ADAMAS
UNIVERSITY
PURSUE EXCELLENCE

ADAMAS UNIVERSITY

SCHOOL OF BASIC AND APPLIED SCIENCES

DEPARTMENT OF GEOGRAPHY

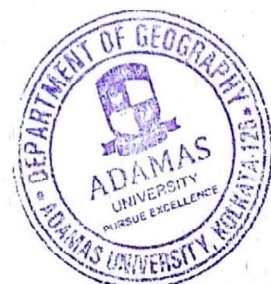Program Name:

B.SC. (HONS.) GEOGRAPHY

Program Code: GEO3304

Total Credit: 154

Course Structure 2022-23 (Under CBCS)

(Course Structure modified as per the Board of Studies meeting held on 9th March 2022)

HOD
Department of Geography
Adamas University

School of Basic and Applied Sciences,
# Department of Geography
B.Sc. (Hons) Geography, Course Structure

Semester I

Subject Code	Subject		L	T	P	C
GEO11003	Geo-tectonics and Geomorphology		6	0	0	6
GEO12004	Scale, Area Measurement and Identification of Rocks and Minerals Lab		0	0	6	4
MTH11510	Basic Mathematics I		4	0	0	4
ENG11057	English Language & Literature		2	0	0	2
DGS11001	Design Thinking		2	0	0	2
Elective Courses (any one group)		Group				
CHM11151	Elective Chemistry I	A	4	0	0	4
CHM12152	Elective Chemistry Lab I		0	0	3	2
ZOL11001	Elective Zoology I	B	4	0	0	4
ZOL12002	Elective Zoology I Lab		0	0	3	2
BOT11001	Elective Botany I	C	4	0	0	4
BOT12002	Elective Botany I Lab		0	0	3	2
MTH11508	Elective Mathematics I	D	6	0	0	6
ECO11040	Introductory Microeconomics	E	6	0	0	6
SOC11003	Introduction to Sociology	F	6	0	0	6
PSG13004	General Psychology	G	4	0	3	6
	TOTAL CREDIT					24

Semester II

Subject Code	Subject		L	T	P	C
GEO11007	Human Geography		6	0	0	6
GEO12008	Thematic Cartography and Geological Map Interpretation Lab		0	0	6	4
MTH11511	Basic Mathematics II		4	0	0	4
EVS11112	Environmental Science		2	0	0	2
EIC11001	Venture Ideation		2	0	0	2

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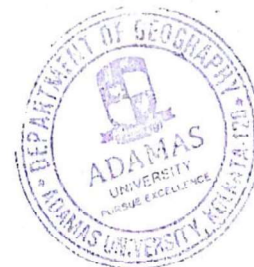
Elective Courses (any one group)		Group				
CHM11153	Elective Chemistry II	A	4	0	0	4
CHM12154	Elective Chemistry Lab II		0	0	3	2
ZOL11003	Elective Zoology II	B	4	0	0	4
ZOL12004	Elective Zoology II Lab		0	0	3	2
BOT11003	Elective Botany II	C	4	0	0	4
BOT12004	Elective Botany II Lab		0	0	3	2
MTH11509	Elective Mathematics II	D	6	0	0	6
ECO11006	Introductory Macroeconomics	E	6	0	0	6
SOC11007	Indian Society: Images and Reality	F	6	0	0	6
PSG13007	Applied Psychology	G	4	0	3	6
	TOTAL CREDIT					24

Semester III

Subject Code	Subject	L	T	P	C
GEO11009	Climatology	6	0	0	6
GEO11010	Regional Planning and Development	6	0	0	6
GEO12011	Statistical Methods in Geography Lab	0	0	6	4
GEO12012	Statistical Techniques and Computer Application Lab	0	0	3	2
GEO12013	Basics of Remote Sensing Lab	0	0	3	2
SOC14100	Community Service	0	0	1	1
IDP14001	Inter-disciplinary Project	0	0	3	3

Elective Courses (any one group)		Group				
CSE11641	Elective Computer Science I	A	4	0	0	4
CSE12642	Elective Computer Science Lab I		0	0	3	2
PHY11015	Elective Physics I	B	4	0	0	4
PHY12016	Elective Physics Lab I		0	0	3	2
SDS11506	Elective Statistics I	C	0	0	6	6
	TOTAL CREDIT					28

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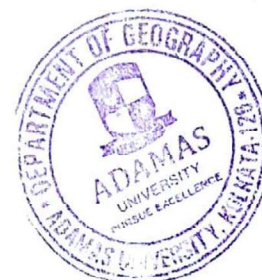
Semester IV

Subject Code	Subject		L	T	P	C
GEO11014	Economic Geography		6	0	0	6
GEO11015	Environmental Geography		6	0	0	6
GEO12016	Map Interpretation and Projection Lab		0	0	6	4
GEO12017	Basic GIS and Cartography Lab		0	0	3	2
GEO12018	Research Methods Lab		0	0	3	2
PSG11021	Human Values and Professional Ethics		2	0	0	2
Elective Courses (any one group)		Group				
CSE11643	Elective Computer Science II		4	0	0	4
CSE12644	Elective Computer Science Lab II	A	0	0	3	2
PHY11024	Elective Physics II		4	0	0	4
PHY12025	Elective Physics Lab II	B	0	0	3	2
SDS11507	Elective Statistics II	C	0	0	6	6
	TOTAL CREDIT					26

Semester V

Subject Code	Subject	L	T	P	C
GEO11020	Geography of India	6	0	0	6
GEO12021	Advance Remote Sensing and GIS Lab	0	0	6	4
GEO11022	Population and Settlement Geography	6	0	0	6
GEO11023	Resource Geography	6	0	0	6
GEO11024	Agricultural Geography	6	0	0	6
GEO11025	Urban Geography	6	0	0	6
GEO14026	Industry Internship	-	-	-	2
	TOTAL CREDIT				24

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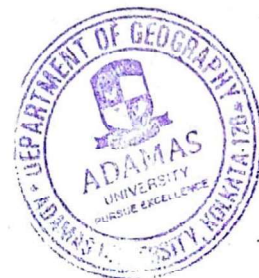
Semester VI

Subject Code	Subject	L	T	P	C
GEO11027	Evolution of Geographical Thought	6	0	0	6
GEO11028	Political Geography	6	0	0	6
GEO11029	Geography of Health and Wellbeing	6	0	0	6
GEO11030	Hydrology and Oceanography	6	0	0	6
GEO11031	Geography of Tourism and Transport	6	0	0	6
GEO15034	Minor Project	0	0	4	4
GEO14035	Field Project	0	0	6	6
	TOTAL CREDIT				28
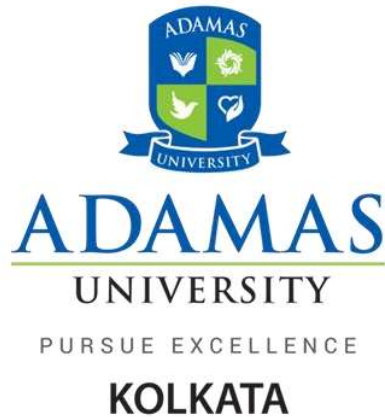
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SCHOOL OF BASIC AND APPLIED SCIENCES

Department of Geography

B.Sc. (Hons) Geography Program

Program Code: GEO3304

Syllabus 2022-23

(Course Structure modified as per the Board of Studies meeting held on 9th March 2022)

SEMESTER I

GEO11003	Geo-tectonics and Geomorphology	L	T	P	C
Version 1		6	0	0	6
Pre-requisites/Exposure	HS level Physical Geography knowledge				
Co-requisites	-				

Course Outcomes

On completion of this course, the students will be able to

CO1. **Describe** the composition and structure of the Earth's crust and interior.
CO2. **Explain** the formation of various crustal features created by crustal deformation and tectonic movement.
CO3. **Relate** the fundamental laws and concepts of geomorphology with the evolution of landforms.
CO4. **Interpret** the history of landform development in different morphoclimatic regions.

Course Content

Unit 1: Origin of the Earth and its interior: (10 hours)

Structure of the Earth-Interior, Discontinuity and Seismic Waves, Rocks: Igneous, Sedimentary and Metamorphic

Unit II: Deformation and Tectonics: (15 hours)

Endogenic and Exogenic Processes; Folds and Faults — Origin and Types, Concept of Isostasy and Isostatic Compensation, Continental Drift, Sea Floor Spreading, Plate Tectonic theory: landforms at plate margins and hotspots; Mountain Building: Orogenic types and Classification - relation with Tectonics, Volcanism and Volcanic landforms

Unit III: Fundamentals of Geomorphology: (15 hours)

Definition and scope of Geomorphology, Landscape and landforms; Uniformitarianism and Neocatastrophic Approaches, Basic concepts of Geomorphology, Geological time scale, System Approach- Concept and Classification. Development of River Network on Folded, Faulted, Uniclinal and Domal structures

Unit IV: Geomorphological Processes and landforms: (20 hours)

Processes of Rock Weathering, Mass wasting and their effects on landform; General Erosion and Depositional Processes; Landforms on granite, basalt and limestone; Landforms: Fluvial, Glacial, Fluvio-Glacial, Aeolian, Fluvio-Aeolian; Landscape Evolution Models- Davis, Penck, King, Hack

Recommended Readings:

1. Husain Majid 2010, Fundamentals of Physical Geography, Second Edition, Rawat Publications, Jaipur and New Delhi.

2. Siddartha K. 2018, Earth Dynamic Surface (Transworld Media & Communications – Publication – Patna,
3. Strahler, A.N. and Strahler, A.H. 1984, Elements of Physical Geography, John Wiley, New York.
4. Selby, M.J., 2005, Earth's Changing Surface, Indian Edition, OUP
5. Singh Savindra (2019), Physical Geography, Prayag Pustak Bhawan, Allahabad.
6. Bloom, A.L. 1992, Geomorphology- Systematic Analysis of Late Cenozoic Landforms, Prentice Hall India, New Delhi.
7. Singh Savindra 2019, Geomorphology, Prayag Pustak Bhawan, Allahabad
8. Strahler, A .N. 1988, Earth Sciences, Harper and Row Publishers, N.D.
9. Thornbury, W.D. 1969. Principles of Geomorphology, 2nd ed, Wiley-India / CBS.
10. Chorley, R.J. 1969: Introduction to Fluvial Processes, Methuen, London
11. Chorley, R.J., Schumm, S. A. and Sugden, D.E. 1984: Geomorphology, Methuen, London
12. Dayal, P. 1996: Textbook of Geomorphology, Shukla Book Depot, Patna.
13. Kale, V. and Gupta, A. 2001: Introduction to Geomorphology, Orient Longman, Kolkata
14. McCullagh, P. 1978: Modern Concepts in Geomorphology, Oxford University Press, Oxford.
15. Morisowa, M. 1968: Streams, their Dynamics and Morphology, McGraw Hill, New York.
16. Ollier, C.D. 1975: Weathering, Longman, London
17. Selby, M. J. 1991: Earth's Changing Surface, Clarendon Press, London
18. Small, R.J. 1978: The Study of Landforms, Cambridge University Press, Cambridge
19. Sparks, B.W. 1960: Geomorphology, Longman, London.
20. Summerfield, M.J. 2003. Global Geomorphology: An Introduction to the Study of landforms, Longman.
21. Strahler, A. 2016. Introducing Physical Geography, 6th ed, Wiley.
22. Kearey, P., Klepeis, K.A., Vine, F.J. 2011. Global Tectonics, 3rd ed, Wiley-India
23. Harvey, A. 2012. Introducing Geomorphology: A Guide to Landforms and Processes, Dunedin Academic Press.
24. Goudie, A.S. (Ed) 2004. Encyclopaedia of Geomorphology, vol. 1 & 2, Routledge.
25. Gregory, K.J., Lewin, J. 2014. The Basics of Geomorphology: Key Concepts, Sage.
26. Billings, M.P. 1971. Structural Geology, Pearson.
27. Frisch, W., Meschede, M., Blakey, R.C. 2011. Plate Tectonics: Continental Drift and Mountain Building. Springer.

Websites:

1. British Society for Geomorphology: www.geomorphology.org.uk
2. Geological Survey of India: www.gsi.gov.in
3. Indian Institute of Geomorphologists: www.indiageomorph.org
4. International Association of Geomorphologists: www.geomorph.org
5. Plaleomap Project: www.scotese.com & www.youtube.com/user/cscotese
6. 'This Dynamic Earth' (USGS): pubs.usgs.gov/gip/dynamic/dynamic.html

GEO12004	Scale, Area Measurement and Identification of Rocks and Minerals Lab	L	T	P	C
Version 1		0	0	6	4
Pre-requisites/Exposure	HS level Physical and Practical Geography knowledge				
Co-requisites	-				

Course Outcomes

On completion of this course, the students will be able to

CO1. **Understand** the basic concept of different types of scale.
CO2. **Compare** different map scales and area measurement techniques.
CO3. **Make** use of different lab instruments.
CO4. **Identify** different type of rocks and minerals.

Course Content

Unit 1: Map Scale Representation; Enlargement – Reduction; Area Measurement and Instrument Identification: (45 hours)

Linear, Diagonal and Vernier scale drawing, Enlargement and reduction – Mathematical calculations, Area measurement by Graphical Method, Lab instruments: Clinometer, Abney Level, and Slide Caliber.

Unit II: Megascopic Identification of Rocks & Minerals: (45 hours)

Rocks: granite, basalt, dolerite, shale, sandstone, limestone, conglomerate, laterite, slate, phyllite, schist, marble, quartzite, gneiss; Minerals: talc, gypsum, calcite, mica, feldspar, quartz, chalcopyrite, hematite, magnetite, bauxite, galena.

Unit III: Laboratory Note Book and Viva-voce:

A project file comprising at least one exercise (as per requirement) from each on using any method on above mentioned themes.

Recommended Readings:

1. Dury, G.H. 1972: Map Interpretation, Pitman Publishing, London
2. Ishtiaque, M. 1989: Practical Geography, Heritage Publishers, New Delhi.
3. Monkhouse, F.J. 1971: Maps and Diagrams, Methuen, London
4. Sarkar, Ashis, Practical Geography: A Systematic Approach, Orient Longman Pvt. Ltd., Kolkata.2000
5. Singh, R.L. and Singh, R.P.B. 1992: Elements of practical Geography.
6. Basu Patha. Practical Geography.

MTH11510	Basic Mathematics I	L	T	P	C
Version 1		4	0	0	4
Pre-requisites/Exposure	12th level Mathematics				
Co-requisites	--				

Course Outcomes

On completion of this course, the students will be able to

- CO1. **Explain** the basic idea of set theory and functions.
- CO2. **Define** the different functional forms and show their graphical presentation.
- CO3. **Utilize** the fundamental concepts of differential calculus to find the maximum/minimum value of a function.
- CO4. **Illustrate** the basic concept of integration and its applications to find areas under the curves.

Course Content:

Module-I: [15 Hours]
Algebra of Set: Mapping and Function, Sets, Subset, Power Set, Union, Intersection, Complement, Set Operations, Venn Diagram, Properties of Set, Laws of Algebra of Sets, Inclusion-Exclusion Principle. Mapping, Different types of Mapping with examples, Function and its properties.

Module-II: [14 Hours]
Differential Calculus: Limits of Function and Continuity, Fundamental Properties of Continuous Functions (without proof), geometric meaning of derivative and differential, rules of differentiation, Examples.

Module -III: [16 Hours]
Differentiation: Definition of Derivative, Rules of Differentiation (Without Proof), Derivatives of Algebraic, Trigonometric, Parametric, Logarithmic, Explicit / Implicit Functions, Second order Derivative with examples, Application: Maxima/Minima of Functions, and its applications.

Module -IV: [15 Hours]
Integration and its application: Definition of Integration, Standard Formulas, Method of Substitution, integration by parts, Partial fraction, Reduction Formulas (Without Proof), Area Bounded by the Curve (Excluding volume) and its applications

Text Books:

1. Grewal, B. S., Higher engineering mathematics, Khanna publishers
2. B. K. Pal and K. Das, BCA Mathematics (Volume - I), U. N. Dhur & Sons Publishers

Reference Books:

1. Shanti Narayan, "Differential Caluculs", S.Chand& Company, 1998.
2. Shanti Narayan, P.K. Mittal, Integral Calculus, S.Chand& Company, 1999

ENG11057	**English Language and Literature**	L	T	P	C
Version 1	**Contact Hours - 30**	2	0	0	2
Pre-requisites/Exposure	Basic Knowledge in English Language and Literature				
Co-requisites	--				

Course Outcomes

On completion of this course, the students will be able to

CO1. Explain the ethical use of language at the work space

CO2. Recognizing the importance of language as lifelong process of learning

CO3. Developing the capability to work as a team.

CO4. Identifying their individual language related skills

CO5. Describe and develop the communication skills through speaking, reading and writing

CO6. Building perceptions for accommodating all sorts of opinions

Course Content:

Module 1:

Communication
a)   Types of Communication
b)   Verbal and Non-verbal Communication
c)   Barriers and Strategies of Communication

Module 2:

Grammar and Syntax
a)   Subject-verb agreement
b)   Conjunction
c)   Articles
d)   Prepositions
e)   Editing
f)   Idioms
g)   One- Word Substitutions

Module 3:

Listening Skills
a)   Active Listening
b)   Types of Listening
c)   Listening Exercises

Module 4:

Speaking Skills
a)   Introduction
b)   Extempore

c)   Group Discussion
d)   Mock Interview

Module 5:

Writing Skills
  a)   Composition
  b)   Paragraph
  c)   Letter writing- CV and application letter
  d)   Report Writing
  e)   Notice writing
  f)   Business Communication

Module 6:

Reading and Textual analysis
Reading Comprehension
Interpreting Graphics

Text Books

T1. Spoken English and Functional Grammar. P. C. Das.

T2. Essential Grammar in Use. Raymond Murphy

Reference Books

R1. Kaul Asha. *Effective Business Communication.* PHI Learning Pvt Ltd. 2014.

R2. Wren and Martin. *High School Grammar And Composition.* S. Chand, 1995.

R3. Lewis, Norman. *Word Power Made Easy*. Anchor: 2014.

R4. Riordan, Daniel G & Pauley Steven A. :*Technical Report Writing Today.* 2004*.*

R5. Hamp-Lyons and Heasely, B . *Study Writing; A Course in Written English. For Academic and Professional Purposes,* Cambridge Univ. Press, 2006.

R6. Quirk R., Greenbaum S., Leech G., and Svartik, J. *A Comprehensive Grammar of the English language*, Longman: London, 1985.

DGS11001	Design Thinking	L	T	P	C
Version 1		2	0	0	2
Pre-requisites/Exposure	Knowledge of analyzing society problems and product usage problems and a zeal to improve the current situation, in addition to knowing to using laptop/computers, internet, social media interaction, file sharing and uploading, email and communication etiquettes.				
Co-requisites	--				

Course Outcomes

On completion of this course, the students will be able to:

CO1. **Examine** design thinking concepts and principles
CO2. **Practice** the methods, processes, and tools of design thinking
CO3. **Apply** the Design Thinking approach and model to real world scenarios
CO4. **Analyze** the role of primary and secondary research in the discovery stage of design thinking

Course Content

UNIT I: What is design thinking (2 hours)
Designers seek to transform problems into opportunities. Through collaboration, teamwork, and creativity, they investigate user needs and desires on the way to developing human-centered products and/or services. This approach is at the very heart of design thinking.

UNIT II: The design thinking model (2 hours)
A tool that helps guide you along a design thinking path. The model does this by providing a series of activities that that will help you effectively design a product, service or solution to a user's need. The model presents the approach as a process, allowing us to look at each step – or phase – along the journey to the development of a final design.

UNIT III: PHASE 1: Discover (4 hours)
Begin the design thinking process with the Discover phase, where you will identify the specific problem your design is intended to solve, as well as important usability aspects from those who will use your design. Discovery can be performed through a variety of different research methods which you will learn in this module.

UNIT IV: PHASE 2: Define (4 hours)
In the Define phase, you come to understand the problem. We often refer to this as framing the problem. You can do this by using a variety of tools, including storytelling, storyboarding, customer journey maps, personas, scenarios, and more.

UNIT V: PHASE 3: Develop (4 hours)
Turn your attention to solving the problem. In this phase you brainstorm custom creative solutions to the problems previously identified and framed. To do this, you conceptualize in any way that helps, putting ideas on paper, on a computer, or anywhere whereby they can be considered and discussed.

UNIT VI: PHASE 4: Deliver (4 hours)
This phase is all about testing and building concepts. Here you take all of the ideas that have been discussed to this point and bring them a little closer to reality by building a concept; something that makes it easier for a user to experience a design. This concept is referred to as a prototype.

UNIT VII: PHASE 5: Iterate (4 hours)

You will test the prototype of your design solution, collecting and acting on feedback received. These actions may mean minor or major revisions to your design, and are repeated as often as necessary until a solution is reached. Tools such as focus groups and questionnaires are used to help you collect feedback that can help with your final design.

UNIT VIII: Beyond design thinking (2 hours)

The Design Thinking Model is a tool that helps guide you along a design thinking path. The model does this by providing a series of activities that that will help you effectively design a product, service or solution to a user's need. The model presents the approach as a process, allowing us to look at each step – or phase – along the journey to the development of a final design.

Text Books
1. All the references are available to download in the online course.

Reference Books

1. Brown, Tim. "What We Can Learn from Barn Raisers." Design Thinking: Thoughts by Tim Brown. Design Thinking, 16 January 2015. Web. 9 July 2015.
2. Knapp, Jake. "The 8 Steps to Creating a Great Storyboard." Co.Design. Fast Company & Inc., 21 Dec. 2013. Web. 9 July 2015.
3. van der Lelie, Corrie. "The Value of Storyboards in the Product Design Process." Journal of Personal and Ubiquitous Computing 10.203 (2006): 159–162. Web. 9 July 2015. [PDF].
4. Millenson, Alisson. "Design Research 101: Prototyping Your Service with a Storyboard." Peer Insight. Peer Insight, 31 May 2013. Web. 9 July 2015.

CHM11151	Elective Chemistry I	L	T	P	C
Version 1		4	0	0	4
Pre-requisites/Exposure	Physics and Chemistry of class 12 or 10+2 level				
Co-requisites	Partial differentiation, model making, graph plotting				

Course Outcomes

On completion of this course, the students will be able to

CO-1   **Learn** to recognize the exclusive terminologies associated with thermodynamics and explain the basic concepts of thermodynamics i.e. heat transfer and its consequences with the thermodynamic system.

CO- 2   **Understand** to explain the difference between what the molecules are doing in a solid, liquid, and gas, including movement, spacing, and organization, and how this explains the physical characteristics of these states.

CO-3   **Understand** the properties of solutions that depends on the number of dissolved particles in solution, but not on the identities of the solutes.

CO-4   **Learn** the concept of reaction rates and be able to use to predict products, yields etc.

CO-5   **Understand** the concept of using the symbols for protons, neutrons, electrons, positrons, alpha particles, beta particles, and gamma rays.

CO-6   **Recognize** the periodic properties of elements, principles in molecular theory and bonding models to the study of inorganic compound.

Course Content:

Physical Chemistry-I

Unit- 1-Thermodynamics   **(10 hours)**

Thermodynamics: Definition of thermodynamic terms; Concept of heat and work; First law of thermodynamics; Concept of enthalpy (H); Expansion of ideal gas under isothermal and adiabatic conditions for reversible and irreversible processes; Concept of standard state, Standard enthalpy changes of physical and chemical transformations: fusion, sublimation, vaporization, solution, dilution, neutralization, ionization.; Hess's law of constant heat summation, Second law of thermodynamics; Heat engine; Carnot cycle and its efficiency; Entropy (S) as a state function. Spontaneous processes; Concept of Free Energy (G and A).

Unit-2-Liquid state: **(4 hours)**

Liquid States and Viscosity of Fluids: Nature of the liquid state (short range order and long range disorder); Physical properties of liquids; Vapor pressure, Surface tension; Surface energy, General features of fluid flow (streamline flow and turbulent flow); Coefficient of viscosity and their determination.

Unit-3-Colligative properties   **(6 hours)**

Colligative Properties: What are colligative properties? Dependence of colligative properties; Freezing point depression; boiling point elevation, Raoult's Law and Vapor Pressure Lowering; osmotic pressure.

Unit-4: Chemical kinetics   **(10 hours)**

Chemical kinetics and catalysis: Order and molecularity of reactions; Rate laws and rate equations for first order and second order reactions (differential and integrated forms); Zero order reactions; Determination of order of reactions; Temperature dependence of reaction rate, energy of activation; Catalytic reactions: homogeneous and heterogeneous catalytic reactions. Enzyme catalysis

Inorganic Chemistry-I

Unit-I: Atomic structure   **(10 hours)**

Extra-nuclear Structure of atoms, Bohr's model. quantum numbers and their significance, Pauli's exclusion principle, Hund's rule, electronic configuration of many¬, electron atoms, Aufbauprinciple.

Unit-II: Chemical Periodicity   **(5 hours)**

Classification of elements on the basis of electronic configuration; Positions of hydrogen and noble gases; Atomic and ionic radii; ionization potential; electron affinity; and electronegativity; periodic and group-wise variation of above properties in respect of s- and p- block elements.

Unit-III: Radioactivity and Nuclear Structure of Atoms   **(5 hours)**

Natural radioactivity, group displacement law, law of radioactive decay, half-life of radio elements. Atomic Nucleus: Stability of 'atomic nucleus, nuclear binding energy,Nuclear reactions: fission, fusion, transmutation of elements.

