Revised
SYLLABUS FOR
Bachelor of Science (Honours)

GENERIC ELECTIVES

THREE YEAR DEGREE COURSE
SEMESTER SYSTEM

(Under New UGC CBCS Guidelines)

GENERIC ELECTIVE
ANTHROPOLOGY

SEMESTER	COURSE	COURSE NAME	COURSE CODE	CREDIT
I	Generic Elective 1	Foundation of Physical Anthropology (Theory)	ANG 1.11	4
		Foundation of Physical Anthropology (Practical)	ANG 1.12	2
II	Generic Elective 2	Foundation of Social Anthropology (Theory)	ANG 2.11	4
		Foundation of Social Anthropology (Practical)	ANG 2.12	2
III	Generic Elective 3	Foundation of Archaeological Anthropology (Theory)	ANG 3.11	4
		Foundation of Archaeological Anthropology (Practical)	ANG 3.12	2
IV	Generic Elective 4	Tools & Techniques of Research Methods	ANG 4.11	4
		Tools & Techniques of Research Methods (Practical)	ANG 4.12	2

GENERIC ELECTIVE 1(ANG 1.11)
FOUNDATION OF PHYSICAL ANTHROPOLOGY

Theory Credit: 4 *Teaching hours: 60*

UNIT I Introduction to Physical Anthropology:
a) Aim & Scope, branches and its relationship with other biological sciences.
b) Concept of evolution; different theories of evolution, factors responsible for evolution, Lamarckism, Darwinism, neo-synthetic theory.

UNIT II: a) Fossil evidences of human evolution: Australopithecine, pithecanthropine, Cro-magnon, Neanderthal man & modern man
b) Mans palce in animal kingdom; order primate-classification & main characterestics, comparative anatomy of Man & apes, changes in human skeleton as a result of erect posture.

UNIT III Human genetics: concept of cell & cell division, mendel's law of inheritance, single & multiple factor inheritance, sex-linked inheritance, ABO & Rh inheritance.

UNIT IV Race & Human variation: concept of race & racism, UNESCO statement on race, factors responsible for race formation, criteria for racial classification, major races of the world.

UNIT V Concept of growth & development, factors affecting growth & development, methods, stages, nutrition, mal-nutrition & under –nutrition.

GENERIC ELECTIVE 1 (ANG 1.12)
FOUNDATION OF PHYSICAL ANTHROPOLOGY

Practical Credit: 2 *Teaching Hours: 30*

1. **Anthropometric Instruments**. Anthropometer, Sliding & Spreading Callipers, Weighing machine, measuring tape.
2. **Somatometry**: Head length and breadth, Total and upper facial height, Stature, Sitting Height vertex, Nasal length & breadth, Bi-acromial breadth, bi-gonial breadth, bi-zygomatic breath, horizontal circumference of head.
3. **Indices**: 1. Cephalic 2. Nasal 3. Total facial 4. Upper facial 5. Relative sitting height. Measurements on five subjects.
4. **Somatoscopy**: Skin colour, Hair (form, texture, colour), Eye (form, slit, colour & eyebrows), Nose (bridge, root), malar prominence, forehead (height and shape), chin form, ear (attachment & shape).

Recommended Books and References:

1. Introduction to Physical Anthropology---------- -B.M.DAS
2. Anthropology: The study of man----------INDRANI BASU ROY
3. Man and his works---------- HERSKOVITS
4. Fundamentals of Physical Anthropology----------R.M. SARKAR
5. Olivia. Practical Anthropology
6. Sen, Tulika - Anthropomentry
7. Singh, I P and Bhasin, M.K. Anthropometry
8. B.R.K. Shukla &Rastogi----------physical anthropology and human genetics.

9. Janusch, J.Buettner----------origins of man.
10. Das, B.M & Ranjan – Physical Anthropology Practical
11. Nath, P – Physical Anthropology
12. Barua, Saumitra – Human Genetics: An Anthropological perspective
13. Ahluwalia, B. Karvita – Genetics
14. Stern, curt – Principles of Human Genetics
15. Winchester, M.A – Genetics
16. Jannusch, J.Buettner – origins of Man
17. Hootan, E.A - up from the Ape
18. Comas, J – Manual of Physical Anthropology
19. Sarkar, R.M – Fundamentals of Physical Anthropology

GENERIC ELECTIVE 2 (ANG 2.11)
FOUNDATION OF SOCIAL & CULTURAL ANTHROPOLOGY

Theory Credit: 4 *Teaching Hours: 60*

UNIT I Meaning and scope of Socio-Cultural Anthropology. Relation with other social sciences.

UNIT II Social Institutions:

a) Definition of Marriage. Laws of marriage – Endogamy, Exogamy, Hyper-gamy, Hypo-gamy, Incest taboo. Types of marriage- Monogamy, Polygamy, Polyandry, Polygyny, preferential marriage – cross, parallel, Levirate and Sororate, prescribed marriage – matrilateral cross cousin marriage, partilateral cross cousin marriage.
b) Definition of Family. Types of Family based on structure, blood relation, marriage, residence and succession, rule of inheritance
c) Kinship- Descent and Descent groups, Lineage, Clan, Phratry and Moiety. Kinship Usages, Kinship terminology.

UNIT III Religion and Magic:

a) Definition and functions of Religion. Theories of origin of Religion- Animism, Animatism, Manaism and Totemism.
b) Definition and types of Magic.
c) Relation between Magic, Religion and Science.
d) Magico-religious functionaries – Priests, Shaman, Sorcerer and Witch.

UNIT IV Culture. Definition and characteristics of Culture. Aspects of culture-Material and Non- material culture.

UNIT V Economic Institutions: Principles of production, distribution, and consumption in simple and complex societies; various forms of exchange: barter, trade and market.

GENERIC ELECTIVE 2 (ANG 2.12)
FOUNDATION OF SOCIAL & CULTURAL ANTHROPOLOGY

Practical Credit: 2 *Teaching Hours: 30*

Drawing, Identification and Description of Technological Implements of Food gathering, Hunting, Fishing and Agriculture.

Recommended Books and References:

1. Ember C R. et al (2011). *Anthropology*. New Delhi: Dorling Kindersley
2. Frazer James (1911). *The Golden Bough*. London: Macmillan
3. Madan T. N. and Majumdar D.N. (1987) *An Introduction to Social Anthropology*. New Delhi: National Publishing House.
4. Mair Lucy (1972). *An Introduction to Social Anthropology*. New Delhi: Oxford University Press
5. Malinowski Brownislow (). *Magic, Science and Religion*.
6. Kroeber A.L. (1923). *Anthropology*. New York: Harcourt, Brace.
7. Roy IndraniBasu (2003). *Anthropology The Study of Man*. New Delhi: S.Chand& Company Ltd.
8. Scupin Raymond and DeCorse Christopher R. (). *Anthropology: A Global Perspective*.
9. Sharma R.N. (). Social and Cultural Anthropology. Delhi: Surjeet Publications
10. Tylor E.B. (1871). Primitive Culture: Researches into the Development of Mythology, Philosophy, Religion, Language, Art and Customs. London:J.Murray.

GENERIC ELECTIVE 3 (ANG 3.11)
FOUNDATION OF ARCHEOLOGICAL ANTHROPOLOGY

Theory Credit: 4 *Teaching hours: 60*

UNIT I Introduction: Definition and Scope of Archaeological Anthropology. Relationship with other Disciplines.

UNIT II Chronology and Dating Method: Absolute Dating Method (Radio Carbon, Potassium-Argon, Thermoluminescence, Dendrochronology, paleo magnetism), Relative Dating (Flurine-Nitrogen Analysis, Stratigraphy, Typology)

UNIT III Pleistocene Environment: The Great Ice Age – Glacial and Inter-glacial, Pluvial and Inter-pluvial

UNIT IV Introduction to pre-history and its major sub-divisions (Paleolithic, Mesolithic and neolithic)

UNIT V Technology and Typology of Prehistoric Tools

GENERIC ELECTIVE 3 (ANG 3.12)
FOUNDATION OF ARCHEOLOGICAL ANTHROPOLOGY

Practical Credit: 2 *Teaching hours: 30*

Practical

1. Identification Between: Man Made Tool and Natural Stone, Core Tool – Flake Tool and Blade Tool.
2. Sketching, Description and Identification of Two Prehistoric Tools from Each Period (Paleolithic - Lower, Middle and Upper, Mesolithic and Neolithic)

Recommended Books and References:

1. Childe Gordon, Man makes Himself
2. Cole Sonia. The Neolithic Revolution

3. Jain, K.C. Prehistory to Proto history of India
4. Roy, IndraniBasu. Anthropology: The study of Man
5. Hole F. and R.F. Heizer. An Introduction to Prehistoric Archaeology.
6. Reddy, V. Rami. Paleolithic and Mesolithic culture
7. Reddy V. Rami. Neolithic and Post Neolithic culture
8. Oaklet, K.P. Man the Tool maker

GENERIC ELECTIVE 4 (ANG 4.11)
TOOLS & TECHNIQUES OF RESEARCH METHODOLOGY

Theory Credit: 4 *Teaching hours: 60*

UNIT I 1**.** Scientific method in anthropology: survey and review of literature, statement of problem, Definition of theory and concept, variable, facts, data, research designs. Synopsis. Hypothesis: Definition, types & formulation of hypothesis,roles of hypothesis in research.

UNIT II Quantitative and qualitative data, Nature and use,Probability and Sampling techniques, types of Sampling

UNIT III Techniques of data collection: interview, observation,Use of survey Schedules and Questionnaires. Difference between Schedule and Questionnaire. Case study and genecology/pedigree method.

UNIT IV Statistical methods:
1. Median, mode, standard deviation, standard error, tests of significanceand chi-square.
2. Processing of data: classification, tabulation and presentation through diagrams, histograms, pie-chart, and analysis of data.

UNIT V: Use of Library and secondary data, Report Writing.,

Recommended Books and References:

1. Russel, Bernard,H Research Methods in Anthropology. Rawat.
2. Goode, J &Hatt, P.K 1952 Methods of social research, Mc graw Hill, Kogakusha, Tokyo
3. Young, P.V.1966 Scientific social survey and research method. Prentice hall. of India, N.Delhi.
4. Hans Raj1979 Theory& Practice in social research, Subject publications, Delhi.

GENERIC ELECTIVE 4 (ANG 4.12)
TOOLS & TECHNIQUES OF RESEARCH METHODOLOGY

Practical Credit: 2 *Teaching hours: 30*

1. Preparation of questionnaire and schedule.
2. Graphical and diagrammatic presentation of data.

GENERIC ELECTIVE
BOTANY

SEMESTER	COURSE	COURSE NAME	COURSE CODE	CREDIT
I	Generic Elective 1	Biodiversity (Microbes, Algae, Fungi and Archegoniate) (Theory)	BOG 1.11	4
		Biodiversity (Microbes, Algae, Fungi and Archegoniate) (Practical)	BOG 1.12	2
II	Generic Elective 2	Plant Ecology and Taxonomy (Theory)	BOG 2.11	4
		Plant Ecology and Taxonomy (Practical)	BOG 2.12	2
III	Generic Elective 3	Plant Anatomy and Embryology (Theory)	BOG 3.11	4
		Plant Anatomy and Embryology (Practical)	BOG 3.12	2
IV	Generic Elective 4	Economic Botany and Biotechnology (Theory)	BOG 4.11	4
		Economic Botany and Biotechnology (Practical)	BOG 4.12	2

GENERIC ELECTIVE 1 (BOG 1.11)
BIODIVERSITY (MICROBES, ALGAE, FUNGI AND ARCHEGONIATE)

Theory Credit: 4 *Teaching Hours: 60*

UNIT I **Microbes** *(12 hours)*
Viruses – Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV, HIV); Economic importance.
Bacteria– Discovery, General characteristics and cell structure; Reproduction– vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance.

UNIT II **Algae** *(12 hours)*
General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life-cycles of the following: *Nostoc, Chlamydomonas*, *Fucus, Polysiphonia*. Economic importance of algae.

UNIT III **Fungi** *(12 hours)*
Introduction- General characteristics, ecology and significance, nutrition, reproduction and classification; True Fungi. Life cycle of *Penicillium, Alternaria* (Ascomycota), *Puccinia, Agaricus*(Basidiomycota). General account and significance of lichens and Mycorrhizae (ectomycorrhiza and endomycorrhiza)

UNIT IV **Introduction to Archegoniate & bryophytes** *(12 hours)*
Unifying features of archegoniates, Transition to land habit, Alternation of generations. Bryophytes-General characteristics, adaptations to land habit, classification, range of thallus organization. Morphology, anatomy and reproduction of *Marchantia*and*Funaria*. (Developmental details not to be included). Ecology and economic importance of bryophytes with special mention of *Sphagnum*.

UNIT V **Pteridophytes & Gymnosperms** *(12 hours)*
Pteridophytes- General characteristics, classification, Early land plants (*Cooksonia*and*Rhynia*). Morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris*. (Developmental details not to be included). Heterospory and seed habit, stellar evolution. Ecological and economical importance of Pteridophytes.
Gymnosperms- General characteristics; Classification. Morphology, anatomy and reproduction of *Cycas*and*Pinus* (Developmental details not to be included). Ecological and economical importance.

GENERIC ELECTIVE 1 (BOG 1.12)
BIODIVERSITY (MICROBES, ALGAE, FUNGI AND ARCHEGONIATE)

Practical Credit: 2

1. EMs/ Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule.
3. Gram staining

4. Study of vegetative and reproductive structures of *Nostoc, Chlamydomonas*(electron micrographs), *Fucus and Polysiphonia*through temporary preparations and permanent slides. (**Fucus*- Specimen and permanent slides)
5. *Penicillium*: Asexual stage from temporary mounts and sexual structures through permanent slides.
6. *Alternaria:* Specimens/photographs and tease mounts.
7. *Puccinia*: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; section/tease mounts of spores on Wheat and permanent slides of both the hosts.
8. *Agaricus*: Specimens of button stage and full grown mushroom; Sectioning of gills of *Agaricus*.
9. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)
10. Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)
11. *Marchantia*- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).
12. *Funaria*- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.
13. *Selaginella*- morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m. microsporophyll and megasporophyll (temporary slides), l.s. strobilus (permanent slide).
14. *Equisetum*- morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore,w.m. spores (wet and dry)(temporary slides); t.s rhizome (permanent slide).
15. *Pteris*- morphology, t.s. rachis, v.s. sporophyll, w.m. sporangium, w.m. spores(temporary slides), t.s. rhizome, w.m. prothallus with sex organs and young sporophyte (permanent slide).
16. *Cycas*- morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet,v.s. microsporophyll, w.m. spores (temporary slides), l.s. ovule, t.s. root (permanent slide).
17. *Pinus*- morphology (long and dwarf shoots, w.m. dwarf shoot, male and female), w.m.dwarf shoot, t.s. needle, t.s. stem, , l.s./t.s. male cone, w.m. microsporophyll, w.m. microspores (temporary slides), l.s. female cone, t.l.s. &r.l.s. stem (permanent slide).

Recommended Books and References:

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
3. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
4. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley and Sons (Asia), Singapore. 4th edition.
5. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India.
6. Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.
7. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
8. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.

GENERIC ELECTIVE 2 (BOG 2.11)
PLANT ECOLOGY AND TAXONOMY

Theory Credit: 4 *Teaching Hours: 60*

UNIT I **Ecological factors** *(12 hours)*
Soil: Origin, formation, composition, soil profile. Water: States of water in the environment, precipitation types. Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes, epiphytes, halophytes and xerophytes

UNIT II **Plant communities, ecosystem & Phytogeography** *(12 hours)*
Characters; Ecotone and edge effect; Succession; Processes and types
Ecosystem- Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids, Productivity; Biogeochemical cycling; Cycling of carbon and nitrogen
Phytogeography- Principle biogeographical zones of India with special reference to North-East India; Endemism, Red Data list and Hot spots.

UNIT III **Introduction to Plant taxonomy, Taxonomic hierarchy & Botanical nomenclature** *(12 hours)*
Identification, Nomenclature and Classification.Functions of Herbarium, important herbaria and botanical gardens of the world and India; Ranks, categories and taxonomic groups
Botanical nomenclature - Principles and rules (ICN); Ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations.

UNIT IV **Angiosperm taxonomy** (**12 hours)**
General characteristics of the following families- Magnoliaceae, Brassicaceae, Fabaceae, Asteraceae, Solanaceae,Lamiaceae, Liliaceae, Orchidaceae&Poaceae.

UNIT V **Classification, Biometrics, numerical taxonomy and cladistics** *(12 hours)*
Types of classification-artificial, natural and phylogenetic. Bentham and Hooker
Biometrics, numerical taxonomy and cladistics- Characters; variations; OTUs, character weighting and coding; cluster analysis; phenograms, cladograms (definitions and differences).

GENERIC ELECTIVE 2 (BOG 2.12)
PLANT ECOLOGY AND TAXONOMY

Practical Credit: 2

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/ hygrometer, rain gauge and lux meter.
2. Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test.
3. Comparison of bulk density, porosity and rate of infiltration of water in soil of three habitats.
4. (a) Study of morphological adaptations of hydrophytes, epiphytes, halophytes and xerophytes

(b)Study of biotic interactions of the following: Stem parasite (*Cuscuta),* Root parasite (*Balanophora*), Epiphytes (*Dendrobium/ Cymbidium*), Predation (Insectivorous plants)

5. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)
6. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law
7. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification): Brassicaceae- *Brassica, Alyssum/ Iberis;* Asteraceae– *Bidens*, *Sonchus/ Launaea, Vernonia/Ageratum, Eclipta/Tridax;* Solanaceae- *Solanum sp., Withania;* Lamiaceae -*Salvia, Leucus*; Liliaceae – *Lilium/ Asphodelus / Allium.*
8. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

Recommended Books and References:

1. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
2. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8thedition.
3. Simpson, M.G. (2006). *Plant Systematics.* Elsevier Academic Press, San Diego, CA,U.S.A.
4. Singh, G. (2012). *Plant Systematics:* Theory and Practice. Oxford & IBH Pvt. Ltd., NewDelhi. 3rd edition.

GENERIC ELECTIVE 3 (BOG 3.11)
PLANT ANATOMY AND EMBRYOLOGY

Theory Credit: 4 *Teaching Hours: 60*

UNIT I **Meristematic and permanent tissues** *(12 hours)*
Root and shoot apical meristems; Simple and complex tissues. Structure of dicot and monocot root stem and leaf.

UNIT II **Secondary Growth** *(12 hours)*
Vascular cambium– structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood)

UNIT III **Adaptive and protective systems** *(12 hours)*
Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.

UNIT IV **Structural organization of flower- Pollination and fertilization** *(12 hours)*
Structure of a typical flower. Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac.Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms.

