :**

- Concepts and Techniques of Geographic Information Systems CP Lo Albert K W Yeung, 2005 Prantice Hall of India.
- Principles of GIS for Land Resources Assessment by P.A. Burrough, Oxford : Science publications, 1986.
- Geographic Information Systems – An introduction by Tor Bernhardsen, John Wiley and Sons, Inc, New York, 2002.
- GIS – A computing Perspective by Micheal F. Worboys, Taylor & Francis, 1995.
- Remote Sensing and Image Interpretation by Thomas M. Lillesand and Ralph W. Kiefer, John Wiley and Sons Inc., New York, 1994.
- Geographical Information Systems – Principles and Applications, Volume I edited by David J. Maguire, Micheal F Goodchild and David W Rhind, John Wiley Sons. Inc., New York 1991.
- Geographical Information Systems – Principles and Applications, Volume II edited by David J. Maguire, Micheal F Goodchild and David W Rhind, John Wiley Sons. Inc., New York 1991.
- Kang-tsung Change, 2003, *Introduction to Geographic Information Systems* (2nd Edition), McGraw-Hill Higher Education press.
- Paul A. Longley et al., 2001, *Geographic Information Systems and Science*, John Wiley & Sons press.

1	Introduction to digital image processing	Digital images, sources of errors; Radiometric and geometric, Image rectification; geometric correction radiometric correction, noise removal.	14
2	Advanced Image enhancement techniques	Gaussian stretch density slicing, spatial filtering, low frequency and high frequency, edge enhancement band rationing, band combination. Contrast enhancement: linear and non linear logarithmic contrast enhancement. Exponential contrast enhancement.	14
3	Digital image classification	Classification Scheme: Supervised classification training sites selection information extraction Discriminate Functions; Maximum Likelihood classifier, Euclidian distance, Mahalanobis distance, Unsupervised classification, Error matrix	14
4	Hybrid Classification Approaches	Texture classification approach, Image processing approach using fuzzy logic, machine approach for hybrid classification.	14

INTERNAL EVALUATION
(seminar+term paper+test)

30 MARKS

Reference Books:

- John R Jenson ‘Introducing Digital Image Processing’ _ Prantice Hall. New Jersey 1986.
- Robert A Schowengerdt, ‘Techniques for Image Processing and Classification in Remote Sensing’; 1983
- Robert A Schowengerdt, ‘Remote Sensing – Models and Methods for Image Processing’ Academic Press 1997 Hord R M, Academic Press, 1982.

1	Object oriented concepts	Difference between object oriented and procedural oriented programming, the object oriented approach, Object oriented design, Concept of OOP's –Data abstraction, Encapsulation , Inheritance , Polymorphism Introduction to C++ : Introduction, Terminology –Tokens, keywords, Identifiers, Basic Data types, Operators, Input –Output streams, Structure of C++	14
2	Classes and objects	Concept of Class and Object, Simple class, Member function, private, public & protected member, Array of objects, Nested class, Passing objects as parameter, Inline function, reference arguments Constructor and Destructor : Introduction of constructor and destructor, Default constructor, Copy constructor, Parameterized constructor, Multiple Constructor in class, Friend function	14
3	Inheritance and Polymorphism	Inheritance Concept of inheritance, defining base and derived classes, Behavior of constructor and destructor in inheritance, Types of Inheritance, Concepts, Types of polymorphism, Overloading of function, Virtual function Operator overloading and type conversions : Concept of operator overloading, Rules for overloading operators, Overloading of Unary, Binary and Special operators, Type conversion, Dynamic memory allocation (New and Delete) , this pointer, Dynamic Initialization of variable, reference variable	14
4	File and Streams	Introduction, C++ Streams, C++ stream classes, Unformatted I/O Operations, Managing output with manipulators, Opening and closing a file, Detecting end of file, More about open () : File modes, file pointers and their manipulations, sequential input and output operations, Updating a file :Random access, Error handling During file Operations. Exception handling	14

INTERNAL EVALUATION

30 MARKS

(Seminar+Term paper+Test)

References:

1. Object oriented programming by E. Balgurusamy
2. Mastering C++ by Venugopal
3. Mastering C++ by Ravichandran
4. Object oriented programming in C++ by Robert Lafore.
5. Object oriented programming in C++ by M. P. Bhawe