Unit-IV: Chemical Bonding   **(10 hours)**

Ionic Bonding: General characteristics of ionic compounds; Lattice energy; Born Haber cycle. Covalent bonding: General characteristics of covalent compounds; valence-bond approach, directional character of covalent bond; hybridization involving s-, p-, d orbitals; multiple bonding; Valence Shell Electron Pair Repulsion (VSEPR) concept; Partial ionic character of covalent bonds; Fajan's rules.Hydrogen bonding and its effect on physical and chemical properties.

Reference Books:

1. D. A. McQuarrie and J. D. Simon: Physical Chemistry — A Molecular Approach
2.G. W. Castellan: Physical Chemistry
3. P. W. Atkins: Physical Chemistry
4. J. E Huheey, E. A. Keiter, R. L. Keiter: Inorganic Chemistry (Principle and structure and reactivity).
5. N. N. Greenwood, A. Earnshaw: Chemistry of the Elements
6. D. F. Shriver, P. W. Atkins, C. H. Langford: Inorganic Chemistry

CHM12152	Elective Chemistry Lab I	L	T	P	C
Version 1		0	0	3	2
Pre-requisites/Exposure	Physics and Chemistry of class 12 or 10+2 level				
Co-requisites	Partial differentiation, model making, graph plotting				

Course Outcomes for SCY32207

On completion of this course, the students will be able to

CO-1   **Develop** skills in the proper handling of apparatus and chemicals.

CO-2   **Develop** experimental skill of quantitative volumetric analysis and determination of physical properties of substances.

CO-3   **Determination** of the concentration or the mass of the minimum formula from the titrated chemical material composing a pure liquid or a solution.

Course Content:

General Chemistry Lab: **(25 hours)**

Preparation of Solution: Normal Solution; Molar Solution

Determination of surface tension of a given solution by drop weight method using a stalagmometer, considering aqueous solutions of $NaCl$, acetic acid, ethanol etc, as systems.

Determination of viscosity of organic solvents with Ostwald Viscometer at room temperature.

To determine the rate constant for the acid catalysed hydrolysis of an ester.

Inorganic Chemistry Lab: **(20 hours)**

Titration of Na_4CO_3 + $NaHCO_3$ mixture vs HCl using phenolphthalein and methyl orange indicators.

Determination of ionization constant of a weak acid by conductometric method

Determination of neutralization point of the reaction between HC1and NaOH with the help of pH meter .

Determination of rate constant of decomposition of H_2O_2 by acidified KI solution using clock reactions.

References:
1. Palit, S.R., De, S. K. Practical Physical Chemistry Science Book Agency
2. Handbook of Inorganic Analysis (First Edition): U.N Dhur& Sons Private Ltd.
3. Das, S.C. Advanced Practical Chemistry:

ZOL11001	Elective Zoology I (Theory)	L	T	P	C
Version 1	Contact Hours - 60	4	0	0	4
Pre-requisites/Exposure	10+2 level biology				
Co-requisites	--				

Course Outcomes

On completion of this course, the students will be able to

1. Students will **explain** about the fundamentals of animal sciences, which helps them to explain the complex relations among various living organisms.
2. Students will be able to **illustrate** the course of evolution: i.e. how complex multicellular organisms develop from unicellular cells and correlate with other fields of biology.
3. Students will **compare** the basis of life processes in the non-chordates and chordates which helps them to identify the economically important organisms.
4. Students will able to know and **contrast** between acoelomate, pseudo-coelomate and coelomate.
5. Students will **develop** as lifelong perceive the knowledge about vertebrate and invertebrate organisms and animal ethical issues which contribute in greater benefit of humanity worldwide.

Course Content

Unit 1: Protista (3 Hours)

General characters of Protozoa; Life cycle of *Plasmodium*; Conjugation in *Paramoecium*.

Unit 2: Porifera (3 Hours)

General characters and canal system in Porifera.

Unit 3: Radiata (3 Hours)

General characters of Cnidarians and polymorphism.

Unit 4: Acoelomates (3 Hours)

General characters of Helminthes; Life cycle of *Taenia solium*.

Unit 5: Pseudocoelomates (3 Hours)

General characters of Nemathehelminthes; Parasitic adaptations.

Unit 6: Coelomate Protostomes (3 Hours)

General characters of Annelida; Metamerism.

Unit 7: Arthopoda (3 Hours)

General characters; Social life in insects; Communication in Honey Bees.

Unit 8: Mollusca (3 Hours)

General characters of mollusca; Torsion in gastropoda.

Unit 9: Coelomate Deuterostome (3 Hours)

General characters of Echinodermata; Water Vascular system in Starfish.

Unit 10. Protochordata (4 Hours)

Salient features

Unit 11. Pisces (5 Hours)

Outline of classification; Parental care in Fish.

Unit 12. Amphibia (5 Hours)

General characters; Outline of classification; Paedogenesis.

Unit 13. Reptilia (5 Hours)

Amniotes; Origin of reptiles; Outline of classification in reptiles.

Unit 14. Aves (5 Hours)

General characters; Flight adaptations

Unit 15. Mammalia (5 Hours)

Outline of classification; Dentition in mammals.

Reference Books
1. Barnes, R.D. (1992). Invertebrate Zoology. Saunders College Pub. USA.
2. Campbell & Reece (2005). Biology, Pearson Education, (Singapore) Pvt. Ltd.
3. Kardong, K. V. (2002). Vertebrates Comparative Anatomy. Function and Evolution. Tata McGraw Hill Publishing Company. New Delhi.
4. Ruppert, Fox and Barnes (2006) Invertebrate Zoology. A functional Evolutionary Approach 7th Edition, Thomson Books/Cole
5. Raven, P. H. and Johnson, G. B. (2004). Biology, 6th edition, Tata McGraw Hill Publications. New Delhi

ZOL12002	Elective Zoology Lab I (Practical)	L	T	P	C
Version 1	Contact Hours - 45	0	0	3	2
Pre-requisites/Exposure	10+2 two level biology				
Co-requisites	--				

Course Outcomes

On completion of this course, the students will be able to

CO1. **Identify**, classify and compare between non-chordate and chordate specimens.
CO2. **Explain** the ecological importance of these both chordate and nonchordate specimens with ethical issues.
CO3. **Perceive the knowledge**, draw and compare between the digestive, reproductive and nervous system of cockroach.
CO4. Explain and **illustrate** the course of evolution: i.e. how complex multicellular organisms develop from unicellular cells and correlate with other fields of biology.
CO5. Perceive the knowledge and **develop** the knowledge of using different modern tools and techniques in the field of biology which will help in their further academics worldwide.

Course Content

1. Identification and Classification of Any these of the following: **(10 Hours)**

   a. **Non-chordate specimens**: Scypha, *Obelia,* Sea-anaemone, *Ascaris, Hirudinaria,* Scorpion, *Bombyxmori, Achatina, Loligo,* Starfish, *Balanoglossus.* **(10 Hours)**

   b. **Chordate specimens**: *Branchiostoma, Petromyzon, Scolidon, Lates,* Axolotl larva, *Tylototriton, Gekko; Hemidactylus,* Turtle, *Naja,* Chiroptera. **(10 Hours)**

2. Ecological Note – On any of the specimens in Exercise No 1. **(10 Hours)**

3. Models of dissection of Cockroach - Cockroach: Digestive, Reproductive, Nervous System.

Reference Books

6. Barnes, R.D. (1992). Invertebrate Zoology. Saunders College Pub. USA.
7. Campbell & Reece (2005). Biology, Pearson Education, (Singapore) Pvt. Ltd.
8. Kardong, K. V. (2002). Vertebrates Comparative Anatomy. Function and Evolution. Tata McGraw Hill Publishing Company. New Delhi.
9. Ruppert, Fox and Barnes (2006) Invertebrate Zoology. A functional Evolutionary Approach 7th Edition, Thomson Books/Cole
10. Raven, P. H. and Johnson, G. B. (2004). Biology, 6th edition, Tata McGraw Hill Publications. New Delhi

BOT11001	Elective Botany - I	L	T	P	C
Version 1	Contact Hours - 60	4	0	0	4
Pre-requisites/Exposure	12th with Biology as one subject				
Co-requisites	12th level English				

Course Outcomes

On completion of this course, the students will be able to

CO1. Students will be able to **illustrate** in detail phycology in various aspects and also implementation of algal biotechnology for commercial purposes;

CO2. Students will be able to **explain** and Categorize in detail various divisions of Fungi and their commercial importance as well harmful effects;

CO3. Students will be able to **interpret** basic knowledge and economic importance of Lichen;

CO4. Students will be able to **compile** and summarize the basic concept of plant pathology and also can be able implement this knowledge in applied fields;

CO5. Students will be able to **develop** fundamental knowledge and can be implemented this skill for cultivation practices and commercial uses of economic important plant.

Course Content:

UNITI   **(10 hours)**

Algae: Introduction; habitat and range of thallus structure in algae; Principles of classification and outline classification of Lee (2009) up to divisions, Diagnostic characters of important algal family's examples, Algal genetics, Economic importance of algae, Bioreactor. Cultivation of algae and its prospects.

UNITII   **(10 hours)**

Fungi: Introduction; habitat, Basic classifications, Diagnostic characters of important families with examples, fungal genetics, Economic importance of fungi, Pathogenic and poisonous fungi.

UNITIII   **(10hours)**

Lichen: Habitat and thallus structures; economic importance.

UNIT IV   **(10 hours)**

Plant Pathology: Plant Diseases: Introduction and Definition; concepts of parasitism and saprophytism, Koch's postulates, Classification of plant diseases based on symptoms; Factors influencing infection, colonization and development of symptoms, Genetic basis of disease resistance and pathogenicity: gene for gene hypothesis; breeding for disease resistance, Brief idea about

symptoms; disease cycles and control measures of: Loose smut of wheat, Citrus canker, Late blight of potato, Rust of wheat, Brown spot of Rice& Alternaria blight of Brassica.

UNIT V   **(10 hours)**

Plant physiology: Transport in plants water and mineral uptake, Transpiration- Mechanism of stomatal movement, significance; Photosynthesis-types of photosystem, significance, cycles; Plant Growth regulators**.**

UNIT VI   **(10 hours)**

Economic Botany: Introduction*,* Method of cultivation, processing and utilities of the products of the following: Rice, Tea, Jute and Brassica.

Text Books

1. Phycology by Robert Edward Lee

2. Introduction to Fungi by John Webster

3. Plant Pathology by G.N. Agrios

4. Plant Physiology by Lincoln Taiz, Eduardo Zeiger

Reference Books

5. College Botany Vol. II By Gangulee and Kar

6. Studies in Botany Vol I & II by J.N. Mitra, D. Mitra, S.K. Chaudhuri

BOT12002	Elective Botany I Lab (Practical)	L	T	P	C
Version 1	Contact Hours - 45	0	0	3	2
Pre-requisites/Exposure	10+2 TWO LEVEL BIOLOGY				
Co-requisites	--				

Course Outcome

CO -1   Students will be able to **perceive** the knowledgethe handling of laboratory instruments with maintaining ethical issues collaboratively –Microscope, Autoclave, Incubator, centrifuge, Analytical balance, pH Meter, Colorimeter, Water bath, Distillation plant, Laminar Air Flow operation etc.

CO-2   Students will be able to **compare** between monocot and dicot plants.

CO-3   Students will be able to **catrgorize** plant pigments professionally.

CO-4   Students will be able to **determine** amount of water absorption, retention and transpiration

CO-5   Students will be able to **show** percent, normal, molal and molar solutions of any compound worldwide.

Course Content:

1.   Acquaintance with laboratory instruments –Microscope, Autoclave, **(5 hours)** Incubator, centrifuge, Analytical balance, pH Meter, Colorimeter, Water bath, Distillation plant, Laminar Air Flow operation etc.

2.   Study of the following genera and their identification: *Oscillatoria,* **(3 hours)** *Scytonema, Oedogonium, Chara, Ectocarpus, Polysiphonia.* (vegetative and reproductive structures).

3.   Study of the following genera and their identification: *Rhizopus, Penicillium,* **(3 hours)** *Ascobolus, Agaricus, Polyporus.*

4.   Identification of specimens with diseases prescribed in the theoretical **(4 hour)** syllabus: Loose smut of wheat, Citrus canker, Late blight of potato, Rust of wheat & Brown spot of Rice.

5.   Chemical separation of photosynthetic pigments by paper chromatography. **(3 hours)**

6.   Preparation of percent, normal, molal and molar solutions of any compound. **(4 hours)**

7.   Comparison of imbibitions of starchy, proteinaceous and fatty seeds. **(6 hours)**

8.   Determination of amount of water absorption, retention and transpiration. **(3 hours)**

9.   Demonstration of Guttation. **(2 hours)**

10. Study of Monocot root. **(4 hours)**

11. Study of Dicot root. **(4 hours)**

12. Study of leaves anatomy of different plants. **(4 hours)**

MTH11508	Elective Mathematics-I	L	T	P	C
Version 1	Contact Hours-90 Lecture Hours	6	0	0	6
Pre-requisites/Exposure	12th level Mathematics				
Co-requisites	-				

Course Outcomes:

After completing this course, a student will,

CO1	**Recall** the knowledge to classify numbers into different number sets.
CO2	**Develop** a modern approach to the treatment of the theory of Integers and Complex numbers.
CO3	**Relate** the fundamental knowledge of limit, continuity and derivatives of different types of function.
CO4	**Illustrate** origins and applications of differential equations. Describe what Solutions of Differential Equations mean.
CO5	**Utilize** the knowledge of group theory with binary operations, properties and perceive the knowledge some special groups.
CO6	**Construct** double and triple integrals and its different applications.
CO7	**Make use of** the matrix calculus in solving a system of linear algebraic equations using multiple methods including Gaussian elimination and Matrix inversion methods.

Course Content:

Unit I [20 hours]

Complex numbers: De-Moivre's theorem and its applications, direct and inverse circular and hyperbolic functions, logarithm of a complex number, expansion of trigonometrical functions,

Classical algebra: Relation between the roots and coefficients, fundamental theorem of Classical algebra (no proof required), nature of roots, Descartes rule of signs and of Sturm's theorem, transformation of equations, multiple roots, reciprocal equations, special roots, symmetric function of roots, solutions of cubic equations (Cardan method) and biquadratic equation (errari's method). Cauchy-Schwartz inequality, inequality involving A.M. (including weighted), G.M., H. M. and their applications, m^{th} power theorem.

Set, relation, mapping and algebraic structure: Basic properties of sets, set operations. De Morgan's laws, Cartesian product, relation, equivalence relation, mapping, injection, surjection, bijection, identity and inverse mappings, composition of mappings.

Group Theory: Group, abelian group, examples of groups from number system, roots of unity, matrices, symmetries of squares, triangles etc., groups of congruence classes, Klein's 4 group, order of an element of a group, order of a group, subgroups.

Unit II [15 hours]

Differential calculus: Limit of a function, indeterminate forms and L'Hopital's rule, continuity, derivatives and rates of change, the derivative of a function, derivatives of polynomials and exponential functions, the product and quotient rules, derivatives of trigonometric functions, the chain rule, implicit differentiation, derivatives of logarithmic functions, Roll's theorem, MVTs and their applications, successive differentiation, Leibnitz's rule, maxima and minima, asymptotes, envelopes, arc length, curvature.

Sequence and series: Sequences, series, the integral test and estimates of sums, the comparison tests, alternating series, absolute convergence and the ratio and root tests, strategy for testing series, power series, representations of functions as power series, Taylor and Maclaurin series.

Unit III [15 hours]

Differential equations: First order differential equations: order and degree of a differential equation, separable differential equations, homogeneous differential equations, equations reducible to homogenous differential equations form, linear differential equations and equations reducible to linear differential equations form, integrating factor and exact differential equations,

Modelling using variable separable equations: Growth and Decay, population growth, growth of bacteria, pharmacology, spread of disease,doubling time and half-life, radioactive decay, carbon dating, Newton's law of cooling and heating,modelling of electric circuits: Kirchhoff's voltage law, Kirchhoff's current law.

Unit IV [15 hours]

Functions of several variables: Partial derivatives, the chain rule, the gradient and its properties, directional derivatives, total derivatives and Jacobians, differentials and their invariance, Taylor's formula for functions of several variables, transformation of partial derivatives by change of variables, the inverse and implicit function theorems, local extremal points, global extreme value problems with and without constraints, the Lagrange multiplier method, the method of least squares**,** maxima and minima of functions of several variables, finding critical points, the second derivative test for local maxima/minima and saddle points, the method of Lagrange multipliers.

Unit V [10 hours]

Matrices and Determinants: Matrices of real and complex numbers, Algebra of matrices. Symmetric and skew symmetric matrices. Hermitian and skew-Hermitian matrices. Orthogonal matrices, determinants: definition, basic properties of determinants, minors and cofactors, symmetric and skew-

symmetric determinants, adjoint, invertible matrix, inverse of an orthogonal matrix, echelon matrix, rank of a matrix, determination of rank of a matrix, normal forms.

Solution of system of linear equation.

Unit VI   **[15 hours]**

Integral calculus: The fundamental theorem of calculus (review), indefinite integrals and the net change theorem, the substitution rule, applications of integration, areas between curves, volumes, techniques of integration, integration by parts, trigonometric integrals, trigonometric substitution integration of rational functions by partial fractions, approximate integration, improper integrals. Multiple integrals: Double integrals over rectangles, iterated integrals, double integrals over general regions, triple integral.

Text Books:

T1)   Shanti Narayan,P K, Mittal, *Integral Calculus* , S Chand

T2)   S. K. Mapa, *Higher algebra*, Lavent book distributors.

T3)   Shanti Narayan, *Differential Calculus*. S.Chand Publishers.

T4)   B. N. Mukherjee, B. C. Das, *Key to differential calculus*, U N Dhur& Sons.

T5)   Ghosh, R.K., Maity K.C., *An Introduction to Differential Equations*, New Central book agency private Ltd.

T6)   M. D. Raisinghania, *Ordinary and Partial Differential Equations*, S.Chand.

T7)   S.K. Mapa, *Classical Algebra*, Lavent book publishers.

Reference Books:

R1)   B. S. Vaatsa, *Theory of matrix*, New Age Publication.

R2)   Hoffman and Kunze, *Linear algebra*, Pearson.

R3)   M.D. Raisinghania, *Advanced Differential Equations*,S.Chand.

R4)   S.K. Mapa, *Introduction to Real Analysis*, Lavent Book House

R5)   Shanti Narayan,M. D. Raisinghania, *Elements of Real Analysis*, S.Chand.

R6)   Shepley L Ross, *Introduction to Ordinary Differential Equation*, John Wiley& Sons

ECO11040	Introductory Microeconomics Elective	L	T	P	C
Version 1	Contact Hours - 90	6	0	0	6
Pre-requisites/Exposure	12th level English				
Co-requisites	--				

Course Outcomes

At the end of the course, the student will be able to:

CO1. **Understand** the terminology and analytic principles used in microeconomics in individual decision-making framework

CO2. **Understand** the application of these conceptual tools to several policy issues

CO3. **Analyze** the decisions of buyers and sellers and their interaction in market transactions thereby shaping the equilibrium market outcomes.

CO4. **Explore** different government interventions such as taxes on subsidies on equilibrium outcomes

Course Content:

Unit I: Demand and Supply   (15 Hours)

Determinants of Demand; Law of Demand; Demand Function, Demand Schedule and Demand Curve; Determinants of Supply; Law of Supply; Supply Function, Supply Schedule and Supply Curve; Shift and movement along the Demand & Supply Curve; Elasticity of Demand – Price, Income, Cross; Elasticity of Supply; Substitutes & Complementary Goods, Normal & Inferior Goods. Equilibrium Determination, Impact of changes in Demand and Supply, Change in Equilibrium, Stability of Equilibrium; Consumer Surplus, Producer Surplus, Deadweight Loss, Change in surplus, Incidence of Tax, Impact of Subsidy.

Unit II: Theory of Consumption   (15 Hours)

Budget Constraint: Composite goods, Budget Set, Properties of budget set, Budget Line, change in budget line due to change in income and prices, Application: Taxes, Subsidies, Rationing Preferences: Consumer Preferences, basic assumptions about preferences; Indifference Curves, Indifference Map, Marginal Rate of Substitution; Shape of Indifference curves: Perfect substitutes, perfect complements, Bads, Neutrals, Satiation, Discrete Goods Utility: Cardinal Utility, Utility function, Total utility, Marginal Utility, Ordinal Utility, Preference, MRS Choice:Optimal Choice, Consumer's Equilibrium, Change in Equilibrium due to change in income, and prices, Income Consumption Curve, Engel Curve, Price Consumption Curve, Individual Demand, From individual to market demand; Price Effect: Hicks, Slutsky approach, Income Effect, Substitution Effect, Compensated Demand.

Unit III: Theory of Production   (17 Hours)

Technological relationship between output and inputs, Production decision of a firm; Production function, short run versus long run production; Production with single variable input: TP, AP, MP, Law of diminishing marginal return; Production with two variable inputs: Isoquant, Economic region of production, Input flexibility, Input substitution; MRTS, Elasticity of substitution; Expansion Path, Returns to scale; Effects of changes in input prices on output. Special Cases: Homogeneous Production Function, Cobb-Douglas Production.

Unit IV: Costs of Production (8 Hours)

Different types of costs; opportunity cost, sunk cost; fixed cost, variable cost; Costs in the SR production, TC, AC, MC, Cost curves; Costs in the LR production, LR cost curves, relation between SR and LR cost curves; Shift in cost curves. Input choices, Iso-cost line, Change in technology and change in input prices; optimal choice of inputs, Economies of Scope, Economics of Scale, Learning Curve.

Unit V: Market: Perfect Competition (11 Hours)

Profit Maximization by a firm, Competition in a market, Different forms of Competition; Perfectly competitive market and its characteristics, Choosing output in Short Run, SR supply curve, Choosing output in the Long Run, LR Industry supply curve: Increasing cost industry, Decreasing cost industry, and Constant cost industry; Efficiency of a competitive market: Effect of Tax, Minimum Prices, Price Support, Production Quota, Impact of tax and subsidy.

Unit VI: Market: Imperfect Competition (9 Hours)

Market Power, Sources, Monopoly, Monopsony, Bilateral Monopoly, Natural Monopoly; Monopolist's Output Decision, and pricing. Monopolistic Competition: Characteristics, Equilibrium in Short and Long run, Economic Efficiency; Branding Oligopoly: market structure, collusion, competition, equilibrium.

Text Books:

T1. Intermediate Microeconomics: A Modern Approach. H.R. Varian. East West Press; 8th edition (2010).
T2. Modern Microeconomics. Koutsoyiannis. Palgrave Macmillan; 2nd edition, 2008.

Reference Books:

R1. Microeconomics: Theory and Applications. G.S. Maddala, and E. Miller. McGraw Hill Education (India) Private Limited; 3rd edition, 2004.
R2. Microeconomics. R. S. Pindyck, D.L. Rubinfeld, and P.L. Mehta. Pearson, India, 7th edition, 2013
R4. Principles of Microeconomics. D. Salvatore. Oxford University Press (5th or later edition).
R5. Microeconomic Theory. Ferguson, and Gould. All India Traveler Book Sellers (6th edition).

SOC11003	Introduction to Sociology	L	T	P	C
Version 1		6	0	0	6
Pre-requisites/Exposure	Understand the major concepts and help students develop proficiency with sociological concepts.				
Co-requisites	--				

Course Outcomes

On completion of this course, the students will be able to--

CO1. Have a clear understanding of sociological concepts and terms.

CO2. Use and apply sociological perspectives to their everyday life.

CO3. Construct an understanding of the major social institutions and the relationship between individual and society.

CO4. Identify the process of social stratification.

CO5. Illustrate the significance and the process of social change.

Course Content:

Unit-I (15 hours)
The nature of sociology
The meaning and scope of sociology — the sociological perspective —

Unit-II (15 hours)
The Relationship of Sociology with Other Social Sciences

Unit-III (15 hours)
Basic concepts:
Society, Socialization; community, institution, association, group, culture; social structure, status and role, etc. —

Unit-IV (15 hours)
Institutions- Family and kinship, Religion, education, politics, etc. — Individual and society

Unit-V (15 hours)
Social Stratification

Unit-VI (15 hours)
Social Control and Change

Text Books

1. Abraham.F.2010. Contemporary Sociology: An Introduction to Concepts and Theories.Oxford University press

2. Bottomore, T.B. 1972. Sociology: A guide to problems and literature. Bombay: George Allen and Unwin (India).

3.Giddens,A., 1993.Essentials of Sociology, Uk: Polity Press

4.Harlambos, M. 1998. Sociology: Themes and perspectives. New Delhi: Oxford University Press.

5.Inkeles, Alex. 1987. What is sociology? New Delhi: Prentice-Hall of India.

6.Jayaram, N. 1988. Introductory sociology. Madras: Macmillan India.

7.Johnson, Harry M. 1995. Sociology: A systematic introduction. New Delhi: Allied Publishers.

8.Schaefer, Richard T. and Robert P.Lamm. 1999. Sociology. New Delhi: Tata-McGraw Hill.

9.Jayaram, N. 1988. Introductory sociology. Madras: Macmillan India.

PSG13004	General Psychology	L	T	P	C
Version 1	Contact Hours=90	4	0	3	6
Pre-requisites/Exposure	10 + 2 knowledge				
Co-requisites	-				

Course Outcomes:

CO1: **Classify** the different methods and methods of Psychology.