UNIT V **Embryo and endosperm: Apomixis and polyembryony** *(12 hours)*
Endosperm types, structure and functions; Dicot and monocot embryo.
Apomixis and polyembryony- Definition, types and Practical applications

GENERIC ELECTIVE 3 (BOG 3.12)
PLANT ANATOMY AND EMBRYOLOGY

Practical Credit: 2

1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)
3. Stem: Monocot: *Zea mays;* Dicot: *Helianthus*; Secondary: *Helianthus* (temporary slide preparation and Permanent slides).
4. Root: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (temporary slide preparation and Permanent slides).
5. Leaf: Dicot and Monocot leaf (only Permanent slides).
6. Adaptive anatomy: Xerophyte (*Nerium* leaf); Hydrophyte (*Hydrilla* stem)
7. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides).
8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous.
9. Female gametophyte: *Polygonum* (monosporic) type of Embryo sac Development (Permanent slides/ photographs).
10. Ultrastructure of mature egg apparatus cells through electron micrographs.
11. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).
12. Dissection of embryo/ endosperm from developing seeds.
13. Calculation of percentage of germinated pollen in a given medium.

Recommended Books and References:

1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.
2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.

GENERIC ELECTIVE 4 (BOG 4.11)
ECONOMIC BOTANY AND PLANT BIOTECHNOLOGY

Theory Credit: 4 *Teaching Hours: 60*

UNIT I **Origin of Cultivated Plants: Cereals** *(12 hours)*
Concept of centres of origin, their importance with reference toVavilov's work.
Rice, Maize & Wheat- Origin, morphology, uses

UNIT II **Legumes & Spices** *(12 hours)*
General account with special reference to Gram and Soyabean
Spices- General account with special reference to ginger, clove and black pepper (Botanical name, family, part used, morphology and uses)

UNIT III **Beverages: Oils and Fats: Fibre Yielding Plants** *(12 hours)*
Tea (morphology, processing, uses)
Oils and Fats- General description with special reference to groundnut/ mustard
Fibre Yielding Plants– General description with special reference to Cotton (Botanical name, family, part used, morphology and uses)

UNIT IV **Plant tissue culture** *(12 hours)*
Micropropagation; haploid production through androgenesis and gynogenesis; brief account of embryo and endosperm culture with their applications

UNIT V **Recombinant DNA Techniques** *(12 hours)*
Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e. RAPD, RFLP; DNA sequencing, PCR. Hybridoma and monoclonal antibodies, ELISA and Immunodetection. Molecular diagnosis of human disease, Human gene Therapy.

GENERIC ELECTIVE 4 (BOG 4.12)
ECONOMIC BOTANY AND PLANT BIOTECHNOLOGY

Practical Credit: 2

1. Study of economically important plants: Rice, maize, Wheat, Gram, Soybean, Black pepper, Ginger, Mustard, Clove Tea, Cotton, Groundnut through specimens, sections and microchemical tests
2. Familiarization with basic equipments in tissue culture.
3. Study through photographs: Anther culture, somatic embryogenesis, endosperm and embryo culture; micropropagation.
4. Study of molecular techniques: PCR, Blotting techniques, ELISA/ PAGE.

Recommended Books and References:

1. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.
2. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

GENERIC ELECTIVE
CHEMISTRY

SEMESTER	COURSE	COURSE NAME	COURSE CODE	CREDIT
I	Generic Elective 1	Conceptual Organic Chemistry (Theory)	CHG 1.11	4
		Chemistry Generic Practical I (Practical)	CHG 1.12	2
II	Generic Elective 2	Biochemistry, Bio-inorganic and Environmental Chemistry (Theory)	CHG 2.11	4
		Chemistry Generic Practical II (Practical)	CHG 2.12	2
III	Generic Elective 3	Chemical Bonding, Transition Metals and Coordination Chemistry (Theory)	CHG 3.11	4
		Chemistry Generic Practical III (Practical)	CHG 3.12	2
IV	Generic Elective 4	Physical Chemistry for Biosciences (Theory)	CHG 4.11	4
		Chemistry Generic Practical IV (Practical)	CHG 4.12	2

GENERIC ELECTIVE 1 (CHG 1.11)
CONCEPTUAL ORGANIC CHEMISTRY (THEORY)

Theory Credit: 4

UNIT I **Fundamentals of Organic Chemistry** *(12 hours)*

Electronic Displacements: Inductive effect, Electromericeffect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Hybridization: Structure and shape of simple molecules CH_4, NH_3, C_2H_4, C_2H_2

Reactive Intermediates: Nucleophiles and electrophiles, Carbocations, Carbanions and free radicalsand the factors affecting theirstability.

UNIT II **Stereochemistry** *(12 hours)*

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations, Conformation and Configuration

Geometrical Isomerism: Requirements for a molecule to show geometrical isomerism, Cis-Trans, E & Z notation along with CIP rules for geometrical isomers.

Optical Isomerism: Optical activity, chirality, enantiomerism, diastereoisomerism, racemic mixtures, resolution. Relative and absolute configuration:D/L nomenclature system for configuration of carbohydrates. Threo&Erythro designation. R and S - configuration (upto two chiral centres).

UNITIII **Addition Reactions** *(12 hours)*

Alkenes and Alkynes: Hydrogenation, addition of halogens, Hydrohalogenation (Markovnikov's and anti-Markovnikov's addition), hydration, hydroxylation, hydroboration-oxidation, ozonolysis. Reactivity of alkenes vs akynes

Aldehydes and ketones: (formaldehyde, acetaldehyde, benzaldehyde, acetone) Addition of sodium bisulphite, hydrogen cyanide and alcohols. Addition- elimination reactions with ammonia and its derivatives

Name Reactions: Aldol, cross Aldol, Cannizzaro, cross Cannizzaro, Claisen,

UNIT IV **Substitution & Elimination Reactions** *(12 hours)*

Free radical substitution reactions: halogenations of alkanes,mechanism of halogenations

Name Reactions: Wurtz reaction, Kolbes reaction, Corey -House reaction

Nucleophilic substitution reactions: Alkyl halides-substitution of halogen by some common nucleophile, mechanism of SN1 and SN2 reactions

Elimination Reactions

Alkyl halides (dehydrohalogenation, Saytzeff's rule), vicinal dihalides (dehalogenation), Alcohols (dehydration), Elimination vs substitution

UNIT V **Electrophilic Substitution, Oxidation & Reduction Reactions** *(12 hours)*

Aromaticity: Benzenoids and Hückel's rule.

Electrophilic Substitution Reactions:

Aromatic compounds: General mechanism of electrophilic substitution reactions (nitration, halogenation, sulphonation, Friedel Crafts alkylation and acylation), ortho/para & meta-director, directive influence of substituents

Oxidation Reaction

Aromatic side chain (Alkyl benzene): Oxidation with potassium permanganate, potassium dichromate

Reduction Reactions

Simple carboxylic acids and its derivatives: Lithium aluminium hydride, sodium-ethanol and Rosenmund reduction.

Recommended Books and References:

1. I. L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
2. R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Pearson Education.
3. ArunBahl and B. S. Bahl :*Advanced Organic Chemistry,* S. Chand
4. Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry,* Orient Longman.
5. Eliel, E. L. &Wilen, S. H. *Stereochemistry of Organic Compounds*; Wiley: London,1994.
6. T. W. Graham Solomon's *Organic Chemistry,* John Wiley and Sons.
7. P.S. Kalsi, *Stereochemistry, Conformation and Mechanism,* John Wiley and Sons.
8. D. Nasipuri, *Stereochemistry of Organic Compounds,* New Age InternationalPublishers.
9. Madan, Tuli and Malik, *Selected topics of Inorganic, Organic &Physical chemistry*
10. R.L. Madan *Chemistry for Degree Students,*S.Chand& Company Ltd
11. O.P. Agarwal *Organic Chemistry Reaction and Reagents*Goel Publishing House, Meerut

GENERIC ELECTIVE 1 (CHG 1.12)
CHEMISTRY- GENERIC ELECTIVE PRACTICAL I

Practical Credit: 2

Qualitative semi micro analysis of mixtures containing 2 anions and 2 cations and 1 interfering radical. Emphasis should be given to the understanding of the chemistry of different reactions

The following radicals are suggested:
CO_3^{2-}, NO_2^-, S_2^-, SO_3^{2-},SO_4^{2-}, CH_3COO^-, F-,Cl-, Br-, I-, NO_3^-, BO_3^{3-}, $C_2O_4^{2-}$, PO_4^{3-},NH^4+, K^+,Pb^{2+}, Cu^{2+}, Cd^{2+}, Bi^{3+}, Sn^{2+}, Sb^{3+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ba^{2+},Sr^{2+}, Ca^{2+},Mg^{2+}

Recommended Books and References:

1. Mendham, J., A. I. Vogel's *Quantitative Chemical Analysis 6th Ed.,* Pearson, 2009.

GENERIC ELECTIVE 2 (CHG 2.11)
BIOCHEMISTRY, BIO-INORGANIC AND ENVIRONMENTAL CHEMISTRY

Theory Credit: 4 *Teaching Hours: 60*

UNIT I **Carbohydrates** *(12 hours)*
Classification of carbohydrates, reducing and non-reducing sugars, General properties ofGlucose, open chain structure. Epimers, mutarotation and anomers.Structure of glucose. Haworth projections. structure of disachharides (sucrose, maltose) and polysachharides (starch and cellulose) excluding their structure elucidation.

UNIT II **Amino Acids, Peptides and Proteins** *(12 hours)*
Classification *of* Amino Acids, Zwitterion structure and Isoelectric point.
Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins. Determinationof primary structure of peptides, Synthesis of simple peptides

(uptodipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid phase synthesis.

UNIT III **Lipids** *(12 hours)*

Introduction to lipids, classification.

Oils and fats: Common fatty acids present in oils and fats, Omega fatty acids, Trans fats,Hydrogenation, Saponification value, Iodine number.Biological importance of triglycerides, phospholipids, glycolipids.

UNIT IV **Bioinorganic Chemistry** *(12 hours)*

Essential and trace elements in biological systems, Metalloporphyrins, chlorophyll, heme proteins (hemoglobin, myoglobin); role of cobalt in vitamin B_{12}; Enzymes; Metalloenzymes(Zn) and their characteristics and functions; Non-complexing cations in biochemical processes (Na and K), Role of metals and non-metals in metabolism; metal and non-metal deficiency and toxicity.

Biological role of alkali and alkaline earth metal ions with special reference to Ca^{2+}. Nitrogen fixation.

UNIT V **Environmental Chemistry***(12 hours)*

Composition of the atmosphere, photochemical reactions in the atmosphere, vehicle exhausts and photochemical smog, metallic pollutants—Hg and Pb; acid rain carbon monoxide and its effects, - suspended particulate matter – size and effects on health, dual role of ozone in the atmosphere tropospheric ozone and stratospheric ozone, ozone hole, carbon dioxide and other gases responsible for global warming, Measures to control air pollution, Quality of water drinking and other purposes. Permissible limits. Common water pollutants—organic and inorganic. Heavy metals and their toxic effects. Pollution of water through use of chemical fertilizers. Measures taken to control water pollution.

Recommended Books and References:

1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd.(Pearson Education).
2. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt.Ltd.(Pearson Education).
3. Finar, I. L. *Organic Chemistry* (*Volume 2)*, Dorling Kindersley (India) Pvt.Ltd.(Pearson Education).
4. Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Biochemistry 7th Ed.,* W. H. Freeman.
5. Berg, J. M., Tymoczko, J. L. &Stryer, L. *Biochemistry 7th Ed.,* W. H. Freeman.
6. Madan, Tuli and Malik, selected topics of inorganic, organic & physical chemistry

GENERIC ELECTIVE 2 (CHG 2.12)
GENERIC ELECTIVE PRACTICAL II

Practical Credit: 2

1. Detection of extra elements present in organic compound, saturation & unsaturation, Aromatic & non aromatic.
2. Functional group test for nitro, amine, amide, alcohols, carboxylic acids, phenols and carbonyl compounds

Recommended Books and References:

1. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education(2009)
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical OrganicChemistry, 5th Ed.,* Pearson (2012)
3. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry:Preparation and Quantitative Analysis,* University Press (2000).
4. Ahluwalia, V.K. &Dhingra, S. *Comprehensive Practical Organic Chemistry:Qualitative Analysis,* University Press (2000).

GENERIC ELECTIVE 3 (CHG 3.11)
CHEMICAL BONDING,TRANSITION METAL & COORDINATION CHEMISTRY

Theory Credit:4 *Teaching Hours: 60*

UNIT I **The covalent bond and the structure of molecules** *(12 hours)*
Valence bond approach, Concept of resonance in various inorganic compounds,Hybridization and structure, equivalent and non-equivalent hybrid orbitals, VSEPR model for predicting shapes of molecules and ions containing lone pairs,sigma and pi bonds.

UNIT II **Molecular Orbital Approach &Intermolecular forces:** *(12 hours)*
LCAO method, symmetry and overlap for s-s,s-p and p-p combinations, MO treatment ofhomonuclear diatomic molecules of 2nd period (B_2, C_2 ,N_2, O_2 , F_2) and heteronuclear di-atomic molecules (CO, NO) and their ions.

Intermolecular forces: van der Waals forces, Hydrogen bonding and its applications, effects of these forces on melting point, boiling point and solubility.

UNIT III **Transition Elements (3*d* series)** *(12 hours)*
General group trends with special reference to electronic configuration, variable valency,colour, magnetic and catalytic properties, ability to form complexes and stability of variousoxidation states (Latimer diagrams) for Mn, Fe and Cu.
Lanthanoids and actinoids: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only).

UNIT IV **Coordination Chemistry** *(12 hours)*
Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordinationnumbers 4 and 6.Drawbacks of VBT. IUPAC system of nomenclature.

UNIT V **Crystal Field Theory** *(12 hours)*
Crystal field effect, Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for *Oh* and *Td* complexes, Tetragonal distortion of octahedral geometry.Jahn-Teller distortion, Square planar coordination.

Recommended Books and References:

1. James E. Huheey, *"Inorganic Chemistry: Principles of structure and reactivity"*,Prentice Hall, IV Edition.
2. D. S. Shriver and P.A. Atkins, *"Inorganic Chemistry"*, Oxford University Press, IVEdition.
3. Alan G. Sharpe, "*Inorganic Chemistry"*, University of Cambridge, III Edition.
4. J. D. Lee, *"A New Concise Inorganic Chemistry"*, ELBS IV Edition
5. Grey L. Miessler and Donald A. Tarr, *"Inorganic Chemistry"*, Prentice Hall, III Edition.
6. B. Douglas, D. H. McDaniel and J. J. Alexander, *"Concepts and Models of InorganicChemistry", John Wiley and Sons, III Edition.*
7. Rodgers, G.E. *Inorganic & Solid State Chemistry,* Cengage Learning India Ltd., 2008.

GENERIC ELECTIVE 3 (CHG 3.12)
CHEMISTRY GENERIC PRACTICAL III

Practical Credit: 2

1. Determination of the heat of neutralization of a strong acid by a strong base.
2. Determination of the molecular weight by Rast's method.
3. Determination of the solubility of a salt ($BaCl_2$) at two different temperatures and to determine the heat of solution.
4. Verification of Hardy-Schulze law: Preparation and coagulation of arsenic sulphide (As_2S_3) sol using NaCl, $BaCl_2$ and $AlCl_3$ solutions.
5. To study the kinetics of iodination of acetone.
6. Determination of enthalpy of hydration of copper sulphate.

Any other experiment carried out in the class.

Recommended Books and References:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R.Chand & Co.: New Delhi (2011).
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry8th Ed.*; McGraw-Hill: New York (2003).
3. Halpern, A. M. &McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H.Freeman & Co.: New York (2003).

GENERIC ELECTIVE 4(CHG 4.11)
PHYSICAL CHEMISTRY FOR THE BIOSCIENCES

Practical Credit: 4 *Teaching Hours: 60*

UNIT I **Chemical Energetics** *(12 hours)*

Review of the Laws of Thermodynamics.

Thermochemical equation and the laws. Concept of standard state and standard enthalpies of formation, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data.

Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.

Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

UNIT II **Chemical Equilibrium and Chemical Kinetics** *(12 hours)*

Chemical Equilibrium:Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG^o, Le Chatelier's principle. Relationships between *Kp, Kc* and *Kx*for reactions involving ideal gases.

Chemical Kinetics:The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero and first order reactions. Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation.

UNIT III **Ionic Equilibria** *(12 hours)*

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. Salt hydrolysis-calculation of hydrolysis constant, degree ofhydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product ofsparingly soluble salts – applications of solubility product principle.

UNIT IV **Phase rule and its application** *(12 hours)*

Definition of its following terms:-phase,component, degrees of freedom, derivation of the phase rule, phase equilibrium and metastable equilibrium, phase diagram involving one system (sulphur). Phase equilibra of two component systems, solid-liquid equilibra, simple eutectic Pb-Ag systems and desilverization of lead, ideal liquid mixtures, azeotropes (ethanol-water systems), Nernst distribution law (elementary idea only).

UNIT V **Electrochemistry and Photochemistry (12 Lecturers)**

Electrical transport-conduction in metals and in solutions; specific conductance and equivalent conductance, measurement of equivalent conductance, variation of specific and equivalent conductance with dilution, Kohlrausch law, Migration of ions, transport number. Arrhenius theory of electrolyte dissociation and its limitations.

Photochemistry**:** Laws of photochemistry.Fluorescence and phosphorescence. Quantum efficiency and reasons for high and low quantum yields. Primary and secondary processes in photochemical reactions. Photochemical and thermal reactions.

Recommended Books and References:

1. Atkins, P. W. & Paula, J. de *Atkin's Physical Chemistry 9*th Ed., Oxford UniversityPress (2011).
2. Ball, D. W. *Physical Chemistry* Thomson Press, India (2007).
3. Castellan, G. W. *Physical Chemistry* 4th Ed. Narosa (2004).
4. Mortimer, R. G. *Physical Chemistry* 3rd Ed. Elsevier: NOIDA, UP (2009).
5. Chang, R. *Physical Chemistry for the Biosciences.* University Science Books (2005).

GENERIC ELECTIVE 4 (CHG 4.12)
GENERIC ELECTIVE PRACTICAL IV

Practical Credit: 2

Titrations involving redox reactions:

1. Standardization of $KMnO_4$ solution (standard solution of Mohr's salt to be prepared).
2. Determination of concentration of Fe(II) in Mohr's salt and/or $K_2Cr_2O_7$ using diphenylamine/N-phenylanthranilic acid as internal indicator (standard solution of K2Cr2O7 and /or Mohr's saltto be prepared).
2. Determination of concentration of Fe(II) in $FeCl_3$ and/or $K_2Cr_2O_7$ using diphenylamine/N-phenylanthranilic acid as internal indicator (standard solution of $K_2Cr_2O_7$ /$KMnO_4$ to be prepared)
4. Determination of iron content in ores / alloys using appropriate redox titration

Gravimetric Analysis:

i. Estimation of nickel (II) using Dimethylglyoxime (DMG).
ii. Estimation of copper as CuSCN
iii. Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$.

Recommended Books and References:

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
2. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.