1	Introduction	Introduction, Nature and Scope. Historical background and economic importance.	14
2	Circulation of the Atmosphere	1) Scales of Atmospheric Motion 2) Models of general circulation:-Tri-cellular theory, Eddy theory	14
3	Humidity	1. Basic Concepts 2. Hydrological Cycle 3. Condensation 4. Evaporation.	14
4	Weather Systems	Thunderstorms – origin, structure stages of development 2. Tornados – development and occurrence, prediction 3. Hurricanes – profile, formation and decay 4. Environmental impact of severe weather	14

Reference Books:

1. Frederick K. Lutgen, Edward Tar buck: "The Atmosphere An Introduction to Meteorology" Prentice Hall, Englewood Cliffs ,New Jersey 0762 ,1998
2. D. S. Lal: Climatology. Sharda Pustak Bhawan ,11 , University road Allahabad- 211002 Edition 2003
3. Trewartha : Introduction to Weather and Climate.
4. H.J. Critchfield (Rep.2010): General Climatology. Prentice Hall, New Delhi
5. Barry and Petty-Synoptic Climatology. 2. Fredrick K.Lutgens and Edward J Tarbuck (1979)
6. Atmosphere 3. A.A. Rama Sastry (1984) Weather and Weather forecasting

1	Cartography	Introduction, Cartography today, Nature and scope of Cartography, History of Cartography, types of map	14
2	Map Projections and Scale and their functions	Geographic Coordinates system, Ellipsoid geoids and datum, types of map projections, constructions of map projections. Types of scales, reduction and enlargement of scale, Map Scale functions and generalization concept.	14
3	Source of data	Ground survey and positioning, Remote sensing data collection, sampling, map digitizing perception and design, cartographic design, color theory and models, color and pattern creation and map compilation.	14
4	Geographic representation	Map and mapping, map design, symbolization, conventional signs and map layout, map referencing and indexing, scale of maps and map contents, socio – economic survey and attribute data.	14

INTERNAL EVALUATION
(Seminar+Term paper+Test)

30 MARKS

Reference Books:

- Cartographic Design and production, Keates, J.S., London, Longman
- Fundamentals of Cartography, Ramesh, P. A., Concept Publishing Co., New Delhi.
- Mapping and Compilation, Rampal, K.K., Concept Publishing Co., New Delhi.
- Basic Cartography, Vol. 1, 2nd ed., Anson, R.W. & Ormeling, F.J., Elsevier Applied Science, Publishers, London.
- http://www.cnr.colostate.edu/class_info/nr502/lg1/map_projections/form_case_aspect.html
- http://www.cnr.colostate.edu/class_info/nr502/lg1/map_projections/developable_surfaces.html
- Colorado State U. http://www.cnr.colostate.edu/class_info/nr502/lg1/map_projections/
- Kang-tsung Change, 2003, *Introduction to Geographic Information Systems* (2nd Edition), McGraw-Hill Higher Education press.
- Paul A. Longley et al., 2001, *Geographic Information Systems and Science*, John Wiley & Sons press.
- Keith C. Clarke, 2003, *Getting Started with Geographic Information System* (4th Edition), Prentice Hall press.

PRACTICAL 205 (INTRODUCTION TO REMOTE SENSING + INTRODUCTION TO GIS & GPS)

INTRODUCTION TO REMOTE SENSING

Marks: External 70

Internal 30

1	Measurement	Determination of photo scale and height determination from aerial photograph, Testing stereo vision, Use of Lens stereoscope and Mirror stereoscope, Determination of vertical exaggeration, Use of Parallax Bar for height calculation from aerial photographs, Calculation of scale of the photographs
2	Land use/ land cover classification method	First level, Second and Third Level
3	Interpretation	Interpretation of aerial photograph and satellite imagery PAN LISS WiFS, OCM, ETM, TM, MSS
4	Application	Application of various imageries

INTRODUCTION TO GIS & GPS

Marks: External 70

Internal 30

1	Software	Introduction to AutoCAD
2	Image registration	Scale, rubber sheeting
	Spatial data input	Drawing tool ,Modify tool, Point, Line, Polygon and Surface Data, Building topology, measuring distance and area, linking attribute data with geographical feature, Data Conversion – Vector to Raster, Raster to Vector
3	Query	Spatial and non-spatial query,
4	Vector Analysis	Buffering, Overlay and Network analysis
5	Data Export	Import in AutoCAD ,Export AutoCAD to other software ,preparing layout ,Text in AutoCAD, Map Menu &its use
6	GPS	GPS handling ,path tracing, location set