CO2: **Explain** the different schools of thought in Psychology.

CO3: **Illustrate** the roles of cognitive processes in regulating behaviour.

CO4: **Build** a clear explaining of the different psychological theories in explaining behaviour.

CO5: **Develop** the knowledge of human perceptual process in explaining illusions.

CO6: **Evaluate** different ways of assessing memorization capacity.

Course Contents:

UNIT 1: Introduction- Definition, Methods and Branches of Psychology.   (15 hours)

UNIT 2: Schools of Psychology – Psychodynamic, Behavioural and Gestalt   (15 hours)

UNIT 3: Attention and Sensation   (15 hours)

     a) Determinants of attention, shift, fluctuation, oscillation and distraction.

     b) Sensation and Perception; Attributes of sensation.

UNIT 4: Perceptual Processes: (15 hours)

     a) Perception of form, space, movement and time.

     b) Optical illusions.

UNIT 5: Emotion – Nature, Basic Emotions, Physiological Correlates of Emotion.   (15 hours)

Perceive the knowledgeing processes: nature and factors of perceive the knowledgeing; theories: trial and error, conditioning – classical and operant; insight; transfer of training, programmed perceive the knowledgeing.

Unit: 6 Practicum: (15 hours)

Perception- To explain the effect of knowledge of results on the extent of Muller- Lyer illusion in the subject.

Memory- Effect of spaced and unspaced method of perceive the knowledgeing on memorization capacity of the subject

Readings:

1. Atkinson, R.L., Atkinson,R.C., Smith, E.E., &Hilgard, E.R. : Introduction to Psychology, (Latest Edition). Harcourt Brace Java Publishers, Tokyo.

2. Baron, R.A. : Psychology: The Essential Science. Allyn and Bacon, New York, 1995.

3. Gallotti, K.M.: Cognitive Psychology– In and Out of the laboratory. 2nd Ed, Int. Thomson Pub. Co. Bangalore, 2000.

4. Lahey, B.B.: Psychology: An Introduction, 6th Ed., Tata McGraw Hill, New York, 1965.

5. Lefton, L.A.: Psychology, Allyn and Bacon, Boston, 1985.

6. McGuigan, F.J.: Experimental Psychology: A Methodological Approach, Prentice- Hall,1990.

7. Mohsin, S.M.: Research Methods in Behavioral Sciences, Orient Longman, Calcutta, 1981.

8. Morgan, C.T., King, R.A., Weisz, J.R., &Schopler, J: Introduction to Psychology (International Student Edition) McGraw Hill Book Co., 1986.

9. Munn, N.L., Fernald, L.D., and Ferhald, P.S.: Introduction to Psychology, Third Edition, Oxford IBH Publishing House Co., Calcutta 1972.

10. Olson, M.; Hergenhahn, B.R.: Introduction to the Theories of Perceive the knowledgeing, Prentice-Hall India, 2009.

11. Rathus, S.A.: Psychology in the New Millenium. Prism Books Pvt Ltd. Bangalore, 1999.

12. Woodworth, R.S. & Schlosberg, H.: Experimental Psychology (Latest Edition) Primlani, Oxford and MBH Publishing Co. Calcutta.

SEMESTER II

GEO11007	Human Geography	L	T	P	C
Version 1		6	0	0	6
Pre-requisites/Exposure	HS level human geography knowledge				
Co-requisites	Elementary level knowledge on social sciences				

Course Outcomes

On completion of this course, the students will be able to:

CO1. **Summarize** the concepts of social structure, social processes, social pattern, and social space.
CO2. **Explain** the social well-being controlled by various social elements and issues.
CO3. **Relate** the elements of culture, cultural groups, and cultural processes contributing in the development of cultural landscapes.
CO4. **Describe** the history and evolution of human societies in different regions.

Course Content

Unit 1: Concept and Components of Social Geography (15 hours)
Definition, Scope and Content of Social Geography, Social Structure and Social Processes: Macro and Micro; Social Patterns, Concept of Space: Social Space, Material Space; Social Elements; Caste, class, religion, race and their spatial distribution; Social Area Analysis

Unit II: Social Wellbeing and Planning (15 hours)
Concepts of social well-being, quality of life: Gender and social well-being – Health and nutrition, housing, education and empowerment; Social geographies of inclusion and exclusion: Slums, gated communities, communal conflicts and crime; Social Impact Assessment: Concept and importance

Unit III: Cultural Geography (15 hours)
Concept of culture in Geography; Definition, scope and content of cultural geography, Cultural Groups: Ethnic, linguistic and religious; Cultural hearth and realm, Cultural regions, Cultural landscape; Cultural assimilation, integration and diffusion

Unit IV: Human Adaptation to the environment: (15 hours)
Evolution of human societies: Hunting and food gathering, pastoral nomadism, subsistence farming and industrial society; Development–environment conflict; Human adaptation to environment: case studies of Eskimo, Bushman, Beduin; Gonds, Masai, Maori, Gujjars.

Recommended Readings:

1. Ahmed, A (2004) : Social Geography, Rawat Publication, New Delhi
2. Chapman, K. (1979): People, Pattern and Process – An Introduction to Human Geography
3. Ghosh, S (2020): A Brief Account of Human Geography, Educreation Publishing.
4. Grover, N. (2004): Cultural Geography: Form and Process, Concept Publishing Co.
5. Guha, R. C: Social Geography. Rawat Publication, New Delhi
6. Chandna, R.C. 2016. Geography of Population: Concepts, Determinants and Patterns, Kalyani Publishers.

7. Fouberg, E.H., Murphy, A.B., de Blij H.J. 2015. Human Geography: People, Place, and Culture, 11th ed, Wiley.
8. Ghosh, S. 1998. Introduction to Settlement Geography, Sangam Books Ltd.
9. Gould, W.T.S. 2015. Population and Development, Routledge.
10. Gregory, D., Johnston, R., Pratt, G., Watts., Whatmore, S. (Eds) 2009. The Dictionary of Human Geography, 5th ed, Wiley.
11. Knox, P.L., Marston, S.A. 2014. Human Geography: Places and Regions in Global Context, 6th ed, Pearson Education Limited.
12. Knox, P.L., McCarthy, L.M. 2011. Urbanization: An Introduction to Urban Geography, 3rd ed, Pearson Educztuion Ltd.
13. Mandal, R.B. 2001. Introduction to Rural Settlement, 2nd ed, Concept Publishing Company.
14. Moseley, W.G., Perramond, E., Hapke, H.M., Laris, P. 2013. An Introduction to Human-Environment Geography: Local Dynamics and Global Processes, Wiley-Blackwell.
15. Norton, W. 2014. Human Geography, 8th ed, Oxford University Press.
16. Pickering K. and Owen A. A. (1997): An Introduction to Global Environmental Issues, 2nd edition Rutledge, London.
17. Rubenstein, J.M. 2016. The Cultural Landscape: An Introduction to Human Geography, 12th ed, Pearson Education Limited.
18. Short, R.J. 2017. Human Geography: A Short Introduction, 2nd ed, Oxford University Press.

GEO12008	Thematic Cartography and Geological Map Interpretation Lab	L	T	P	C
Version 1		0	0	6	4
Pre-requisites/Exposure	Basic coordinates and basic geology knowledge				
Co-requisites	--				

Course Outcomes

On completion of this course, the students will be able to

CO1. **Demonstrate** the different techniques of surveying.

CO2. **Apply** the knowledge and skills of surveying and levelling for land measurements with the help of prismatic compass and dumpy level.

CO3. **Describe** the fundamentals of geologic structure and geological mapping.

CO4. **Interpret** the geological structures and landform development from Geological maps.

Course Content

Unit I: Surveying and Levelling (45 hours)
Surveying and Levelling - Concept and Classification, Closed and Open traverse survey by Prismatic Compass, Longitudinal /profile levelling by Dumpy Level; Contouring by levelling along radial line by a Dumpy Level: at least three radial lines to be set out from a common centre and their relative position to be obtained by measurement of magnetic bearing and/or included angle by Prismatic Compass, Micro slope analysis using Abney level.

Unit II: Geological Map (45 hours)
Study of Horizontal, Vertical and tilted beds along with alignment of contours: Study of strike, dip and bedding plane, Drawing of sections on uniclinal and simple folded structures depicting unconformity, succession of beds and their thickness, Interpretation of the section covering geological history and relation between topography and structure.

Unit III: Laboratory notebook and viva voce

Recommended Readings:

1.Gopal Singh (1996) – Map Work and Practical Geography, Vikas Publications, New Delhi.
2.Kanetkar, T.P. and Kulkarni, S.V. 1972: Surveying and Levelling, Part I & II, Pune Vidyarthi Griha
3.Prakashan, Pune.
4.Mishra, R.P.and Ramesh (1989) – Fundamentals of Cartography, Concept, New Delhi.
5.Monk house, F.J and Wilkinson, M.R.(1968) _ Maps and Diagrams, Methuen, London
6.Negi, B.S. (1998) –Practical Geography, Kedarnath and Ramnath, Meerut.
7.Robinson, A.H. (1995) – Elements of Cartography, John Willey, New York.
8.Sarkar, Ashis, Practical Geography: A Systematic Approach, Orient Longman Pvt. Ltd.

9.Misra, R.P. and Ramesh, A. 1986: Fundamentals of Cartography, McMillan, New Delhi.
10. Plat: Basics and Advanced Geological Maps (Selected Exercise)

MTH11511	Basic Mathematics II	L	T	P	C
Version 1		4	0	0	4
Pre-requisites/Exposure	Class 12 Mathematics				
Co-requisites	--				

Course Outcomes:

On completion of this course, the students will be able to

CO1: **Find** the derivatives of polynomial and trigonometric functions, and perform various algebraic operations on derivatives.

CO2: **List** the various methods of integration and also compute the area under a simple curve.

CO3: **Define** the types of vectors, vectors addition, and multiplications of a vector by a scalar.

CO4: **Explain** the general form of a straight line and plane with their basic properties to be used in co-ordinate Geometry.

CO5: **Solve** simple constrained and unconstrained optimization problems by using the graphical method and linear programming methods.

Course Content:

Unit I: Limits and Derivatives (15 hours)

Derivative introduced as rate of change both as that of distance function and geometrically, intuitive idea of limit. Definition of derivative, relate it to slope of tangent of the curve, derivative of sum, difference, product and quotient of functions. Derivatives of polynomial and trigonometric functions.

Unit II: Integration (10 hours)

Integration as inverse process of differentiation. Integration of a variety of functions by substitution, by partial fractions and by parts. Finding the area under simple curves.

Unit III: Vector (15 hours)

Vectors and scalars, magnitude and direction of a vector. Direction cosines/ratios of vectors. Types of vectors (equal, unit, zero, parallel and collinear vectors), position vector of a point, negative of a vector, components of a vector, addition of vectors, multiplication of a vector by a scalar.

Unit IV: Co-ordinate Geometry (10 hours)

Direction cosines/ratios of a line joining two points. Cartesian and vector equation of a line, coplanar and skew lines, shortest distance between two lines. Cartesian and vector equation of a plane. Angle between (i) two lines, (ii) two planes, (iii) a line and a plane. Distance of a point from a plane.

Unit V: Linear Programming (10 hours)

Related terminology such as constraints, objective function, optimization, different types of linear programming (L.P.) problems, mathematical formulation of L.P. problems, and graphical method of solution for problems in two variables, feasible and infeasible regions.

Text Books:

1. Grewal, B. S., Higher engineering mathematics, Khanna publishers.

Reference Books:

1. Ramana, B. V., Higher Engineering Mathematics, Mcgraw Hill Education Private Limited

EVS11112	Environmental Science	L	T	P	C
Version 1	Contact Hours – 30	2	0	0	2
Pre-requisites/Exposure	Basic physics, chemistry, mathematics of +2 level.				
Co-requisites	--				

Course Outcomes:

On completion of this course, the students will be able to

CO 1: Compare between various types of ecosystems, ecosystem dynamics, perceive and appreciate the surrounding nature.

CO 2: Perceive the intrinsic relation between humans and the environment, our position in the ecosystem around us, and the importance of biodiversity.

CO 3: Identify the presence of various pollutants, their significance, and impacts, and develop the underlying concepts involved in various air pollution prevention and mitigation measures.

CO 4: Estimate the importance of natural resources including energy resources.

CO 5: Relate to the legal framework in our country for safeguarding the environment including pollution prevention, control, management, and wildlife management.

Course Content

Unit I: Resources

Multidisciplinary nature of environmental sciences; scope and importance; need for public awareness; concept of sustainability and sustainable development

Forest resources: Function of forests, cause and effects of deforestation, case studies.

Water resources: distribution of water, hydrological cycle, use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies

Food Resources: World food problems and environmental concern, Food security, case studies

Energy resources: Concept of energy, SI Units of Work, Heat and Power, World energy use, Energy consumption pattern in India and U.S., Environmental aspects of energy utilization Renewable and non-renewable sources; Fossil fuel: types, use and environmental impacts, Solar energy: Solar Radiation – Passive and active solar systems – Flat Plate and Concentrating Collectors – Solar direct Thermal Application– Fundamentals of Solar Photo Voltaic Conversion- advantages and disadvantages of Solar Power generation, Solar energy status in India; Wind Energy: site selection, Wind turbine: basic working principle and types, Wind energy status in India, advantages and disadvantages of Wind Power generation; Hydroelectric power : How is it generated, advantages and disadvantages; Biomass energy: various types, generations of biofuel, Biogas plants, Bio diesel;

Geothermal Energy: source, advantages and disadvantages, Nuclear Power: nuclear fission, moderation of reaction, nuclear reactor: pressurized water reactor, advantages and disadvantages

Unit II: Ecosystems and Biodiversity and its conservation

Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Food chains, food webs and ecological pyramids, energy flow, ecological succession, Levels of Biodiversity: genetic, species and ecosystem diversity. Biogeographical classification of India, Values of biodiversity, Biodiversity at global, National and local levels, India as a mega-diversity nation, Biodiversity hotspots, Threats to Biodiversity, In-situ and Ex-situ conservation of Biodiversity

Unit III: Environmental Pollution and Waste Management

Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution, marine pollution; case studies. Nuclear hazards and human health risks.
Sources and generation of solid wastes, their characterization, chemical composition and classification. Different methods of disposal and management of solid wastes, Recycling of waste material. Waste minimization technologies.

Unit IV: Global Issues and Environmental Acts if India

Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents, habitat loss, Holocene Extinction.
International agreements on Environmental conservation and pollution prevention.
Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and Control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. Waste Management Rules, 2016   and other important acts.

Text Books:

1. Principles of Environmental Science, 4th edition by Cunningham, W.P. and Cunningham, M.A. (2002), Tata McGraw-Hill Publishing Company, New Delhi
2. Basic Environmental Engineering & Elementary Biology by Monidranath Patra and Rahul Kumar Singha, Aryan Publishing house
3. Introduction to Environmental Engineering and Science, by Masters, G.M., Prentice Hall of India, Second Indian Reprint.

Reference Books:

1 Wastewater Engineering: Treatment and Reuse, 4th Edition, Metcalf and Eddy, Inc. McGraw-Hill, Inc., New York, 2002
2 Environmental Engineering", Howard S. Peavy, Donald R. Rowe and George Tchobanoglous, McGraw-Hill Education (India) Private Limited, New Delhi
3 Introduction to Environmental Engineering, 2nd Ed. by Davis, M. L. and Cornwell D. A. McGraw Hill, Singapore.
4 Environmental Sciences: The Environment and Human Impact by Jackson, A.R.W. and Jackson, J.M., Longman Publishers

EIC11001	Venture Ideation	L	T	P	C
Version 1		2	0	0	2
Pre-requisites/Exposure	Basic knowledge of English and computer applications such as Internet Explorer and MS Office				
Co-requisites	--				

Course Outcomes

On completion of this course, the students will be able to:

CO1. **Assess** personal capacity in the context of the entrepreneurial process
CO2. **Assess** characteristics of successful entrepreneurs and entrepreneurial forms and processes
CO3. **Apply** resources, research and tools for Entrepreneurial ventures
CO4. **Analyze** and apply opportunity identification techniques, feasibility terminology, processes and models
CO5. **Develop** Ideation and planning documents for entrepreneurial venture

Course Content

Unit 1. Introduction (6 hours)
Preview of the Course, Introduction to the Course, Guest Lecture with U.S. Secretary of Commerce Penny Pritzker – Meaning of Innovation, Entrepreneurial opportunities, Factors influencing the feasibility of an innovation, Innovation strategy: technology-push or market-pull, Product-market fit, How to develop a business model, Walkthrough of the business model canvas, Welcome to Innovation for Entrepreneurs: From Idea to Marketplace.

Unit 2. Customer Discovery and Validation (6 hours)
Customer types, Customer archetypes, Customer segments and business models, Customer segments, value propositions, product features, value mapping, interviewing customer, insights of your customers.

Unit 3: Product Understanding and Marketing. (6 hours)
Customer value, The DNA of customer-centricity, Crossing the chasm, Qualitative and quantitative marketing research, importance and methods of market segmentation, Focusing on the target market, Beyond the chasm, Strategic implications of beyond the chasm, E-commerce: The internet as a selling platform.

Unit 4. Prototyping and Testing. (6 hours)
Planning for prototyping, Rapid prototyping and development, Lean startup MVPs, Choosing a wire framing/UX prototyping tool, Anatomy of an experience map, What you'll learn from user testing, Analytics and insight, Troubleshooting your customer discovery, Levels of a product/service.

CHM11153	Elective Chemistry II	L	T	P	C
Version 1		4	0	0	4
Pre-requisites/Exposure	Physics and Chemistry of class 12 or 10+2 level				
Co-requisites	Partial differentiation, model making, graph plotting				

Course Outcomes for SCY32208

On completion of this course, the students will be able to

CO-1   **Describe** fundamental principles and theories for stabilisation/destabilisation of colloidal systems.

CO- 2   To **explain**, using LeChâtelier's Principle, how the equilibrium quantities of reactants and products are shifted by changes in the parameters of the chemical reactions.

CO-3   **Understand** the properties of solutions that depends on the number of dissolved particles in solution, but not on the identities of the solutes.

CO-4   To justify a reasonable mechanism for a chemical reaction.

CO-5   **To** study the acid-base concept in aqueous and non-aqueous media and reactions in non-aqueous media.

CO-6   **To understand** the fundamental tasks performed by inorganic elements in living organisms as well as the related methods.

CO-7   **To identify** the structure of unknown/new compounds with the help of different spectroscopic methods like UV-Visible, IR and NMR spectroscopic Technique.

Course Content:

Physical Chemistry-II

Unit-I: Colloids   **(5 Hours)**

Colloids and crystalloids; classification of colloids; Preparation and purification of colloids; Properties of colloids: Brownian motion, peptization, dialysis, Tyndal effect and its applications. Protecting colloids, Gold number, Isoelectric points, Coagulation of colloids by electrolytes, Schulze-Hardy rule

Unit II: Chemical and Ionic equilibrium   **(10 Hours)**

Concept of Gibbs Free Energy; Criteria for thermodynamic equilibrium and spontaneity of a process; Chemical equilibria of homogeneous and heterogeneous systems, Derivation of expression of equilibrium constants; Temperature, pressure and concentration dependence of equilibrium constants (K_p, K. Kx); Le Chatelier's principle of dynamic equilibrium.Strong, moderate and weak electrolytes,

degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di-and triprotic acids (exact treatment).Concept of salt hydrolysis; Buffer solution and buffer capacity.

Organic Chemistry I

Unit-I: Fundamentals of Organic Chemistry and Stereochemistry: (5 Hours)

Functional group-based classification and nomenclature; Sources I origin of different compounds; Concept of hybridization; resonance (including hyperconjugation); inductive effect; steric effect; steric inhibition of resonance. Orbital pictures of bonding (spa, sp^2, sp: C-C, C-N & C-O system).

Stereochemistry: Symmetry elements, Molecular chirality, Concept of Stereo Centre, Representation of molecules in Fischer projection, Concept of E/Z and Cis-Trans stereo-isomers.

Unit-II: (3 Hours)

Mechanistic classification: ionic, radical and pericyclic; heterolytic and homolytic bond cleavage and bond formation; representation of mechanistic steps using formalism. Reactive intermediates: carbocations (cabenium and carbonium ions), Carbanions, Carbon radicals, Carbenes-structure using orbital picture, Electrophilic/nucleophilic behaviour, Stability, generation and fate (elementary idea); Nucleophilic and electrophilic substitution reaction (only spcentre); Introduction to Elimination reaction and its types.

Unit-III: (7 Hours)

Basic Organic Reactions:(Addition, Substitution, Elimination, Rearrangement Reactions) Addition Reactions: Halogenations, Hydration, Hydrogenation, Epoxidation, Hydroxylation, Ozonolysis, electrophilic addition to diene; Hydroboration-oxidation reaction; Radical addition: HBr addition, Birch Reduction. Nucleophilic addition to carbonyl group.

Substitution Reactions: SN 1 , SN2, NGP, Elimination Reactions: El, E2, Elimination vs. Substitution, Rearrangement Reactions: Rearrangement to electron-deficient carbon: Wagner-Meerwein rearrangement, pinacol-pinacolon and related rearrangements, dienone-phenol.

Inorganic Chemistry-II:15L

Unit-I: (7 Hours)

Acids-Bases and Redox: Bronsted- Lowry concept of acid-base reaction, solvated proton, types of acid-base reactions, levelling solvents, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) Application of HSAB principle. Theory of acid-base titration and significance of Acid-base indicators.Common ion effect ;Ion-electron method of balancing equation of redox reaction. Elementary idea on standard redox potentials with sign conventions; Nernst equation (without derivation);redox indicators

Unit-II: (8 Hours)

Bioinorganic Chemistry:

Elements of life: essential major, trace and ultra-trace elements; Basic chemical reactions in the biological systems and the role of metal ions (specially Na^+, K^+, Mg^{2+}, Ca^{2+}, Fe^{3+}, $12+$, Cu^{2+}, R-,and Zn^{2+});Biological functions of haemoglobin and myoglobin.

Spectroscopy: 15 L

Unit-I:

UV-Vis Spectra: Electronic transition, relative positions of k-max, Woodward's empirical rule; Labert-Beers Law.

Unit-II:

IR Spectra: Modes of molecular vibrations, application of Hooke's law, characteristic stretchingfrequencies and factors effecting stretching frequencies.

Unit-III:

NMR Spectra: Preliminary idea of NMR, Nuclear spin, NMR active nuclei, Equivalent and non-equivalent carbons and protons; Chemical shift 6; Shielding deshielding, Upfield and Downfield shifts.

Unit-IV:

Photochemistry: Fluorescence and phosphorescence; Quantum Yield; Jablonsky diagram

Reference Books:

Physical Chemistry:

1. D. A. Mcquarrie and J. D. Simon: Physical Chemistry — A Molecular Approach

2. G. W. Castellan: Physical Chemistry

3. P. W. Atkins: Physical Chemistry

Organic Chemistry:

1.D. Nasipuri: Stereochemistry of organic compounds: Principles and Applications

2.P. Sykes: A Guide to Mechanism in Organic Chemistry

3. R. T. Morrison and R. N. Boyd: Organic Chemistry

Inorganic Chemistry

1. Bioinorganic Chemistry. Asim K. Das.

Spectroscopy.

CHM12154	Elective Chemistry Lab II	L	T	P	C
Version 1		0	0	3	2
Pre-requisites/Exposure	Physics and Chemistry of class 12 or 10+2 level				
Co-requisites	Partial differentiation, model making, graph plotting				

1. Organic Spectroscopy. William Kemp.

Course Outcomes

On completion of this course, the students will be able to

CO-1   To acquaint students with various quantitative determination methods using small instruments.

CO-2   To detect qualitative determination of various acid and basic radicals in an inorganic complex.

CO-3   To identify various functional groups in the given organic compounds.

Course Content:

Practical IIa: **(25 Hours)**

1. Determination of E^0 of Fe^{+3}/Fe^{+2} couple in the hydrogen scale by potentiometric titration of ferrous ammonium sulfate solution using $KMnO_4$, or, $K_2Cr_2O_7$ as standard.

2. Determination of concentration of (i) $AgNO_3$ solution and (ii) solubility product of AgC1 by potentiometric titration of standard KC1 solution against $AgNO_3$ solution.

3. Detection of some acid and basic radicals present in water, soil etc.

Practical IIb: **(20 Hours)**

1. To study the kinetics of inversion of sucrose using polarimeter.

2. Experiment A: Detection of special elements (N, Cl, and S) in organic compounds. Experiment B: Solubility and Classification (solvents: H20, dil. HC1, dil. NaOH) Experiment C: Detection of functional groups -NO2, -NH2, -COOH, carbonyl (-CHO, >C=0), -OH (phenolic) in solid organic compounds.

References:

1. Das, S.C. Advanced Practical Chemistry, Sixth edition

ZOL11003	Elective Zoology II (Theory)	L	T	P	C
Version 1	Contact Hours - 60	4	0	0	4
Pre-requisites/Exposure	10+2 level biology				
Co-requisites	--				

Course Outcomes

On completion of this course, the students will be able to

CO1. Know about habitat and niche, ecotone, edge effect, ecological succession.

CO2.   Understand the significance of energy flow in ecosystem and ecological succession, variation and ecological process which implement changes in learning towards a sustainable development.