GENERIC ELECTIVE
COMPUTER SCIENCE

SEMESTER	COURSE	COURSE NAME	COURSE CODE	CREDIT
I	Generic Elective 1	Computer Fundamentals (Theory)	CSG 1.11	4
		Computer Fundamentals (Practical)	CSG 1.12	2
II	Generic Elective 2	Office Automation Tools (Theory)	CSG 2.11	4
		Office Automation Tools (Practical)	CSG 2.12	2
III	Generic Elective 3	HTML Programming (Theory)	CSG 3.11	4
		HTML Programming (Practical)	CSG 3.12	2
IV	Generic Elective 4	Web & E-Commerce Technologies (Theory)	CSG 4.11	4
		Web & E-Commerce Technologies (Practical)	CSG 4.12	2

GENERIC ELECTIVE 1 (CSG 1.11)
COMPUTER FUNDAMENTALS

Theory Credit: 4

UNIT I **Introduction to Computer**:
Introduction to Computer:-Definition, Characteristics, Capabilities and Limitations.Introduction to Operating System.Components of a Computer System-Control Unit,ALU, input/output functions and characteristics. Memory Introduction, Classifications- Volatile Memory and Non- Volatile , Flash Memory, ROM, RAM, EPROM, PROM, EEPROM other types of memory.

UNIT II **Data Representation:**
Number systems and character representation, binary arithmetic.

UNIT III **Devices:**
Input, Output Units: Computer Keyboard, Pointing Devices: Mouse, Trackball, Touch Panel, and Joystick, Light Pen, Scanners, Various types of Monitors, Touch-sensitive screens, Optical Recognition System, Pen based systems, Digitizers, MICR, OCR, OMR, Bar-code Reader, digitalcamera. Impact and Non- Impact Printers- Daisy Wheel, Dot Matrix, Line Printer, Chain Printer, Comb Printers, Non Impact Printers- DeskJet, Laser Printer, Thermal Transfer Printer, Barcode Printers, Electro static printers and plotters.

UNIT IV **Computer Organization and Architecture:**
C.P.U., registers, system bus, main memory unit, cache memory, SMPS, Motherboard, Ports and Interfaces, expansion cards, ribbon cables, memory chips, processors

UNIT V **Overview of Emerging Technologies:**
Bluetooth, cloud computing, big data, data mining, mobile computing and embedded systems.

Recommended Books and References:

1. Computer Fundamentals – B. Ram – New Age International Publishers
2. C.S. French "Data Processing and Information Technology", BPB Publications
3. P.K “Sinha Computer Fundamentals”, BPB Publications
4. S.K.Basandra, “Computers Today”, Galgotia Publications.

GENERIC ELECTIVE 1 (CSG 1.12)
COMPUTER FUNDAMENTALS (PRACTICAL)

Practical Credit: 2

GENERIC ELECTIVE 2 (CSG 2.11)
OFFICE AUTOMATION TOOLS

Theory Credit: 4

UNIT I Ms word: Starting word - Parts of word window - formatting features - menus, commands, Toolbars - File menu, Edit, view, insert, Format and tool menus - Working with text, tables - checking spelling and Grammars.

UNIT II Mail merge concept - creating main document, data source, Adding fields - Remarks fields Macros - Creating templates and working with templates.

UNIT III MS - Excel: Excel Basics - Creating Work Sheets - Formulas - Functions - Charts - Coping Data, between worksheets - Case studies pay bill, profit and loss accounts etc.

UNIT IV Power point - Making presentation with Ms power points - working with power point - organization chart - inserting chart from excel.

UNIT V Ms-Access: Introduction - creating a new Database - saving the database - Forms - Reports.

Recommended Books and References:

1. **"Microsoft Office 365: Connect and Collaborate Virtually Anywhere, Anytime"** by Katherine Murray
2. **Office 2010:**Vasu Jain

GENERIC ELECTIVE 2 (CSG 2.12)
OFFICE AUTOMATION TOOLS(PRACTICAL)

PracticalCredit: 2

GENERIC ELECTIVE 3 (CSG 3.11)
HTML PROGRAMMING

Theory Credit: 4

UNIT I **Introduction:**Basic HTML Concepts, HTML, HEAD, TITLE, BODY, Paragraphs, Lists, Formatted and Unformatted Text, Hyperlink, Font (Size, Color),image,Attributes,Lists, ordered and unordered.

UNIT II **Links:**Introduction, Relative Links, Absolute Links,Link Attributes,Using the ID Attribute to Link Within a Document.

UNIT III **Images:**Putting an Image on a Page,Web Graphic Format GIF, JPEG, PNG, Inline Images Using Images as Links,Putting an Image in the Background. Working with Divs and Layers,1 Placing tags, Creating Layers, Modifying a Layer

UNIT IV **Tables:**Creating a Table,Table Headers,Captions,Spanning Multiple Columns Styling Table.

UNIT V **Forms:**Basic Input and Attributes,Other Kinds of Inputs,Styling forms with CSS.

Recommended Books and References:

1. Introduction to **HTML** and CSS --O'Reilly

GENERIC ELECTIVE 3 (CSG 3.12)
HTML PROGRAMMING

PracticalCredit: 2

GENERIC ELECTIVE 4 (CSG 4.11)
WEB AND E-COMMERCE TECHNOLOGIES

Theory Credit: 4

UNIT I **An introduction to Electronic commerce**: What is E-Commerce (Introduction And Definition), Main activities E-Commerce, Goals of E-Commerce, Technical Components of E-Commerce, Functions of E-Commerce, Advantages and disadvantages of E-Commerce, Scope of E-Commerce, Electronic Commerce Applications.

UNIT II **The Internet and WWW:** Evolution of Internet, Domain Names and Internet Organization (.edu, .com, .mil, .gov, .net etc.) , Types of Network, Internet Service Provider, World Wide Web, Internet & Extranet, Role of Internet in B2B Application, building own website, Cost, Time, Reach, Registering a Domain Name, Web promotion, Target email, Baner, Exchange, Shopping Bots.

UNIT III Internet Security: Secure Transaction, Computer Monitoring, Privacy on Internet, Corporate Email privacy, Computer Crime(Laws , Types of Crimes), Threats, Attack on Computer System, Software Packages for privacy, Hacking, Computer Virus(How it spreads, Virus problem, virus protection, Encryption and Decryption, Secret key Cryptography, DES, Public Key Encryption, RSA, Authorisation and Authentication, Firewall, Digital Signature.

UNIT IV Electronic Data Exchange: Introduction, Concepts of EDI and Limitation, Applications of EDI, Disadvantages of EDI, EDI model,Electronic Payment System: Introduction, Types of Electronic Payment System, Payment Types, Value Exchange System, Credit Card System, Electronic Fund Transfer, Paperless bill, Modern Payment Cash, Electronic Cash.

UNIT V Planning for Electronic Commerce: Planning Electronic Commerce initiates, Linking objectives to business strategies, Measuring cost objectives, Comparing benefits to Costs, Strategies for developing electronic commerce web sites.

Recommended Books and References:

1. E-Commerce Concepts, Models, Strategies: G.S.V.Murthy Himalaya Publishing House
2. E-Commerce:-Kamlesh K Bajaj and Debjani Nag
3. Electronic commerce:-Gray P. Schneider
4. E-Commerce, Fundamentals & Applications: Chand (Wiley)

GENERIC ELECTIVE 4 (CSG 4.12)
WEB AND E-COMMERCE TECHNOLOGIES

Practical Credit: 2

GENERIC ELECTIVE
ECONOMICS

SEMESTER	COURSE	COURSE NAME	COURSE CODE	CREDIT
I	Generic Elective 1	Introductory Microeconomics	ECG 1.11	6
II	Generic Elective 2	Introductory Macroeconomics	ECG 2.11	6
III	Generic Elective 3	(a) Indian Economy-I OR (b) Money and Banking OR (c) Environmental Economics	ECG 3.11(a) ECG 3.11(a) ECG 3.11(a)	6
IV	Generic Elective 4	(a) Indian Economy-II OR (b) Economic History of India 1857-1947 OR (c) Public Finance	ENG 4.11(a) ENG 4.11(a) ENG 4.11(a)	6

GENERIC ELECTIVE 1 (ECG 1.11)
INTRODUCTORY MICROECONOMICS

1. Exploring the subject matter of Economics
Why study economics? Scope and method of economics; the economic problem: scarcity and choice; the question of what to produce, how to produce and how to distribute output; science of economics; the basic competitive model; prices, property rights and profits; incentives and information; rationing; opportunity sets; economic systems; reading and working with graphs.

2. Supply and Demand: How Markets Work, Markets and Welfare
Markets and competition; determinants of individual demand/supply; demand/supply schedule and demand/supply curve; market versus individual demand/supply; shifts in the demand/supply curve, demand and supply together; how prices allocate resources; elasticity and its application; controls on prices; taxes and the costs of taxation; consumer surplus; producer surplus and the efficiency of the markets.

3. The Households
The consumption decision - budget constraint, consumption and income/price changes, demand for all other goods and price changes; description of preferences (representing preferences with indifference curves); properties of indifference curves; consumer's optimum choice; income and substitution effects; labour supply and savings decision - choice between leisure and consumption.

4. The Firm and Perfect Market Structure
Behaviour of profit maximizing firms and the production process; short run costs and output decisions; costs and output in the long run.

5. Imperfect Market Structure
Monopoly and anti-trust policy; government policies towards competition; imperfect competition.

6. Input Markets
Labour and land markets - basic concepts (derived demand, productivity of an input, marginal productivity of labour, marginal revenue product); demand for labour; input demand curves; shifts in input demand curves; competitive labour markets; and labour markets and public policy.

Recommended Books and References:

1. Karl E. Case and Ray C. Fair, *Principles of Economics*, Pearson Education Inc., 8th Edition, 2007.
2. N. Gregory Mankiw, *Economics: Principles and Applications*, India edition by South Western, a part of Cengage Learning, Cengage Learning India Private Limited, 4th edition, 2007.
3. Joseph E. Stiglitz and Carl E. Walsh, *Economics*, W.W. Norton & Company, Inc., New York, International Student Edition, 4th Edition, 2007.

GENERIC ELECTIVE2(ECG 2.11)
INTRODUCTORY MACROECONOMICS

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; national income accounting for an open economy; balance of payments: current and capital accounts.

2. Money
Functions of money; quantity theory of money; determination of money supply and demand; credit creation; tools of monetary policy.

3. Inflation
Inflation and its social costs; hyperinflation.

4. The Closed Economy in the Short Run
Classical and Keynesian systems; simple Keynesian model of income determination; IS-LM model; fiscal and monetary multipliers.

Recommended Books and References:

1. Dornbusch, Fischer and Startz, *Macroeconomics*, McGraw Hill, 11th edition, 2010.
2. N. Gregory Mankiw. *Macroeconomics,* Worth Publishers, 7th edition, 2010.
3. Olivier Blanchard, *Macroeconomics*, Pearson Education, Inc., 5th edition, 2009.
4. Richard T. Froyen, *Macroeconomics*, Pearson Education Asia, 2nd edition, 2005.
5. Andrew B. Abel and Ben S. Bernanke, *Macroeconomics*, Pearson Education, Inc., 7th edition, 2011.
6. Errol D'Souza, *Macroeconomics*, Pearson Education, 2009.
7. Paul R. Krugman, Maurice Obstfeld and Marc Melitz, *International Economics*, Pearson Education Asia, 9th edition, 2012.

GENERIC ELECTIVE 3 (ECG 3.11(a))
INDIAN ECONOMY-I

1. Economic Development since Independence
Major features of the economy at independence; growth and development under different policy regimes—goals, constraints, institutions and policy framework; an assessment of performance—sustainability and regional contrasts; structural change, savings and investment.

2. Population and Human Development
Demographic trends and issues; education; health and malnutrition.

3. Growth and Distribution
Trends and policies in poverty; inequality and unemployment.

4. **International Comparisons**

Recommended Books and References:

1. Jean Dreze and Amartya Sen, 2013. *An Uncertain Glory: India and itsContradictions*, Princeton University Press.
2. Pulapre Balakrishnan, 2007, The Recovery of India: Economic Growth in the Nehru Era, *Economic and Political Weekly*, November.

3. Rakesh Mohan, 2008, ―Growth Record of Indian Economy: 1950-2008. A Story of Sustained Savings and Investment, *Economic and Political Weekly*, May.
4. S.L. Shetty, 2007, ―India‘s Savings Performance since the Advent of Planning, in K.L. Krishna and A. Vaidyanathan, editors, *Institutions and Markets in India'sDevelopment.*
5. Himanshu, 2010, ―Towards New Poverty Lines for India, *Economic andPolitical Weekly*, January.
6. Jean Dreze and Angus Deaton, 2009, ―Food and Nutrition in India: Facts and Intepretations, *Economic and Political Weekly*, February.
7. Himanshu. 2011, ―Employment Trends in India: A Re-examination, *Economicand Political Weekly*, September.
8. Rama Baru et al, 2010, ―Inequities in Access to Health Services in India: Caste, Class and Region, *Economic and Political Weekly*, September.
9. Geeta G. Kingdon, 2007, ―The Progress of School Education in India, *OxfordReview of Economic Policy.*
10. J.B.G. Tilak, 2007, ―Post Elementary Education, Poverty and Development in India, *International Journal of Educational Development.*
11. T. Dyson, 2008, ―India‘s Demographic Transition and its Consequences for Development in Uma Kapila, editor, *Indian Economy Since Independence*, 19th edition, Academic Foundation.
12. Kaushik Basu, 2009, ―China and India: Idiosyncratic Paths to High Growth,*Economic and Political Weekly*, September.
13. K. James, 2008, ―Glorifying Malthus: Current Debate on Demographic Dividend in India, *Economic and Political Weekly*, June.
14. ReetikaKhera, 2011, ―India‘s Public Distribution System: Utilisation and Impact*Journal of Development Studies*.
15. Aniruddha Krishna and Devendra Bajpai, 2011, ―Lineal Spread and Radial Dissipation: Experiencing Growth in Rural India, 1992-2005, *Economic andPolitical Weekly*, September.
16. Kaushik Basu and A. Maertens, eds, 2013, *Oxford Companion to Economics*, Oxford University Press.

GENERIC ELECTIVE 3 (ECG 3.11(b))
MONEY AND BANKING

1. Money
Concept, functions, measurement; theories of money supply determination.

2. Financial Institutions, Markets, Instruments and Financial Innovations
a. Role of financial markets and institutions; problem of asymmetric information – adverse selection and moral hazard; financial crises.
b. Money and capital markets: organization, structure and reforms in India; role of financial derivatives and other innovations.

3. Interest Rates
Determination; sources of interest rate differentials; theories of term structure of interest rates; interest rates in India.

4. Banking System
a. Balance sheet and portfolio management.
b. Indian banking system: Changing role and structure; banking sector reforms.

5. Central Banking and Monetary Policy
Functions, balance sheet; goals, targets, indicators and instruments of monetary control; monetary management in an open economy; current monetary policy of India.

Recommended Books and References:

1. F. S. Mishkin and S. G. Eakins, *Financial Markets and Institutions*, Pearson Education, 6th edition, 2009.
2. F. J. Fabozzi, F. Modigliani, F. J. Jones, M. G. Ferri, *Foundations of Financial Marketsand Institutions*, Pearson Education, 3rdedition, 2009.
3. L. M. Bhole and J. Mahukud, *Financial Institutions and Markets,* Tata McGraw Hill, 5th edition, 2011.
4. M. Y. Khan, *Indian Financial System*, Tata McGraw Hill, 7th edition, 2011.
5. Various latest issues of R.B.I. Bulletins, Annual Reports, Reports on Currency and Finance and Reports of the Working Group, IMF Staff Papers.

GENERIC ELECTIVE 3 (ECG 3.11(c))
ENVIRONMENTAL ECONOMICS

1. Introduction
Key environmental issues and problems, economic way of thinking about these problems, basic concepts from economics; Pareto optimality and market failure in the presence of externalities; property rights and other approaches.

2. The Design and Implementation of Environmental Policy
Overview, Pigouvian taxes and effluent fees, tradable permits, implementation of environmental policies in India and international experience; transboundary environmental problems; economics of climate change.

3. Environmental Valuation Methods and Applications
Valuation of non-market goods and services--theory and practice; measurement methods; cost-benefit analysis of environmental policies and regulations.

4. Sustainable Development
Concepts; measurement; perspectives from Indian experience

Recommended Books and References:

1. Roger Perman, Yue Ma, Michael Common, David Maddison and James McGilvray, "*Natural Resource and Environmental Economics"*, Pearson Education/Addison Wesley, 4th edition, 2011.
2. Charles Kolstad, "*Intermediate Environmental Economics"*, Oxford University Press, 2nd edition, 2010.
3. Robert N. Stavins (ed.), "*Economics of the Environment: Selected Readings"*, W.W. Norton, 6th edition, 2012.
4. Robert Solow, "An Almost Practical Step toward Sustainability," Resources for the Future 40th anniversary lecture,1992.
5. Kenneth Arrow et al., "Are We Consuming Too Much?" *Journal of EconomicPerspectives*, 18(3): 147-172, 2004.
6. IPCC (Intergovernmental Panel on Climate Change), Fifth Assessment Report (forthcoming 2014).

GENERIC ELECTIVE 4 (ECG 4.11(a))
INDIAN ECONOMY-II

1. Macroeconomic Policies and Their Impact
Fiscal Policy; trade and investment policy; financial and monetary policies; labour regulation.

2. Policies and Performance in Agriculture
Growth; productivity; agrarian structure and technology; capital formation; trade; pricing and procurement.

3. Policies and Performance in Industry
Growth; productivity; diversification; small scale industries; public sector; competition policy; foreign investment.

4.Trends and Performance in Services

Recommended Books and References:

1. Shankar Acharya, 2010, ―Macroeconomic Performance and Policies 2000-8,‖ in Shankar Acharya and Rakesh Mohan, editors, *India's Economy: Performancesand Challenges: Development and Participation*, Oxford University Press.
2. Rakesh Mohan, 2010, ―India's Financial Sector and Monetary Policy Reforms, in Shankar Acharya and Rakesh Mohan, editors, *India's Economy: Performancesand Challenges: Development and Participation*, Oxford University Press.
3. Pulapre Balakrishnan, Ramesh Golait and Pankaj Kumar, 2008, ―Agricultural Growth in India Since 1991, *RBI DEAP Study no. 27*.
4. Kunal Sen, 2010, ―Trade, Foreign Direct Investment and Industrial Transformation in India, ïnPremachandraAthukorala, editor, *The Rise of Asia*, Routledge.
5. A. Ahsan, C. Pages and T. Roy, 2008, ―Legislation, Enforcement and Adjudication in Indian Labour Markets: Origins, Consequences and the Way Forward, in D. Mazumdar and S. Sarkar, editors, *Globalization, Labour Marketsand Inequality in India*, Routledge.
6. Dipak Mazumdar and Sandeep Sarkar, 2009, ―The Employment Problem in India and the Phenomenon of the ‗Missing Middle, *Indian Journal of LabourEconomics*.
7. J. Dennis Rajakumar, 2011, ―Size and Growth of Private Corporate Sector in Indian Manufacturing, *Economic and Political Weekly,* April.
8. Ramesh Chand, 2010, Understanding the Nature and Causes of Food Inflation,*Economic and Political Weekly*, February.
9. BishwanathGoldar, 2011, Organised Manufacturing Employment: Continuing the Debate, *Economic and Political Weekly,* April.
10. Kaushik Basu and A. Maertens, eds, 2013. *The New Oxford Companion toEconomics in India*, Oxford University Press.