INTERNAL EVALUATION

30 MARKS

(viva-voce+journal + data evaluation)

**PRACTICAL 206 (DIGITAL IMAGE PROCESSING + C PROGRAMING / CLIMATOLOGY /
CARTOGRAPHY AND MAP ANALYSIS)
DIGITAL IMAGE PROCESSING**

Marks: External 70

Internal 30

1	Image Rectification	Toposheet and satellite imagery With ERDAS IMAGINE.
2	Image Enhancement	Contrast enhancement: linear and non linear, Density slicing, Spatial filtering, Band rationing, Edge enhancement, histogram equalization, NDVI, RVI
3	Image Classification	Supervised Classification: Training Sites, Discriminant Function: maximum likelihood classifier, Euclidian distance, Mahalanobis distance. Unsupervised Classification, Accuracy Assessment, Error Matrics

C++ PROGRAMMING

(Marks: External 35)

Internal 15

1	OOP Concepts, C++ Programming basics, objects and classes, Array of objects, constructors destructors, types of constructors (2)
2	Functions : Reference arguments, overloaded functions, inline functions, default arguments, returning by reference, friend functions and static functions (3)
3	Operator Over loading : Overloading unary and binary operators, Overloading extraction and insertion operators, data Conversion. (3)
4	Inheritance : Derived class and base class, derived class constructors, over riding member functions, public and private inheritance, multiple inheritance (3)
5	Advanced C++ features : Files, Exception handling, Library organisation and containers

CLIMATOLOGY**Marks: External 70****Internal 30**

1	Weather Elements and sign symbols	Represents of weather elements using IDWR(Indian Daily Weather Report)
2	IDWR	Preparation of report about the monsoon activity during a particular week with respect to temperature, rainfall.
3	Analysis climatic data	Analysis of temperature, pressure etc. for various station using IDWR.
4	Dispersion diagram	Temperature, rainfall

CARTOGRAPHY AND MAP ANALYSIS**Marks: External 70****Internal 30**

1	Map Scale	Types and Conversion
2	Map Projection	Types: source of light, developable surface, global properties
3	Representation of statistical data	One dimensional, Two dimensional, Three dimensional,
4	Topographical Map	Numbering, latitude-longitude, Sign and Symbols, color system, interpretation, use of total station for mapping.

INTERNAL EVALUATION**30 MARKS**

(viva-voce+journal + data evaluation)

GIT 301: SPATIAL ANALYSIS

(Marks: External 70)
Internal 30

1	Introduction to Analysis	Introduction and Significance of Spatial Analysis, its utilization Overview of various tools used for analysis: spatial, network, surface. Geostatistics	14
2	Spatial Analysis Vector and Raster Based	Single Layer Operations: Erase, Split, Update, Dissolve, Eliminate, Proximity analysis, Features Identification, Features Classification Multilayer Operations, Overlay Operations: Point In Polygon, Line in Polygon, Polygon In Polygon, Union, Intersection, Difference, Clip, Spatial join Map Algebra: Grid Based Operations: Local, Focal, Zonal and Global Functions, Cost Surface Analysis, Optimal Path and Proximity Search.	14
3	Network Analysis	Concept of Network Analysis, Network Structure, Evaluation Of Network Complexity Using Alpha, Gama Indices, Network Connectivity: C, C1, C2, C3 Matrix, Network Accessibility	14
4	Point Pattern Analysis & Spatial Modeling	Method For Evaluating Point Patterns: Clustered And Random Distribution Role Of Spatial Model, Types of Spatial Model: Descriptive, Explanatory, Predictive and Normative Models, Handling Complex Spatial Query, Case Studies	14