CO3. Compare and analyze between population growth curves, life strategies.

CO4. Understand and correlate between different animal behaviour, bee dancing which follows future practice of ethical philosophies.

CO5. Solve the analytical problems on density, mortality, natality from fecundity tables and life tables and population genetics.

Course Content

Unit 1: Introduction to Ecology   (4 Hours)

History of ecology, Autecology and synecology, Levels of organization.

Unit 2: Population   (9 Hours)

Unitary and Modular populations.Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion. Exponential and logistic growth, equation and patterns, r and K strategies.Population regulation - density-dependent and independent factors.

Unit 3: Community   (9 Hours)

Community characteristics: species richness, dominance, diversity, Ecotone and edge effect. Ecological succession with one example.

Unit 4: Ecosystem   (9 Hours)

Types of ecosystems with one example in detail, definition, components, energy flow, food chain, food web, and ecological pyramids.

Unit 5: Historical review of evolutionary concept (9 Hours)

Lamarckism, Darwinism, Neo-Darwinism, Geological time scale.

Unit 6: Sources of variations and Population genetics (9 Hours)

Heritable variations and their role in evolution, Hardy-Weinberg Law (statement and derivation of equation, application of law to human Population); Evolutionary forces upsetting H-W equilibrium; Natural selection (concept of fitness, selection coefficient, derivation of one unit of selection for a dominant allele, genetic load, mechanism of working, types of selection, density-dependent selection, heterozygous superiority, kin selection, adaptive resemblances, sexual selection. Genetic Drift (mechanism, founder's effect, bottleneck phenomenon; Role of Migration and Mutation in changing allele frequencies), Speciation.

Unit 7: Animal Behaviour (9 Hours)

Instinctive and learning behaviour, Fixed action pattern, Communication in honeybees (dance Language), Elements of Sociobiology: Altruism and selfishness.

Unit 8: Biodiversity (9 Hours)

Basic concept of Biodiversity, Biodiversity hotspots, Conservation of wild life- purpose & methods, concept of Biosphere Reserve, importance & strategies of wildlife conservation; conservation act and application. National park & Wildlife Sanctuary, Animal cruelty and prevention act.

Reference Books

1. Colinvaux, P. A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc.
2. Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings.
3. Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
4. Robert Leo Smith Ecology and field biology Harper and Row publishers
5. Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Press
6. Ridley,M (2004) Evolution III Edition Blackwell publishing
7. Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.

ZOL12004	Elective Zoology Lab II (Practical)	L	T	P	C
Version 1	Contact Hours - 60	0	0	3	2
Pre-requisites/Exposure	10+2 two level biology				
Co-requisites	--				

Course Outcomes

On completion of this course, the students will be able to

CO1. Identify and compare between fossil specimens and also learn how to construct phylogenetic tree and draw them.

CO2. Understand the importance of field trip and they will get more interest on the subject as they learn how to work in the field trip effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

CO3. Learn, calculate and analyse Shanon-Weiner diversity index for the same community.

CO4. Solve the analytical problems on Hardy-Weinberg Law by chi square analysis.

CO5. Compare and analyze between survivorship curves of different types from the hypothetical/real data provided.

Course Content

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided. **(10 Hours)**

2. Determination of population density in a natural/hypothetical community by quadrate method and calculation of Shannon-Weiner diversity index for the same community. **(10 Hours)**

3. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary. **(10 Hours)**

4. Study of fossils from models/ pictures. **(10 Hours)**

5. Study and verification of Hardy-Weinberg Law by chi square analysis. **(10 Hours)**

6. Construction of phylogenetic trees and its interpretation. **(10 Hours)**

Reference Books

11. Barnes, R.D. (1992). Invertebrate Zoology. Saunders College Pub. USA.
12. Campbell & Reece (2005). Biology, Pearson Education, (Singapore) Pvt. Ltd.
13. Kardong, K. V. (2002). Vertebrates Comparative Anatomy. Function and Evolution. Tata McGraw Hill Publishing Company. New Delhi.

BOT11003	Elective Botany II	L	T	P	C
Version 1	Contact Hours - 60	4	0	0	4
Pre-requisites/Exposure	12ᵗʰwith Biology as one subject				
Co-requisites	12ᵗʰ level English				

14. Ruppert, Fox and Barnes (2006) Invertebrate Zoology. A functional Evolutionary Approach 7th Edition, Thomson Books/Cole
15. Raven, P. H. and Johnson, G. B. (2004). Biology, 6th edition, Tata McGraw Hill Publications. New Delhi

Course Outcomes

On completion of this course, the students will be able to

CO1. Students will be able to **illustrate** in detail about *Moses and Ferns*in various aspects and also their implementation for commercial purposes;

CO2. Students will be able to **explain** and Categorize in detail various divisions of *Gymnosperms* and their commercial importance as well harmful effects;

CO3. Students will be able to **infer** basic knowledge in Angiospermic plants and also be able to explain various divisions for explaining in details;

CO4. Students will be able to **construct** fundamental knowledge about surrounding ecosphere and biosphere and their corelations;

CO5. Students will be able to explain and **summarize** the basic concept of pharmacognosy and also can be able implement this knowledge in applied fields;

CO6. Students will be able to **develop** fundamental knowledge in plant biotechnology and can be implemented this skill for cultivation practices and commercial uses.

Course Content: **(60 hours)**

UNITI   **(10 hours)**

Moses and Ferns:

Bryophytes: Introduction, Basic classifications, Diagnostic characters of important families with examples, Economic importance.

*Pteridophytes:*Introduction, Basic classifications, Diagnostic characters of important families with examples, Economic importance.

UNITII   **(10 hours)**

*Gymnosperms:*Introduction, Basic classifications, Diagnostic characters of important families with examples, Economic importance.

UNITIII   (10 hours)

*Angiosperm:*Brief ultra-structure of plant cell and tissues, Brief description of Plant Architecture (vegetative and reproductive parts); Taxonomic Definitions, principles, Outline of the system of classification with examples, Herbarium, ICBN(ICN), Diagnostic features of important angiospermic families.

UNIT IV   (10 hours)

Plant Ecology: Population and community ecology, Ecological Succession, Major Ecosystems and ecological adaptations, Environmental Pollution and its effects on plants, Biodiversity and conservation, Bio/Phytoremediation and their environmental significance.

UNIT V   (10 hours)

Pharmacognosy: A brief idea about pharmacognosy, discuss about- active principles; Pharmacopeia and adulteration; Study of the following drug plants (Diagnostic features, active principles and uses): *Rauwolfia serpentina* (root), *Adhatoda vasica* (leaf), *Strychnos nuxvomica* (seed), *Cinchona succirubra* (bark), Business review of herbal industry.

UNIT VI   (10 hours)

Plant Biotechnology: Plant Tissue Culture: Introduction, Composition of media; Nutrient and hormone requirements, Types, Applications, In vitro germplasm conservation; Methods of gene transfer: Agrobacterium-mediated, Direct gene transfer methods; Applications of Biotechnology: Problems and prospects of transgenic crops and their commercial utilizations

Text Books

1 Bhojwani S S & Dantu P K Plant Tissue Culture: An introductory text
2.Odum, E. P. 1971. Fundamentals of Ecology. W.B Sounders Co., Philadelphia
3. TrigianoR N & Gray D J Plant Tissue Culture, Development and Biotechnology
4. Trease & Evans: Pharmacognosy

Reference Books

5. College Botany Vol. II By Gangulee and Kar

6. Studies in Botany Vol I & II by J.N. Mitra, D. Mitra, S.K. Chaudhuri

BOT12004	Elective Botany II Lab	L	T	P	C
Version 1	Contact Hours –45	0	0	3	2
Pre-requisites/Exposure	12th with Biology as one subject				
Co-requisites	12th level English				

Course Outcomes

On completion of this course, the students will be able to

CO1. Students **develop** their skill by hands on training in laboratory Experiments on Imbibition in Plants

CO2. Students will be able to **design** and explain Root Pressure in Plants;

CO3. Students will be able to **explain** by performing Demonstration of opening & closing of stomata;

CO4. Students will be able to **compose** fundamental knowledge and can be implemented this skill for demonstrating Transpiration in Plants;

CO5. Students will be able to **illustrate** and explain Demonstration of respiration;

CO6. Students will be able to **elaborate** experiments for Osmosis in Plants;

CO7. Students **organize** their skill by hands on training in laboratory Experiments on performing Plasmolysis in Plants

CO8. Students **develop** their skill by hands on training in laboratory for Photosynthesis in Plants;

CO9. **Explain** the importance of plant growth and development by demonstration and hands on training;

CO10.   Students develop their skill by **demonstration** and hands on training in laboratory basic techniques use for plant tissue culture;

CO11.   **Perceive** the knowledge and develop the knowledge of using different modern tools and techniques in the field of biology which will help in their further academics.

Course Content:

UNITI   **(5 hours)**
Experiments on Imbibition in Plants

UNITII   **(5 hours)**
Experiment on Root Pressure in Plants

UNITIII **(3hours)**
Demonstration of opening & closing of stomata

UNIT IV
Experiments on Respiration in Plants **(2 hours)**

UNIT V **(5 hours)**
Experiments on Osmosis in Plants

UNIT V I **(5 hours)**
Experiments on Ascent of Sap in Plants

UNIT VII **(2 hours)**
Experiments on Plasmolysis in Plants

UNIT VIII **(3hours)**

Experiments on Photosynthesis in Plants

UNIT IX **(5 hours)**
Experiments on Plant growth

UNIT X **(5 hours)**
Basic plant tissue culture techniques: Media composition and Preparation of media Sterilization and contamination, Initiation of aseptic cultures from seed, isolated embryos and other explants

UNIT XI **(5 hours)**
Local Excursions and Field records

Text Books

1. Hopkins, W.G. and Huner, P.A. 2008 Introduction to Plant Physiology. John Wiley and Sons.

2. Plant cell culture – A practical approach by Dixion RA. 1995

Reference Books

1. Practical Botany, Volume II, S C Samanta

MTH11509	Elective Mathematics II	L	T	P	C
Version 1		6	0	0	6
Pre-requisites/Exposure	10th / 12th level Mathematics				
Co-requisites	-				

Course Outcomes

On completion of this course, the students will be able to

CO1. Define a real vector spaces, subspaces and various concepts on it

CO2. Extend the knowledge on ordinary differential equation

CO3. Find Series solution of differential equations by Power series method, Legendre's polynomials, and Bessels function

CO4. Solvevibrating string problem, heat conduction problem, Laplace and beam equationusing Lagrange's method, Charpit's method and Method of separation of variables for second order partial differential equations

CO5. Define Laplace transform and Fourier transform and obtain solutions of ordinary differential equations

CO6. Illustratevarious numerical methods with examples to obtain numerical integration and solutions of algebraic and transcendental equations, differential equations

CO7. Findthe errors in computation by numerical methods

CO8. Define analytic functions and study various concepts on it.

Course Content

Unit I **(18 Hours)**

Vector / linear space: Definitions and examples, subspace, linear combination, independence and dependence, linear span, basis, dimension of a vector space, null space, rank-nullity theorem (statement), linear transformation, translation, rotation, matrix representation of linear transformation, Eigen values and eigenvectors of matrices and their properties, Cayley-Hamilton, AM, GM, diagonalizations, quadratic forms, definiteness.

Unit II **(15 Hours)**

Advanced differential equation: linear differential equations of order 2, homogeneous linear equations of arbitrary order with constant coefficients, non-homogeneous linear equations with constant coefficients, Euler and Cauchy's equations, method of variation of parameters, system of linear differential equations. Series solution of differential equations, Power

series method, Legendre's equation and Legendre's polynomials, Bessel's equation, Bessels function and its application

Unit III (15 Hours)

Partial differential equation of first order, Lagrange's method, some special types of equation which can be solved easily by methods other than general method, Charpit's method, Method of separation of variables for second order PDE, vibrating string problem, existence and uniqueness of solution of vibrating string problem, heat conduction problem, existence and uniqueness of solution of heat conduction problem, Laplace and beam equation, non-homogeneous problem.

Unit IV (17 Hours)

Laplace Transforms: Motivation, Definition, Linearity property, Laplace transforms of elementary functions, shifting theorem Inverse Laplace transforms of derivatives and integrals, Convolution theorem, Application of Laplace transforms in solving ordinary differential equations

Fourier series: Periodic functions, Euler's formulae. Fourier expansion of periodic functions with period 2, Dirichlet's conditions, Fourier series of even and odd functions, Fourier series of periodic functions with arbitrary periods, Half-range Fourier series.

Unit V (22 Hours)

Approximation and error in computation: Accuracy of numbers, error, types of error, round- off error, truncation error, error propagation, error in the approximation of a function, order of approximation.

Solution of algebraic and transcendental equations: Bisection method, false position method, fixed-point iteration method, secant method, Newton's method and its convergence.

Numerical integration: Newton-Cotes formula, Trapezoidal rule, Simpson's one-third and three-eight rules, Weddle's rule.

Numerical solutions of differential equations: Euler's method, Picard's method and Runge-Kutta method.

Unit VI (13 Hours)

Functions Of Complex Variables: Reorientation, Analytic function, Cauchy − Riemann equation (Cartesian and Polar forms), Harmonic functions, Conformal mappings, Complex integration, Cauchy's theorem and integral formula, Singularities, Taylor's and Laurent's Series theorem, Evaluation of integrals using residues

Reference Books:

1.B. S. Vaatsa, Theory of matrix, New Age Publication.

2.Hoffman and Kunze, Linear algebra, Pearson.

3.M.D. Raisinghania, Advanced Differential Equations,S.Chand.

4.M. D. Raisinghania, Ordinary and Partial Differential Equations, S.Chand.

5.R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House 2002

ECO11006	Introductory Macroeconomics Elective	L	T	P	C
Version 1	Contact Hours - 90	6	0	0	6
Pre-requisites/Exposure	12th level English				
Co-requisites	--				

Course Outcomes:

At the end of the course, the student will be able to:
   CO1 **Understand** various theoretical issues related to an economy.
   CO2 **Develop** ideas about measurement of aggregate macroeconomic variable like savings, investment, GDP and National Income.
   CO3 **Understand** the role of money and different concepts of inflation.
   CO4 **Understand** various alternative theories of output and employment determination in a closed economy in the short run as well as long run and the role of policy in this context

Course Structure:

Unit 1: Introduction to Macroeconomics and National Income Accounting
Basic issues studied in macroeconomics; measurement of gross domestic product; income, expenditure and the circular flow; real versus nominal GDP; price indices.

Unit 2: The Closed Economy in the Short Run
Classical and Keynesian systems; simple Keynesian model of income determination; ISLM model; fiscal and monetary multipliers.

Unit 3: Aggregate Demand and Aggregate Supply Curves
Derivation of aggregate demand and aggregate and supply curves; interaction of aggregate demand and supply.

Unit 4: Money and Inflation
Functions of money; quantity theory of money; determination of money supply and demand; credit creation; tools of monetary policy, cost push and demand pull inflation.

Unit 5: Unemployment and Expectations
Aggregate supply- the Sticky-Price Model, the Imperfect Information Model; Okun's Law; the short-run trade -off between inflation and unemployment; Phillips Curve; Shifts in the Phillips curve; the role of expectation; Natural Rate of unemployment; The Phillips curve and the Aggregate supply curve; The debate.

Text Books
T1. N. Gregory Mankiw. Macroeconomics, Worth Publishers, 7th edition, 2010.
T2. Dornbusch, Fischer and Startz, Macroeconomics, McGraw Hill, 11th edition, 2010
T3. Andrew B. Abel and Ben S. Bernanke, Macroeconomics, Pearson Education, Inc.,

SOC11007	Indian Society: Images and Realities	L	T	P	C
Version 1		6	0	0	6
Pre-requisites/Exposure					
Co-requisites	--				

Reference Books

R1 Olivier Blanchard, Macroeconomics, Pearson Education, Inc., 5th edition, 2009

R2 Steven M. Sheffrin, Rational Expectations, Cambridge University Press, 2nd edition, 1996.

Course Outcomes

On completion of this course, the students will be able to--
   CO1. Determine an understanding about the different aspects of Indian society.
   CO2. Distinguish between Indian unity and diversity in terms of its aspects.
   CO3. Construct an understanding about the major social and political institutions and processes.
   CO4. Identify the relation between family and gender along with caste and religion.
   CO5. Illustrate the criticisms of different aspects and diversities of Indian society.

Course Content:

Unit – I: **Ideas of India: Civilization, Colony, Nation and Society**   (15 hours)

Unit II: **Institutions and Processes: Family, Kinship, Marriage**   (15 hours)

Unit III: **Village, Town and Region**   (15 hours)

Unit IV: **Caste, Religion and Ethnicity; Family and Gender**   (15 hours)

Unit V: **Political Economy**   (15 hours)

Unit VI: **Critiques of all aspects of Indian society.**   (15 hours)

Text Books
   1. Embree, Ainslie Thomas,. Imagining India. Delhi: Oxford University Press, 1989. Chapter 1- Brahmanical Ideology and Regional Identities. Pp. 9 – 27
   2. Cohn, Bernard. India: Social Anthropology of a Civilization, Delhi: OUP. Chapters 1, 3, 5 & 8 (1-7, 24-31, 51-59, 79-97)
   3. Breman, Jan. 'The Village in Focus' from the Village Asia Revisited, Delhi: OUP 1997. Pp. 15-64
   4. Cohn, Bernard, An Anthropologist Among Historians and Other Essays, Delhi: OUP, 1987, Chapters. 4 and 6. Pp.78-85 & 100 – 135
   5. Mines, Diane P. Caste in India. Ann Arbor, Mich.: Association for Asian Studies, 2009. Pp. 1-35
   6. Fuller, C. J. The Camphor Flame: Popular Hinduism and Society in India. Delhi: Viking, 1992. Chapter 1. Pp. 3 – 28.
   7. Dube, Leela. 'On the Construction of Gender: Hindu Girls in Patrilineal India', Economic and Political Weekly, Vol. 23, No. 18 (Apr. 30, 1988), pp. WS11-WS19

8. Gray, John N. & David J. Mearns. Society from the Inside Out: Anthropological Perspectives on the South Asian Household. New Delhi: Sage,
9. Chatterjee, Partha. State and Politics in India. Delhi: Oxford University Press, 1997. Introduction: A Political History of Independent India. Pp. 1-39
10. Omvedt, Gail. Understanding Caste. New Delhi: Orient Black Swan, 2011. Chapters. 5, 9, 11 and Conclusion. Pp. 30-38, $67-73$, $83-90$, $97-105$

PSG13007	Applied Psychology	L	T	P	C
Version 1		4	0	3	6
Pre-requisites/Exposure	10 + 2 knowledge				
Co-requisites	-				

Course Outcomes:

CO1: **Discuss** the application of psychological principles in different areas of psychological research.
CO2: **Understand** the role of psychology in Organizations.
CO3: **Summarize** the application of psychological principles in school and education.
CO4: **Determine** the role of psychology in regulating mental health.
CO5: **Define** the role of psychological principles in understanding social interactions.
CO6: **Evaluate** the stress level of students and job satisfaction of industry employees.

Course Contents:

UNIT-I: (10 Hours)

Introduction: Nature and fields of scientific research in applied psychology. Scientific discipline of applied psychology and challenges.

UNIT-II: (10 Hours)

Psychology in industries and organizations: Personnel selection; job analysis; fatigue and accidents; advertising and consumer behaviour.

UNIT-III: (10 Hours)

Psychology in education: School as an agent of socialization. Factors influencing school achievement. Exceptional children: Problems and remedial measures.

UNIT-IV: (10 Hours)

Psychology and mental health: Symptoms and causes of anxiety disorders and schizophrenia, mental retardation. Anti-social behaviour: Crime and delinquency.

UNIT-V: (10 Hours)

Psychology and social behaviour: Prejudice and stereotypes; conflict and its resolution. Applying Social Psychology and Social Problems: Intervention and Evaluation with emphasis on Environmental Problems and Poverty in India.

UNIT-VI: (10 Hours)

Practicum

1. Academic stress questionnaire. – Determine the Subject's academic stress by administering Student Academic Stress Scale (SASS).
2. To assess the job satisfaction level of employees.

Readings:

1. An Introduction to Applied Cognitive Psychology. Psychology Press: New York. Sternberg, R. J. (Ed.) (2000).
2. Anastasi, A. (1979). Fields of applied psychology. New Delhi: McGraw Hill.
3. Applied Psychology: Perceiving Learning and Remembering. Australia: Cengage Learning.
4. Durso, F. T. (2007). Handbook of Applied Psychology (2nd Ed). New West Sussex : Wiley & Sons. Esgate, A. et al. (2005).
5. Goldstein, A. P., & Krasner, B. (1987). Modern applied psychology. Elmford, New York: Pergmon Press.
6. Handbook of intelligence. New York: Cambridge University Press. Sternberg, R. J. (2009).

SEMESTER III

GEO11009	Climatology	L	T	P	C
Version 1		6	0	0	6
Pre-requisites/Exposure	HS level Physical Geography knowledge				
Co-requisites	-				

Course Outcomes

On completion of this course, the students will be able to

CO1. **Describe** the composition and structure of the atmosphere, physical basis of the isolation, regional   temperature variations and greenhouse effect.

CO2. **Identify** the fundamental physical laws that govern various planetary wind circulations and its relation with the monsoon variability.

CO3. **Explain** the forms and processes of condensation and precipitation, and their measurements.

CO4. **Demonstrate** the factors and mechanisms responsible for the development of cyclones, and the basis of global climate classifications.

Course Content

Unit I: Atmospheric Layers and Thermal Variation   (20 hours)
Nature, Composition and Layered Structure of the Atmosphere, Factors Controlling Insolation; Heat Budget of the Atmosphere, Horizontal and Vertical Distribution of Temperature; Mechanism of energy transfers: Conduction, convection, and radiation; Nature of radiation; radiation laws; Inversion of Temperature; Green House Effect and Importance of Ozone Layer.

Unit II: Global Wind Circulation System   (30 hours)
Factors influencing air motion and resulting flow patterns; Global Atmospheric Pressure Belts and Their Oscillation, General Wind Circulation – Primary, Secondary and Tertiary Systems, Stream and Index Cycle; Monsoon Variability: El Nino, ENSO, La Nina, Indian Ocean Dipole (IOD); Monsoon Mechanism with Reference to Jet Stream, Polar Vortex

Unit III: Precipitation and Air Mass   (20 hours)
Humidity: Relative Humidity & Dew point; Processes and Forms of Condensation; Smog: Photochemical smog & Sulfurous smog; Forms of Precipitation- Ice Crystal Theory, Collision-Coalescence Theory, Airmass: Typology, Origin, and Characteristics; Types of Fronts: Stationary Front, Warm Front, Cold Front & Occluded Front; Frontogenesis and Frontolysis

Unit IV: Weather Disturbance and Climatic Classification: (20 hours)
Tropical Cyclones: Favorable Conditions for Formation, Stages of Formation & Structure; Storm Surge; Naming of Cyclones: Cyclones in the Arabian Sea, Bay of Bengal; Mid-Latitude Cyclone and Anti-Cyclone, Climatic Classification after Koppen and after Thornthwaite: 1931 And 1948

Recommended Readings:

1. Barry, R.G. and Chorely, R.J. (2009) Atmosphere, Weather and Climate, ELBS, Methuen & Co. Ltd. London.
2. Critchfield, H.J. (2011): General Climatology 4^{Th} Edition, Pearson India, New Delhi.
3. Lal, D.S. (2011): Climatology, Chaitanya Publishing House, Allahabad.
4. Savindra Singh (2006): Climatology , Prayag Pustak Bhawan, Allahabad
5. Siddhartha, K. (2018): Climatology: Atmosphere Weather Climate, Kitab Mahal, New Delhi.
6. Trewartha, G.T. (1968) Introduction to Climate McGraw Hill, New York.

GEO11010	**Regional Planning and Development**	L	T	P	C
Version 1		6	0	0	6
Pre-requisites/Exposure	10+2 level Geography knowledge				
Co-requisites	10th Standard Level Economics knowledge				

Course Outcomes

On completion of this course, the students will be able to:

CO1. **Identify** different types of the region and their formation processes

CO2. **Summarize** the idea of development and inequality quantitatively.

CO3. **Compare** different theories and concepts of regional development.

CO4. **Articulate** the development trajectories of India as a case study and also sketch the development plan for backward regions.

Course Content

Unit I: Regions and Development (25 hours)

Concept of regions - nature and types of regions, Formal and Functional Regions; Regionalization – approaches, scale and dimension; Bases of regional division, Concept Growth, Development and Underdevelopment; Measuring development (Economic, Social and Environmental); Human development.

Unit II: Planning Regions and Allied Theories (25 hours)

Concept of planning regions – need for regional planning, types of regional planning and planning Regions; Models for Regional Planning and their applications: Growth Pole Model of Perroux; Myrdal, Rostow and Friedmann.

Unit III: Regional planning in India (20 hours)

Regional Approach to Planning in India's Five Year Plans; NITI Aayog and its functionalities; Multi-level planning in India; Regional disparities and measures for balanced development in India.

Unit IV: Regional Planning and Prospects (20 hours)

Damodar Valley as Planning Region, Kolkata Metropolitan Development Authority (KMDA) as a Planning Region; Jungle Mahal as a backward region; State and development – Comparative study on West Bengal, Kerala, Gujarat.