GENERIC ELECTIVE 4 (ECG 4.11(b))
ECONOMIC HISTORY OF INDIA 1857-1947

1. Introduction: Colonial India: Background and Introduction
Overview of colonial economy.

2. Macro Trends
National Income; population; occupational structure.

3. Agriculture
Agrarian structure and land relations; agricultural markets and institutions – credit, commerce and technology; trends in performance and productivity; famines.

4. Railways and Industry
Railways; the de-industrialisation debate; evolution of entrepreneurial and industrial structure; nature of industrialisation in the interwar period; constraints to industrialbreakthrough; labor relations.

5. Economy and State in the Imperial Context
The imperial priorities and the Indian economy; drain of wealth; international trade, capital flows and the colonial economy – changes and continuities; government and fiscalpolicy.

Recommended Books and References:

1. Lakshmi Subramanian, *"History of India 1707-1857",* Orient Blackswan, 2010, Chapter 4.
2. Sumit Guha, 1991, _ Mortality decline in early 20th century India', *IndianEconomic and Social History Review (IESHR),* pp 371-74 and 385-87.
3. Tirthankar Roy, *The Economic History of India 1857-1947*, Oxford University Press, 3rd edition, 2011.
4. J. Krishnamurty, *Occupational Structure,* Dharma Kumar (editor), The Cambridge Economic History of India, Vol. II, (henceforth referred to as CEHI), 2005, Chapter 6.
5. Irfan Habib, *Indian Economy 1858-1914,* A People's History of India,Vol.28, Tulika, 2006.
6. Ira Klein, 1984, ―When Rains Fail: Famine relief and mortality in British India‖,*IESHR* 21.
7. Jean Dreze, *Famine Prevention in India in Dreze and Sen (eds.) PoliticalEconomy of Hunger*, WIDER Studies in Development Economics, 1990, pp.13-
8. John Hurd, *Railways*, CEHI, Chapter 8, pp.737-761.
9. Rajat Ray (ed.), *Entrepreneurship and Industry in India*, 1994.
10. AK Bagchi, ―Deindustrialization in India in the nineteenth century:Some theoretical implications‖, *Journal of Development Studies*, 1976.
11. MD Morris, *Emergence of an Industrial Labour Force in India*, OUP 1965, Chapter 11, Summary and Conclusions.
12. K.N. Chaudhuri, *Foreign Trade and Balance of Payments*, CEHI, Chapter 10.
13. B.R. Tomlison, 1975, *India and the British Empire 1880-1935,* IESHR, Vol.XII.
14. Dharma Kumar, *The Fiscal System,* CEHI, Chapter 12.
15. Basudev Chatterjee, *Trade, Tariffs and Empire*, OUP 1992, Epilogue.

Background reading for students:

- Irfan Habib, *Indian Economy 1858-1914* (A People's History of India), Vol.28, Tulika 2006.
- Daniel Thorner, *Agrarian Prospect in India*, 1977.

GENERIC ELECTIVE 4 (ECG 4.11(c))
PUBLIC FINANCE

Part1:
Theory

1. Overview of Fiscal Functions, Tools of Normative Analysis, Pareto Efficiency, Equity and the Social Welfare.
2. Market Failure, Public Good and Externalities.
3. Elementary Theories of Product and Factor Taxation (Excess Burden and Incidence).

Part 2: Issues from Indian Public
Finance

4. Working of Monetary and Fiscal Policies.
5. Current Issues of India's Tax System.
6. Analysis of Budget and Deficits
7. Fiscal Federalism in India
8. State and Local Finances

Recommended Books and References:

1. Musgrave, R.A. and P.B. Musgrave, *Public Finance in Theory and Practice*, Mc-GrawHill, 1989.
2. Mahesh Purohit , "*Value Added Tax: Experience of India and Other Countries*", Gayatri Publications, 2007.
3. Kaushik Basu, and A. Maertens (ed.), *The Oxford Companion to Economics inIndia,* Oxford University Press,2007.
4. M.M Sury, Government Budgeting in India, Commonwealth Publishers,1990.
5. Shankar Acharya, "Thirty years of tax reform" in India, *Economic and Political Weekly,* May 2005.
6. Government of India, *Report of the 13thFinanceCommission.*
7. *Economic Survey*, Government of India (latest).
8. State Finances: A Study of Budgets*, Reserve Bank of India* (latest).

GENERIC ELECTIVE
ENGLISH

SEMESTER	COURSE	COURSE NAME	COURSE CODE	CREDIT
I	Generic Elective 1	Academic Writing & Composition	ENG 1.11	6
II	Generic Elective 2	Media & Communication Skills	ENG 2.11	6
III	Generic Elective 3	Contemporary India: Women & Empowerment	ENG 3.11	6
IV	Generic Elective 4	Language, Literature & Culture	ENG 4.11	6

GENERIC ELECTIVE 1 (ENG 1.11)
ACADEMIC WRITING AND COMPOSITION

Theory Credit: 6

UNIT I Introduction to the Writing Process and Conventions of Academic Writing

UNIT II Writing in one's own words: Summarizing and Paraphrasing

UNIT III Critical Thinking: Syntheses, Analyses, and Evaluation

UNIT IV Structuring an Argument: Introduction, Interjection, and Conclusion

UNIT V Citing Resources; Editing, Book and Media Review

Recommended Books and References:

1. Liz Hamp-Lyons and Ben Heasley, *Study writing: A Course in Writing Skills for Academic Purposes* (Cambridge: CUP, 2006).
2. Renu Gupta, *A Course in Academic Writing* (New Delhi: Orient BlackSwan, 2010).
3. Ilona Leki, *Academic Writing: Exploring Processes and Strategies* (New York: CUP, 2nd edn, 1998).
4. Gerald Graff and Cathy Birkenstein, *They Say/I Say: The Moves That Matter in Academic Writing* (New York: Norton, 2009).

GENERIC ELECTIVE 2 (ENG 2.11)
MEDIA AND COMMUNICATION SKILLS

Theory Credit: 6

UNIT I **Introduction to Mass Communication**

1. Mass Communication and Globalization
2. Forms of Mass Communication

Topics for Student Presentations:

a. Case studies on current issues Indian journalism
b. Performing street plays
c. Writing pamphlets and posters, etc.

UNIT II **Advertisement**

1. Types of advertisements
2. Advertising ethics
3. How to create advertisements/storyboards

Topics for Student Presentations:

a. Creating an advertisement/visualization
b. Enacting an advertisement in a group
c. Creating jingles and taglines

UNIT III **Media Writing**

1. Scriptwriting for TV and Radio

UNIT IV Writing News Reports and Editorials

Editing for Print and Online Media
Topics for Student Presentations:

a. Script writing for a TV news/panel discussion/radio programme/hosting radioprogrammes on community radio
b. Writing news reports/book reviews/film reviews/TV program reviews/interviews
c. Editing articles
d. Writing an editorial on a topical subject

UNIT V **Introduction to Cyber Media and Social Media**

1. Types of Social Media
2. The Impact of Social Media
3. Introduction to Cyber Media

GENERIC ELECTIVE 3 (ENG 3.11)
CONTEMPORARY INDIA: WOMEN AND EMPOWERMENT

Theory Credit: 6

UNIT I Social Construction of Gender (Masculinity and Feminity), Patriarchy

UNIT II Women and Law, Women and the Indian Constitution,

UNIT III Personal Laws(Customary practices on inheritance and Marriage), (Supplemented by workshop on legal awareness)

UNIT IV Women and Environment: State interventions

UNIT V Domestic violence, Female foeticide, sexual harassment

GENERIC ELECTIVE 4 (ENG 4.11)
LANGUAGE, LITERATURE AND CULTURE

Theory Credit: 6

Four essays to be studied from the prescribed text

An Anthology of Writings on Diversities in India, Editorial Board: Department of English, University of Delhi (In the press)

GENERIC ELECTIVE
GEOGRAPHY

SEMESTER	COURSE	COURSE NAME	COURSE CODE	CREDIT
I	Generic Elective 1	Introduction to Physical Geography (Theory)	GGG 1.11	4
		Thematic Cartography (Practical)	GGG 1.12	2
II	Generic Elective 2	Human Geography (Theory)	GGG 2.11	4
		General Cartography (Practical)	GGG 2.12	2
III	Generic Elective 3	Geography of India (Theory)	GGG 3.11	4
		Introduction to Statistical Methods (Practical)	GGG 3.12	2
IV	Generic Elective 4	Regional Geography of Northeast India and Nagaland (Theory)	GGG 4.11	4
		Presentation (Practical)	GGG 4.12	2

GENERIC ELECTIVE 1 (GGG 1.11)
INTRODUCTION TO PHYSICAL GEOGRAPHY

Theory Credit: 4 *Teaching Hours: 60*

Objective: *The objective of this paper is to understand the origin of the Earth and its various landforms. The inter-relation of various branches of geography with other branches of natural and social science.*

UNIT I Physical geography: nature and scope; Branches of Physical Geography; interrelations of geography with physical science and social sciences.

UNIT II Forces affecting Earth's crust (endogenetic and exogenetic): Geomorphic Processes.

UNIT III Major Landforms (Types and classification of Mountains and Plains): Cycle of Erosion (Davis), Penck's Theory.

UNIT IV Origin and types of rocks; classification of igneous, sedimentary and metamorphic rocks.

UNIT V Soils: processes and factors of soil formation, soil types, soil profile.

Recommended Books and References:

1. Bryant, H. Richard (2001): **Physical Geography Made Simple,** Rupa and Company, New Delhi.
2. Bunnett, R.B. (2003): **Physical Geography in Diagrams**, Fourth GCSE edition, Pearson Education (Singapore) Private Ltd.
3. Hugget, R.J. (2003): **Fundamentals of Geomorphology**, Routledge, London.
4. Monkhouse, F.J. (1979): **Physical Geography**, Methuen, London.
5. Negi, B.S. (2000): **Physica lGeography**, Kedar Nath Ram Nath, Meerut.
6. Singh, S. (2003): **Physical Geography,** Prayag Pustak Bhawan, Allahabad. (2007): Physical Geography, Lakshmi Narain Agarwal, Agra.
7. Sharma, Y.K. (2007): **Physical Geography**, Lakshmi Narain Agarwal, Agra.
8. Strahler, A.N. and Strahler, A.m. (1992): **Modern Physical Geography**, John Wiley and Sons, New York.
9. Thornbury, W.D. (1960): **Principles of Geomorphology**, John Willey & Sons, New York.
10. Wooldrige, S.H and Morgan, R.S. (1959): **The Physical Basis of Geography** –An Outline of Geomorphology, Longman Green & Co., London

GENERIC ELECTIVE 1 (GGG 1.12)
THEMATIC CARTOGRAPHY

Practical Credit: 2 *Teaching Hours: 30*

UNIT I Concept of map and types of maps.

UNIT II Types of scale; preparation of scale: simple, comparative and diagonal.

UNIT III Enlargement and Reduction of map by graphical method, combination of maps of different scales.

UNIT IV Viva voce and Practical Notebook.

Recommended Books and References:

1. Binch, T.W. (1968**): Maps: Topographical and Statistica**l, Clarendon Press, Oxford.
2. Khan, Md. Z.A. (1998): **Text Book of Practical Geography**, Concept Publishing, New Delhi.
3. Lownsberg, J.F. and Aldrich, F.T. (1979): **Introduction to Geographical Methods and Techniques**, Charles Marlin, Columbus.
4. Mishra, R.P. and Ramesh A. (1989): **Fundamentals of Cartography**, Concept Publishing Company, New Delhi.
5. Mohammad, N. (2008): **Practical Work in Geography**, Sunflower Publishers, New Delhi.
6. Sarkar, A.K. (1997): **Practical Geography: A Systematic Approach**, Orient Longman, Kolkata.
7. Singh, L.R. (2006): **Fundamentals of Practical Geography**, Sharda Pustak Bhawan, Allahabad.
8. Singh, R.L. and Singh, Rana P.B. (1993): **Elements of Practical Geography**, Kalyani Publishers, New Delhi.

GENERIC ELECTIVE 2 (GGG 2.11)
HUMAN GEOGRAPHY

Theory Credit: 4 *Teaching Hours: 60*

Objective: *To acquaint the students with the nature of man- environment relationship and to make them understand the spatial distribution of different racial groups***.**

UNIT I Human Geography-meaning, nature and scope; branches of Human geography.

UNIT II Man-environment dynamic relationships; determinism and possibilism.

UNIT III Physical, economic and social factors influencing spatial distribution of world population; growth distribution and density of population.

UNIT IV Concept of over population, under population and optimum population; Migration: types and consequences.

UNIT V Settlement: Geographical factors influencing human settlement; rural and urban settlement (Types and patterns)

Recommended Books and References:

1. Beyman, E.F. (1995): **Human Geography** – Culture, Connections and Landscape, Prentice Hall, New Jersey.
2. Hazra, Jayati et al., (1977): **Dimensions of Human Geography**, Rawat Publications, Jaipur.
3. Hopkins, I. (1982): **An Introduction to Human Geography**, Widenfield and Nicolson, London.
4. Hussain, M. (1994): **Human Geography,** Rawat Publications, Jaipur.
5. James, R. (2010):**The Cultural Landscape – An Introduction to Human Geography**, Prentice Hall of India, New Delhi.
6. Leong Goh Cheng (2003): **Physical and Human Geography,** Oxford University Press, New Delhi.
7. Norton, W. (1995): **Human Geography,** Oxford University Press, New York.

8. Singh, L.R. (2005): **Fundamentals of Human Geography**, Sharda Pustak Bhawan, Allahabad.
9. Stoddard, R.H., Wishart, D.J. and and Blouet, B.W.: **Human Geography,** Prentice-Hall, Englewood Cliffs, New Jersey.

GENERIC ELECTIVE 2 (GGG 2.12)
GENERAL CARTOGRAPHY

Practical Credit: 2 *Teaching Hours: 30*

UNIT I The nature and scope of cartography, developments and trend, traditional versus modern cartography

UNIT II Diagrammatic population data presentation by Line, bar, circle

UNIT III Representation of population data: Distribution, density and growth by dots and proportionate circles; Age-sex pyramid.

UNIT IV Viva voce and Practical Note book.

Recommended Books and References:

1. Kanetker, T.P. and Kulkarni, S.V. (1967): **Surveying and Levelling,** (Vol I and II), V.G. Prakashan, Poona
2. Mishra, R.P. and Ramesh A. (1989): **Fundamentals of Cartography**, Concept Publishing Company, New Delhi.
3. Sarkar, A. K. (1997): **Practical Geography: A Systematic Approach,** Orient Longman, Kolkata
4. Singh, L.R. (2006): **Fundamentals of Practical Geography**, Sharda Pustak Bhawan, Allahabad.
5. Steers,J. A. (1965): **An Introduction to the Study of Map Projection**, University of London Press, London
6. Talukdar, S. (2008): **Introduction to Map Projection**, EBH Publishers, Guwahati.

GENERIC ELECTIVE 3 (GGG 3.11)
GEOGRAPHY OF INDIA

Theory Credit: 4 *Practical Hours: 60*

Objectives: *Aims and presenting a comprehensive, integrated and empirically based profile of India so as to sensitize the students with development issues, policies and programmes designed to regional development.*

UNIT I Physiographic features, Climate, soil

UNIT II Population characteristics: population growth, distribution and density, sex ratio

UNIT III Agriculture: agricultural development, modernisation of Indian agriculture (Green Revolution, yellow revolution), Agricultural Trade (Wheat, Rice).

UNIT IV Transport: Roads and railways, air transport and water transport.

UNIT V Industry: Industrial development and Indian economy, distribution of major industries (cotton textile, Iron Steel and cement industries).

Recommended Books and References:

1. Gautam, A. (2006): **Advanced Geography of India,** Sharda Pustak Bhawan, Allahabad.
2. Gopal Singh (1992): **A Geography of India**, Atma Ram & Sons, Lucknow.
3. Khullar, D.R. (2007): **A Comprehensive Geography,** Kalyani Publishers, New Delhi.
4. Kundee, A. (1992): **Urban Development Urban Research in India**, Khanna Pub.l, New Delhi.
5. Nag, P. and Gupta, S.S. (1992): **Geography of India**, Concept Publishing Company, New Delhi.
6. Premi, M.K. (2007**): Population of India**, NBT, New Delhi.
7. Singh, J. (2003): **India: A Comprehensive Systematic Geography**, Gyanodaya Prakashan, Gorakhpur.
8. Singh, R.L. (ed.) (1971): **India: A Regional Geography**, National Geographical Society of India, Varanasi.
9. Srinivasan, K. and Vlassoff, M. (2001): **Population and Development Nexus in India, Challenges for the new Millenium**, Tata Mc Graw Hill, New Delhi.
10. Tiwari, R.C. (2007): **Geography of India**, Prayag Pustak Bhawan, Allahabad.

GENERIC ELECTIVE 3 (GGG 3.12)
INTRODUCTION TO STATISTICAL METHOD

Practical Credit: 2 *Teaching Hours: 30*

UNIT I Sampling- Types and their Uses

UNIT II Statistical methods: Measures of central tendency (Mean, Median and Mode), Measures of dispersion (Mean deviation and Standard deviation).

UNIT III Chorochromatic mapping of population data (Density, Sex ratio, Literacy rate)

UNIT IV Practical notebook and viva voce.

Recommended Books and References:

1. Talukdar, S. (2008): **Introduction to Map Projection**, EBH Publishers, Guwahati
2. Sarkar, A. K. (1997): **Practical Geography: A Systematic Approach,** Orient Longman, Kolkata
3. Singh, L.R. (2006): **Fundamentals of Practical Geography**, Sharda Pustak Bhawan, Allahabad.
4. Steers, J. A. (1965): **An Introduction to the Study of Map Projection**, University of London Press, London
5. Mishra, R.P. and Ramesh A. (1989): **Fundamentals of Cartography**, Concept Publishing Company, New Delhi

GENERIC ELECTIVE 4 (GGG 4.11)
REGIONAL GEOGRAPHY OF NORTHEAST INDIA AND NAGALAND

Theory Credit: 4 *Teaching Hours: 60*

Objective: *To understand the geographical settings of North-East India with special reference to Nagaland and analyze the regions potentiality for sustainable development.*

UNIT I Northeast India: Locational significance; Physical characteristics- Physiography, climate, soil and natural vegetation

UNIT II Population of NE India: Growth, Distribution and Density, Age-Sex composition, Rural-Urban composition

UNIT III Economic basis of NE India: Agriculture, Industries and Transport system.