INTERNAL EVALUATION
(seminar+Term paper+Test)**30 MARKS****Reference Books:**

- 1 GIS and Multi-criteria Analysis by Makrewski Jacek, USA, 1999.
- 2 Principals of GIS by Burrough P.A. MacDonneli R.A. published by Oxford University Press, 2000.
- 3 Geographical Information Science, vol. I by Roy P.S. Published by IIRS, 2000.
- 4 Fundamentals of Geographic Information Systems, 2nd Edition by Demers M.N. published by John Wiley & Sons 2000.
- 5 Introduction to Geographic Information System, Knag, Tsung, Chang 5th edition

1	Microwave Remote sensing	Introduction: Sensors, Radiometers, Scatterometer, Altimeter, Rain Mapping Radar. Side Looking Radar: Radar Operating Principles, Definitions, Spatial Resolution in Radar, Synthetic Aperture Radar. Radar Return and Image Signature: System Properties, Terrain Properties Radar Image Characteristics: Slant Range Distortion, Relief Displacement, Parallax and Stereo Capability, Speckle. Interpretation of Radar Imagery	14
2	Spaceborne SAR	Description and importance of various Synthetic Aperture Radar data related to SEASAT, SHUTTLE (SIR-A, SIR-B), ALMAZ, ERS-1, JERS-1	14
3	Advanced Techniques in Digital Image Processing	Principal Component Analysis (PCA), Colour Transformation and Image Fusion techniques related to Digital image processing.	14
4	Thermal Infrared Remote sensing	Introduction: Wavelength, Atmospheric Transmission, Emitted Energy, Atmospheric effect. Thermal Radiation Laws: Planck Radiation (Blackbody) Law, Wien's Displacement Law, Stefan-Boltzmann Law, Kirchhoff radiation law. Basic Thermal Radiation Principles, Thermal Properties of Materials, Important Thermal IR Sensors, Interpreting Thermal Scanner Imagery	14

INTERNAL EVALUATION
(seminar+term paper+test)

30 MARKS

Reference Books:

- 1 Remote Sensing: Principles and application by Panda.
- 2 Satellite Remote Sensing in Climatology, Studies in Climatology series CBS publication by Andrew Carleton.
- 3 Remote Sensing & Image Interpretation, Wiley publication by Thomas M.Lillesand, Ralph W.Kiefer and Jonathan W. Chipman.
- 4 Digital Image Processing Prithvish Nag, Concept publishing
- 5 Technique and application of hyperspectral and map analysis by Hans Grahn, Niley publication.

1	Surface Analysis & decision making models	Interpolation Method, DEM, TIN, Variance Filter, Slope and Aspect, Relief and Hill Shading. Fuzzy Logic, Operation On Fuzzy Set Fuzzy Vs. Boolean, Basic Rules of Inference, Artificial Neural Network.	14
2	Recent Trends In GIS	Recent Trends: Location Based Services, Virtual Globe, Enterprise Resource Planning, SAP ERP. Internet and GIS: Introduction, History, Services, Open Geospatial Consortium (OGC), Geographic Markup Language (GML), Keyhole Markup Language (KML), Web Map Services. WEB GIS. Open source GIS (Geoserver)	14
3	Spatial Decision Support System (DSS)	Introduction, Process of spatial Decision Making, Types of Problems, Characteristics of spatial DSS, Efficiency and Effectiveness of Decision Making, Architecture of A DSS, Spatial DSS and Expert System.	14
4	Spatial Multicriteria Decision Analysis	Introduction, Components, Estimation of Weights: Trade off Method, Rating Method, Ranking Method, Weighted Summation, Paired Comparison. Spatial Data Mining : Method of Knowledge Discovery in Spatial Database, Spatial Mining Tasks: Spatial Classification, Spatial Clustering, Association Rules	14

INTERNAL EVALUATION
(Seminar+Term paper+Test)

30 MARKS

Reference Books:

- 1 GIS and Multi-criteria Analysis by Makrewski Jacek, USA, 1999.
- 2 Principals of GIS by Burrough P.A. MacDonneli R.A. published by Oxford University Press, 2000.
- 3 Expert Systems and Applied Artificial Intelligence, E. Turban, Macmillan, 1992
- 4 Introduction to Expert Systems, Peter Jackson, Harlow, England: Addison Wesley Longman, 1999.
- 5 Neural networks: A comprehensive Foundation, Simon Haykins, Prentice Hall Inc., 1999.
- 6 Fuzzy sets, uncertainty and information, Geroge J. Klir, Tina A. Folger, Prentice Hall inc., 2000.
- 7 Genetic Algorithms in Search, Optimization, and Machine Learning, Goldberg, David Edward, Addison-Wesley Pub. Co., 1989
- 8 Genetic Programming: On the Programming of Computers by Means of Natural Selection, J. Koza, The MIT Press, 1992.