Recommended Readings:

1. Chatterjee, S. P. (1973): Physiography of India, Gazetteer of India, Vol. I, Chopra, P. N. (Ed.), Govt. of India, New Delhi.
2. Singh, R. L. (1989): India – A Regional Geography, National Geographical Society of India, Varanasi.
3. Spate, O. H. K. and Learmonth, J. A. (1972): India and Pakistan, Methuen Co. Ltd., London.
4. Ganguly, D. S., Damodar Valley Corporation.

5. Mamoria. C.B. 1996, Economic and Commercial Geography of India. Revised edition.ShivlalAggarwalaan Co. Agral.
6. Bhat L S. – Regional Planning in India, Statistical Publishing Society, Calcutta, 1973.
7. Bhat L. S. et. at. : Micro-Level Planning: A Case Study of Karnal Area, Haryana, K.B. Publishing, New Delhi, 1976.
8. Chand M. &Puri V.K.– Regional Planning in India, Allied Publishers Pvt. Ltd., N.Delhi, 1983.
9. Friedman J. & Alonso W. – Regional Development and Planning – A Reader, M.I.T. Press, Cambridge, Mass, 1967.
10. Friedmann, J. and Alonso, W. : Regional Development Policy – A Case Study of Venezuela, M.I.T. Press, Cambridge, Mass, 1966.
11. Glasson J. - An Introduction to Regional planning : Concept, Theory & Practice, Hutchinson & Co.(Publishers) Ltd., London, 1983.
12. Glikson, Arthur : Regional Planning and Development, Netherlands Universities foundation for International Cooperation, London, 1955.
13. Gosal, G. S. and Krishan, G. : Regional Disparities in Levels of Socio-Economic Development in Punjab, Vishal Publications, Kurukshetra, 1984.
14. Inamdar, N. R. &Kshire, V.K., - District Planning in India : A Case study of Maharastra, Oxford & IBH Publishing Co., Delhi, 1986.
15. Kundu A. & Raza M. – Indian Economy : The Regional dimension – Spectrum Publishers, N. Delhi, 1982.

GEO12011	**Statistical Methods in Geography Lab**	L	T	P	C
Version 1		0	0	6	4
Pre-requisites/Exposure	10+2 level Geography knowledge				
Co-requisites	10th Standard Level Mathematical knowldge				

Course Outcomes:

On completion of this course, the students will be able to:

CO1. **Classify** different data types and associated statistical operations
CO2. **Perform** sampling, hypothesis testing with appropriate probability value
CO3. **Figure out** the associationship and estimation of variable
CO4. **Apply** the knowhow of the statistical knowledge on day to day socio-economic as well as environmental data.

Course Content

Unit I: Basic Concepts (40 hours)
Significance of statistical techniques in Geography, Descriptive and Inferential Statistics, nature of statistical data: discrete, continuous, parametric and non-parametric statistics; Data types, scales and ratings; Tabulation and Descriptive Statistics: Frequency distribution – Histogram, Frequency Polygon, Ogive, normal and skewed distribution, Kurtosis; Probability of distribution/occurrences - Normal Distribution, sampling techniques: Probability and non-probability sampling, random, systematic and stratified, Cluster sampling, Quota sampling, Snow-ball sampling.

Unit II: Measures of Central Tendency and Dispersion (40 hours)
Measures of central tendency: mean, median, mode, partition values – quartile, deciles and percentile and data visualisation- boxplot, violin plot, Pyramid Diagram, Donut Diagram; Measures of dispersion: mean deviation, quartile deviation, variance, standard deviation and Co- efficient of variation; Hypothesis testing- Student's T Test, F Test and Z Test, Chi square test and Analysis of variance, Analysis of Co-variation, Z-Score computation and Mapping; Association and Correlation – Rank correlation and Product Moment Correlation (Karl Pearson)

Unit III: Data Analysis (45 hours)
Bivariate scatter diagram and regression trend line - Simple Regression and nonlinear regression; Residuals from regression; Residual Mapping, Time Series Analysis - Moving average, semi average and least square method; Application of statistics on climatic data, rainfall dispersion diagram, ombro-thermic diagram, rating curve, hydrograph, unit hydrograph, climatic chart, Ergograph Application of Statistics on Socio-economic data, Lorenz Curve, Index of Dissimilarity, Location Quotient.

Unit IV: Laboratory Note book and viva voce (10 hours)
A project file comprising at least one exercise (as per requirement) from each on using any method on above mentioned themes.

Recommended Readings:

1. Alvi, Z. 1995: Statistical Geography-Methods & Application, Rawat Publications, Jaipur.

2. Berry B. J. L. and Marble D. F. (eds.): Spatial Analysis – A Reader in Geography.

3. Clark, W.A.V. and Hosking, P.L. 1986: Geographical Methods for Geographers, John Wiley and Sons, New York

4. Croxton, F.E., Cowden, D.J. & Klein, S 1969: Applied General Statistics, Prentice Hall of India Pvt. Ltd., New Delhi

5. Dickinson, G.C. (1973): Statistical Mapping and Presentation of Statistics
6. Ebdon D., 1977: Statistics in Geography: A Practical Approach
7. Goon, A.M., Gupta, M.K. &Dasgupta, B. 1992: Basic Statistics, Volume 1, The World Press Pvt. Ltd., Kolkata

8. Goon, A.M., Gupta, M.K. &Dasgupta, B. 1992: Fundamentals of Statistics, Volume 1, The World Press Pvt. Ltd., Kolkata

9. Gregory, S. 1985: Statistical Methods and the Geographer, Longman, London

10. Hammond P. and McCullagh P. S., 1978: Quantitative Techniques in Geography: An Introduction, Oxford University Press.

11. King L. S., 1969: Statistical Analysis in Geography, Prentice-Hall

12. Mahmood A., 1977: Statistical Methods in Geographical Studies, Concept.

13. Mahmood, A. 1998: Statistical Methods in Geographical Studies, Rajesh Publications, New Delhi

14. Norcliffe, G.B. 1977: Inferential Statistics for Geographers-An Introduction, Hutchinson and Co., London

15. Pal S. K., 1998: Statistics for Geoscientists, Tata McGraw Hill, New Delhi

GEO12012	Statistical Techniques and Computer Application Lab	L	T	P	C
Version 1		0	0	3	2
Pre-requisites/Exposure	10+2 level Geography knowledge				
Co-requisites	10th Standard Level Mathematical knowledge				

Course Outcomes

On completion of this course, the students will be able to:

CO1. **Develop** application of versatile graphical representation on data.
CO2. **Perform** statistical analysis between variables in a quick time.
CO3. **Predict** and estimate the value of the desired variable using linear and nonlinear models.
CO4. **Apply** the computer-based statistical knowledge on socio-economic as well as environmental data.

Course Content

Unit I: Statistical Techniques   (20 hours)
Data entry and moving around the workbook and worksheet – Tabulation, construction of GDM, Data representation and visualization – construct and interpret Histogram, Frequency Polygon and Curve. Descriptive Statistics and interpretations – Mean, Median, Mode, Variance, Standard deviation and Coefficient of variation, Inferential statistics and interpretation – Probability of distribution, Correlation, Regression.

Unit II: Data Analysis   (20 hours)
Time Series Analysis - Moving average, semi average and least square method; Application of statistics on climatic data: rainfall dispersion diagram, ombro-thermic diagram, rating curve, unit hydrograph; Application of Statistics on Socio-economic data: Lorenz Curve, Index of Dissimilarity, Location Quotient.

Unit III: Laboratory Notebook   (5 hours)
 A project file consisting of 5 exercises on using any method on above mentioned themes.

 Recommended Readings:

1. Mahmood A., 1977: Statistical Methods in Geographical Studies, Concept.

2. Mahmood, A. 1998: Statistical Methods in Geographical Studies, Rajesh Publications, New Delhi

3. Norcliffe, G.B. 1977: Inferential Statistics for Geographers-An Introduction, Hutchinson and Co., London

4. Pal S. K., 1998: Statistics for Geoscientists, Tata McGraw Hill, New Delhi.

5. Pal, S.K. 1998: Statistics for Geo-Scientists- Techniques and Application, concept Publishing Company,New Delhi.

6. Sarkar, A. (2013) Quantitative geography: techniques and presentations. Orient Black Swan Private Ltd., New Delhi

7. Winston (2013), Microsoft Excel 2013: Data Analysis and Business Modeling

8. Rajan E. (2015), Excel VBA: A Beginners' Guide

9. Webpage: https://office.live.com/start/Excel.aspx

GEO12013	Basics of Remote Sensing Lab	L	T	P	C
Version 1		0	0	3	2
Pre-requisites/Exposure	Basic computer knowledge				
Co-requisites	-				

Course Outcomes

On completion of this course, the students will be able to

CO1. **Understand** the history and fundamentals of Remote Sensing.

CO2. **Interpret** Arial Photographs and Satellite Imageries.

CO3. **Develop** an idea about different types of Satellites, Sensors and their resolutions.

CO4. **Apply** remote sensing techniques in image processing and land use land cover mapping.

Course Content

Unit I: Remote Sensing: Definition and Development; Platforms and Types; Photogrammetry. (20 hours)
Concept of aerial photography; different types of aerial photography, Satellite Remote Sensing: Principles, EMR Interaction with Atmosphere and Earth Surface; types of Satellites, Sensors; resolution

Unit II: Image pre-processing and enhancement (10 hours)
Geometric Corrections, Radiometric Corrections, Visualizing Multispectral Images Contrast Stretching, Filtering Techniques: Low Pass, High Pass, Directional Filters, Edge Enhancement

Unit III: Estimation of Earth Surface Properties (15 hours)
Image Processing (Manual): Selection of band combination, Mosaicking to FCC image, Categorization Land Use Land Cover -Satellite Image Interpretation.

Unit III: Laboratory Notebook
A project file consisting of 5 exercises on using any method on above-mentioned themes.

Recommended Readings:

1. Bhatta, B. (2008) Remote Sensing and GIS, Oxford University Press, New Delhi.
2. Campbell J. B., 2007: Introduction to Remote Sensing, Guildford Press
3. Jensen, J. R. (2005) Introductory Digital Image Processing: A Remote Sensing Perspective, Pearson Prentice-Hall.
4. Joseph, G. 2005: Fundamentals of Remote Sensing, United Press India.
5. Lillesand T. M., Kiefer R. W. and Chipman J. W., 2004: Remote Sensing and Image Interpretation, Wiley. (Wiley Student Edition).
6. Li, Z., Chen, J. and Batsavias, E. (2008) Advances in Photogrammetry, Remote Sensing and Spatial Information Sciences CRC Press, Taylor and Francis, London
7. Mukherjee, S. (2004) Textbook of Environmental Remote Sensing, Macmillan, Delhi.
8. Nag P. and Kudra, M., 1998: Digital Remote Sensing, Concept, New Delhi.
9. Singh R. B. and Murai S., 1998: Space-informatics for Sustainable Development, Oxford and IBH Pub.

SOC14100	Community Service	L	T	P	C
Version 1		-	-	-	1
Pre-requisites/Exposure	Knowledge of Basic English				
Co-requisites	Knowledge of Basic Computer Skills				

Course Outcomes

On completion of this course, the students will be able to

CO1: **Understand** the concept of social responsibility through an internship.

CO2: **Acquire** hands on experience in 'giving back to the society' through the concept of social responsibility through an internship.

Course Content

Unit I:
Introduction to the course. A brief on social issues facing the society with both global and Indian examples.

Unit II:
Minimum 24 hours of field work on a social issue and helping the marginalized / affected community / cause with photographs and testimonies.

Unit III:
Submission of individual reflection on the social service rendered.

The benefits that accrue to the students are

A.) Subjective

1. Psychosomatic benefits: Volunteering increases overall life satisfaction and also helps to relive stress and acts as an anti-depressant.
2. Intellectual benefits: Enhances knowledge through new experiences, and develops communication skills.
3. Career benefits: Enhances career prospects by acquisition of work-related skills, builds good references for employers and provides a forum to network with future potential employers. It also The experience allows gained helps students to take up leadership positions. Letters of recommendation can also be easily sought. Research shows that students who indulge in volunteer word perform better in studies as it invigorates their passion for learning
4. Personal benefits : Real world skills like leadership, problem-solving, collaboration with others, time management and communication skills, learn patience and empathy.
5. Connect learning to real world and enables deeper and lifelong learning.

B.) Community

1. Collective benefits: Strong interpersonal bonds are created, and leads to increased civic and social awareness and responsibility.

Further Reading:

1. Tadevosyan, Goha & Schoenhuth, Michael. Participatory Research Approach : Principles, Challenges and Perspectives. http://ysu.am/files/01G_Tadevosyan_M_Schoenhuth.pdf
2. Bergold, Jarg& Thomas Stefan. Participatory Research Methods: A Methodological Approach in Motion http://www.qualitative-research.net/index.php/fqs/article/view/1801/3334

Plan of Work

1. Reading on social issues facing the society with both global and Indian examples.
2. Selecting an issue where the student wishes to contribute and wants to make a difference.
3. Areas - The internship may be broadly completed by getting in touch with NGO in your city / town / Police / Municipal Corporation / Local Gram Panchayat / Hospital / State Health Department / Women & Child Development Centre / CSR departments of Corporates /school / Old Age Home / Orphanage / Literacy Drive / Aanganwadi Centres / etc.
4. **Online Discussion –** Throughdiscussion, students elaborate their preferred area of work with reference to the Global Scenario and India. Reason for choosing that area also needs and resources of the people in their area of Social Internship and also submit the testimonials, which include signature of the authority where students initiated theirwork, or the signature of the authority in whose area students are currently working or photographs of work (photographs must include students working).
5. **Final Report Submission** - Submission of theTestimonials include signatures of the authorities you have worked with, or the signature of the authority in whose area you have worked or photographs of your work (photographs must include you working). Students' accomplishment in their area of operation along with the major successes student experienced and major challenges faced.
6. Students will submit the complete elaborated report along with testimonials and completion certificate in the form of signed Template
- The registration for all students will open twice, during winter and summer breaks. They may enroll for the internship in either of the two breaks.
- The student will have to submit a continuous record of their 10 to 15 days internship in the form of photographs and testimonies (wherever required).

IDP14001	Inter-Disciplinary Project	L	T	P	C
Version 1		-	-	-	3
Pre-requisites/Exposure	Knowledge of Basic English				
Co-requisites	Knowledge of Basic Computer Skills				

Course Objectives

Upon successful completion of the course, students will be able to

CO1. recognize the unique advantages of integrative research and learning
CO2. understand the fundamentals of research methods and practices of various academic disciplines
CO3. demonstrate an understanding of current issues and concerns
CO4. realize the importance of ethics in research process
CO5. understand the inter-disciplinary systems of research documentation

Course Content

- After discussion with the Project Advisor(s), each student shall prepare an initial outline of their assigned project indicating the major sections of discussion, list the principal research sources for each section, and explain the overall objective of the project, including a justification of the interdisciplinary nature of the work.
- Each student shall meet with the Project Advisor(s) regularly as per the weekly Time-Table. Other meetings may be scheduled at the discretion of the Project Advisor(s) at mutually agreed upon timings.
- Typically, the progress will include a combination of industrial and academic mentoring, self-study sessions, case studies, trend studies, presentation by students, interactive sessions, industrial visits etc.
- Regular submission of progress reports shall be required of each student-group as notified through the Project Advisor(s) from time to time.

CSE11641	Elective Computer Science I	L	T	P	C
Version 1		4	0	0	4
Pre-requisites/Exposure	Basics of Computer knowledge				
Co-requisites					

Course Outcomes

On completion of this course, the students will be able to

CO1: **Describe** the usage of computers and why computers are essential components in business and society.

CO2: **Work** effectively with a range of current, standard, Office Productivity software applications.

CO3: **Evaluate**, select and use office productivity software appropriate to a given situation

CO4: **Utilize** the Internet Web resources and evaluate on-line e-business system.

CO5: **Solve** common business problems using appropriate Information Technology applications and systems.

Course Content

Unit I: Knowing computer: (8 hours)

What is Computer, Basic Applications of Computer; Components of Computer System, Central Processing Unit (CPU), VDU, Keyboard and Mouse, Other input/output Devices, Computer Memory, Concepts of Hardware and Software; Concept of Computing, Data and Information; Applications of IECT; Connecting keyboard, mouse, monitor and printer to CPU and checking power supply.

Unit II: Operating Computer using GUI Based Operating System: (8 hours)

What is an Operating System; Basics of Popular Operating Systems; The User Interface, Status Bar, Using Menu and Menu-selection, Running an Application, Viewing of File, Folders and Directories, Creating and Renaming of files and folders, Opening and closing of different Windows; Using help; Creating Short cuts, Basics of O.S Setup; Common utilities.

Unit III: Understanding Word Processing: (10 hours)

Word Processing Basics; Opening and Closing of documents; Text creation and Manipulation; Formatting of text; Table handling; Spell check, language setting and thesaurus; Mail merge, Printing of word document.

Unit IV: Using Spread Sheet: (9 hours)

Basics of Spreadsheet; Manipulation of cells; Formulas and Functions; Editing of Spread Sheet, printing of Spread Sheet, Macro.

Making Small Presentation: Basics of presentation software; Creating Presentation; Preparation and Presentation of Slides; Slide Show; Taking printouts of presentation/handouts.

Unit V: Communications and collaboration: (15 hours)

Basics of electronic mail; Getting an email account; Sending and receiving emails; Accessing sent emails; Using Emails; Document collaboration; Instant Messaging; Netiquettes.

Unit VI: Introduction to Internet, WWW and Web Browsers: (5 hours)

Basic of Computer networks; LAN, WAN; Concept of Internet; Applications of Internet; connecting to internet; What is ISP; Knowing the Internet; Basics of internet connectivity related troubleshooting, World Wide Web; Web Browsing software, Search Engines; Understanding URL; Domain name; IP Address; Using e-governance website

Reference Books

1. Introduction to Computers with MS-Office, Leon, TMH
2. Personal Computer Software, EXCEL BOOKS
3. A First Course in Computers 2003, Saxena, VIKAS
4. Windows & MS-Office 2000, Krishnan, SCITECH

CSE12642	Elective Computer Science I Lab	L	T	P	C
Version 1		0	0	3	2
Pre-requisites/Exposure	Basics of Computer knowledge				
Co-requisites					

Course Outcome:

On completion of this course, the students will be able to

CO1: Familiarization with word and its different features.
CO2: Designing different documents using Word.
CO3: Using mail merge to create template using word.
CO4: Familiarization with excel and its different formulas.
CO5: Creating presentation with animation and effects.

Course Content

List of experiments:

1. Introduction and familiarization with word with different type of stylings.

2. Table creation in and basic formatting.

3. Inclusion of image and editing image using Word and some basic designing features.

4. Example of Mail-merge.

5. Create spreadsheet with some basic calculation.

6. Creating Spreadsheet with some advance level formula and conditions.

7. Creating Macro in spreadsheet.

8. Creating colour conditioning in spreadsheet.

9. Creating different kinds of charts in spreadsheet.

10. Creating basic presentation.

11. Inclusion of different levels of animations in the presentation.

12. Project on Word.

13. Project on Excel.

14. Project on power-point.

Reference Books

1. Introduction to Computers with MS-Office, Leon, TMH

2. Personal Computer Software, EXCEL BOOKS

3. A First Course in Computers 2003, Saxena, VIKAS

4. Windows & MS-Office 2000, Krishnan, SCITECH

PHY11015	Elective Physics I	L	T	P	C
Version 1		4	0	0	4
Pre-requisites/Exposure	12th level Physics				
Co-requisites	Basic concept of Differential and Integral Calculus				

On completion of this course, the students will be able to

CO1: Develop knowledge of vector differentiation, integration, essential theorems and apply it in further study of physics.

CO2: Relate and illustrate the fundamental principles of dynamics of a single particle and system of particles and apply it in real life problems.

CO3: Define and develop the concepts of work and energy, Conservative and non-conservative forces and Central forces.

CO4: Define and analyse the fundamentals of rotational dynamics of a rigid body, and estimate the Moment of Inertia of different objects, explain Coriolis and Centrifugal forces.

CO5: Define and explain the basic concepts of Elasticity, viscosity, surface tension and apply it in different relevant areas.

CO6: Develop the basic concepts of electromagnetic theory and apply it in practical situation.

CO7: Define, explain and estimate different phenomenon of wave and optics.

Course Content

Unit I: Vector Analysis (8 hours)
Axial and polar vectors, dot product and cross product, scalar triple product and vector triple product. Scalar and vector fields --- gradient, divergence and curl, statement of divergence theorem, statement of Stokes' theorem.

Unit II: Newtonian Mechanics (10 hours)
(a) Newton's laws of motion, principle of conservation of linear momentum, time and path integral of force, conservative force field, concept of potential, conservation of total energy, equation of motion of a system with variable mass.
(b) Rotational motion, angular velocity, angular acceleration, angular momentum, torque, fundamental equation of rotational motion, principle of conservation of angular momentum, radial and cross-radial acceleration.
(c)Central force and Gravitation: Central force and its properties, Differential equation of orbits under central force field, Gravitational potential and intensity due to thin uniform spherical shell and solid sphere of uniform density, escape velocity.

Unit III: Elasticity (6 hours)
Elastic moduli and their interrelations, bending of a beam, cantilever, simply supported beam with concentrated load at the center.

Unit IV: Viscosity and Fluid Motion (6 hours)
Streamline and turbulent motion, Poiseuille's formula, critical velocity, Reynolds number, Bernoulli's theorem, Stokes' law (statement only).

Unit V: Surface Tension (6 hours)

Surface tension and surface energy, molecular theory, angle of contact, elevation and depression of liquid columns in a capillary tube, excess pressure in a spherical bubble and spherical drop.

Unit VI: **E M Theory** (12 hours)

Gauss's Law in Electrostatics (in vacuum and in presence of dielectric), Laplace's Equation and Poisson's Equation, Lorentz Force, Motion of Charged Particles in crossed Electric & Magnetic fields, Velocity Selector & Magnetic focussing, Biot-Savart Law and Ampere's Law and their applications, Vector and Scalar potential, Electromagnetic induction, Faraday's Law, Maxwell's equations (differential and integral forms), Poynting vector, Poynting Theorem (Statement only), propagation of plane electromagnetic waves in vacuum, dielectric and conducting media.

Unit VII: Wave and Optics (12 hours)

Differential equation and its solution, analytical treatment, Lissajous figures, natural, damped and forced vibration, resonance, sharpness of resonance. Light as an electromagnetic wave, full electromagnetic spectrum, properties of electromagneticwaves, Huygens' principle, Interference of light, Young's experiment, intensity distribution, conditions of interference, Diffraction of light, Fresnel and Fraunhofer class, Fresnel's half-period zones, zone plate. Fraunhofer diffraction due to a single slit and plane transmission grating (elementary theory). Polarization of light Different states of polarization, Brewster's law.

Reference Books

1. Vector Analysis by Murray R Spiegel

2 Theoretical mechanics by Spiegel

3 An Introduction To Mechanics, by Robert J. Kolenkow and Daniel Kleppner

4. A Treatise on General Properties of Matter, Sengupta Chatterjee

5 Electromagnetic Fields (Theory and Problems), TVS Arun Murthy

6 Principles of Optics, B.K. Mathur, 1995, Gopal Printing

7 Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publications

PHY12016	Elective Physics Lab I	L	T	P	C
Version 1.0	Contact Hours –45 Hours	0	0	3	2
Pre-requisites/Exposure	Basic knowledge on physics experiment (12th level Physics)				
Co-requisites	--				

Course Outcomes:

CO1. **Demonstrate** realistic explaining of measurement of general properties of matter and experiment of light
CO2. Experiment**, relate** with measurement of Young's modulus by Flexure method
CO3. Estimate**, explain** the fundamental idea of experiment with some basic measurement instruments, such as slide callipers, screw gauge etc.
CO4. **Experiment,** relate with measurement Rigidity modulus by Dynamic method
CO5. **Estimate**with measurement of coefficient of viscosity by Poiseuille's capillary flow method, develop idea on conduct experiment with capillary tube
CO6. **Organize** the practical explaining on measurement of surface tension by Jurin's law
CO7. **Develop** skill enhancement on experiment of light and estimatethe Brewster's angle and refractive index of glass Hands-on knowledge on spectrometer (Schuster's focussing), estimate the idea of polarized and un-polarized light by using polaroid
CO8. **Construct** the visualization of interference pattern of monochromatic light by Newton's ring method and concept of wavelength measurement

Course Content:

Experiment 1:   [3 hours]
 Determination of Rigidity modulus by Dynamic method.

Experiment2:   [6 hours]
Determination of Young's Modulus by Flexure method.

Experiment3:   [6 hours]
Determination of coefficient of viscosity by Poiseuille's capillary flow method.

Experiment4:   [6 hours]
Determination of Surface Tension of a given liquid by Jurin's Law.

Experiment5:   [6 hours]
To determine the value of 'g' using Compound Pendulum.

Experiment6:   [6 hours]
To determine the wavelength of a monochromatic light by Newton's ring method.

Experiment7:   [3 hours]
Dispersive power of the material of the prism using spectrometer and Na light source.

Experiment8:   [6 hours]
Determination Brewster's Angle and Refractive Index of Glass by using spectrometer and Polaroid.

Experiment9:   [3 hours]
Determination of wavelength of a light by LASER diffraction method**.**

SDS11506	Elective Statistics-I	L	T	P	C
Version 1.0	Contact Hours – 60	6	0	0	6
Pre-requisites/Exposure	12th level Mathematics				
Co-requisites	--				

Course Outcomes:

On completion of this course, the students will be able to:

CO1: **Define** different types of statistical data, attributes, and variables (discrete and continuous) with frequency distribution.