UNIT IV Nagaland: Locational significance, physiography, Population growth and distribution

UNIT V Economic Attributes of Nagaland: Tourism and its potential, Problems and prospects of agriculture and allied activities, Biodiversity and its conservation.

Recommended Books and References:

1. Bhagabati, A.K.(ed): **Biodiversity of Assam**, Eastern Book House, Guwahati.
2. Bhattacharyya,N.N.(2005): .**North East India: A systematic Geography,** Rajesh Pub. New Delhi.
3. Gopal Krishnan,R. : **Geography of North East India**
4. **Gopal Krishnan R. (1991): North-East India: Land, People and Economy, Vikash Publishing House, NewDelhi.**
5. Sebu, Sonyhulo (2013): **Geography of Nagaland**, Spectrum Publications Guwahati, Delhi.
6. Singh, S. (1994): **Agricultural Development in India : A Regional Analysis**, Kaushal Publ., Shillong.
7. Taher,M. and Ahmed,P.(1988): **Geography of North East India**, Mani Manik Prakash, Guwahati.

GENERIC ELECTIVE 4 (GGG 4.12)
PAPER PRESENTATION

Practical Credit: 2 *Teaching Hours:30*

NOTE: Students will be assigned topics based on the theory paper for presentation. They would be assessed on the following:

a) Report writing
b) Presentation
c) Viva-voce

GENERIC ELECTIVE
GEOLOGY

SEMESTER	COURSE	COURSE NAME	COURSE CODE	CREDIT
I	Generic Elective 1	Essentials of Geology (Theory) OR Earth Surface Processes (Theory)	GLG 1.11(a) GLG 1.11(b)	4
		Essentials of Geology (Practical) OR Earth Surface Processes (Practical)	GLG 1.12(a) GLG 1.12(b)	2
II	Generic Elective 2	Rocks and Minerals (Theory) OR Soils: Present and Past (Theory)	GLG 2.11(a) GLG 2.11(b)	4
		Rocks and Minerals (Practical) OR Soils: Present and Past (Practical)	GLG 2.12(a) GLG 2.12(b)	2
III	Generic Elective 3	Fossils and their Applications (Theory) OR Earth Resources (Theory)	GLG 3.11(a) GLG 3.11(b)	4
		Fossils and their Applications (Practical) OR Earth Resources (Practical)	GLG 3.12(a) GLG 3.12(b)	2
IV	Generic Elective 4	Natural Hazards and Disaster Management (Theory) OR Nuclear Waste Management (Theory)	GLG 4.11(a) GLG 4.11(b)	4
		Natural Hazards and Disaster Management (Practical) OR Nuclear Waste Management (Practical)	GLG 4.12(a) GLG 4.12(b)	2

GENERIC ELECTIVE 1 (GLG 1.11(a))
ESSENTIALS OF GEOLOGY

Theory Credit: 4

UNIT I Introduction to geology, scope, sub-disciplines and relationship with other branches of sciences

UNIT II Earth in the solar system, origin
Earth's size, shape, mass, density, rotational and evolutional parameters
Solar System- Introduction to Various planets - Terrestrial Planets and Jovian Planets
Internal constitution of the earth - core, mantle and crust

UNIT III Convections in the earth's core and production of magnetic field. Origin and composition of hydrosphere and atmosphere

UNIT IV Origin of biosphere**,** Origin of oceans, continents and mountains

UNIT V Age of the earth; Radioactivity and its application in determining the age of the Earth, rocks,minerals and fossils

GENERIC ELECTIVE (GLG 1.12(a))
ESSENTIALS OF GEOLOGY

Practical Credit: 2

1. Study of major geomorphic features and their relationships with outcrops through physiographic models.
2. Study of topographic sheets and preparation of physiographic description of an area
3. Study of soil profile of any specific area
4. Study of distribution of major litho stratigraphic units on the map of India
5. Study of distribution of major dams on map of India and their impact on river systems
6. Study of major ocean currents of the World
7. Study of seismic profile of a specific area and its interpretation

Recommended Books and References:

1. Holmes' Principles of Physical Geology. 1992. Chapman & Hall.
2. Emiliani, C, 1992. Planet Earth, Cosmology, Geology and the Evolution of Life and Environment.,Cambridge University Press.
3. Gross,M.G., 1977. *Oceanography: A view of the Earth*, Prentice Hall.

GENERIC ELECTIVE (GLG 1.11(b))
EARTH SURFACE RESOURCES

Theory Credit: 4

UNIT I Historical development in concepts, terrestrial relief, scales in geomorphology.

UNIT II Weathering and formation of soils, karst and speleology, slope and catchment erosion processes, fluvial,aeolian, glacial, peri-glacial and coastal processes and resultant landforms, , Water and sediment flux in river systems, Morphometric analysis of drainage basin and geomorphology-hydrology relationship.

UNIT III Techniques for measuring rates of processes: sediment budgeting, rock magnetism, isotope geochemical tracers, cosmogenic nuclides, OSL & C-14 dating.

UNIT IV Controlling factors (tectonics, climate, sea level changes and anthropogenic) and surfaceProcesses Climate change and geomorphic response of fluvial systems of arid and humid regions.Geomorphic response to tectonics, sea level/base level change, anthropogenic affects. Introduction to Anthropocene.

UNIT V Spatial & temporal scales, geomorphic system, connectivity, buffering, magnitude-frequency concept,time lag, sensitivity, equilibrium, threshold, non-linearity & complexities. Mega geomorphology and process interrelationship. Surface processes and natural hazards; Applied aspects of geomorphology; Introduction to planetary geomorphology.

COURSE (GEOL 1.12(b))
EARTH SURFACE RESOURCES

Practical Credit: 2

Mapping of different landforms and interpretation of surface processes
Exercises on hill slope development, fluvial channel, sediment erosion and transport, sediment budgeting,aggradation and degradation events, drainage basin, drainage morphometry
Basic exercises on computation of rate for different surface processes

Recommended Books and References:

1. Alien, P.A., 1997. *Earth Surface Processes,* Blackwell publishing.
2. Bloom, A.L., 1998. *Geomorphology: A Systematic Analysis of Late Cenozoic Landforms,*PearsonEducation.
3. Bridge, J.S. and Demicco, R.V., 2008. *Earth Surface Processes, Landforms and Sediment Deposits,*Cambridge University Press.
4. Esterbrook, D.J., 1992. *Surface Processes and Landforms,* MacMillan Publ.
5. Kale, V.S. and Gupta A 2001 *1ntoduction to Geomorphology,* Orient Longman Ltd.
6. Leeder, M. and Perez-Arlucea M 2005 Physical processes in earth and environmentalsciences,Blackwell' publishing.
7. Summerfield M A 1991Globle *Geomorphology* Prentice Hall.
8. Wllcock, P.R., Iverson R M (2003) Prediction in geomorphology ' AGU Publication.

GENERIC ELECTIVE (GLG 2.11(a))
ROCKS AND MINERALS

Theory Credit: 4

UNIT I Minerals-Definitions, Physical properties of minerals: Color, Lustre, transparency and translucency, form, hardness, fracture, streak, cleavage, specific gravity.

UNIT II Study of Petrological microscope, nature of light, Isotropic and Anisotropic substances, Refractive Index, Interference color, Extinction, Pleochroism absorption, twinning.

UNIT III Crystal: definition and characteristics- face, edge, solid angle, zone, zone axis, interfacial angle parameters and indices. Crystallographic axes, axial ratio and symmetry, common crystal forms.

UNIT IV Rocks- Definitions and types, Igneous rock- magma generation and differentiation, Metamorphic rocks- chemical system and types of metamorphism

UNIT V Sedimentary rocks: sedimentary processes- physical, chemical and biological weathering, transportation, diagenesis. Genetic classification ofsedimentary rocks.

GENERIC ELECTIVE (GLG 2.12(a))
ROCKS AND MINERALS

Practical Credit: 2

1. Study of physical properties of minerals
2. Introduction to optical microscopy
3. Study of optical properties of minerals
4. Study of physical properties of rocks
5. Study of optical properties of rock under thin sections
6. Understanding crystal symmetry via wodden models
7. Stereographic projection of mineral faces
8. Mineral formula calculation
9. Crystal chemical calculation
10. Introduction to analytical techniques for rock and mineral study.

Recommended Books and References:

1. Earth Materials- Introduction to Mineralogy and Petrology, Cornelis Klein and Anthony Philpotts,Cambridge University Press, 2013.
2. Understanding Earth (Sixth Edition), John Grotzinger and Thomas H. Jordan, 2010, W.H. Freeman and company, New York.

GENERIC ELECTIVE (GLG 2.11(b))
SOILS: PRESENT AND PAST

Theory Credit: 4

UNIT I Soil forming processes: Physical weathering, loosening and particle size reduction; pressurerelease; thermal expansion; growth of foreign crystal.

UNIT II Soil structures; horizons; roots; Fe-Mn mottles and concretions; pedogenic carbonate. Introduction to paleopedology and paleosols; role of factors controlling paleosol formation- parent material, climate, vegetation, topography, time.

UNIT III Introduction to soil taxonomy and paleosol taxonomy. Micromorphology: Thin section analysis of paleosols. Geochemistry: molecular rations; chemical weathering indices.

UNIT IV Diagenetic overprinting in fossil soils: compaction; oxidation of organic matter; cementation;Illitization. Geological record of fossil soils.

UNIT V Pleistocene-Holocene paleosols- human impact on landscape and soils, climate change,neotectonics. Paleosols and non-marine sequence stratigraphy based on paleopedology and sedimentology of fluvial successions.

GENERIC ELECTIVE (GLG 2.12(B))
SOILS: PRESENT AND PAST

Practical Credit: 2

1. Micromorphic detailing of the paleosols- structure, horizonation, color, rhizocretions, Pedogeniccarbonate etc.
2. Particle size analysis and clay mineral analysis of the paleosols
3. Micromorphological analysis- thin section preparation, description, and interpretation
4. Geochemical analysis- bulk geochemistry, molecular rations and weathering indices
5. Field trip to examine modern and fossil soils- field characterization and sampling procedures

Recommended Books and References:

1. Retallack, G.J. (2001) *Soils of the Past: An Introduction to Paleopedology*(2nd edition): Oxford, Blackwell Science, Ltd., 416 p.
2. Birkeland, P.W. (1999) Soil and Geomorphology. Oxford University Press (430 pp.). reconstruction using paleosols. Earth-Science Reviews 95, 1–52.
5. Stoops, G. (2003) Guidelines for analysis and distribution of soil and regolith thin sections. SoilSci. Soc. Am., Madison, Wisconsin, 184 pp.
7. Bhattacharyya T., Sarkar, D., Pal, D. K. (Eds.) **Soil Survey Manual.** NBSSLUP Publication No

GENERIC ELECTIVE (GLG 3.11(a))
FOSSILS AND THEIR APPLICATION

Theory Credit: 4

UNIT I Definition of fossil, Types, fossilization processes (taphonomy), modes of fossil preservation, fossils sampling techniques, uses of fossils

UNIT II Definition of species, speciation, methods of description and naming of fossils, code of systematic nomenclature

UNIT III Brief introduction of important fossils groups: invertebrate, vertebrate, microfossils, spore, pollens and plant fossils. Important age-diagnostic fossiliferous horizons of India

UNIT IV Principles and methods of paleoecology, application of fossils in the study of paleoecology,paleobiogeography and paleoclimate

UNIT V Morphological study and geological distribution of the following classes: brachiopoda, lamellibranchia, gastropoda and cephalopoda.

GENERIC ELECTIVE (GLG 3.12(a))
FOSSILS AND THEIR APPLICATIONS

Practical Credit: 2

1. Study of fossils showing various modes of fossilization
2. Distribution of age diagnostic fossils in India
3. Biostratigraphic correlation

Recommended Books and References:

1. Schoch, R.M. 1989. Stratigraphy, Principles and Methods.VanNostrand Reinhold.
2. Clarkson, E.N.K.1998. Invertebrate Paleontology and Evolution George AlIen&Unwin
3. Prothero, D.R. 1998. Bringing fossils to life - An introduction to Paleobiology, McGraw Hill.
4. Benton, M.J. 2005. Vertebrate paleontology (3rd edition). Blackwell Scientific, Oxford.
5. Colbert's Evolution of the Vertebrates: A History of the Backboned Animals Through Time,EdwinH. Colbert, Michael Morales, Eli C. Minkoff, John Wiley & Sons, 1991.

GENERIC ELECTIVE (GLG 3.11(B))
EARTH RESOURCES

Theory Credit: 4

UNIT I Resource and reserve definitions; mineral, energy and water resources.

UNIT II Definition of Energy: Primary and Secondary Energy. Difference between Energy, Power and Electricity. Renewable and Non-Renewable Sources of Energy.

UNIT III Major Types and Sources of Energy: Natural Oil and Gas, Coal and Nuclear Minerals.Potential of Hydroelectric Power, Solar Energy, Wind, Wave and Biomass based power and energy.

UNIT IV Ground water resources and its role in economic development of a country. Impact of urbanization on groundwater.

UNIT V Metallic and non-metallic mineral deposits and their conservation.
The concept and significance of Renewability: Social, Economic, Political and Environmental Dimension of Energy.

GENERIC ELECTIVE (GLG 3.12(b))
EARTH RESOURCES

Practical Credit: 2

1. Plotting of major Indian oil fields on map of India
2. Problems related to hydroelectric power generation
3. Problems related to assessment of possible oil exploration site from geological maps
4. Problems related to energy demand projection of India and possible mitigation pathways
5. Problems related to bio fuel

Recommended Books and References:

1. Energy and the Environment by Fowler, J.M 1984. McGraw-Hill
2. Global Energy Perspectives by NebojsaNakicenovic 1998, Cambridge University Press.
3. Energy Resources and Systems: Fundamentals and Non-Renewable Resources by Tushar K. Ghosh and M. A. Prelas. 2009, Springer

GENERIC ELECTIVE (GLG 4.11(a))
NATURAL HAZARDS AND DISASTER MANAGEMENT

Theory Credit: 4

UNIT I The Lithosphere and Related Hazards
Atmospheric Hazards, Hydrosphere and Related Hazards

UNIT II Types of disaster: natural and manmade - cyclone, flood, land slide, land subsidence, fire and earthquake, tsunami and volcanic eruption

UNIT III Disaster management, mitigation, and preparedness, Techniques of monitoring and design against the disasters, Management issues related to disaster

UNIT IV Risk, Vulnerability and Hazard, Mitigation through capacity building, Pre-disaster risk & vulnerability reduction, Post disaster recovery & rehabilitation

UNIT V Prevention and rehabilitation: Emergency alert System, Management, Bhopal Gas leak disaster. Disaster related infrastructure development

GENERIC ELECTIVE (GLG 4.12(a))
NATURAL HAZARDS AND DISASTER MANAGEMENT

Practical Credit: 2

Trainings in first aid, relief, rescue and mock drill.
The course will also include discussions on topics assigned to students based on their interest.

Recommended Books and References:

1. Bell, F.G., 1999. Geological Hazards, Routledge, London.
2. Bryant, E., 1985. Natural Hazards, Cambridge University Press.

3. Smith, K., 1992. Environmental Hazards. Routledge, London.
4. Subramaniam, V., 2001. Textbook in Environmental Science, Narosa International

GENERIC ELECTIVE (GLG 4.11(b))
NUCLEAR WASTE

Theory Credit: 4

UNIT I Nuclear reactors and generation of nuclear waste, nuclear fuel cycle.

UNIT II Basic concepts about nuclear wastemanagement. Classification, composition and types of nuclear waste, their sources and characteristics.

UNIT III Introduction to immobilization and vitrification processes. Nuclear waste forms and containments.Immobilization of nuclear waste in synthetic glasses and natural glass/rocks (acidic:obsidian, rhyolite and basic: nephiliniite and basaltic).

UNIT IV Glass/rock characterization and its long-term performance assessment. Geochemistry of glass/rock-water interaction-solution and neoformed mineral chemistry.

UNIT V Nuclear waste confinement and safe disposal in deep geological repository. Application of clays as natural barrier.

GENERIC ELECTIVE (GLG 4.12(b))
NUCLEAR WASTE

Practical Credit: 2

1. Determination of physical properties such as hardness, durability, melting and pouringtemperatures.
2. Chemical characterization of synthetic and natural glass.
3. Mathematical modeling and extrapolation of synthetic glass alterations.
4. Mathematical modelling and extrapolation of natural acidic (obsidian, rhyolite) and Basic(nephilinite and basaltic) glasses.
5. Determination of rate of alteration and recognition of neo-formed minerals.
6. Calculation of retention coefficient for glass residue.

Recommended Books and References:

1. Saling, J. (2001). Radioactive waste management. CRC Press.
2. Ojovan, M. I., & Lee, W. E. (2013). An introduction to nuclear waste immobilisation.Newnes.
3. T.G. Wolery: reaction path modeling of aqueous geochemical systems.
4. Bethke, C. M. (2007). Geochemical and biogeochemical reaction modeling. CambridgeUniversity Press.

GENERIC ELECTIVE
MATHEMATICS

SEMESTER	COURSE	COURSE NAME	COURSE CODE	CREDIT
I	Generic Elective 1	Calculus (Theory) OR Object Oriented Programming in C++ OR Finite Element Methods	MAG 1.11(a) MAG 1.11(b) MAG 1.11(c)	5 4 5
		Calculus (Tutorial) OR Object Oriented Programming in C++(Practical) OR Finite Element Methods (Tutorial)	MAG 1.12(b)	1 2 1
II	Generic Elective 2	Algebra (Theory) OR Mathematical Finance (Theory) OR Econometrics (Theory)	MAG 2.11(a) MAG 2.11(b) MAG 2.11(c)	5
		Algebra (Tutorial) OR Mathematical Finance (Tutorial) OR Econometrics (Tutorial)		1
III	Generic Elective 3	Vectors and Analytical Geometry (Theory) OR Cryptography and Network Security (Theory) OR Information Security (Theory)	MAG 3.11(a) MAG 3.11(a) MAG 3.11(a)	5
		Vectors and Analytical Geometry (Tutorial) OR Cryptography and Network Security (Tutorial) OR Information Security (Tutorial)		1
IV	Generic Elective 4	Differential Equations and Higher Trigonometry (Theory) OR Applications of Algebra (Theory) OR Combinatorial Mathematics (Theory)	MAG 4.11(b) MAG 4.11(b) MAG 4.11(a)	5
		Differential Equations and Higher Trigonometry (Tutorial) OR Applications of Algebra (Tutorial) OR Combinatorial Mathematics (Tutorial)		1

GENERIC ELECTIVE 1 (MAG 1.11(a))
CALCULUS

Theory Credit: 5
Tutorial Credit: 1

UNIT I Successive differentiation: n^{th} derivative of functions. Formation of equation involving derivatives. Leibnitz formula for the n^{th} order derivative of a product. The meaning of derivative. Meaning of the sign of the differential coefficients. Rate of change of variables, velocity and acceleration

UNIT II Rolle's theorem, Mean value theorems (statement and proof), applications on inequality. application based on theory of equations and numerical analysis need to be done). Indeterminate forms (l'Hospital's Rule) (Proof & Problems). Asymptotes.