Unit 1	Solar system : major concepts, planets, satellites, asteroids, meteorites and comets; formation and internal differentiation of the planets; general features of terrestrial and Jovian planets. Planetary atmosphere; exogenic and endogenic processes association with origin and internal evolution of planets – Planetary volcanism, craters, impact cratering processes, elemental composition, mineralogy and petrology; thermal, seismic and magnetic properties and chronological techniques.	14
Unit 2	Planetary surfaces, atmospheres, interiors, magnetic fields, and ring systems and their associated origins. The Sun and its effects on the planets. The moon and its terrestrial analog IO, Phobos and Deimos, minor bodies such as asteroids, comets, meteorites. Past, present and future planetary exploration mission.	14
Unit 3	Earth's atmosphere: evolution, structure and chemical composition, Solar radiation and terrestrial radiation: electromagnetic spectrum, latitude and seasonal variations, effect of atmosphere, greenhouse effect and heat budget, Temperature measurements and controls, lapse rate and inversion of temperature.	14
Unit 4	Atmospheric pressure and winds: pressure measurement and distribution, wind observation and measurement, factor affecting wind, geostrophic wind and gradient wind, local winds, models of general circulation of the atmosphere, Jet stream, Atmospheric moisture: forms of condensation and precipitation, hydrological cycle, Stable and unstable atmosphere: environmental lapse rate, dry and wet adiabatic lapse rate and atmospheric stability, Air masses: classification and modification, Fronts: characteristics and types, Classification of climates : Thornthwaite's and Koppen's classification.	14

INTERNAL EVALUATION (30 Marks)

(Seminar + Term paper + Test)

Reference books:

Fourie G., and Mensing T.M., Introduction to Planetary Science
Taylor and Francis, Introduction to Planetary Geology

GIT 304: INTRODUCTION TO STATISTICAL METHODS**Marks: External 70
Internal 30**

1	Geographical data and Statistical methods	Sampling, Types of data, Methods of collection and Recording. Measures of central tendency: Mean, Median, Mode.	14
2	Measures of Dispersion	Range and Deviations: a) Mean Deviation b) Quartile Deviation and c) Standard Deviation Absolute and Relative measures of dispersion, skewness and kurtosis	14
3	Correlation and Regression	Types of correlation, methods of studying correlation, Karl Pearson coefficient of correlation, T-test, F-Test, Chi-Square test, Lines of regression and properties.	14
4	Probability	Sample space, events, types of events, algebra of events, and probability of an event.	14

INTERNAL EVALUATION**30 MARKS****(Seminar+Term paper+Test)****Reference Books**

- 1 Quantitative Techniques in Geography by Hammond, R. and McCullough. P. Clarendon oxford 1991.
- 2 Statistical Methods for Geographers by Gregory, S, Longman 1978
- 3 Statistical: Concept and Applications by frank, Hand Alt S.L. Cambridge University Press 1994.
- 4 Statistics in Geography by Ebdon, D. Basil Blackwell, 1977.
- 5 A text book of agricultural Statistics R. Rangaswamy Statistical Method, for Environmental & Agricultural Science Bidgelli Hossien

GIT 304: URBAN GEOGRAPHY**Marks: External 70
Internal 30**

1	Nature and scope	Definition, Nature and scope, Recent Trends, Urbanization as a process from early period to modern 20th century.	14
2	study of urban settlement	Location, size and spacing of urban settlements. Central place, Rank size rule. Morphology of city- models, characteristics and demarcation	14
3	Settlement classification	Basic and ancillary functions of Urban Settlements, functional classification of towns	14
4	Population Study	Demographic characteristics of city population density and distribution, population growth, immigration. Population structure.	14

INTERNAL EVALUATION**30 MARKS****(Seminar+Term paper+Test)****Reference Books**

1. Fundamentals of Urban Geography by Suba singh
2. Urban Geography by Balvinder Singh.
3. Urban Geography a text book by R. B. Mandal
4. Urban Geography by Balvinder Singh.