CO2: **Find** various measures of central tendency and dispersion for grouped and ungrouped data, regression lines and correlation coefficients.

CO3: **Summarize**, collect**,** and present the different types of data graphically and numerically.

CO4: **Compare** the results obtain from various central and dispersion measures, regression, and correlation Analysis.

CO5: **Utilize** the concept of correlation and regression and its properties to obtain the solution of simple statistical/business/economics problems.

Course Content

Unit-I   **(10 hours)**
Collection and Scrutiny of Data
Statistical data: Primary Data and Secondary Data, Collection of Data, Presentation of data, tabular representation of data, Scrutiny of Data.

Unit-II   **(14 hours)**
Frequency Distribution
Attribute and variable, Discrete variable and continuous variable, Frequency Distribution of an Attribute, Frequency Distribution of a variable, Case of a discrete variable, Case of a continuous variable, Graphical Representation of a frequency Distribution, Frequency curve.

Unit-III   **(8 hours)**
Presentation of Data
Frequency data and non-frequency data, Textual presentation of Data, Tabulation of Data, Diagrammatic presentation of Data (Bar chart, pie diagram, Histogram, Ogives).

Unit-IV   **(17 hours)**
Measures of Central Tendency:
Meaning of Central Tendency, Common measure of Central Tendency, Requirements of an ideal Average, Comparison of Mean, Median and Mode, Geometric Mean and Harmonic Mean, weighted Means.

Unit-V (15 hours)
Measures of Dispersion:
Range, Mean Deviation, Standard Deviation, Quantiles and Percentiles, Quantile Deviation, Comparison of the Measures of Dispersion, Some important relations, Measures of relative Dispersion.

Unit-VI (13 hours)
Moments and Measures of Skewness and Kurtosis:
Moments, Relationship between central and ordinary moments, Skewness, Kurtosis, Some important relations.

Unit-VII (13 hours)
Correlation and Regression:
Correlation: Scatter diagram, Karl-Pearson's correlation, concurrent deviation method, rank correlation, uses of correlation in business regression, regression lines, regression coefficients, properties of regression coefficients, Use of regression in business problems.

Books Recommended

T1. A.M. Goon, M.K. Gupta and B. Dasgupta (2005): *Fundamentals of Statistics*, Vol. I, 8th Ed., World Press, Kolkata

T2. S.C. Gupta and V.K. Kapoor (2007): *Fundamentals of Mathematical Statistics*, 11th Ed., Sultan Chand and Sons.

Reference book:

R1. N. G. Das (2009): Statistical Methods, combined edition (vol I & II), McGraw Hill Education (India).

SEMESTER IV

GEO11014	Economic Geography	L	T	P	C
Version 1		6	0	0	6
Pre-requisites/Exposure	10+2 level Geography knowledge				
Co-requisites	10th Standard Level Economics knowledge				

Course Outcomes

On completion of this course, the students will be able to:

CO1. **Comprehend** resource, types of it and functional ideas around the resource.
CO2. **Locate** the major regions of agricultural activities with the operational procedures around the world.
CO3. **Compare** different theories and concepts of industrial locations
CO4. **Measure** the role of the service sector in as growth engine for the national economy.

Course Content

Unit I: Resources and Economy (20 hours)

Economic and Institutional Bases of Economic Geography; Concept and Classification of Resources: Economic and Environmental Approaches to Resource Utilization, Resource Depletion and Resource Conservation; Forrester-Meadows Model on Limits to Growth; Sustainable Use of Resources, Economic Activity: Concept and Classification; Concept of Human Capital Economic deveopment: Conceptualizing and Measuring Development; Economic inequality

Unit II: Primary Activities (20 hours)

World View of Primary Activities-- With Reference To Forestry, Fishing and Mining, Critical Appreciation Of Agricultural Systems: Intensive Agriculture (Rice), Extensive Agriculture (Wheat), Plantation Farming (Tea) and Mixed Farming (NW Europe), Locational Theories of Agriculture: Vonthunen; Fishing: Inland and Ocean (in-shore/off shore), methods, types of fish, storage and marketing, importance, problems and solutions.

Unit III: Secondary Activities (25 hours)

Factors of Industrial Location; Industrial Location and Economic Growth Models: Weber, Losch, Industries-- Their Resource Base, Distribution, Potentials Of Growth And Problems With Reference To Iron And Steel (India, Japan), Cotton Textile (India), Petrochemicals (India and USA) And Food Processing (India), Manufacturing regions; Industrial Association, Integration, Infrastructure and Problems With Reference to Kanto Plains, and Kolkata-Haldia.

Unit IV: Tertiary Activities (25 hours)

Tertiary activities and service: concept, classification and importance, International trade: Balance of payment, Ricardian theory, role of GATT and WTO in international trade. Domestic and International Trade: with reference to India; Trade strategies – import substitution and export promotion and impact of information technology on trade in India, SEZ and Technology Park. Transport: concept of distance, accessibility and connectivity, relative cost advantage of various modes of transport and their advantages

Recommended Readings:

1. Alexander J.W. (1976): Economic Geography, Prentice Hall of India. New Delhi.
2. Alexanderson G. (1988): Geography of manufacturing, Prentice Hall of India. New Delhi.
3. Berry, Conkling & Ray (1988): Economic Geography Prentice Hall of India, New Jersey.
4. Guha, J.L. and Chattaraj, P.R. 1989: A New Approach to Economic Geography: A Study of Resources, World Press, Kolkata 8.
5. Hartshorne, T. A. and Alexander, J. W. (1988): Economic Geography, Prentice Hall
6. Hurst Elliott (1986): Geography of Economic Behaviour, Unwin, London.
7. Johnson R.J. & Taylor D.J. (1989): A world in crisis, Basil-Blackwell, Oxford.
8. Leong. G.C. and Morgan, G.C. 1975: Human and Economic Geography, Oxford University Press, Hong Kong
9. Lloyd, P. and B. Dicken (1972): Location in space - A theoretical approach to economic geography Harper and Row, New York.
10. Losch (1954): Economics of Location, Yale University Press New York.
11. Redcliff, M. (1987): Development & the environmental crisis. Methuen. London. 8. Sinha B.N.(1971): Industrial geography of India
12. Siddhartha, K. (2000): Economic Geography - Theories, process and patterns, K-isalaya Publications Pvt. Ltd., New Delhi
13. World Development Report, Oxford University Press, New York, (Published annually).
14. Zimmermann, E.W. 1956: World Resources and Industries, Harper Brothers, New York.

GEO11015	Environmental Geography	L	T	P	C
Version 1		6	0	0	6
Pre-requisites/Exposure	HS level Physical Geography and Environmental Science knowledge				
Co-requisites	-				

Course Outcomes

On completion of this course, the students will be able to

CO1. **Understand** basic concepts of abiotic and abiotic environment, human-environment relationship and environmental degradation.
CO2. **Compare** the structures and functions of different ecosystems and environmental problems of different biomes.
CO3. **Understand** the significance environmental movements and the concept of sustainable development.

Course Content

Unit 1: Nature and Concepts   **(20 hours)**

Environmental Science: Introduction, Scope, approaches to study of environment, Components of environment: Energy, Abiotic and Biotic components, Human-Environment Relationships – Historical Progression, Environmental degradation and pollution.

Unit II: Soil - An Abiotic Component of Environment   **(20 hours)**

Definition and factors responsible for soil formation: Active factors, Passive factors; Process of Soil Formation; Soil types; Soil Profile: Laterite, Podzol; and Chernozem; Physical and chemical properties of soil: Texture, Structure and Moisture; pH, Organic matter and NPK; Measures of soil conservation.

Unit III: Ecosystem - A Biotic Component of Environment   **(30 hours)**

Ecosystem: Concept, structure and organization: Components, Trophic Structure, Food Chain and Food Web, Keystone Species, Ecological Pyramids; Functions: Energy Flow, Biogeochemical Cycles, Gross and Net Productivity, Concept of Biomes, Niche, Adaptation and Climax in different Biomes; Ecotone and Community; Ecosystem Types - Terrestrial and Aquatic; Biodiversity: Concepts, Significance and Types of Biodiversity.

Unit IV: Environmental Problems and Policies   **(20 hours)**

Biodiversity: Threats and conservation; Geodiversity: Concept and conservation; Concept of Hazards and Disaster; Physical, Biological and Social Hazards; Environmental Movements: Bishnoi, Chipko, Silent valley, Appiko Movement, Narmada Bachao Andholan, Tehri Dam Conflict; Concept of Sustainable Development, Environmental awareness, Environmental Programmes and Policies – Global, National and Local levels.

Recommended Readings:

1. Anderson, J.M. (1981): Ecology for Environmental Science: Biosphere, Ecosystems and Man, Arnold, London.
2. Nobel and Wright (1996): Environmental Science, Prentice Hall, New York.
3. Odum, E.P. (1971) : Fundamental of Ecology, W.B. Sanders, Philadelphia.
4. Saxena, H.M. (1994): PrayavaranevnParisthitikiBhugool (Geography of Environment and Ecology) Rajasthan Hindi Granth Academy, Jaipur.
5. Singh, S. (1991): Environmental Geography, PrayagPustakBhawan, Allahabad.
6. Strahler, A.H. and Strahler A.N. (1977): Geography and Mans Environment, John Wiley, New York.
7. William, M.M. and John, G. (1996): Environmental Geography - Science, Landuse and Earth System, John Wiley and Sons, New York.
8. Chandna, R.C. (2002): Environmental Geography, Kalyani, Ludhiana.
9. Cunninghum, W.P. and Cunninghum, M.A. (2004): Principals of EnvironmentalScience: Inquiry and Applications, Tata Macgraw Hill, New Delhi.
10. Goudie, A. (2001): The Nature of the Environment, Blackwell, Oxford.
11. 4. Mal, S. and Singh, R.B. (Eds.) (2009) : Biogeography and Biodiversity. Rawat Publication, Jaipur
12. Miller, G.T. (2004): Environmental Science: Working with the Earth, Thomson BrooksCole, Singapore.
13. MoEF, (2006): National Environmental Policy-2006, Ministry of Environment and Forests, Government of India.

GEO12016	Map Interpretation and Projection Lab	L	T	P	C
Version 1		0	0	6	4
Pre-requisites/Exposure	HS level geographical practical knowledge & trigonometry				
Co-requisites	--				

Course Outcomes

On completion of this course, the students will be able to

CO1. **Describe** the fundamentals of topographical map interpretation using various symbols and nomenclature.

CO2. **Utilize** the skill of map interpretation for geographical research.

CO3. **Demonstrate** the need and calculation techniques of various types of map projections.

CO4. **Construct** various types of planer, conical and cylindrical map projections.

Course Content

Unit I: Nomenclature of Indian Topographical Sheets and Identification of Physical Features
(30 hours)
Principles of toposheet numbering as followed by Survey of India (SOI); Principles of modern toposheet numbering as followed by SOI, study of toposheet of 1:50,000 scale: Identification of macro and micro geomorphic features, Interpretation of a Mountain Area and Plateau Area: Cross and Longitudinal Profiles; Interpretation using Morphometric techniques

Unit II: Identification and analysis of features from Toposheet and Interpretation of weather map
(30 hours)
Grid-wise (10 x 12 cm area) Road density and Settlement Frequency Map with interpretation, Drawing and analysis of profiles and transect chart with interpretation, Analysis of landforms and correlation between physical and cultural elements under the heads of: relief, drainage, natural vegetation, settlements and transport
Interpretation of Weather Maps (Indian Sub-continent) – Pre monsoon, Monsoon and Post Monsoon; Season, Preparation of Station models for different meteorological stations of India with the help of synoptic chart

Unit III: Map Projections - Planer Case **(40 hours)**
Concept, classification and suitability of map projections, Construction and properties of Planer (azimuthal) Projection – i. Polar Zenithal Gnomonic Projection. ii. Polar Zenithal Stereographic Projection, iii. Polar Zenithal Orthographic Projection, iv. Polar Zenithal Equidistant Projection, v. Polar Zenithal Equal Area Projections

Unit IV: Map Projection – Conical and Cylindrical Cases **(35 hours)**
Construction and properties of Conical Projection – i. Simple Conical Projection with one standard parallel, ii. Bonne's Projection, iii. Sinusoidal Projection, iv. Polyconic Projection. Construction and properties of – i. Cylindrical Equal Area, ii. Mercator's Projection

Unit V: Laboratory Note book and viva voce

Recommended Readings:

1. Sarkar, A. 2015: Practical geography: A systematic approach. Orient Black Swan Private Ltd., New Delhi
2. Dury, G.H. 1972: Map Interpretation, Pitman Publishing, London
3. Gupta K.K. and Tyagi, V. C., 1992: Working with Map, Survey of India, DST, New Delhi.
4. Mishra R.P. and Ramesh, A., 1989: Fundamentals of Cartography, Concept, New Delhi.
5. Monkhouse F. J. and Wilkinson H. R., 1973: Maps and Diagrams, Methuen, London.
6. P Saha and P Basu; Advanced Practical Geography, Books & Allied Ltd. Publisher (3rd Revised edition).
7. Robinson A. H., 2009: Elements of Cartography, John Wiley and Sons, New York.
8. Robinson, A.H., Morrison, J.L., Muehrcke, P.C., Kimerling, A.J. and Guptill, S.C. 1995: Elements of Cartography, John Wiley and Sons, New York.
9. Singh R. L. and Singh R. P. B., 1999: Elements of Practical Geography, Kalyani Publishers.

GEO12017	Basic GIS and Cartography Lab	L	T	P	C
Version 1		0	0	3	2
Pre-requisites/Exposure	Basic computer knowledge				
Co-requisites	-				

Course Outcomes

On completion of this course, the students will be able to

CO1. **Develop** a basic concept of cartography as well as digital cartography.
CO2. **Interpret** the different data structure.
CO3. **Develop** a concept of digitization and geo referencing.
CO4. **Construct** a project file based on different methods.

Course Content

Unit I: Basics of Digital Cartography (15 hours)
GIS and Digital Cartography: Concept of Digital Cartography, Advantages and Disadvantages of Digital Cartography, GIS Data structure, and conversions; Types of Geospatial datasets: Raster, Vector, Surface - Attributes, and Functionality; Attributes of a Geodatabase

Unit II: Database Manipulation (15 hours)
Attaching attribute data for point, segment, and polygon layers Attribute Table Maintenance - editing, updating, adding, deleting data fields Importing and incorporating external datasets into existent databases

Unit II: Digital mapping (15 hours)
The input of Raster Image, Georeferencing, Digitization, Assigning map scales,
Preparation of Map Layout and Printing Setup, Map Projection Systems of the World - Errors and deformations.

Unit III: Laboratory Notebook
A project file consisting of 5 exercises on using any method on above-mentioned themes.

Recommended Readings:

1. Bhatta, B. (2010) Analysis of Urban Growth and Sprawl from Remote Sensing,Springer, Berlin Heidelberg
2. Burrough, P.A., and McDonnell, R.A. (2000) Principles of Geographical Information System- Spatial Information System and Geo-statistics. Oxford University Press
4. Heywoods, I., Cornelius, S and Carver, S. (2006) An Introduction to Geographical Infromation system. Prentice Hall.
5. Jensen J. R., 2004: Introductory Digital Image Processing: A Remote Sensing Perspective, Prentice Hall.
7. Joseph, G. 2005: Fundamentals of Remote Sensing, United Press India.
8. Lillesand T. M., Kiefer R. W. and Chipman J. W., 2004: Remote Sensing and Image Interpretation, Wiley. (Wiley Student Edition).
9. Nag P. and Kudra, M., 1998: Digital Remote Sensing, Concept, New Delhi.
10. Nag, P. (2008) Introduction to GIS, Concept India, New Delhi.

GEO12018	Research Methods Lab	L	T	P	C
Version 1		0	0	3	2
Pre-requisites/Exposure	English writing skill				
Co-requisites	Statistical Methods in Geography				

Course Outcomes

On completion of this course, the students will be able to

CO1. **Describe** the various modes and steps of research design including identifying problems, hypothesis building
CO2. Sampling, data collection
CO3. **Analyze** data using various research techniques and their graphical representation.
CO4. **Design** own research for solving real world problem using modern tools and technology and skill to write research proposals and research articles to enhance lifelong learning.

Course Content

Unit I: Introduction to Research Methodology (10 hours)
Geographic Research: Definition; Motivation and significance, Framing research questions, Objectives and hypothesis; Preparing sample questionnaire

Unit II: Sampling (10 hours)
Concepts of Statistical Population, Sample, Sampling frame, Sampling error, Sample size, Non-response; Characteristics of a good sample; Probability Sample – Simple random sample, Systematic sample, Stratified Random sample & multi-stage sampling

Unit III: Data Processing (10 hours)
Data Collection: Type and sources of data; Methods of collection; Input and editing, Data Analysis: Qualitative data analysis; Quantitative data analysis; Data representation techniques

Unit IV: Report writing (15 hours)
Use of academic databases: Literature Review; Writing of research report: Structure; Preliminaries; Text; References, Bibliography and Citations: Reference Management tools, Abstract; Preparing of a research report on a specific problem following mentioned framework - must be submitted by each individual students

Reading Lists
1. Creswell J., 1994: Research Design: Qualitative and Quantitative Approaches Sage Publications.
2. Dikshit, R. D. 2003. The Art and Science of Geography: Integrated Readings. Prentice-Hall of India, New Delhi.
3. Evans M., 1988: "Participant Observation: The Researcher as Research Tool" in Qualitative Methods in Human Geography, eds. J. Eyles and D. Smith, Polity.
4. Misra, R.P. (2002) Research Methodology, Concept Publications, New Delhi.
5. Mukherjee, Neela 1993. Participatory Rural Appraisal: Methodology and Application. Concept Publs. Co., New Delhi.
6. Mukherjee, Neela 2002. Participatory Learning and Action: with 100 Field Methods. Concept Publs. Co., New Delhi

PSG11021	Human Values and Professional Ethics	L	T	P	C
Version 1		2	0	0	2
Pre-requisites/Exposure	--				
Co-requisites	--				

Course Outcome

At the completion of the course, the student should be able to:

CO1.**Understand** the importance of values, ethics, harmony and lifelong learning in personal and professional life

CO2.**Apply** the knowledge to perform self-exploration and transformation augmenting harmony, peace and positivity in the surroundings

CO3.**Appreciate** the core values that shape the ethical behavior of a professional

Course Content

Unit I: Introduction to Human Values:
Character, Integrity, Credibility, Mutual Respect, Dedication, Perseverance, Humility and Perception. Self-Assessment & Analysis, Setting Life Goals, Consciousness and Self-Transformation. Team Work, Conflict Resolution, Influencing and Winning People, Anger Management, Forgiveness and Peace, Morality, Conscience. Yoga and Spirituality

Unit II: Harmony and Lifelong Learning:
Harmony in human being, Nature and Existence. Harmony in family and society–Responsibilities towards society, respecting teachers. Transition from School to College-Freedom & Responsibilities, Respecting Cultural Diversity, Learning beyond the Classrooms, Independent study and research

Unit III: Introduction to Professional Ethics:
Work Ethics, Engineering Ethics, Moral Dilemma, Moral Development Theories, Ethical Theories-Kantinism, Utilitarianism, etc, Case Studies for Choice of the theory, Code of Ethics.

Unit IV: Individual to Global Issues:
Industrial Standards, A Balanced Outlook on Law, Safety, Responsibility, Rights, Confidentiality, Conflict of Interest, Occupational Crime, Whistle Blowing, Environmental Ethics, Business Conduct in MNC, E-Professionalism (IPR, Internet Ethics & Privacy issues)

Text Books

1. Shetty, FoundationCourse in Human Values and Professional Ethics [R.R. Gaur, R. Sangal, G.P. Bagaria]

CSE11643	**Elective Computer Science II**	L	T	P	C
Version 1		4	0	0	4
Pre-requisites/Exposure	Basics of computer knowledge				
Co-requisites					

Course Outcomes

On completion of this course, the students will be able to

CO1: **Understanding** a functional hierarchical code organization.

CO2: **Ability** to define and manage data structures based on problem subject domain.

CO3: **Ability** to work with textual information, characters and strings.

CO4: **Design** algorithms to solve simple problems.

CO5: **Demonstrate** the ability to correct, test and debug Processing programs.

Course Content

Unit I: (8 hours)
Basics of C Programming: Characters used in C, Identifiers, Keywords, Data type & sizes, Constants &Variables, Different types of Operators, Standard Input/output functions.

Unit II: (8 hours)
Control Flow: Control Flow, if-else, switch-case, Loop Control Statements, for loop, while loop, do-while loop, nested loop, break, continue, goto label and exit( ) function.

Unit III: (15 hours)
Arrays: Definition, Single and Multidimensional Arrays, Representation of Arrays - Row Major Order, and Column Major Order, Application of arrays – searching and sorting, Sparse Matrices and their representations.

Unit IV: (9 hours)
String: Definition of a String, Declaration of a String, Initialization of a String, Various String Handling Functions with example.

Unit V: (10 hours)
Pointers: Definition of Pointer, Declaration of Pointer, Operators used in Pointer, Pointer Arithmetic, Functions with Pointer.

Unit VI: (5 hours)
Functions: Basic Concept of Function, Declaration or Prototype of Function, Types of Functions, Call by Value, Call by Reference, Recursion, Tail Recursion.

Reference Books
1. "The C Programming Language", 2nd Edition, Brian W. Kernighan, Dennis M. Ritchie, PHI
2. "Schaum's Outline of Programming with C", 2nd Edition, Byron S. Gottfried, Mcgraw Hill Education
3. "The Complete Reference", 4th Edition by Herbert Schildt, Tata Mcgraw Hill Education

CSE12644	**Elective Computer Science II Lab**	L	T	P	C
Version 1		0	0	3	2
Pre-requisites/Exposure	Basics of computer skills				
Co-requisites					

Course Outcomes

On completion of this course, the students will be able to

CO1: **Identify** situations where computational methods and computers would be useful.

CO2: Given a computational problem, **identify** and abstractthe programming task involved.

CO3: **Approach** the programming tasks using techniques learned and write pseudo-code.

CO4: **Choose** the right data representation formats based on the requirements of the problem.

CO5: **Write** the program on a computer, edit, compile, debug, correct, recompile and run it.

CO6: **Identify** tasks in which the numerical techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task.

Course Content

List of experiments:

1. Introduction to C Programming
2. C program to implement different aspects of Control Flow
3. C program to implement different aspects ofArrays
4. C program to implement different aspects of String
5. C program to implement different aspects of Pointers
6. C program to implement different aspects of Functions

Reference Books

1. "The C Programming Language", 2nd Edition, Brian W. Kernighan, Dennis M. Ritchie, PHI

2. "Schaum's Outline of Programming with C", 2nd Edition, Byron S. Gottfried, Mcgraw Hill Education

3. "The Complete Reference", 4th Edition by Herbert Schildt, Tata Mcgraw Hill Education

PHY11024	Elective Physics II	L	T	P	C
Version 1		4	0	0	4
Pre-requisites/Exposure	Knowledge of Class12 level Physics				
Co-requisites	Basic concept of Differential and Integral Calculus				

Course Outcomes

On completion of this course, the students will be able to

CO1: Acquire the basic concepts of kinetic theory of gasses.
CO2: Develop the preliminary concepts of thermodynamics.
CO3: Build up the fundamental knowledge of quantum mechanics and apply it to few simple quantum mechanical systems.
CO4: Gain the elementary idea about the distribution functions of statistical mechanics.
CO5: Develop the basic knowledge of different topics of modern physics like LASER and fibre optics, solid state physics, band theory of solids and magnetism.

Course Content

Unit 1. Kinetic Theory of Gases: Maxwell's distribution of molecular velocities (statement only). Calculation of r.m.s, mean and most probable velocities.

Unit 2. Thermodynamics: Basic concepts: (Thermodynamic system, Surroundings and boundary, Thermodynamic coordinates, State, State function Thermodynamic equilibrium), First law of thermodynamics and its application. Isothermal and adiabatic changes and their relations, indicator diagrams. Reversible and irreversible processes, second law of thermodynamics, Carnot cycle and its efficiency calculation, entropy and its physical interpretation.

Unit 3. Quantum Physics: Planck's concept of blackbody radiation and radiation formula (statement only), qualitative discussion of photo-electric effect and Compton effect in support of quantum theory, wave-particle duality, Heisenberg uncertainty principle, and Schrödinger equation, particle in a one-dimensional infinite well, energy eigenvalues, wave function and its probabilistic interpretation. Bohr's theory of hydrogen spectra, concept of quantum number, Pauli Exclusion Principle.

Unit 4. Statistical Physics: Elementary idea about three distribution functions (Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics), Concepts of Bosons and Fermions.

Unit 5. Modern Physics: LASER and Fibre Optics, Einstein's A, B coefficient, Population Inversion, He-Ne LASER, Ruby LASER. Concept of Lattice structure, Bravais Lattice, Free electron theory, Electrical and Thermal conductivity, Band Theory, Elementary idea about Magnetism and Superconductivity.

Reference Books
1. Arthur Beiser, S RaiChoudhury, ShobhitMahajan, (2009), Concept of Modern Physics, 6th Edition, Tata-McGraw Hill.
2. A J Dekker, Solid State Physics, Mcmillan India Ltd, 1st Ed. 2009
3. Thermal Physics, Roy and Gupta
4. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.