UNIT III Taylor's theorem, (Cauchy's form of remainder, Lagrange's form of remainder) Maclaurin theorem. (Proof and problems) Expansion of functions, Limits using Taylors theorem. (as applications)

UNIT IV (All the integrals can be definite and indefinite ones). Integrals of irrational functions. Properties of definite integrals (Proof and problems). Reduction formulas (Both definite and indefinite integrals need to be done). Bernoulli's formula (Integration by parts). Improper integrals, Comparison test for improper integrals. Beta and Gamma functions. Applications of Beta and Gamma functions in evaluating some definite integrals.

UNIT V Cylindrical Coordinates.Spherical Coordinates. Quadrature (Cartesian, polar coordinate, Parametric curves). Volume of solid of revolution(methods of cylinder, Method of rings), Length of curve. Area of surface of revolution (Cartesian,Parametric curves, polar coordinates.), Theorems of Pappus – Guldinus.

Recommended Books and References:

1. A Text book on Differential Calculus by A.K. Sharma
2. Differential Calculus by Ghosh &Maity
3. A Text book on Integral Calculus by A.K. Sharma
4. Integral Calculus by Ghosh &Maity

GENERIC ELECTIVE 1 (MAG 1.11(b))
OBJECT ORIENTED PROGRAMMING IN C++

UNIT I OOP Paradigm: Comparison of Programming paradigms, Characteristics of Object-Oriented Programming Languages,

UNIT II Object-based programming languages C++: Brief History of C++, Structure of a C++ program, Difference between C and C++ - cin, cout, new, delete operators, ANSI/ISO Standard C++, Comments, Working with Variables and const Qualifiers. Enumeration, Arrays and Pointer.

UNIT III Implementing oops concepts in C++ Objects, Classes, Encapsulation, Data Abstraction, Inheritance, Polymorphism, Dynamic Binding, Message Passing, Default Parameter Value, Using Reference variables with Functions.

UNIT IV Abstract data types, Class Component, Object & Class, Constructors Default and Copy Constructor, Assignment operator deep and shallow coping, Access modifiers – private, public and protected. Implementing Class Functions within Class declaration or outside the Class declaration. instantiation of objects, Scope resolution operator, Working with Friend Functions, Using Static Class members.

UNIT V Understanding Compile Time Polymorphism function overloading Rules of Operator Overloading (Unary and Binary) as member function/friend function, Implementation of operator overloading of Arithmetic Operators, Overloading Output/Input, Prefix/ Postfix Increment and decrement Operators, Overloading comparison operators, Assignment, subscript and function call Operator, concepts of namespaces.

Practical to be performed in lab.

Recommended Books and References:

1. A. R. Venugopal, *Rajkumar, and T. Ravishanker, Mastering C++*, TMH, 1997.
2. S. B. Lippman and J. Lajoie, *C++ Primer, 3rd Ed.*, Addison Wesley, 2000.
3. Bruce Eckel, *Thinking in C++, 2nd Ed.*, President, Mindview Inc., Prentice Hall.
4. D. Parasons, *Object Oriented Programming with C++*, BPB Publication.
5. Bjarne Stroustrup, *The C++ Programming Language, 3rd Ed.*, Addison Welsley

GENERIC ELECTIVE 1 (MAG 1.11(c))
FINITE ELEMENT METHODS

UNIT I Introduction to finite element methods, comparison with finite difference methods, Methods of weighted residuals, collocations, least squares and Galerkin's method. Variational formulation of boundary value problems equivalence of Galerkin and Ritz methods.

UNIT II Applications to solving simple problems of ordinary differential equations.

UNIT III Linear, quadratic and higher order elements in one dimensional and assembly, solution of assembled system.

UNIT IV Simplex elements in two and three dimensions, quadratic triangular elements, rectangular elements, serendipity elements and isoperimetric elements and their assembly, discretization with curved boundaries

UNIT V Interpolation functions, numerical integration, and modeling considerations. Solution of two dimensional partial differential equations under different Geometric conditions

Recommended Books and References:

1. J.N. Reddy, *Introduction to the Finite Element Methods*, Tata McGraw-Hill, 2003.
2. K.J. Bathe, *Finite Element Procedures, Prentice-Hall*, 2001.
3. R.D. Cook, *D.S. Malkus and M.E. Plesha, Concepts and Applications of Finite Element Analysis*, John Wiley and Sons, 2002.

4. Thomas J.R. Hughes, *The Finite Element Method: Linear Static and Dynamic Finite Element Analysis*, Dover Publication, 2000. 5. George R. Buchanan, Finite Element Analysis, McGraw Hill, 1994.

GENERIC ELECTIVE 2 (MAG 2.11(a))
ALGEBRA

Theory Credit: 5
Tutorial Credit: 1

UNIT I **Sequence**

The Bounds of a set. Greatest Lower Bound(GLB or Infimum), Least Upper Bound(LUB or Suprimum) of a set. Triangle inequality ($|x \pm y| \leq |x| + |y|$, $|x \pm y| \geq ||x| - |y||$). Definition of a sequence. Types of sequences. Limit of sequence. Convergence and divergence of a sequence. Algebra on the limits of converging sequences. Result on convergence of bounded monotonic sequence to be discussed. Examples and counter examples need to be discussed.

UNIT II **Series**

Definition of a series. Sum of a series. Convergence and divergence of a series. $\lim_{n\to\infty} u_n = 0$ where u_n is the n^{th} term of a convergent series. Counter example. Tests for convergence of a series. Comparison test, Ratio test, Integral test. Absolute and conditional convergence. Alternating series test.

UNIT III **Theory of Equations**

Definition of polynomial and algebraic equation. Degree of an equation. Remainder theorem. Even and odd functions. Number of real roots of even and odd functions depending on their values at two different points. Descartes rule of signs. (Proof is not necessary). n^{th} degree equation cannot have more than n roots. Equations with real coefficients will have complex roots and irrational roots occurring in conjugate pair. Relation between the roots and coefficients. Symmetric functions of roots. Sum of the powers of roots of an equation. Transformations of equations. Reciprocal equations. Removal of terms, Carden's Method.

UNIT IV **Abstract Algebra**

Binary operation. Definitions of Associativity, Commutativity, Identity, and Inverse. Problems. Definition of a Group. Finite and infinite groups. Abelian group. Cyclic group. Examples. Subgroup. Characterisation of subgroup. Union and intersection of subgroups.

UNIT V Order of an element, Order of a Subgroup. Examples on integer modulo p and permutation group on 3,4 symbols to be discussed. Cosets. Properties of cosets. Lagrange's Theorem on finite group. Number of generator of a finite cyclic group.

Recommended Books and References:

1. Higher Algebra by Ghosh &Maity
2. Algebra and Trigonometry by G.C. Sharma & Madhu Jain
3. A Text Book on Modern Algebra by R. S. Aggarwa

GENERIC EELECTIVE 2 (MAG 2.11(b))
MATHEMATICAL FINANCE

UNIT I Basic principles: Comparison, arbitrage and risk aversion, Interest (simple and compound, discrete and continuous), time value of money, inflation, net present value, internal rate of return (calculation by bisection and Newton-Raphson methods), comparison of NPV and IRR. Bonds, bond prices and yields,

UNIT II Macaulay and modified duration, term structure of interest rates: spot and forward rates, explanations of term structure, running present value, floating-rate bonds, immunization, convexity, putable and callable bonds.

UNIT III Asset return, short selling, portfolio return, (brief introduction to expectation, variance, covariance and correlation), random returns, portfolio mean return and variance,

UNIT IV Diversification, portfolio diagram, feasible set, Markowitz model (review of Lagrange multipliers for 1 and 2 constraints), Two fund theorem, risk free assets, One fund theorem,

UNIT V Capital market line, Sharpe index. Capital Asset Pricing Model (CAPM), betas of stocks and portfolios, security market line, use of CAPM in investment analysis and as a pricing formula, Jensen's index.

Recommended Books and References:

1. David G. Luenberger, *Investment Science*, Oxford University Press, Delhi, 1998.
2. John C. Hull, Options, *Futures and Other Derivatives*, 6th Ed., Prentice-Hall India, Indian reprint, 2006.
3. Sheldon Ross, *An Elementary Introduction to Mathematical Finance*, 2nd Ed., Cambridge University Press, USA, 2003.

GENERIC ELECTIVE 2 (MAG 2.11(c))
ECONOMETRICS

UNIT I Statistical Concepts Normal distribution; chi-square, t and F-distributions; estimation of parameters; properties of estimators; testing of hypotheses: defining statistical hypotheses; distributions of test statistics; testing hypotheses related to population parameters; Type I and Type II errors; power of a test; tests for comparing parameters from two samples.

UNIT II Simple Linear Regression Model: Two Variable Case Estimation of model by method of ordinary least squares; properties of estimators; goodness of fit; tests of hypotheses; scaling and units of measurement; confidence intervals; Gauss-Markov theorem; forecasting.

UNIT III Multiple Linear Regression Model Estimation of parameters; properties of OLS estimators; goodness of fit - R2 and adjusted R2; partial regression coefficients; testing hypotheses – individual and joint; functional forms of regression models; qualitative (dummy) independent variables.

UNIT IV Violations of Classical Assumptions: Consequences, Detection and Remedies Multicollinearity; heteroscedasticity;

UNIT V Serial correlation. Specification Analysis Omission of a relevant variable; inclusion of irrelevant variable; tests of specification errors.

Recommended Books and References:

1. Jay L. Devore, *Probability and Statistics for Engineers*, Cengage Learning, 2010.
2. John E. Freund, *Mathematical Statistics, Prentice Hall*, 1992.
3. Richard J. Larsen and Morris L. Marx, *An Introduction to Mathematical Statistics and its Applications*, Prentice Hall, 2011.
4. D. N. Gujarati and D.C. Porter, *Essentials of Econometrics*, McGraw Hill, 4th Ed., International Edition, 2009.
5. Christopher Dougherty, *Introduction to Econometrics*, Oxford University Press, 3rd Ed., Indian edition, 2007.

GENERIC ELECTIVE 3 (MAG 3.11(a))
VECTORS & ANALYTICAL GEOMETRY

Theory Credit: 5
Tutorial Credit: 1

UNIT I Functions of Several Variables. Vector Functions. Calculus with Vector Functions. Limits and continuity. Vector derivative. Tangent, Normal and Binormal Vectors. Arc Length with Vector Functions. Curvature. Velocity and Acceleration. Definition of vector field. Divergence and Curl.

UNIT II Line Integral: Definition of line integral. Line integral with respect to x, y and z . Line integrals of vector fields. The fundamental theorem for line integrals. Conservative vector field. Independence of path. Green's theorem. Area as a line integral. Green's theorem for multiply connected regions. Alternative forms of Green's theorem.

UNIT III Normal derivatives. Surface integration. Flux integrals. Integrals over parametrically defined surfaces. Stokes theorem. Theoretical applications of Stokes' theorem. Physical interpretation of Stokes' theorem. Divergence Theorem (Gauss Theorem). Application. Physical interpretation of divergence. (Proofs of Green's, Stokes, Gauss's theorem is not required)

UNIT IV **2 - D Geometry**
Change of axis. Removal of xy term. Invariants. General equation of 2^{nd} degree represents a conic. Tangent to an ellipse. Auxiliary circle, Director circle. Chord of contact. Pole, Polar of an ellipse. Conjugate line with respect to an ellipse. Eccentric angle. Properties of an ellipse. Chord in terms of middle point. Conjugate diameter, properties.

UNIT V **3 - D Geometry**
Introduction. The 3-D Coordinate System. Equations of Lines. Equations of Planes. Quadric Surfaces

Recommended Books and References:

1. *A text book of Vector Analysis by Shanti Narayan*
2. *Vector Calculus by G.C Sharma, A.R. Vasishtha*
3. *Analytical Geometry by B. Das*

GENERIC ELECTIVE 3 (MAG 3.11(b))
CRYPTOGRAPHY AND NETWORK SECURITY

UNIT I Public Key Cryptography Principles & Applications, Algorithms: RSA, Message Authentication: One way Hash Functions: Message Digest, MD5, SHA1. Public Key Infrastructure: Digital Signatures, Digital Certificates, Certificate Authorities.

UNIT II Network Attacks: Buffer Overflow, IP Spoofing, TCP Session Hijacking, Sequence Guessing, Network Scanning: ICMP, TCP sweeps, Basic Port Scans; Denial of Service Attacks: SYN Flood, Teardrop attacks, land, Smurf Attacks.

UNIT III IP security Architecture: Overview, Authentication header, Encapsulating Security Pay Load, combining Security Associations, Key Management. Virtual Private Network Technology: Tunneling using IPSEC.

UNIT IV Requirements, Secure Socket Layer, and Secure Electronic Transactions, Network Management Security: Overview of SNMP Architecture- SNMPV1, SNMPV3.Firewall Characteristics & Design Principles,

UNIT V Types of Firewalls: Packet Filtering Router, Application Level Gateway or Proxy, Content Filters, Bastion Host.

Recommended Books and References:

1. W. Stallings, *Networks Security Essentials: Application & Standards*, Pearson Education, 2000.
2. TCP/IP Protocol Suite, *Behrouz A. Forouzan, Data Communication and Networking*, Tata McGraw Hill.
3. W. Stallings, *Cryptography and Network Security, Principles and Practice*, Pearson Education, 2000.

GENERIC ELECTIVE 3 (3.11(c))
INFORMATION SECURITY

UNIT I Overview of Security: Protection versus security; aspects of security–data integrity, data availability, privacy; security problems, user authentication, Orange Book.

UNIT II Security Threats: Program threats, worms, viruses, Trojan horse, trap door, stack and buffer over flow; system threats- intruders; communication threats- tapping and piracy.

UNIT III Cryptography: Substitution, transposition ciphers, symmetric-key algorithms-Data Encryption Standard, advanced encryption standards, public key encryption - RSA;

Diffie Hellman key exchange, ECC cryptography, Message Authentication- MAC, hash functions.

UNIT IV Digital signatures: Symmetric key signatures, public key signatures, message digests, public key infrastructures.

UNIT V Security Mechanisms: Intrusion detection, auditing and logging, tripwire, system-call monitoring.

Recommended Books and References:

1. W. Stallings, *Cryptography and Network Security Principles and Practices*, 4th Ed., Prentice Hall of India, 2006.
2. C. Pfleeger and S.L. Pfleeger, *Security in Computing*, 3rd Ed., Prentice-Hall of India, 2007.
3. D. Gollmann, *Computer Security*, John Wiley and Sons, NY, 2002.
4. J. Piwprzyk, T. Hardjono and J. Seberry, *Fundamentals of Computer Security*, SpringerVerlag Berlin, 2003.
5. J.M. Kizza, *Computer Network Security, Springer*, 2007. 6. M. Merkow and J. Breithaupt, Information Security: Principles and Practices, Pearson Education, 2006.

GENERIC ELECTIVE 4 (MAG 4.11(a))
DIFFERENTIAL EQUATIONS

Theory Credit: 5
Tutorial Credit: 1

UNIT I Differential equations. Equations reducible to homogeneous forms. Bernoulli's equation. Linear equation of 2nd order with constant coefficients. Higher order homogeneous equations.

UNIT II Exact differential equations. Equations of the first order but of higher degree. Singular solutions.

UNIT III Linear equations of second order. Ordinary simultaneous equations. Total Differential Equations, Integration in Series.

UNIT IV **Higher Trigonometry**
Polar form of a complex number. DeMoivre's Theorem. Solutions of equations. Expansion of $\sin n\theta$, $\cos n\theta$ and $\tan n\theta$ in terms of powers of $\sin\theta$, $\cos\theta$ and $\tan\theta$. Expansion of $\sin^n\theta$ and $\cos^n\theta$ in terms of multiple angle of θ of sine and cosine. Series for $\sin\theta$ and $\cos\theta$ in powers of θ.

UNIT V Exponential series for complex quantities, Circular functions for complex angles. Hyperbolic functions. Period of circular functions and Hyperbolic functions. Inverse circular functions and Hyperbolic functions. Logarithm of a complex quantity. Gregory Series. Summation of series.

Recommended Books and References:

1. A text book of Differential Equation by N.M.Kapoor
2. Differential Equation by Dr. S. Balachandra Rao &H.R.Anuradha
3. Higher Trigonometry by S.L. Loney

GENERIC ELECTIVE 4 (MAG 4.11(b))
APPLICATIONS OF ALGEBRA

UNIT I Balanced incomplete block designs (BIBD): definitions and results, incidence matrix of a BIBD, construction of BIBD from difference sets, construction of BIBD using quadratic residues, difference set families, construction of BIBD from finite fields.

UNIT II Coding Theory: introduction to error correcting codes, linear cods, generator and parity check matrices, minimum distance, Hamming Codes, decoding and cyclic codes.

UNIT III Symmetry groups and color patterns: review of permutation groups, groups of symmetry and action of a group on a set; colouring and colouring patterns, Polya theorem and pattern inventory, generating functions for non-isomorphic graphs.

UNIT IV Special types of matrices: idempotent, nilpotent, involution, and projection tri diagonal matrices, circulant matrices, Vandermonde matrices, Hadamard matrices, permutation and doubly stochastic matrices, Frobenius- König theorem, Birkhoff theorem. Positive Semi-definite matrices: positive semi-definite matrices, square root of apositive semi-definite matrix, a pair of positive semi-definite matrices, and their simultaneous diagonalization. Symmetric matrices and quadratic forms: diagonalization of symmetric matrices, quadratic forms, constrained optimization, singular value decomposition, and applications to image processing and statistics.

UNIT V Applications of linear transformations: Fibonacci numbers, incidence models, and differential equations. Least squares methods: Approximate solutions of system of linear equations, approximate inverse of an m×n matrix, solving a matrix equation using its normal equation, finding functions that approximate data. Linear algorithms: LDU factorization, the row reduction algorithm and its inverse, backward and forward substitution, approximate inverse and projection algorithms.

Recommended Books and References:

1. I. N. Herstein and D. J. Winter, *Primer on Linear Algebra, Macmillan Publishing Company*, New York, 1990.
2. S. R. Nagpaul and S. K. Jain, *Topics in Applied Abstract Algebra, Thomson Brooks and Cole*, Belmont, 2005.
3. Richard E. Klima, Neil Sigmon, Ernest Stitzinger, *Applications of Abstract Algebra with Maple*, CRC Press LLC, Boca Raton, 2000.
4. David C. Lay, *Linear Algebra and its Applications. 3rd Ed.*, Pearson Education Asia, Indian Reprint, 2007.
5. Fuzhen Zhang, *Matrix theory*, Springer-Verlag New York, Inc., New York, 1999.