PRACTICAL 305 (SPATIAL ANALYSIS + ADVANCED TECHNIQUES IN REMOTE SENSING)

GIP 301: SPATIAL ANALYSIS

**Marks: External 35
Internal 15**

1	Overview Of Arc GIS: Arc map, Arc catlog, Arc toolbox
2	Georefrencing
3	Digitization: Point, Line, Polygon Topology: Point, Line, Polygon
4	Data Attachment: Internal Data Attachment, External Data Attachment
5	Data preparation Operation: Clip, Erase, Split, Update, Spatial join, Dissolve, Eliminate, Proximity analysis(Buffer), Map Creation, Layout of Map

GIP 302: ADVANCED TECHNIQUES IN REMOTE SENSING

**Marks: External 35
Internal 15**

1	ENVI: Georeferancing
2	Classification: supervised and unsupervised
3	Advanced Techniques in Digital Image Processing: Principle Component Analysis, IHS to RGB, RGB to IHS, Image Fusion: Resolution Merge, Wavelet Fusion, Ehlers Fusion
4	Spectroradiometer: data collection and spectral signatures.
5	Image Interpretation Techniques: RADAR, Hyper spectral

INTERNAL EVALUATION

30 MARKS

(viva-voce+journal + data evaluation)

PRACTICAL 306 (ADVANCED TECHNIQUES IN GIS + INTRODUCTION TO STATISTICAL METHODS / ATMOSPHERIC AND PLANETARY SCIENCES)

GIP 303 PRACTICAL OF ADVANCED TECHNIQUES IN G I S

**Marks: External 35
Internal 15**

1	Overview of Q GIS software (Open source)
2	Interpolation: IDW, Kriging
3	Surface Analysis: DEM, Slope, Aspect, Contour, Hillshade, Viewshade, TIN
4	Google Earth: Layer creation : Point, Line, Polygon
5	Site suitability Analysis using Multi Criteria Analysis In Arc GIS

GIP 304 ATMOSPHERIC AND PLANETARY SCIENCES

**Marks: External 35
Internal 15**

1	Study of Planetary images
2	Construction of geological maps
3	Study of Meteorites
4	Wind rose diagram
5	Line graphs, Dispersion diagram etc

GIP 304: INTRODUCTION TO STATISTICAL METHODS

**Marks: External 35
Internal 15**

1	Geographical data and Statistical methods	Sampling, Types of data, Methods of collection and Recording. Measures of central tendency: Mean, Median, Mode.	14
2	Measures of Dispersion	Range and Deviations: a)Mean Deviation b) Quartile Deviation and c) Standard Deviation Absolute and Relative measures of dispersion, skewness and kurtosis	14
3	Correlation and Regression	Types of correlation, methods of studying correlation, Karl Pearson coefficient of correlation, T-test, F-Test, Chi-Square test, Lines of regression and properties.	14
4	Probability	Sample space, events, types of events, algebra of events, and probability of an event.	14

GIP 304: URBAN GEOGRAPHY**Marks: External 35
Internal 15**

1	Study of urban settlements
2	Morphology of city
3	Functions of Urban Settlements, classification of towns
4	Demographic characteristics of city

GIT 401: GEOINFORMATICS APPROACH FOR NATURAL RESOURCE MANAGEMENT

(Marks: External 70)

Internal 30

1	Forest	Forest classification and mapping forest inventory, sampling techniques, growing stock estimation, forest management, wildlife habit suitability analysis	14
2	Water resources	Basic concept of water resources, Hydrological cycle, Sustainable watershed management, water pollution detection, Salinity and waterlogged area mapping	14
3	Soil	Physiographic soil mapping, soil type identification, soil moisture mapping	14
4	Marine resources	Fundamental of marine ecology, Bio resources, mapping, monitoring, coastal Bathymetry, ocean colour mapping, SST mapping, potential fishing zone mapping	14

INTERNAL EVALUATION

30 MARKS

(Seminar+Term paper+Test

References:

- 1 Remote Sensing of the Environment Earth Resource Perspectives, 2nd Edition, by John R. Jensen.
- 2 Geoinformatics for Environmental Management, B.S. Publication, by M. Anji Reddy.
- 3 Remote Sensing: Principles and application by Panda.
- 4 Biodiversity characteristics at Landscape level in North East using satellite Remote and GIS by Roy P.S., IIRS, 2002.