PHY12025	Elective Physics Lab II	L	T	P	C
Version 1	Contact Hours -45	0	0	3	2
Pre-requisites/Exposure	Knowledge about basic higher secondary physics.				
Co-requisites					

Course Outcome:

CO1: Students shall be able to estimate the thermal conductivity of a bad conductor.

CO2: Students shall be able to verify different laws of network theorems of electrical circuits.

CO3: Students shall be able to study of the response of various non-ohmic devices like inductance, capacitance in the electrical circuits.

CO4: Students shall be able to study the characteristic curves of junction diodes and bipolar junction transistors.

Course Content: (45 Hours)

List of Experiments:

1. Determination of thermal conductivity of a bad conductor of heat by Lee's and Charlton's method.

2. To verify the Thevenin and Norton theorem, Superposition theorem, and Maximum Power Transfer theorems.

3. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.

4. To study V-I characteristics of PN junction diode, and Light emitting diode.

5. To study the V-I characteristics of a Zener diode and its use as voltage regulator.

6. To study the characteristics of a Bipolar Junction Transistor in CE configuration.

SDS11507	Elective Statistics II	L	T	P	C
Version 1	Contact Hours -90	6	0	0	6
Pre-requisites/Exposure	Basic Statistics				
Co-requisites	--				

Course Outcomes

On completion of this course, the students will be able to

- CO1. **Recall** basic terminologies of sampling, hypothesis testing.
- CO2. **Illustrate** sampling distribution of statistics and test of significance for large sample and small sample.
- CO3. **Explain** several methods of estimation to estimate population parameters.
- CO4. **Classify** several types of index numbers to measure relative changes.

Course Content:

Unit-I (22 hours)

Definitions of random sample, parameter and statistic, null and alternative hypotheses, simple and composite hypotheses, level of significance and probabilities of Type I and Type II errors, power of a test and critical region. Sampling distribution of a statistic, sampling distribution of sample mean, standard error of sample mean.

Unit-II (22 hours)

Large sample tests for single mean, difference of means, standard deviation and difference of standard deviations. Sampling distributions of chi-sq, t and F: definitions, properties and relationships between them. Tests of Significance based on Chi-square (goodness of fit and independence of attributes), t distribution and F- distribution using classical and p-value approach.

Unit-III (22 hours)

Methods of estimation: maximum likelihood, least squares and minimum variance, statement of Rao-Blackwell theorem and Lehmann-Schaffer theorem. Properties of maximum likelihood estimators (illustration). Interval Estimation: confidence intervals for the parameters of normal distribution, confidence intervals for difference of mean and for ratio of variances.

Unit-IV (24 hours)

Basic concept of index numbers – simple and weighted index numbers – concept of weights -types of index numbers – Business index number – CPT, WPI, Sensex, Niffy, Production Index.

Text book
  T1. A.M. Goon, M.K. Gupta and B. Dasgupta (2003): *An outline of Statistical Theory* (Vol. I), 4th Ed., World Press, Kolkata.
  T2. S.C. Gupta and V.K. Kapoor (2007): *Fundamentals of Mathematical Statistics*, 11th Ed., Sultan Chand and Sons.
Reference book
  R1. V.K. Rohtagi and A.K. Md. E. Saleh (2009): *An Introduction to Probability and Statistics*, 2nd Edition, John Wiley and Sons.

SEMESTER V

GEO11020	Geography of India	L	T	P	C
Version 1		6	0	0	6
Pre-requisites/Exposure	HS level Physical, Social and Economic Geography knowledge				
Co-requisites	-				

Course Outcomes

On completion of this course, the students will be able to

CO1. **Describe** the physical, social, cultural and economic diversity of India.

CO2. **Establish** the relationship between physical and socio-economic condition of the country.

CO3. **Understand** geographical problems of India and develop an idea about the regional planning in India.

CO4. **State** the physical, social, cultural and economic diversity of West Bengal and know about some geographical problem of the state.

Course Content

Unit 1: Physical Settings of India   (30 hours)
Geological setup of India; Physiographic regions of India (R.L. Singh), Drainage System (Peninsular and Extra Peninsular): Characteristics and classifications; Climatic, Soil and Vegetation Region of India.

Unit II: Demography and Economy   (20 hours)
Population size and growth; age and sex structure; rural-urban distribution; Socio – cultural regions of India (Sopher); Resource distribution: Forest resources – distribution and utilization; Agricultural Regions and Green revolution; Mineral and power resources, Multipurpose river projects and Atomic power stations, distribution and utilization of Iron ore, Coal, Petroleum, Natural Gas, Bauxite and Hydroelectricity; Industrial development: Automobile Industry, Information Technology and Industrial Regions; Foreign trade of India.

Unit III: Regional Problems and Planning   (15 hours)
Regional and social conflicts: Population pressure and growing environmental, housing and unemployment problems; Socio-spatial inequalities: patterns and problems; interstate water disputes; anti-regime and inter-ethnic and communal/inter religious disputes, Geographical diversity in social composition, problems of identity consciousness, questions of regionalism and nationalism in contemporary North-East India; Objectives of regional planning in India; Planning regions after Sengupta and Sdasyuk, Chandrasekhara; Liberalization, Privatization and Globalization; PURA; Bharata Nirman; Five year plans and Indian economy - a review.

Unit IV: Geography of West Bengal   (25 hours)
Physical settings – Physiography, drainage, climate, soils and natural vegetation, Population distribution – Post independent spatio – temporal distribution of population; Fertility, Mortality and Migration, Economy and development – Distribution of Paddy and Tea Cultivation; Distribution of

Power and Mineral resources- coal and iron ore; Industrial development and industrial belts of West Bengal – problems and consequences; Problems of development of SEZ in West Bengal.

Recommended Readings:

1. Bose, A. et. al. eds, 2001: Population in India's Development, 1947-2000, Vikas, New Delhi.
2. Chatterjee, S. P. (1973): Physiography of India, Gazetteer of India, Vol. I, Chopra, P. N. (Ed.), Govt. of India, New Delhi.
7. Khullar, D. R. (2006): India. A Comprehensive Geography. Kalyani Publishers., New Delhi.
8. Mandal R. B. (ed.), 1990: Patterns of Regional Geography – An Intenational Perspective. Vol. 3 – Indian Perspective.
9. Mita, A. Levels of regional Development India Census of India, Vol. Part I-A (i) and (ii) New Delhi, 1967.
11. Pathak, C. R. 2003: Spatial Structure and Processes of Development in India. Regional Science Assoc., Kolkata
12. Routray, J.K. Geography of Regional Disparity Asian Institute of Technology, Bankok, 1993.
14. Sdyasuk Galina and P Sengupta (1967): Economic Regionalisation of India, Census of India
15. Sharma, T. C. 2003: India - Economic and Commercial Geography. Vikas Publ., New Delhi.
16. Singh R. L., 1971: India: A Regional Geography, National Geographical Society of India.
17. Singh, Jagdish 2003: India - A Comprehensive & Systematic Geography, GyanodayaPrakashan, Gorakhpur.
18. Spate O. H. K. and Learmonth A. T. A., 1967: India and Pakistan: A General and Regional Geography, Methuen.
19. Tirtha, Ranjit 2002: Geography of India, RawatPubls., Jaipur & New Delhi.
20. Tiwari, R. C. (2007): Geography of India, PrayagPustakBhawan, Allahabad
22. Wadia, D.N: Geogrphy of India, McMillan & Co., London, 1967.

GEO12021	Advance Remote Sensing and GIS Lab	L	T	P	C
Version 1		0	0	6	4
Pre-requisites/Exposure	Basic Remote Sensing and GIS knowledge				
Co-requisites	-				

Course Outcomes

On completion of this course, the students will be able to

CO1. **Develop** an idea about Multispectral, Hyperspectral, Thermal and Microwave remote sensing.
CO2. **Understand** GIS data structure and its operations and prepare thematic maps using GIS softwares
CO3. **Prepare** land use land cover maps and perform temporal change detection studies.
CO4. **Apply** remote sensing and GIS techniques in the field of urban sprawl analysis, water resource management and forests monitoring

Course Content

Unit I: Advances in Remote Sensing (40 hours)

Advances in remote sensing: Concepts and applications of Multispectral, Hyperspectral, Thermal and Microwave remote sensing; Open source satellite data acquisition: Landsat and IRS data; Digital image concepts: Pixels, DN values, Grey level, histogram, Color image fundamentals – RGB, HSI models.

Unit II: GIS Data Structure and Operations (40 hours)

GIS data types: spatial and non-spatial, Digitization, Raster and Vector data Structure: Geodatabase, Non-topological and topological vector data models; Raster Data Analysis – Local, Focal, Global and Zonal; Vector Data Analysis- Map Manipulation Techniques, Buffering and Overlay operations; Scale design; Preparation of thematic map

Unit III: Image Processing and Applications (55 hours)

Image preprocessing: Radiometric and Geometric Correction, Image enhancement: Linear enhancement and Filtering; Concept of band combination and selection of bank combinations for identifying distinct objects; Image classification schemes: Supervised and Un-supervised; Interpretation and Application of Remote Sensing and GIS: Land use/ Land Cover, Urban Sprawl Analysis; Forests Monitoring

Unit IV: Laboratory Notebook
A project file consisting of two exercises will be done from Unit II (Raster, Vector operations, Thematic maps, scale, orientation and interpretation) and 3 exercises on Land use/ Land Cover, Urban Sprawl Analysis; Forests Monitoring.

Recommended Readings:

1. Bhatta, B. (2008) Remote Sensing and GIS, Oxford University Press, New Delhi.

2. Campbell, J. B. (2007): Introduction to Remote Sensing, Guildford Press.

3. Chauniyal, D.D. (2010): Sudur Samvedanevam Bhogolik Suchana Pranali, Sharda Pustak Bhawan, Allahabad

4. Jensen, J. R. (2004): Introductory Digital Image Processing: A Remote Sensing Perspective, Prentice Hall.

5. Joseph, G. 2005: Fundamentals of Remote Sensing, United Press India.

6. Li, Z., Chen, J. and Batsavias, E. (2008) Advances in Photogrammetry, Remote Sensing and Spatial Information Sciences CRC Press, Taylor and Francis, London

7. Lillesand T. M., Kiefer R. W. and Chipman J. W., 2004: Remote Sensing and Image Interpretation, Wiley. (Wiley Student Edition).

8. Lo, C.P. and Yeung, A.K.W. (2002): Concepts and Techniques in Geographic Information Systems. Upper Saddle River, New Jersey: Prentice Hall.

9. Mukherjee, S. (2004) Textbook of Environmental Remote Sensing, Macmillan, Delhi.

10. Nag P. and Kudra, M., 1998: Digital Remote Sensing, Concept, New Delhi.

11. Narayan, L.R.A. (1999): Remote Sensing and Its Application, Universities Press (India) Ltd., Hyderabad.

12. Rees, W.G. (2001): Physical Principles of Remote Sensing, Cambridge University Press.

GEO11022	Population and Settlement Geography	L	T	P	C
Version 1		6	0	0	6
Pre-requisites/Exposure	**10+2 level Geography knowledge**				
Co-requisites	**10th Standard Level social studies knowledge**				

Course Outcomes

On completion of this course, the students will be able to:

CO1. **Explain** different aspects of population dynamics and spatial pattern of such dynamics.
CO2. **Elaborate** different theories associated with population growth and settlement pattern
CO3. **Classify** different settlement patterns over spaces.
CO4. **Understand** the problems and solution pathways of major settlements of India and world.

Course Content

Unit I: Population Dynamics   (16 hours)
Population Geography: Nature, scope and trends, Sources of Data with special reference to India (Census, Vital Statistics and NSS). The concept of population density and its types: Factors influencing spatial distribution and density of population; World distribution of population, Population - Resource Region, Population Dynamics: Fertility, Mortality and Migration – Measures, Determinants and Implications.

Unit II: Demographic Attributes and Concerns   (24 hours)
Population structure and composition: Age and Sex specific, Rural and Urban Composition, Literacy Theories of Population Growth: Malthus and Marx, Demographic Transition; Population policy with reference to India and China; Theories of Migration: Ravenstein, Lee and Todaro, Emerging issues and concerns - Ageing of Population; Declining Sex Ratio; HIV/AIDS; nutrition andmorbidity with special reference to India

Unit III: Introduction to Rural and Urban Settlements   (25 hours)
Definition, nature, types and characteristics of settlements; Morphology of rural settlements: site and situation, Social segregation rural landuse morphology; Types and Patterns of Rural Settlements; Rural house types and forms with reference to India, Urban settlements: Characteristics and definition, Census definition and categories in India; Concept of Metropolitan, Conurbation, Megacity, Megalopolis, Ecumenopolis and Necropolis, Morphology and Functions of Settlements: Classical models of Burgess, Homer Hoyt, Harris and Ullman, Central Place theory of Christaller; City Region, Umland and Rural urban Fringe and Continuum

Unit IV: Rural – Urban Infrastructure: Issues and Concerns   (25 hours)
Problems of Rural settlements: Housing, Drinking water, Power, Education and Finance, Urban Housing problem: study of outgrowth and urban sprawl with reference to India; Urban

Redevelopment, Renewal and New Town – case studies with reference to India. Urban basic infrastructure and issues: Water supply and sanitation; solid waste management; role of National policies and JNNURM

Recommended Readings:

1. Carter, H.1975: The Study of Urban Geography, Edward Arnold, London
2. Daniel, P. 2002: Geography of Settlement, RawatPubls., Jaipur & New Delhi.
3. G. Dickinson, R. E. (1964) : City and Region.
4. Ghosh, S. 1998 : Settlement Geography, Orient Longman Ltd. , Kolkata.
5. Hudson, F. S. (1976) : Geography of Settlement.
6. Johnson, J.H. 1977 Urban Geography- An Introductory Analysis, Pergamon press, Oxford
7. Mandal, R.B. 2001: Introduction to Rural Settlements, Concept Publishing Company, New Delhi
8. Misra, H.N. (1987) Rural Georaphy, Vol. IX, Contributions to Indian Geography, Heritage Publishers, New Delhi.
9. Ramachandran R., 1989: Urbanisation and Urban Systems of India, Oxford University
10. Singh R.L. & K.N. Singh : Readings in Rural Settlement Geography, NGSI Varanasi, 1975
11. Agarwala, S.N. 1985: India's Population Problems, Tata McGraw hill, New Delhi
12. Chandna, R.C. 1986: A Geography of Population, Kalyani Publishers, New Delhi
13. Clarke, J. I. 1971: Population Geography and the Developing Countries, PergamonPress, Oxford
14. Clarke, J. I. 1972 Population Geography, Pergamon Press, Oxford
15. Hassan, M.H. 2005: Population Geography, Rawat Publications, New Delhi
16. Mamoria, C.B. India's Population Problem, KitabMahal New Delhi, 1981.
17. Mitra, Ashok India's Population: Aspects of Quality and Control Vol I & II. Abhiman Publications, New Delhi, 1978.
18. Trewartha, G.T. 1969: A Geography of Population- World Patterns, John Wiley, New York.
19. Zacharia, E. and Sinha, V.C., 1986 : Elements of Demography, Allied publishers Pvt Ltd, New Delhi

GEO11023	**Resource Geography**	L	T	P	C
Version 1		6	0	0	6
Pre-requisites/Exposure	10+2 level Geography knowledge				
Co-requisites	10th Standard Level Economics knowledge				

Course Outcomes

On completion of this course, the students will be able to:

CO1. **Define** different types of resources and characterize their properties.

CO2. **Explain** myriad processes of resource management.

CO3. **Solve** complexities arising from resource utilization.

CO4. **Summarizes** resource related policies to achieve sustainable development goals.

Course Content

Unit I: Concept and Nature of Resources (20 hours)

Concept, Scope, Nature and Classification of resources, Economic and Environmental approaches to resource utilization; Process of resources: Zimmerman model, Principals of resource adequacy and resource scarcity: Pressure on resources.

Unit II: Distribution and management of Natural Resources (22 hours)

Resources; problem of land acquisition in developing countries; Extensive Economic Zones (EEZ) of the world, Global scenario of utilisation, problems and trend of management of resources: Forests and Energy Resources, Distribution, depletion and management of resource: Mineral and Soil Resources.

Unit III: Environmental Crisis and Management (24 hours)

Environment as a resource system; Technology, Market, Culture and resources, Environmental crisis-nature and management of deforestation, Flood and droughts, Land degradation, Depletion of fresh water resources and their management.

Unit IV: Concept of resource conservation and sustainability (24 hours)

Conservation of natural resources in the context of environment, population and development., Sustainable Resource Development' eco-friendly technology and sustainable development, National policies, plans, programmes, processes and patterns of resource development

Recommended Readings:

1. Adams, W.M.1995: Green development: Environmental sustainability in the Third World, London: Rout ledge.
2. Burton, I. and Kates, R.W. 1978: Readings in Resources Management and Conservation, McGraw Hill, New York.
3. Canter,L. W. 1996: Environmental Impact Assessment, 2nd edition, New Yprk: McGraw hill.

4. Chapman J.L. and Reiss, M.J. 1993: Ecology: Principles and applications, Cambridge: Cambridge university Press.

5. Clark, G.L; Feldman, M.P. and Gertler, M.S.(eds.) 2000: The Oxford handbook of Economic Geography,

6. Oxford University Press, Oxford and New York.

7. Cutter S. N., Renwich H. L. and Renwick W., 1991: Exploitation, Conservation,Preservation: A Geographical Perspective on Natural Resources Use, John Wiley and Sons, New York.

8. David W. Pearce and Kerry R. Turner 1999: Economics of Natural Resources and the Environment, The Johns Hopkins University press, Baltimore.

9. Gadgil M. and Guha R., 2005: The Use and Abuse of Nature: Incorporating This Fissured Land: AnEcological History of India and Ecology and Equity, Oxford University Press. USA.

10. Holechek J. L. C., Richard A., Fisher J. T. and Valdez R., 2003: Natural Resources: Ecology, Economics and Policy, Prentice Hall, New Jersey.

11. Hoyt,J.B. (1973) Man and the earth,Prentice Hall, New Jersy.

12. Husain, M. (2010) Human Geography, Rawat Publication, Jaipur.

13. John Bowers (1997), Sustainaility and Environmental Economics, Addison Weley Longman Ltd, Singapore.

14. Jones G. and Hollier G., 1997: Resources, Society and Environmental Management, Paul Chapman, London.

15. Klee G., 1991: Conservation of Natural Resources, Prentice Hall, Englewood.

GEO11024	Agricultural Geography	L	T	P	C
Version 1		6	0	0	6
Pre-requisites/Exposure	HS level Economic Geography knowledge				
Co-requisites	-				

Course Outcomes

On completion of this course, the students will be able to

- CO1. **Develop** an idea about the origin and evolution of agricultural system and compare major agricultural types of the world.
- CO2. **Estimate** agricultural productivity and efficiency, crop combination and diversification
- CO3. **Understand** the characteristics, problems and challenges of Indian agriculture
- CO4. **Apply** agricultural geographical knowledge to solve real world agricultural problems.

Course Content

Unit 1: Introduction to Agricultural Geography (20 hours)
Introduction to Agricultural Geography; Origin of agriculture: Major Gene centers and Diffusion of agriculture – Agriculture and human civilization, Agricultural Region, Concept and techniques of delineation of agricultural regions, Determinants of agriculture (tropical) – Physical, economic, social and technological factors

Unit II: Agricultural Systems: (30 hours)
Major agricultural types in the world: Shifting cultivation, Subsistence agriculture, Commercial agriculture, Plantation agriculture, Measurement of agricultural productivity and efficiency; Crop combination and Diversification, Model Agricultural Systems of the world: Von Thunen and Whittlesey; Land use model: L.D. Stamp

Unit III: Agriculture in India (20 hours)
Characteristics and challenges of Indian agriculture; Agro-climatic, Agro-ecological & Crop Combination Regions of India, Role of Technological Changes in Agricultural Productivity and Efficiency, Green ,White, Blue and Pink Revolution-success and failures in India, Problem associated with Indian agriculture – National Agricultural Policy; Impact of Globalization, Food Security and Corporate Farming

Unit IV: Applied Agricultural Geography (20 hours)
Problems and Prospects of Tropical Agriculture – droughts, over irrigation, land fragmentation and marketing, areas in agriculture and Agricultural Development - Dairy farming, Poultry, Sheep and Goat farming, Agro –Tourism, Bee keeping, Poly houses, Sustainable Agricultural Practices in Tropical Region - Ecological conservation, organic farming, Crop rotation and group plantation, pest and weed management.

Recommended Readings:

1. Basu, D.N., and Guha, G.S., 1996: Agro-Climatic Regional Planning in India, Vol.I& II, Concept Publication, New Delhi.
2. Bryant, C.R., Johnston, T.R, 1992: Agriculture in the City Countryside, Belhaven Press, London.
3. Burger, A., 1994: Agriculture of the World, Aldershot, Avebury.
4. Dhillon, J.S. Agricultural Geography
5. Gregory H. P. (1970), "Geography of Agricultural", Prentice Hall New York
6. Grigg, D.B., 1984: Introduction to Agricultural Geography, Hutchinson, London.
7. Husain, Majid. (1999), "Agricultural Geography", Rawat Pub. New Delhi
8. Ilbery B. W., 1985: Agricultural Geography: A Social and Economic Analysis, Oxford University Press.
9. Mohammad, N., 1992: New Dimension in Agriculture Geography, Vol. I to VIII, Concept Pub., New Delhi.
10. Mohammad, N., 1992: New Dimension in Agriculture Geography, Vol. I to VIII, Concept Pub., New Delhi.
11. Roling, N.G., and Wageruters, M.A.E.,(ed.) 1998: Facilitating Sustainable Agriculture, Cambridge University Press, Cambridge.
12. Shafi, M., 2006: Agricultural Geography, Doring Kindersley India Pvt. Ltd., New Delhi
13. Singh, J. and Dhillon, S.S. (1984), "Agricultural Geography", 2nd edition, Tata McGraw-Hill, New Delhi.
14. Singh, J., 1974: An Agricultural Atlas of India: A Geographical Analysis, Vishal Publications, Kurukshetra.
15. Singh, J., and Dhillon, S.S., 1984: Agricultural Geography, Tata McGraw Hill, New Delhi.

GEO11025	Urban Geography	L	T	P	C
Version 1		6	0	0	6
Pre-requisites/Exposure	HS level knowledge of human geography and social sciences				
Co-requisites					

Course Outcomes

On completion of this course, the students will be able to:

CO1.   **Explain** the major disciplinary changes that have occurred in the field of urban geography over the course of the last century.

CO2.   **Identify** processes and patterns of urbanization associated with the evolution of urban landscapes.

CO3.   **Describe** the fundamentals of urban classifications.

CO4.   **Interpret** major urban problems with reference to planning.

Course Content

Unit 1: Introduction to Urban Geography: (25 hours)
Definition of Urban Geography: Nature and scope; Approaches: Positivist approaches, Behavioural and humanistic approaches, Structuralist approaches, Urbanization: Definition and measurements; process of urbanization during ancient, medieval, modern and postmodern period; Globalization and political economy of Urbanization.

Unit II: Patterns of Urbanization in Developed and Developing Countries: (20 hours)
Process of urbanization in developed and developing countries; Pattern of world cities: Global cities, Represented city, Hybrid City, Intransitive City and the Creative City, Suburbanisation, Segregation and Gentrification; Urban Aesthetics and changing urban spaces: working in the skyline, mobile and wireless in urban place; Cyborganization and Smart City

Unit III: Classification of Urban Places: (20 hours)
Urban Space and Urban Place: Urban Image, Centrality, Mobility, Transnational Urbanism; La Corbusier's Model of Sustainable city; Demographic characteristics of urban populations; Gradients of Population Density within Cities, Occupational structure of urban populations, Functional classification of towns in medieval period with reference to India; Recent Developments in Urban Classification with reference to India.

Unit IV: Urban Problems and Issues: (25 hour)
City Employment issues, Displacement issues, Subsidy issues, Housing issues, Cultural issues, Urban green spaces, Urban transport, sustainability issue, Case studies of Delhi, Kolkata, Mumbai, Chennai, Bangalore and Chandigarh with reference to Land use, Urban and Environmental Issues and planning; Urban Planning in India- Policies, framework and reforms.

Recommended Readings:

1. Graham, S. and Marvin, S. (2001): Splintering Urbanism: Networked Infrastructures, Technological Motilities and the Urban Condition, Rutledge
2. Hall T. (2006): Urban Geography, Taylor and Francis.
3. Harvey, David (1989) The Conditions of Post modernity, Blackwell Oxford.
4. Kaplan, D.H., Wheeler, J.O. and Holloway, S.R. (2008): Urban Geography, John Wiley.
5. Knox, P.L. and McCarthy, L. (2005): Urbanization: An Introduction to Urban Geography, Pearson Prentice Hall New York.
6. Knox, P.L. and Pinch, S. (2006): Urban Social Geography: An Introduction, Prentice-Hall.
7. Kundu, A (1992) Urban Development and Urban Research in India, Khanna Publication, New Delhi.
8. Mayer H.M. and Kohn, C.F. (1958), Reading Urban Geography. University of Chicago Press,Chicago.
9. Pacione, Michael (2001), Urban Geography - A Global Perspective, Routedge, London.
10. Ramachandran, R. (1992): The Study of Urbanisation, Oxford University Press, Delhi.
11. Singh, K. and Steinberg, F. (eds.) (1987) Urban India in Crisis, New Age International, New Delhi.
12. Singh, R.B. (Ed.) (2015): Urban development, challenges, risks and resilience in Asian megacities.