GENERIC ELECTIVE 4 (MAG 4.11(c))
COMBINATORIAL MATHEMATICS

UNIT I Basic counting principles, Permutations and Combinations (with and without repetitions), Binomial theorem, Multinomial theorem, Counting subsets, Set-partitions, Stirling numbers

UNIT II Principle of Inclusion and Exclusion, Derangements, Inversion formulae Generating functions: Algebra of formal power series,

UNIT III Generating function models, Calculating generating functions, Exponential generating functions.
Recurrence relations: Recurrence relation models, Divide and conquer relations, Solution of recurrence relations, Solutions by generating functions.

UNIT IV Integer partitions, Systems of distinct representatives.
Polya theory of counting: Necklace problem and Burnside's lemma, Cyclic index of a permutation group, Polya's theorems and their immediate applications.

UNIT V Latin squares, Hadamard matrices, Combinatorial designs: t designs, BIBDs, Symmetric designs.

Recommended Books and References:

1. J.H. van Lint and R.M. Wilson, A Course in Combinatorics, 2nd Ed., Cambridge University Press, 2001.
2. V. Krishnamurthy, Combinatorics, Theory and Application, Affiliated East-West Press 1985.
3. P.J. Cameron, Combinatorics, Topics, Techniques, Algorithms, Cambridge University Press, 1995.
4. M. Jr. Hall, Combinatorial Theory, 2nd Ed., John Wiley & Sons, 1986.
5. S.S. Sane, Combinatorial Techniques, Hindustan Book Agency, 2013.
6. R.A. Brualdi, Introductory Combinatorics, 5th Ed., Pearson Education Inc., 2009.

GENERIC ELECTIVE
NCC ARMY WING

SEMESTER	COURSE	COURSE NAME	COURSE CODE	CREDIT
I	Generic Elective 1	NCC (Theory)	NCG 1.11	4
		NCC (Practical)	NCG 1.12	2
II	Generic Elective 2	NCC (Theory)	NCG 2.11	4
		NCC (Practical)	NCG 2.12	2
III	Generic Elective 3	NCC (Theory)	NCG 3.11(a)	4
		NCC (Practical)	NCG 3.12(a)	2
IV	Generic Elective 4	NCC (Theory)	NCG 4.11(a)	4
		NCC (Practical)	NCG 4.12(a)	2

GENERIC ELECTIVE 1 (NCG 1.11)
NCC (THEORY)

Theory Credit: 4 *Teaching Hours: 60*

UNIT I NCC ORGANIZATION

Aims and objectives of NCC-Cardinal points of NCC-Organization of defence forces in general; Organizational structure of Indian Army, Organizational structure of NCC, NCC Song, Incentives of NCC, Ranks in Army, Air Force and Navy; Certificate Examination in NCC; Honours and Awards.

UNIT II FOOT DRILLS BASICS

Aims and objectives of leaning the drill commands and its importance, General word of commands, attention, stand at ease, turning left, right and inkling at halt; Sizing, forming three ranks and numbering, open and close march order, dressing the squad; Saluting at halt, getting on Parade, dismissing and falling out.

UNIT III FIRST AID

Aims of First Aid-Principles of First Aid, Motto of First Aid, List of items in First Aid Box, Types of Bandages, Types of Fracture, Dislocation, Types of Wounds, Burns and Scalds, Sprain, Asphyxia, Drowning, Poison, Shock, Snake bite, Sun and Heat Stroke, Insect bite, Dog bite, Hanging, Artificial respiration, Haemorrhage, Carriage of sick and wounded.

UNIT IV ADVENTURE & OBSTACLE TRAINING

a) Adventure training tips, Para sailing and its principles; Slithering, Rock climbing, cycling and trekking and their impacts on physical health.
b) Obstacle training: aim, types and importance.

UNIT V PERSONALITY DEVELOPMENT

Introduction to personality development, Factors influencing/shaping personality, Self-Awareness, Empathy, Critical and creative thinking, Communication Skills, Decision making and problem solving, Coping with stress and emotional stress, Importance of changing mindset, Time management, Sociability: Social Skills, Etiquettes and manners, Importance of Group/Teamwork, Interview Skills.

GENERIC ELECTIVE 1 (NCG 1.12)
NCC (PRACTICAL)

Practical Credit: 2 *Teaching Hours: 30*

UNIT I BASIC FOOT DRILLS

General word of commands, Attention, stand at ease, turning left, right and inkling at halt. Sizing, forming three ranks and numbering; Open and close March, dressing the squad; Saluting at halt, getting on Parade, Dismissing and falling out.

UNIT II FIRST AID, HEALTH & HYGINE

a) Identification of First Aid items/instruments/equipments.
b) Types of bandages, Basics of home nursing and first aid in common medical emergencies.

Recommended Books and References:

1. Cadets training handbook common subjects (2017), D.G NCC Delhi-110030
2. Pamphlets issued by the ministry of Defence
3. DG, NCC Training directive
4. Femida Handy, Kassam Meenaz, Ingold Sharjah Jillian, Ranade, Bhagyashree (2011). From Seva to Cyberspace: The Many Faces of Volunteering in India. Sage.
5. United National Volunteers, India (2012). Volunteering in India: Contexts, Perspectives and Discourses (under publication)
6. Cadet training hand book specialised subjects (2017)

GENERIC ELECTIVE 2 (NCG 2.11)
NCC (THEORY)

Theory Credit: 4 *Teaching Hours: 60*

UNIT I INDIAN MILITARY ORGANIZATION

a) History of Indian Military, Ministry of Defence, Paramilitary forces-BSF, CRPF and CISF; Mode of entry to Defence Service.
b) Development of Aviation, History of IAF, Organization of Air Force, Branches of the IAF, Modes of entry in the IAF, Career in IAF as an Officer/Airmen; Aircraft Recognition-Fighters, Transports, Helicopters, Foreign Aircraft; Aircraft Particulars-Micro light of Squadron.

UNIT II HEALTH & HYGINE

Structure and functioning of Human body, Hygiene and Sanitation, Physical and mental health, Infections and contagious diseases and its preventions, basics of home nursing and first aid in common medical emergencies, introduction to yoga and exercises.

UNIT III FOOT DRILL II

Marching, length of pace and time in marching in quick time and halt, slow march and halt, side pace, pace forward and to the rear; Turning on the march and wheeling, saluting on the march, Marching timing, forward march and halt in quick march; changing step, formation of squad and squad drill.

UNIT IV LEADERSHIP

Leadership traits, Indicators of good leadership, Leadership and motivation, Moral values & character traits, Honour code concept, Case studies: leadership in NCC, Vivekananda, Kiran Bedi & M S Dhoni.

UNIT V SOCIAL AWARENESS & COMMUNITY DEVELOPMENT

Basics of social service and its needs, Rural development programmes, role of NGO's, Civic responsibilities, Social evils-drug abuse & drug trafficking, HIV/AIDS, counter terrorism, corruption, RTI & RTE and protection of child & POCSO Act 2012.

GENERIC ELECTIVE 2 (NCG 2.12)
NCC (PRACTICAL)

Practical Credit: 2 *Teaching Hours: 30*

UNIT I FOOT DRILL II

Marching, length of pace and time in marching in quick time and halt, slow march and halt, side pace, pace forward and to the rear; Turning on the march and wheeling, saluting on the march, Marching timing, forward march and halt in quick march; changing step, formation of squad and squad drill.

UNIT II TENT PITCHING & TREKKING

Recommended Books and References:

1. Cadets training handbook common subjects (2017), D.G NCC Delhi-110030
2. Pamphlets issued by the ministry of Defence
3. DG, NCC Training directive
4. United National Volunteers, India (2012). Volunteering in India: Contexts, Perspectives and Discourses (under publication)
5. Femida Handy, Kassam Meenaz, Ingold Sharjah Jillian, Ranade, Bhagyashree (2011). From Seva to Cyberspace: The Many Faces of Volunteering in India. Sage Publications.
6. Cadet training hand book specialised subjects (2017)
7. United Nations Volunteers (2011). Inspiring Youth. UNV Annual Report 2010
8. United Nations Volunteers (2011). The State of World Volunteerism Report. Available on the UNV website *http://www.unv.org/en/swvr2011.html*

GENERIC ELECTIVE 3 (NCG 3.11(a))
NCC (THEORY)

Theory Credit: 4 *Teaching Hours: 60*

UNIT I DRILL WITH ARMS

Attention and stand at ease and stand easy; Getting on parade with rifle, dressing with rifle and dressing at the order; Dismissing and falling out; Ground/take up arms; Present from the order and vice-versa; General salute, salame sasth, squad drill, short and long trail from the order and vice versa, Examining arms.

UNIT II BASICS OF WEAPON TRAINING

The stripping, assembling, loading, unloading of Rifle, Light Machine Gun and Stern Machine Carbine; Characteristics of weapons (Rifles, LMG, &Stern), Safety procedures; Loading, cocking and unloading of weapons; Positions in shooting and its advantages, Trigger control and firing a shot; Theory of group and snap shooting, short range firing and aiming.

UNIT III NATIONAL INTEGRATION I

Heritage of India, Freedom struggle & Nationalist movements in India, Introduction to Indian Constitution

UNIT IV NATIONAL INTEGRATION II

National Integration importance & necessity, factors affecting National Integration, Unity in Diversity, Slogans and images of National integration, Role of NCC in Nation building, NCC & National integration.

UNIT V ENVIRONMENTAL AWARENES

Ecology and Environment-Biodiversity-Pollution-Environment conservation-Personal Hygiene, Sanitation, Waste Management, Water conservation, Rain water conservation and harvesting, Pollution control and types of pollution; Communicable and Non-communicable diseases; Methods of Purification of drinking water; Latrine types, Urinal types; Wild life conservation projects in India.

GENERIC ELECTIVE 3 (NCG 3.12(a))
NCC (PRACTICAL)

Practical Credit: 2 *Teaching Hours: 30*

UNIT I ADVANCE DRILL

Guard mounting, Guard of Honour, Platoon/Coy drill, Instructional Practice.

UNIT II DRILL WITH ARMS

Attention and stand at ease and stand easy; Getting on parade with rifle, dressing with rifle and dressing at the order; Dismissing and falling out; Ground/take up arms; Present from the order and vice-versa; General salute, salame sasth, squad drill, short and long trail from the order and vice versa, Examining arms.

Recommended Books and References:

1. Cadets training handbook common subjects (2017), D.G NCC Delhi-110030
2. Cadets training handbook Specialised subjects (2017), D.G NCC Delhi-110030
3. Pamphlets issued by the ministry of Defence
4. DG, NCC Training directive
5. United National Volunteers, India (2012). Volunteering in India: Contexts, Perspectives and Discourses (under publication)
6. Femida Handy, Kassam Meenaz, Ingold Sharjah Jillian, Ranade, Bhagyashree (2011). From Seva to Cyberspace: The Many Faces of Volunteering in India. Sage Publications.
7. Cadet training hand book specialised subjects (2017)

GENERIC ELECTIVE 4 (NCG 4.11(a))
NCC (THEORY)

Theory Credit: 4 *Teaching Hours: 60*

UNIT I MAP READING TECHNIQUES

Introduction to map and conventional signs; Grid system; Cardinal points, finding north, types of bearing and use of service protractor; Relief, Contour Gradients, Setting a map, Finding own position, Map to ground and ground to map, Prismatic compass, Night march.

UNIT II ELEMENTS OF FIELDS TRAINING

Judging distance, observation, Indication and Recognition of targets, Section Post; Organization and weapons in rifle section; Fire order, section battle drill, obstacles scout and patrols, Field signals, Ambush; Field craft-Types of ground-Camouflage and its types-Concealment; Types of movements; Types of covers, Fire discipline; Types of fire control orders; Section and platoon formation; Section battle drill; Patrol-Ambush and its types.

UNIT III COMMUNICATION

Types of communication, characteristics of wireless technology, Walkie/Talkie, Basic RT procedure, Latest trends and development (Multi-media, video conferencing, IT)

UNIT IV CIVIL DEFENCE & DISASTER MANAGEMENT

Disaster management organisation- NDMA and NDRF, types of disasters, essential services and maintenance, traffic control during disaster under police Supervision, Assistance during Natural Disasters, Do's and don'ts for NCC cadets performing Disaster management duties, Fire services and fire fighting, Civil Defence organisation and their Duties; Air raid system of warning and home guard duties, rescue parties and their organization.

UNIT V HUMAN RIGHTS EDUCATION

Meaning of Human Rights, Importance of Human Rights: Social, Economic and Political, Universal Declaration of Human Rights, Importance of Internalizing Human Rights values-Urgent need for not only sensitizing others of Human Rights and duties but of practising oneself those values: Self inculcation, endeavour to live up to those ideals; Duty to respect others' rights, respect each other's human dignity, Human Rights and Duties in India: Fundamental Rights, Directive Principles of State Policy and Fundamental Duties.

GENERIC ELECTIVE 4 (NCG 4.12(a))
NCC (PRACTICAL)

Practical Credit: 2 *Teaching Hours: 30*

UNIT I MAP READING, FIELD CRAFT & BATTLE CRAFT.

UNIT II PROJECT REPORT

Report writing on NCC activities and its impact on cadets.

Recommended Books and References:

1. Cadets training handbook common subjects (2017), D.G NCC Delhi-110030
2. Cadets training handbook Special subjects (2017), D.G NCC Delhi-110030
3. Pamphlets issued by the ministry of Defence
4. DG, NCC Training directive
5. Jayapalan, N., Human Rights (New Delhi: Atlantic Publishers, 2000)
6. Mohanti, M., Human Rights Education (New Delhi: Deep and Deep, 2000) 5. NHRC, Know Your Rights Series (2005) 6. NHRC, Human Rights Education for Beginners (2005)
7. Cadet training hand book specialised subjects (2017)

GENERIC ELECTIVE
NCC AIR WING

SEMESTER	COURSE	COURSE NAME	COURSE CODE	CREDIT
I	Generic Elective 1	NCC (Theory)	NCG 1.11	4
		NCC (Practical)	NCG 1.12	2
II	Generic Elective 2	NCC (Theory)	NCG 2.11	4
		NCC (Practical)	NCG 2.12	2
III	Generic Elective 3	NCC (Theory)	NCG 3.11(b)	4
		NCC (Practical)	NCG 3.12(b)	2
IV	Generic Elective 4	NCC (Theory)	NCG 4.11(b)	4
		NCC (Practical)	NCG 4.12(b)	2

GENERIC ELECTIVE 1 (NCG1.11)
NCC (THEORY)

Theory Credit: 4 *Teaching Hours: 60*

UNIT I NCC ORGANIZATION

Aims and objectives of NCC-Cardinal points of NCC-Organization of defence forces in general; Organizational structure of Indian Army, Organizational structure of NCC, NCC Song, Incentives of NCC, Ranks in Army, Air Force and Navy; Certificate Examination in NCC; Honours and Awards.

UNIT II FOOT DRILLS BASICS

Aims and objectives of leaning the drill commands and its importance, General word of commands, attention, stand at ease, turning left, right and inkling at halt; Sizing, forming three ranks and numbering, open and close march order, dressing the squad; Saluting at halt, getting on Parade, dismissing and falling out.

UNIT III FIRST AID

Aims of First Aid-Principles of First Aid, Motto of First Aid, List of items in First Aid Box, Types of Bandages, Types of Fracture, Dislocation, Types of Wounds, Burns and Scalds, Sprain, Asphyxia, Drowning, Poison, Shock, Snake bite, Sun and Heat Stroke, Insect bite, Dog bite, Hanging, Artificial respiration, Haemorrhage, Carriage of sick and wounded.

UNIT IV ADVENTURE & OBSTACLE TRAINING

c) Adventure training tips, Para sailing and its principles; Slithering, Rock climbing, cycling and trekking and their impacts on physical health.
d) Obstacle training: aim, types and importance.

UNIT V PERSONALITY DEVELOPMENT

Introduction to personality development, Factors influencing/shaping personality, Self-Awareness, Empathy, Critical and creative thinking, Communication Skills, Decision making and problem solving, Coping with stress and emotional stress, Importance of changing mindset, Time management, Sociability: Social Skills, Etiquettes and manners, Importance of Group/Teamwork, Interview Skills.

GENERIC ELECTIVE 1 (NCG1.12)
NCC (PRACTICAL)

Practical Credit: 2 *Teaching Hours: 30*

UNIT I BASIC FOOT DRILLS

General word of commands, Attention, stand at ease, turning left, right and inkling at halt. Sizing, forming three ranks and numbering; Open and close March, dressing the squad; Saluting at halt, getting on Parade, Dismissing and falling out.

UNIT II FIRST AID, HEALTH & HYGINE

c) Identification of First Aid items/instruments/equipments.

d) Types of bandages, Basics of home nursing and first aid in common medical emergencies.

Recommended Books and References:

7. Cadets training handbook common subjects (2017), D.G NCC Delhi-110030
8. Pamphlets issued by the ministry of Defence
9. DG, NCC Training directive
10. Femida Handy, Kassam Meenaz , Ingold Sharjah Jillian , Ranade , Bhagyashree(2011). From Seva to Cyberspace: The Many Faces of Volunteering in India. Sage.
11. United National Volunteers, India (2012). Volunteering in India: Contexts, Perspectives and Discourses (under publication)

GENERIC ELECTIVE 2 (NCG 2.11)
NCC (THEORY)

Theory Credit: 4 *Teaching Hours: 60*

UNIT I INDIAN MILITARY ORGANIZATION

c) History of Indian Military, Ministry of Defence, Paramilitary forces-BSF, CRPF and CISF; Mode of entry to Defence Service.
d) Development of Aviation, History of IAF, Organization of Air Force, Branches of the IAF, Modes of entry in the IAF, Career in IAF as an Officer/Airmen; Aircraft Recognition-Fighters, Transports, Helicopters, Foreign Aircraft; Aircraft Particulars-Micro light of Squadron.

UNIT II HEALTH & HYGINE

Structure and functioning of Human body, Hygiene and Sanitation, Physical and mental health, Infections and contagious diseases and its preventions, basics of home nursing and first aid in common medical emergencies, introduction to yoga and exercises.

UNIT III FOOT DRILL II

Marching, length of pace and time in marching in quick time and halt, slow march and halt, side pace, pace forward and to the rear; Turning on the march and wheeling, saluting on the march, Marching timing, forward march and halt in quick march; changing step, formation of squad and squad drill.

UNIT IV LEADERSHIP

Leadership traits, Indicators of good leadership, Leadership and motivation, Moral values & character traits, Honour code concept, Case studies: leadership in NCC, Vivekananda, Kiran Bedi & M S Dhoni.

UNIT V SOCIAL AWARENESS & COMMUNITY DEVELOPMENT

Basics of social service and its needs, Rural development programmes, role of NGO's, Civic responsibilities, Social evils-drug abuse & drug trafficking, HIV/AIDS, counter terrorism, corruption, RTI & RTE and protection of child & POCSO Act 2012.