GIT 402: APPLICATION OF REMOTE SENSING AND GIS IN DISASTER MANAGEMENT**(Marks: External 70)****Internal 30**

1	Disasters	Meaning and types of hazards, disasters and catastrophes – Disaster Management; Earthquakes: Causes and effects – measurements - earthquake zones of the world and India – vulnerability and microzonation; Volcanoes: Causes and effects – volcanic zones of the world and in India - volcanic hazards; Landslides : Causes and effects – landslide prone zones in India – GIS case studies for earthquake, volcano and landslide.	14
2	Drought and Desertification	Drought : Types – factors influencing drought – variable identification – vegetation index – land use / ground water level changes – soil erosion – delimiting drought prone areas – short term and long term effects; Desertification: Processes – over utilization of water and land resources – GIS based management strategies – GIS case studies for drought and desertification.	14
3	Cyclones and Flooding	Cyclone: Origin and types - effects on land and sea – damage assessment; Flooding: Topography, land use and flooding – Space-time integration – GIS based parameters and layers – flood prone area analysis and management – risk assessment – GIS case studies for cyclones and floods.	14
4	Anthropogenic Disasters	Atmospheric Disasters: Ozone layer depletion – green house / global warming – acid rain – snow melt – sea level rise – related problems; Nuclear, Chemical / Industrial and Mining Disasters: Types – consequences – major disasters of the world and India; Marine Disasters: Oil spill and chemical pollution – coastal zone management strategies – GIS case studies.	14

INTERNAL EVALUATION**30 MARKS****(Seminar+Term paper+Test)****References:**

1. National Disaster Management Division (2004) Disaster Management in India - A Status Report, Ministry of Home Affairs, Government of India, New Delhi.
2. Matthews , J.A., (2002) Natural Hazards and Environmental Change, Bill McGuire, Ian Mason.
3. Skeil, A (2002) Environmental Modeling with GIS and Remote sensing, John Wiley and sons, New York.
4. Singh, R.B (Ed.) (1996) Disasters, Environment and Development, Oxford & IBH, New Delhi.
5. Barrett E.C., and L. F. Curtis, (1992) Introduction to Environmental Remote Sensing, Chapman and Hall, London.
6. UNDRO (1995) Guidelines for Hazard Evaluation Procedures, United Nations Disasters Relief Organization, Vienna.
7. Nagarajan, R., (2004) Landslide Disaster Assessment and Monitoring, Anmol Publications, New Delhi.

GIT 403 WEB GIS**Marks: External 70
Internal 30**

1	Basics	Internet, web and internet GIS - Fundamentals of computer networking – network environment – network communication models – protocols – TCP/IP.	14
2	Distributed Geographic Information Services	Principle – components – logic and data components.	14
3	Geographic Markup Language	Principle – characteristics - commercial web mapping programs - mobile GIS. Distributed GIS in data warehousing and data sharing.	14
4	Internet GIS Applications	Intelligent transportation system, planning and resource management.	14

**INTERNAL EVALUATION
(Seminar+Term paper+Test)****30 MARKS****References:**

1. Korte,G. B., (2001) The GIS book: 5th Edition, Onward Press, Melbourne.
2. Cartwright, W., M.P. Peterson, G. Gartner (Eds)., (2004) Multimedia Cartography, Springer, Berlin.
3. Kraak,M., and A.Brown (2001) Web Cartography: Development and Prospects,,: Taylor and Francies, London.
4. Kraak, M. and F. Ormeling (2003) Cartography: Visualization of Geospatial Data, Pearson Education, New Delhi.