GEO14026	Industry Internship	L	T	P	C
Version 1		-	-	-	2
Pre-requisites/Exposure	10+2 level Geography knowledge				
Co-requisites					

Course Outcomes

On completion of this course, the students will be able to:

    CO1.**Demonstrate** the skill learned in classroom to solve practical problems
    CO2. **Match** the required competency for real world.
    CO3. **Learn** work ethics and in a team.
    CO4. **Act** as a bridge in between industry and academia

Course Content

An Industry Interaction Report to be prepared and submitted individually by each student, based on actual industrial interaction and visits, done jointly or in groups with other students.

SEMESTER VI

GEO11027	**Evolution of Geographical Thought**	L	T	P	C
Version 1		6	0	0	6
Pre-requisites/Exposure	HS level elementary knowledge on branches of geography				
Co-requisites					

Course Outcomes

On completion of this course, the students will be able to:

CO1. **Explain** the nature and scope of geography as a study of man-environment relationship adopting various approaches of time, space, and system.

CO2. **Describe** the evolution of geographical thinking with reference to classical periods, medieval age and modern era.

CO3. **Explain** the fundamentals of modern geographical approaches.

CO4. **Relate** future of geography with the contemporary spatial concepts.

Course Content

Unit 1: Nature and Concepts in Geography: (24 hours)
Nature of Geography and its relation with other disciplines; Human – Environment Relationship, Concepts in Geography: Encyclopaedism; Location, Time and Space, Approaches in Geography: Ideographic and Nomothetic; Areal differentiation and Spatial organization; Systems Approach

Unit II: Paradigms in Geography: (24 hours)
Early Origins of Geographical Thinking with reference to the Classical periods: Greek, Roma, Evolution of Geographical Thinking during Medieval and Dark age: Indian and Chinese Philosophies; Arabian School of thoughts, Modern Trends in Germany, France, Britain, United States of America.

Unit III: Modern Debates and Thoughts: (22 hours)
Environmental Determinism and Possibilism; Empiricism and Positivism, Systematic and Regional approaches in Geography, Probabilism and Structuralism

Unit IV: Contemporary Thoughts: (20 hours)
Quantitative Revolution and its Impact; Radicalism, and Behavioural Approaches; Feminism, towards Post Modernism – Changing Concept of Space in Geography, Future of Geography.

Recommended Readings:

1. Adhikari, S. (2002): Fundamentals of Geographical Thought, ChaitanyaPublishing. House, Allahabad.
2. Harvey, D. (1969): Explanations in Geography, London.
3. Hartshorne, R. (1939): The Nature of Geography: Association of American Geographers, USA.
4. Harvey, Milton E. and Brian, P. Holly (Ed.) (1981): Themes in Geographical Thought, Rawat Publication, Delhi.

5. Hossain, M. (2004): Evolution of Geographical Thought, Rawat Publications, Jaipur.
6. Johston, R. J. et al (Ed.) (1981) The Dictionary of Human Geography, Blackwell, England.
7. Peet, R. (Ed.) (1977): Radical Geography, Methuen, London.
8. Haggett.: Geography – A Modern Synthesis.
9. Arentsen M., Stam R. and Thuijis R. (2000): Post-modern Approaches to Space, ebook.
10. Bonnett, A. (2008): What is Geography? Sage.
11. Dikshit, R. D. (2005): Geographical Thought: A Contextual History of Ideas, Prentice– Hall India.
12. Hartshone, R. (1959): Perspectives of Nature of Geography, Rand MacNally and Co.
13. Holt-Jensen, A. (2011): Geography: History and Its Concepts: A Students Guide, SAGE.
14. Johnston, R. J. (1997): Geography and Geographers, Anglo-American Human Geography since 1945, Arnold, London.
15. Kapur, A. (2001): Indian Geography Voice of Concern, Concept Publications.
16. Martin Geoffrey, J. (2005): All Possible Worlds: A History of Geographical Ideas, Oxford.
17. Soja, E. (1989): Post-modern Geographies, Verso, London. Reprinted 1997, Rawat Publ., Jaipur and New Delhi.

GEO11028	Political Geography	L	T	P	C
Version 1		6	0	0	6
Pre-requisites/Exposure	World and Indian History				
Co-requisites	-				

Course Outcomes

On completion of this course, the students will be able to

CO1. **Describe** the key concepts of political geography, political organization, administrative and political divisions.

CO2. **Identify** the geographical perspective in struggle for global power, voting, political actions and processes.

CO3. **Relate** the recent conflicts for border and water of India with neighbouring countries as a threat for national security.

CO4. **Explain** the politics of regional conflicts for land and resources, and gap in policy to solve disputes.

Course Content

Unit I: Concepts and Nature of Political Geography (25 hours)

Definition and scope of Political Geography; Approaches and schools of political geography, State and Nation: The idea of the state, special factors of the state (Location, size and shape); Concept of Nation, elements and characteristics of nation, Nationalism; Concept of Nation-State, Frontiers and boundaries: Definitions, Classifications of boundaries; Border lands and Buffer zones; states; Land locked nations; Enclaves and Exclaves; Territory and Sovereignty

Unit II: Global strategic views (20 hours)

Geo- strategic views of Mackinder and Spykeman, Concept of Geopolitics, Concept of cold war; bi-polarisation and uni-polarisation, Electoral Geography: Geography of Voting, Geographic Influences on Voting pattern, Geography of Representation, Gerrymandering

Unit III: Political Geography of India (20 hours)

Impact of partition of India. International borders and disputes; Terrorism and Indian Defence Policies. International and interstate water dispute in Indian subcontinent: Water Sharing between India and Bangladesh and Karnataka and Tamil Nadu.

Unit IV: Geopolitics of global resources and role of multinational organizations

(25 hours)

Political Geography of Resource Conflicts – Water Sharing Disputes, Disputes and Conflicts Related to Forest Rights and Minerals. Politics of Displacement: Issues of relief, compensation and rehabilitation: with reference to Dams and Special Economic Zones Significance of ASEAN, SAARC and EU; Role and emergence of NATO

Recommended Readings:

1. Adhikari, S. (2004): Political Geography, Rawat Publication, New Delhi.

2. Alexander, L.M. (1963): World Political Patterns Ran McNally, Chicago.
3. De Blij, H.J. and Martin, G. (1968): Systematic Political Geography, John Wiley, New York.
4. Dikshit, R.D. (1996): Political Geography: A Contemporary Perspective. Tat McGraw Hill New Delhi.
5. Dwivedi, R.L. (2004): Fundamentals of Political Geography, Chaitanya Publishing House, Allahabad
6. Cox, K.R., Low, M. and Robinson, J. (2008): The Sage Handbook of Political Geography, Sage Publications.
7. Cox, K., (2002): Political Geography: Territory, State and Society, Wiley-Blackwell
8. Gallaher, C. (2009): Key Concepts in Political Geography, Sage Publications.
9. Jones, M. (2004): An Introduction to Political Geography: Space, Place and Politics, Routledg .
10. Mathur, H.M. and Cernea, M.M. (eds.) Development, Displacement and Resettlement – Focus on Asian Experience, Vikas, Delhi
11. Painter, J. and Jeffrey, A. (2009): Political Geography, Sage Publications.
12. Taylor, P. and Flint, C. (2000): Political Geography, Pearson Education.
13. Verma. M.K. (2004): Development, Displacement and Resettlement, Rawat Publications, Delhi

GEO11029	Geography of Health and Wellbeing	L	T	P	C
Version 1		6	0	0	6
Pre-requisites/Exposure	HS level knowledge of human geography and social sciences				
Co-requisites					

Course Outcomes

On completion of this course, the students will be able to:

CO1. **Explain** various perspectives of health and wellbeing associated with the geography, environment, development, population dynamics, poverty and inequality.

CO2. **Relate** anthropogenic activities with the degrading environmental quality and health risks.

CO3. **Describe** the concepts, measurements and classification of diseases with reference to its genesis and distribution.

CO4. **Describe** the role of national and international organisations in addressing the issues of healthcare disparity with special reference to India.

Course Content

Unit 1: Basic Concepts: **(15 hours)**
Introduction to geography of health and wellbeing: Definition, Nature and Scope, Perspectives on Health and wellbeing: Linkages with environment, development and health; Driving forces in health and environmental trends – population dynamics, urbanization, poverty and inequality.

Unit II: Exposure and Health Risk: **(25 hours)**
Exposure: concept and types, Pathways and routes of exposure, duration of exposure, dose-response, Environmental pollution: Air, Water, soil and noise pollution, Indoor-outdoor exposures in developed and developing nations, climate change and human health – heat and cold; Biological disease agents; food production and nutrition, Diseases causing factors and agents: Environmental, Hereditary, Behavioural, and deficiency diseases, Xenobiotics, Pathogens, Geogens, Tetragens, Allergens, Carcinogens etc. Occupational health and safety.

Unit III: Disease Distribution and Epidemiology: **(25 hours)**
Mortality and Morbidity: concept and measurements, Diseases – Concepts and classifications - genetic, communicable and non-communicable; WHO classification of diseases; Principles of Epidemiology: concept, measures and techniques, Spatial and Geographical Epidemiology: Infectious diseases modelling, Epidemiological Transition Theory. Temporal distribution of disease in Environmental Context with special reference to India, Types of Diseases and their regional pattern (Communicable and Lifestyle-related diseases).

Unit IV: National and Global Issues in Healthcare Systems: **(25 hours)**
Health care systems of developed and developing countries; Financing of Health care System, regional disparity in healthcare distribution - issues of accessibility and availability of healthcare, Role of international organization and healthcare - World Health (WHO), UNICEF and Red Cross.

Health Care Systems in India; National Health Policies, Health Care Programmes – Family welfare, Immunization, National Disease Eradication, and National Rural Health Mission.

Recommended Readings:

1. Akhtar Rais (Ed.), 1990: Environment and Health Themes in Medical Geography, Ashish Publishing House, New Delhi.
2. Avon Joan L. and Jonathan A Patzed. 2001: Ecosystem Changes and Public Health, Baltimin, John Hopling Unit Press(ed).
3. Bradley,D.,1977: Water, Wastes and Health in Hot Climates, John Wiley Chichesten.
4. Christaler George and HristopolesDionissios, 1998: Spatio Temporal Environment Health Modelling, Boston Kluwer Academic Press.
5. Cliff, A.D. and Peter,H., 1988 : Atlas of Disease Distributions, Blackwell Publishers, Oxford.
6. Gatrell , A.C. (2002) Geographies of Health: An Introduction, Blackwell,
7. Gatrell, A.,andLoytonen (1998). GIS and Health, London: Taylor and Francis Ltd.
8. Gesler, W.M. (1992). Therapeutic landscapes: Medical issues in light of the new cultural geography.
9. Hardham T. and Tannav M.,(eds): Urban Health in Developing Countries; Progress, Projects, Earthgoan, London.
10. Meade.M.S and Emch M: Medical Geography, London: The Guilford Press.
11. Moeller Dade wed., 1993: Environmental Health, Cambridge, Harward Univ. Press.
12. Murray C. and A. Lopez, 1996: The Global Burden of Disease, Harvard University Press.
13. Phillips, D.andVerhasselt, Y., 1994: Health and Development, Routledge, London.
14. Rais, A. and Learmonth, A.T.A.: Geographical Aspects of Health and Diseases in India.
15. Smyth, Fiona (2008). Medical geography: Understanding health inequalities. Progress in Human Geography 32 (1): 119-127.
16. Sattenspiel, L. (2009). *The geographic spread of infectious diseases*. Princeton University Press.
17. Souris, M. (2019). *Epidemiology and geography: principles, methods and tools of spatial analysis*. John Wiley & Sons.

GEO11030	**Hydrology and Ooceanography**	L	T	P	C
Version 1		6	0	0	6
Pre-requisites/Exposure	HS level Physical Geography knowledge				
Co-requisites	-				

Course Outcomes

On completion of this course, the students will be able to

CO1. **Understand** the physical phenomena and processes of hydrological cycle and their measurement techniques.

CO2. **Evaluate** the groundwater potentials of a region and its flow to solve the real-world crisis.

CO3. **Summarize** the basic principles of Oceanography, including the basic tenets of the sub-disciplines, and to explain complex phenomena in their own sub discipline.

CO4. **Evaluate** the various factors for ocean water pollution and marine ecosystem conservation.

Course Content

Unit 1: Introduction to Hydrology (20 hours)
Definition, Scope, and Content of Hydrology; Global Hydrological Cycle: Its Physical and Biological Role; Drainage Basin as a Hydrological Unit; Human impact on the hydrological cycle; Systems approach in hydrology; Components of Hydrology and their controlling Factors: interception, evaporation, evapotranspiration, infiltration, ground-water, runoff and overland flow; Estimates of Potential Evapotranspiration by Thornthwaite's Equation

Unit II: Subsurface and Surface Hydrology (30 hours)
Sub-Surface Zonation of Ground Water; Types of Aquifers, their formations; Controlling Factors of the Movement of the Ground Water - Recharge, Discharge, and Storage; Darcy's Laws; Issues related to their overutilization; Salt Water Intrusion; Measurement of Surface Runoff and River Discharge; Precipitation: Frequency Analysis of Point Rainfall: Intensity-Duration-Frequency Relationship; Hydrographs, Rating Curves; Stream flow analysis; River Regimes; Characteristics of river basins; Drainage Basin and its morphometric analysis; Floods and Droughts.

Unit III: Configuration of the Ocean Floor (20 hours)
Configuration of the ocean floor, continental shelf, continental slope, abyssal plain, mid-oceanic, and oceanic trenches; Relief of Atlantic, Pacific, and Indian Oceans, Major features of the ocean floor: formation explained by Plate Tectonics. Coral reefs and atolls: types and factors; Theories of origin of coral and volcanic islands; Oceanic sediments: Origin and classification;

Unit IV: Ocean Properties and Resources (20 hours)
Major properties (Physical and Chemical) of Ocean water, Concept of water mass; Waves, Tides; Ocean heat budget, deep water circulation, ocean currents and their influence, Resource potential of the oceans; Exclusive economic zone; Marine Pollution.

Recommended Readings:

1. Linsley, K., Kohler, M. and Paulhus, J.L. (1975): Applied Hydrology, Tata McGraw Hill, New York.

2. Meinzer, O.E. (1942): Hydrology, Dover Publication Inc. New York.

3. Rahgunath, H.M. (1997): Hydrology- Principles, analysis, Design, New Age International Pvt. Ltd, New Delhi

4. Sverdrup, H.U. (1942): The Oceans, their Physics, Chemistry and General Biology, Prentice-Hall, New York.

5. Todd, D.K. (1959): Ground Water Hydrology, John Wiley and Sons, New York

6. Walton, W.C. (1970): Ground Water Resource Evaluation, McGraw Hill, Tokyo

7. Andrew. D. ward and Stanley, Trimble (2004): Environmental Hydrology, 2nd edition, Lewis Publishers, CRC Press.

8. Karanth, K.R. (1988): Ground Water: Exploration, Assessment and Development, Tata-McGraw Hill, New Delhi.

9. Ramaswamy, C. (1985): Review of floods in India during the past 75 years: A Perspective. Indian National Science Academy, New Delhi.

10. Singh, Vijay P. (1995): Environmental Hydrology. Kluwar Academic Publications, The Netherlands.

11. Garrison T. (1998): Oceanography, Wordsworth Company, Belmont.

12. Sharma, R.C. and Vatal, M. (1980): Oceanography for Geographers, Chaitanya Publishing House, Allahabad.

13. Sverdrup, K.A. and Armbrust, E.V. (2008): An Introduction to the World Ocean, McGraw Hill, Boston.

GEO11031	Geography of Transport and Tourism	L	T	P	C
Version 1		6	0	0	6
Pre-requisites/Exposure	10+2 level Geography knowledge				
Co-requisites	10th Standard Level Economics knowledge				

Course Outcomes

On completion of this course, the students will be able to:

CO1. **Classify** major tourism types and differences among the tourism types
CO2. **Relate** the picture of tourism with socio economic development in different states of India
CO3. **Understand** the basics of transport geography and their types
CO4. **Elaborate** transport related issues and their consequences on environment in major cities of India.

Course Content

Unit I: Introduction to Tourism Geography (20 hours)
Scope and Nature: Concepts and Issues, Tourism, Recreation and Leisure Inter-Relations; Geographical Parameters of Tourism. Type of Tourism: Nature Tourism, Cultural Tourism, Medical Tourism, Pilgrimage; Impact of Tourism: Environment, economic and social, Positive and negative impact of tourism, Recent Trends of Tourism: International and Regional; Eco-Tourism, Sustainable Tourism, Meetings Incentives Conventions and Exhibitions (MICE).

Unit II: Tourism in India (20 hours)
Tourism Infrastructure and support system – accommodation, other facilities and amenities, Tourism industry in India: Regional attraction and promotion of tourism; Problems of Tourism in India, Case Studies of Tourism Industry: Himalaya, Desert and Coastal Areas; Tourism Policy and planning in India.

Unit III: Introduction to Transport Geography (25 hours)
Nature and scope of transport geography, Transport networks – Network structure and concepts and measures of distance, accessibility and connectivity, Transport and development; Factors associated with the development of transport system: physical, economic, social, cultural and institutional; economic, technological and regional development; Theoretical framework and The Taffe, Morril and Gould Model.

Unit IV: Transport System – Policy and Planning (25 hours)
Transport Network and regional development: Transport policies, development and planning in developing countries with reference to India, Surface transportation: Growth and problems of Road and Rail transportation networks of India; National Highway Development and Planning, Transport and environmental degradation: Vehicular pollution and congestion; alternatives to transport system in mega cities of India (Case studies of Delhi, Kolkata and Bangalore).

Recommended Readings

1. Babu, S. S., Mishra, S., and Parida, B.B. (eds.): Tourism Development Revisited – Concepts, Issues and Paradigms, Sage.

2. Bamford, C.G. and Robinson, H. (1978): Geography of Transport, Macdonald and Evans, London.

3. Bhaduri S. (1992): Transport and Regional Development, Concept Publishing Company, New Delhi. 4. Bhardwaj, (eds.): International Tourism: Issues and Challenges, Kanishka New Delhi

5. Bhatia, A.K., (1991): International Tourism: Fundamentals and Practices, Sterling Publishers, New Delhi.

6. Boniface, B.G. and Chris, C. (2005): Worldwide Destinations: The Geography of Travel and Tourism, Elsevier Butterworth-Heinemann, Oxford.

7. Chorley R.J. &Haggett P.(1967): Models in Geography Methuen & Co. London.

8. Dhar, P.N. (2006): International Tourism: Emerging Challenges and Future Prospects, Kanishka, New Delhi.

9. Hagget, F and Chorley, R.J. (1968): Network Analysis', Edward Arnold, London.

10. Hall M. and Stephan P., (2006): Geography of Tourism and Recreation – Environment, Place and Space, Routledge, London.

11. Hay, A(1973): Transport Economy, MacMillan, London.

12. Hoyle, B.S. (1973): Transport and Development, Macmillan, London.

13. Hoyle, Band Knowles, R. (2000): Modern Transport Geography, John Wiley and Sons, New York.

14. Hurst, M.E.(ed.) (1974): Transportation Geography, McGraw-Hill.

15. Kamra, K.K. and Chand, M. (2007): Basics of Tourism: Theory, Operation and Practise, Kanishka Publishers, Pune.

16. Page, S. J. (2011): Tourism Management: An Introduction, Butterworth-Heinemann- USA. Chapter 2.

17. Raj, R. and Nigel, D. (2007): Morpeth Religious Tourism and Pilgrimage Festivals Management: An International perspective by, CABI, Cambridge, USA, www.cabi.org.

18. Raza, M. and Agrawal Y.P.(1985): Transport Geography of India, Concept, New Delhi.

19. Robinson H & Bamford C.G.(1978): Geography of Transport Macdonald & Evans.

20. Singh, J. (2014): Eco-Tourism. I.K. International Pvt. Ltd. S-25, Green Park Extension, Uphaar Cinema Market, New Delhi, India (www.ikbooks.com).

21. Taffe, E.J. & Gauthier (Jr.) H.L.(1973): Geography of Transportation, Prentice-Hall

22. Tourism Recreation and Research Journal, Center for Tourism Research and Development, Lucknow.

GEO15034	Minor Project	L	T	P	C
Version 1		0	0	4	4
Pre-requisites/Exposure	HS/Graduate level exposure to field excursion				
Co-requisites					

Course Outcomes

On completion of this course, the students will be able to

CO1. **Identify** appropriate tools and techniques necessary to conduct research on contemporary physical, social and cultural issues.

CO2. **Explain** problem specific research report based on the analysis of the collected data using suitable tools and techniques of geoinformatics.

Course Content

Problem identification, analysis and project writing on contemporary issues using Geoinformatics.

[Word Limit = 5000 (maximum) excluding Tables and Appendix (Computer typed, Line Spacing= 1½, Arial Narrow / Times New Roman / Helvetica 10 / 11 / 12)]

Recommended Readings:

1. Basu, R. and Bhaduri, S. ed, (2007): Contemporary Issues and Techniques in Geography, Progressive Publishers, Kolkata.
2. Hammond, R, and McCullagh, P. (1978): Quantitative Techniques in Geography: An Introduction, Oxford University Press, Oxford.
3. Creswell, J. (1994): Research Design: Qualitative and Quantitative Approaches Sage Publications.
4. Mukherjee, N. (1993): Participatory Rural Appraisal: Methodology and Application. Concept Publs. Co., New Delhi.
5. Mukherjee, N. (2002): Participatory Learning and Action: with 100 Field Methods. Concept Publs. Co., New Delhi.
6. Robinson, A. (1998): "Thinking Straight and Writing That Way", in Writing Empirical Research Reports:A Basic Guide for Students of the Social and Behavioural Sciences, eds. by F. Pryczak and R. Bruce Pryczak, Publishing: Los Angeles.
7. Special Issue on "Doing Fieldwork" The Geographical Review 91:1-2 (2001).
8. Stoddard, R.H. (1982): Field Techniques and Research Methods in Geography, Kendall/Hunt.
9. Wolcott, H. (1995): The Art of Fieldwork. Alta Mira Press, Walnut Creek, CA.

GEO14035	**Field Project**	L	T	P	C
Version 1		0	0	6	6
Pre-requisites/Exposure	Basic exposure to field excursion				
Co-requisites					

Course Outcomes

On completion of this course, the students will be able to:

- CO1. **Identify** appropriate tools and techniques necessary to conduct field survey.
- CO2. **Interpret** physical and socio-economic status of the study area based on analysis of the collected data.
- CO3. **Identify** appropriate tools and techniques to prepare disaster preparedness plan.

Course Content

Unit 1: Selection of study area: (25 hours)
Selection of either a rural area or an urban area based on cadastral or municipal maps to study specific problems (Rural / Urban / Physical / Human / Environmental). Field Techniques and Tools: Merits, Demerits and Selection of the Appropriate Technique; Observation (Participant / Non Participant), Questionnaires (Open/ Closed / Structured / Non-Structured); Interview with Special Focus on Focused Group Discussions; Space Survey (Transects and Quadrants, Constructing a Sketch), Field Tour Planning: Collection of Material for Physical and Socio-Economic Surveys.

Unit II: Physical and Socio – Economic Status Analysis and Report Writing: (40 hours)
Identification of physical problem, data collection and post field discussion, Preparation of Questionnaire and Survey schedule for assessing data of households, industrial and market for perception study; Post field discussion., Designing the Field Report: Aims and Objectives, Methodology, Analysis, Interpretation and Writing the Report

Unit III: Project on Disaster Management: (40 hours)
The Project Report based on any field based case studies among following disasters and one disaster preparedness plan of respective college or locality: i. Flood, ii. Drought, iii. Cyclone and Hailstorms, iv. Earthquake, v. Landslides, vi. Human Induced Disasters: Fire Hazards, Chemical, Industrial accidents

Unit IV: Field Notebook and viva – voce: (30 hour)
Limits with guide lines: a) Each student will prepare an individual report based on primary and secondary data collected during field work. b) The duration of the field work should not exceed 10 days. c) The text of the report should not exceed 20 typed A4 pages (8000 to 12,000 words excluding figures, tables, photographs, maps, references and appendices) with line spacing of 1.5 and neatly drawn maps and diagrams with photographs and should be submitted in soft binding. d) The report should be written in English. e) Each lesson of the report should be signed by the concerned teacher who conducted the field work. f) Recurrence of visit to the same field area is prohibited. g) Students will give seminar after completing the project.

Recommended Readings:

1. Basu, R. and Bhaduri, S. ed, (2007): Contemporary Issues and Techniques in Geography, Progressive Publishers, Kolkata.
2. Hammond, R, and McCullagh, P. (1978): Quantitative Techniques in Geography: An Introduction, Oxford University Press, Oxford.
3. Mukherjee, N. (2002): Participatory Learning and Action: with 100 Field Methods. Concept Publs. Co., New Delhi.
4. Robinson, A. (1998): "Thinking Straight and Writing That Way", in Writing Empirical Research Reports:A Basic Guide for Students of the Social and Behavioural Sciences, eds. by F. Pryczak and R. Bruce Pryczak, Publishing: Los Angeles.
5. Special Issue on "Doing Fieldwork" The Geographical Review 91:1-2 (2001).