GIT 405: APPLICATION OF REMOTE SENSING AND GIS IN LAND EVALUATION**(Marks: External 70)****Internal 30**

1	Nature, Principles and Processes of Land Evaluation	Land Evaluation Definition, Actors, need, aim, objectives, Land evaluation and Land use planning, Principles, Land Evaluation process, approaches, Levels of detail: Frame work, Guidelines, Evaluations	14
2	Geomorphology	Land capability, Physical Land Suitability, Soil Erosion Model, Groundwater Suitability, Watershed and Land Use Planning: Database - Thematic layers – Weightage, Ranking and Rating scale - Integration – Suitability classification, Decision making.	14
3	Application for Agricultural	Crop suitability for Irrigated and Rainfed agriculture (Rice, Banana, Groundnut and Cotton), Agroclimatic Land Suitability, Forestry and Grazing: Database - Thematic layers – Weightage, Ranking and Rating scale - Integration – Suitability classification, Decision making.	14
4	Applications For Non – Agricultural	Wildlife conservation, Tourism development, Urban fringe development: Database - Thematic layers – Weightage, Ranking and Rating scale - Integration – Suitability classification, Decision making.	14

INTERNAL EVALUATION**30 MARKS****(Seminar+Term paper+Test)****References:**

1. Christian, C.S., (1957). The Concept of Land Units and Land System, Proc. 9th Pacific Science Congress, 20: 74 – 81.
2. David G. Rossiter, (1994). Land Evaluation Lecture Notes, Department of Soils, Crop & Atmospheric Sciences, College of Agriculture & Life Sciences, Cornell University.
3. Davidson, Donald A. (1992). The Evaluation of Land Resources, Longman Scientific, London.
4. Dent, D.L. and R.B. Ridgway, 1986. A Landuse Planning Handbook for Sri Lanka, Landuse Policy Planning Division, Ministry of Lands and Land Development, Colombo.
5. FAO (1976). A Framework for Land Evaluation, Soils Bulletin 32, FAO, Rome.
6. FAO (1983). Land Evaluation for Rainfed Agriculture, FAO Soils Bulletin 52, FAO, Rome.
7. FAO, (1984). Land Evaluation for Forestry, FAO Forestry Paper 48, FAO, Rome.
8. FAO. (1985). Land Evaluation for Irrigated Agriculture, Soils Bulletin 55, FAO, Rome.
9. FAO, (1991). Land Evaluation for Extensive Grazing, FAO Soils Bulletin 58, . FAO, Rome.
10. FAO/UNEP, (1993). Agro-ecological Assessments for National Planning: the Example of Kenya, FAO Soils Bulletin, 67, FAO, Rome.
11. FAO (1996). Guidelines for Land-use Planning, FAO Development Series 1, FAO, Rome.
12. FAO (1996). Land Evaluation for Development, FAO Development Series, FAO, Rome.
13. Mitchell, C.W., (1973). Terrain Evaluation, Longman, London.

PRACTICAL 401 (GEOINFORMATICS APPROACH FOR NATURAL RESOURCE MANAGEMENT + APPLICATION OF REMOTE SENSING AND GIS IN DISASTER MANAGEMENT)

GIP 401 GEOINFORMATICS APPROACH FOR NATURAL RESOURCE MANAGEMENT

Marks: External 35

Internal 15

1	Spatial Analyses, Land use land cover change analysis
2	Morphometric Analysis
3	Prioritization of watershed
4	Geostatistical Analyses
5	3D analysis of small projects in Arc map

GIP 402 APPLICATION OF REMOTE SENSING AND GIS IN DISASTER MANAGEMENT

Marks: External 35

Internal 15

1	Drought Assessment
2	Cyclone Track Analysis
3	Flood Damage Assessment
4	Land sliding susceptibility mapping
5	Earthquake hazard zonation mapping

GIP 403 WEB GIS

Marks: External 35

Internal 15

1	Creating KML file and display in Google earth
2	Adding a KML to a map
3	Making dynamic Layouts
4	Setting layer Symbology
5	Creating Map file - Viewing and display the shape file in web browser using map server

INTERNAL EVALUATION

30 MARKS

(viva-voce + journal + data evaluation)

GIT 404: DISSERTATION

Student will submit their independent dissertation work at the end of semester IV. Assessment of the dissertation and internship will be based on the submitted M. Sc. dissertation report, seminar and viva-voce examination for 100 marks.

GIP

404 APPLICATIONS OF REMOTE SENSING AND G I S IN LAND EVALUATION

(Marks: External 35)

Internal 15

1	Data collection for resources analysis
2	Land surface temperature mapping
3	Parcel Editing
4	NDVI change Analysis
5	Crop suitability for rain fed agriculture

INTERNAL EVALUATION

30 MARKS

(viva-voce+journal + data evaluation)