GENERIC ELECTIVE 2 (NCG 2.12)
NCC (PRACTICAL)

Practical Credit: 2 *Teaching Hours: 30*

UNIT I FOOT DRILL II

Marching, length of pace and time in marching in quick time and halt, slow march and halt, side pace, pace forward and to the rear; Turning on the march and wheeling, saluting on the march, Marching timing, forward march and halt in quick march; changing step, formation of squad and squad drill.

UNIT II TENT PITCHING & TREKKING

Recommended Books and References:

1. Cadets training handbook common subjects (2017), D.G NCC Delhi-110030
2. Pamphlets issued by the ministry of Defence
3. DG, NCC Training directive
4. United Nations Volunteers (2011). Inspiring Youth. UNV Annual Report 2010
5. United Nations Volunteers (2011). The State of World Volunteerism Report. Available on the UNV website *http://www.unv.org/en/swvr2011.html*

GENERIC ELECTIVE 3 (NCG 3.11(b))
NCC (THEORY)

Theory Credit: 4 *Teaching Hours: 60*

UNIT I PRINCIPLES OF FLIGHT AND MODERN TRENDS

Introduction, Laws of Motion, Glossary of Terms, Bernoulli's Theorem and Venturi Effect, Aerofoil, Forces on an Aircraft, Lift & Drag, Flaps & Slats, Stalling, Thrust, modern Trends in aviation, basic knowledge of modern equipment used in aviation.

UNIT II AIRCRAFT RECOGNITION AND AIRMANSHIP

Aircraft recognition: Fighters, Transport, Helicopters& Foreign Aircraft. Concept of Airmanship, Airfield layout, Rules of Air, Circuit procedure, ATC/RT Procedures, Basics of aviation medicine and survival techniques.

UNIT III NAVIGATION AND AIR CAMPAINGS

Requirement of Navigation, Glossary of Terms, Maps, Map Reading.
Indo-Pak war 1971, Op Safed Sagar, Famous Air Heroes, Motivational Movies

UNIT IV NATIONAL INTEGRATION

Heritage of India, Freedom struggle & Nationalist movements in India, Introduction to Indian Constitution, National Integration importance & necessity, factors affecting National Integration, Unity in Diversity, Slogans and images of National integration, Role of NCC in Nation building, NCC & National integration.

UNIT V ENVIRONMENTAL AWARENES

Ecology and Environment, Biodiversity, Pollution, Environment conservation, Personal Hygiene, Sanitation, Waste Management, Water conservation, Rain water conservation and harvesting, Pollution control and types of pollution; Communicable and Non-

communicable diseases; Methods of Purification of drinking water; Latrine types, Urinal types; Wild life conservation projects in India.

GENERIC ELECTIVE 3 (NCG 3.12(b))
NCC (PRACTICAL)

Practical Credit: 2 *Teaching Hours: 30*

UNIT I ADVANCE DRILL

Guard mounting, Guard of Honour, Platoon/Coy drill, Instructional Practice.

UNIT II Standard Operating Procedure (SOP)

Recommended Books and References:

1. Cadets training handbook common subjects (2017), D.G NCC Delhi-110030
2. Pamphlets issued by the ministry of Defence
3. DG, NCC Training directive
4. United National Volunteers, India (2012). Volunteering in India: Contexts, Perspectives and Discourses (under publication)
5. Femida Handy, Kassam Meenaz , Ingold Sharjah Jillian , Ranade , Bhagyashree(2011). From Seva to Cyberspace: The Many Faces of Volunteering in India. Sage Publications.
6. Air wing Cadets training hand book specialised subject (SD/SW) (2015)

GENERIC ELECTIVE 4 (NCG 4.11(b))
NCC (THEORY)

Theory Credit: 4 *Teaching Hours: 60*

UNIT I METEOROLOGY (MET) and AERO-ENGINES (AE)

Importance of MET in aviation, Atmosphere, Clouds and Precipitation, Visibility, Humidity and Condensation; Introduction to Aero engines, Types of Engines, Piston Engines, Jet Engines, Turboprop Engines, Consolidation.

UNIT II AIRFRAMES AND INSTRUMENTS

Aircraft controls, fuselage, main and tail plane, Ailerons, Elevators and Rudder, Landing gear, Basic Flight Instruments, Introduction to Radar, Instrument Battery Test (Introduction to PABT)

UNIT III AERO MODELLING

History of Aero modelling, Material used in Aero modelling, Types of Aero Models, Flying/Building of Aero-Models.

UNIT IV CIVIL DEFENCE & DISASTER MANAGEMENT

Disaster management organisation- NDMA and NDRF, types of disasters, essential services and maintenance, traffic control during disaster under police Supervision, Assistance during Natural Disasters, Do's and don'ts for NCC cadets performing Disaster management duties, Fire services and fire fighting, Civil Defence organisation and their Duties; Air raid system of warning and home guard duties, rescue parties and their organization.

UNIT V HUMAN RIGHTS EDUCATION

Meaning of Human Rights, Importance of Human Rights: Social, Economic and Political, Universal Declaration of Human Rights, Importance of Internalizing Human Rights values-Urgent need for not only sensitizing others of Human Rights and duties

but of practising oneself those values: Self inculcation, endeavour to live up to those ideals; Duty to respect others' rights, respect each other's human dignity, Human Rights and Duties in India: Fundamental Rights, Directive Principles of State Policy and Fundamental Duties.

GENERIC ELECTIVE 4 (NCG 4.11(b))
NCC (THEORY)

Practical Credit: 2 *Teaching Hours: 30*

UNIT I Building Aero-Models.

UNIT II PROJECT REPORT
Report writing on NCC activities and its impact on cadets.

Recommended Books and References:

8. Cadets training handbook common subjects (2017), D.G NCC Delhi-110030
9. Pamphlets issued by the ministry of Defence
10. DG, NCC Training directive
11. Jayapalan, N., Human Rights (New Delhi: Atlantic Publishers, 2000)
12. Mohanti, M., Human Rights Education (New Delhi: Deep and Deep, 2000) 5. NHRC, Know Your Rights Series (2005) 6. NHRC, Human Rights Education for Beginners (2005)
13. Air wing Cadets training hand book specialised subject (SD/SW) (2015)

Generic Elective
PHYSICS

SEMESTER	COURSE	COURSE NAME	COURSE CODE	CREDIT
I	Generic Elective 1	Mechanics (Theory)	PHG 1.11	4
		Mechanics (Practical)	PHG 1.12	2
II	Generic Elective 2	Electricity and Magnetism (Theory)	PHG 2.11	4
		Electricity and Magnetism (Practical)	PHG 2.12	2
II	Generic Elective 3	Elements of Modern Physics (Theory)	PHG 3.11	4
		Elements of Modern Physics (Practical)	PHG 3.12	2
IV	Generic Elective 4	Waves and Optics (Theory)	PHG 4.11	4
		Waves and Optics (Practical)	PHG 4.12	2

GENERIC ELECTIVE 1 (PHG 1.11)
MECHANICS

Theory Credit:4 *Teaching Hours: 60*

UNIT I **Vectors:** Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter.
Laws of Motion: Frames of reference. Newton's Laws of motion. Dynamics of asystem of particles. Centre of Mass.

UNIT II **Ordinary Differential Equations:** 1storder homogeneous differential equations. 2ndorder homogeneous differential equations with constant coefficients.
Oscillations: Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations.

UNIT III **Momentum and Energy:** Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets.
Rotational Motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum.

UNIT IV **Gravitation:** Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity isconstant). Kepler's Laws (statement only). Satellite in circular orbit and applications. Geosynchronous orbits. Basic idea of global positioning system (GPS).Weightlessness. Physiological effects on astronauts.
Special Theory of Relativity: Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.

UNIT V **Elasticity:** Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants - Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants - Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion – Torsional pendulum-Determination of Rigidity modulus and moment of inertia - q, η and σ by Searles method.

Note: *Students are not familiar with vector calculus. Hence all examples involve differentiation either in one dimension or with respect to the radial coordinate.*

Recommended Books and References:

1. University Physics. F.W. Sears, M.W. Zemansky and H.D. Young, 13/e, 1986. Addison-Wesley
2. Mechanics Berkeley Physics, v.1: Charles Kittel, et. al. 2007, Tata McGraw-Hill.
3. Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley
4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

GENERIC ELECTIVE 1 (PHG 1.12)
MECHANICS

Practical Credit: 2 *Teaching Hours: 60*

1. Measurements of length (or diameter) using verniercaliper, screw gauge and travelling microscope.
2. To determine the Height of a Building using a Sextant.
3. To determine the Moment of Inertia of a Flywheel.
4. To determine the Young's Modulus of a Wire by Optical Lever Method.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
6. To determine the Elastic Constants of a Wire by Searle's method.
7. To determine g by Bar Pendulum.
8. To determine g by Kater's Pendulum.
9. To study the Motion of a Spring and calculate (a) Spring Constant, (b) g.

Recommended Books and References:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

GENERIC ELECTIVE 2 (PHG 2.11)
ELECTRICITY AND MAGNETISM

Theory Credit: 4 *Teaching Hours: 60*

UNIT I **Vector Analysis**: Scalar and Vector product, gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only).

UNIT II **Electrostatics:** Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential.

UNIT III Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.

UNIT IV **Magnetism:** Magnetostatics: Biot-Savart's law and its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law.
Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para-and ferro-magnetic materials.

UNIT V **Electromagnetic Induction:** Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field.

Maxwell's equations and Electromagnetic wave propagation: Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

Recommended Books and References:

1. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education
2. Electricity & Magnetism, J.H. Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press.
3. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
5. D.J. Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cummings.

GENERIC ELECTIVE 2 (PHG 2.12)
ELECTRICITY AND MAGNETISM

Practical Credit: 2 *60 Lectures*

1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses.
2. Ballistic Galvanometer:
   (i) Measurement of charge and current sensitivity
   (ii) Measurement of CDR
   (iii) Determine a high resistance by Leakage Method
   (iv) To determine Self Inductance of a Coil by Rayleigh's Method.
3. To compare capacitances using De'Sauty's bridge.
4. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx)
5. To study the Characteristics of a Series RC Circuit.
6. To study a series LCR circuit LCR circuit and determine its (a) Resonant frequency, (b) Quality factor
7. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b)Quality factor Q
8. To determine a Low Resistance by Carey Foster's Bridge.
9. To verify the Thevenin and Norton theorems
10. To verify the Superposition, and Maximum Power Transfer Theorems

Recommended Books and References:

1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I. Prakash& Ramakrishna, 11th Ed.2011, Kitab Mahal

GENERIC ELECTIVE 3 (PHG 3.11)
ELEMENTS OF MODERN PHYSICS

Theory Credit: 4 *Teaching Hours: 60*

UNIT I Planck's quantum, Planck's constant and light as a collection of photons; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment.
Problems with Rutherford model- instability of atoms and observation of discrete atomic spectra; Bohr's quantization rule and atomic stability; calculation of energy levels for hydrogen like atoms and their spectra. Two slit interference experiment with photons, atoms & particles; linear superposition principle as a consequence;

UNIT II Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of wavefunction, probabilities and normalization; Probability and probability current densities in one dimension.

UNIT III One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as an example; Quantum mechanical scattering and tunnelling in one dimension - across a step potential and across a rectangular potential barrier.

UNIT IV Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle- impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle.
Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in nucleus as a consequence of the uncertainty principle.

UNIT V Nature of nuclear force, NZ graph, semi-empirical mass formula and binding energy.
Radioactivity: stability of nucleus; Law of radioactive decay; Mean life and half-life; α decay; β decay - energy released, spectrum and Pauli's prediction of neutrino; γ-ray emission.

Recommended Books and References:

1. Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill
2. Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson,2009, PHI Learning
3. Six Ideas that Shaped Physics: Particle Behave like Waves, Thomas A. Moore, 2003, McGraw Hill
4. Quantum Physics, Berkeley Physics, Vol.4. E.H. Wichman, 2008, Tata McGraw-Hill Co.
5. Modern Physics, R.A. Serway, C.J. Moses, and C.A.Moyer, 2005, Cengage Learning

GENERIC ELECTIVE 3 (PHG 3.12)
ELEMENTS OF MODERN PHYSICS

Practical Credit: 2 *Teaching Hours: 60*

1. To determine value of Boltzmann constant using V-I characteristic of PN diode.
2. To determine work function of material of filament of directly heated vacuum diode.

3. To determine the ionization potential of mercury.
4. To determine value of Planck's constant using LEDs of at least 4 different colours.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the absorption lines in the rotational spectrum of Iodine vapour.
7. To study the diffraction patterns of single and double slits using laser and measure its intensity variation using Photosensor& compare with incoherent source – Na.
8. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
9. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
10. To setup the Millikan oil drop apparatus and determine the charge of an electron.

Recommended Books and References:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

GENERIC ELECTIVE 4 (PHG 4.11)
WAVES AND OPTICS

Theory Credit:4 *Teaching Hours: 60*

UNIT I **Superposition of Two Collinear Harmonic oscillations**: Linearity & Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats).
Superposition of Two Perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures (1:1 and 1:2) and their uses.
Waves Motion- General: Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity.

UNIT II **Fluids:** Surface Tension: Synclastic and anticlastic surface - Excess of pressure - Application to spherical and cylindrical drops and bubbles - variation of surface tension with temperature - Jaegar's method. Viscosity - Rate flow of liquid in a capillary tube - Poiseuille's formula - Determination of coefficient of viscosity of a liquid - Variations of viscosity of liquid with temperature- lubrication.
Sound: Simple harmonic motion - forced vibrations and resonance - Fourier's Theorem - Application to saw tooth wave and square wave - Intensity and loudness of sound - Decibels - Intensity levels - musical notes - musical scale. Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient - Sabine's formula - measurement of reverberation time - Acoustic aspects of halls and auditoria.

UNIT III **Wave Optics:** Electromagnetic nature of light. Definition and Properties of wavefront. Huygens Principle.
Interference: Interference: Division of amplitude and division of wavefront. Young's Double Slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: measurement of wavelength and refractive index.

UNIT IV **Michelson's Interferometer:** (1) Idea of form of fringes (no theory needed), (2)Determination of wavelength, (3) Wavelength difference, (4) Refractive index, and(5) Visibility of fringes.

Polarization: Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization.

UNIT V **Diffraction:** Fraunhofer diffraction- Single slit; Double Slit. Multiple slits and Diffraction grating. Fresnel Diffraction: Half-period zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis.

Recommended Books and References:

1. Fundamentals of Optics, F.A Jenkins and H.E White, 1976, McGraw-Hill
2. Principles of Optics, B.K. Mathur, 1995, Gopal Printing
3. Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publications
4. University Physics. F.W. Sears, M.W. Zemansky and H.D. Young. 13/e, 1986. Addison-Wesley

GENERIC ELECTIVE 4 (PHG 4.12)
WAVES AND OPTICS

Practical Credit: 2 *Teaching Hours: 60*

1. To investigate the motion of coupled oscillators.
2. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experimentand to verify λ^2 – T Law.
3. To study Lissajous Figures.
4. Familiarization with Schuster`s focussing; determination of angle of prism.
5. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
6. To determine the Refractive Index of the Material of a Prism using Sodium Light.
7. To determine Dispersive Power of the Material of a Prism using Mercury Light
8. To determine the value of Cauchy Constants.
9. To determine the Resolving Power of a Prism.
10. To determine wavelength of sodium light using Fresnel Biprism.
11. To determine wavelength of sodium light using Newton's Rings.
12. To determine the wavelength of Laser light using Diffraction of Single Slit.
13. To determine wavelength of (1) Sodium and (2) Spectral lines of the Mercury light using plane diffraction Grating
14. To determine the Resolving Power of a Plane Diffraction Grating.
15. To measure the intensity using photosensor and laser in diffraction patterns of single and double slits.

Recommended Books and References:

1. Advanced Practical Physics for students, B.L. Flint and H.T.Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition,2011, Kitab Mahal, New Delhi.

GENERIC ELECTIVE
STATISTICS

SEMESTER	COURSE	COURSE NAME	COURSE CODE	CREDIT
I	Generic Elective 1	Statistical Methods (Theory)	STG 1.11	4
		Statistical Methods (Practical)	STG 1.12	2
II	Generic Elective 2	Introductory Probability(Theory)	STG 2.11	4
		Introductory Probability(Practical)	STG 2.12	2
II	Generic Elective 3	Basics of Statistical Inference(Theory)	STG 3.11	4
		Basics of Statistical Inference(Practical)	STG 3.12	2
IV	Generic Elective 4	Applied Statistics(Theory)	STG 4.11	4
		Applied Statistics(Practical)	STG 4.12	2

GENERIC ELECTIVE 1 (STG 1.11)
STATISTICAL METHODS

Theory Credit: 4

UNIT I Introduction: Definition and scope of Statistics, concepts of statistical population and sample. Data: quantitative and qualitative, attributes, variables, scales of measurement - nominal, ordinal, interval and ratio. Presentation: tabular and graphic, including histogram and ogives.

UNIT II Measures of Central Tendency: arithmetic mean, geometric mean, harmonic mean, median and mode with properties and merit, demerits, quartiles, deciles and percentiles.

UNIT III Measures of Dispersion: range, quartile deviation, mean deviation and standard deviation, their definitions and properties, uses and merits, demerits, absolute and relative measures of dispersions, Raw and central moments and their relations,Sheppard's correction for moments and factorial moments, Measures of skewness and kurtosis.

UNIT IV Probability: Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability – classical, statistical, and axiomatic. Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem and its applications.

UNIT V Theory of attributes, consistency of data, independence and association of attributes, measures of association and contingency.

Recommended Books and References:

1. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata.
2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
3. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.

GENERIC ELECTIVE 1 (STG 1.12)
STATISTICAL METHODS

Practical Credit: 2

PRACTICAL/ LAB WORK

List of Practical

1. Graphical representation of data
2. Problems based on measures of central tendency
3. Problems based on measures of dispersion
4. Problems based on combined mean and variance and coefficient of variation
5. Problems based on moments, skewness and kurtosis
6. Finding the class frequencies of attributes, examine the independency of attributes.
7. Checking consistency of data and finding association among attributes.

GENERIC ELECTIVE 2 (STG 2.11)
INTRODUCTORY PROBABILITY

Theory Credit: 4

UNIT I Correlation and regression: Definition, scatter diagram, product moment correlation coefficient and rank correlation coefficient. Method of least square and Curve fitting (fitting of polynomials and exponential curves). Regression analysis: line of regression, regression coefficients and their properties.

UNIT II Multiple and partial correlation (3 variables only), Properties of residual, Plane of regression.

UNIT III Random Variables: Discrete and continuous random variables, p.m.f., p.d.f. ,c.d.f. Illustrations of random variables and its properties. Expectation, variance, moments and moment generating function. Convergence in probability, almost sure convergence, Chebyshev's inequality, weak law of large numbers

UNIT IV Standard discrete probability distributions: Binomial, Poisson, hypergeometric and geometric.

UNIT V Standard continuous probability distributions: uniform, normal and exponential.

Recommended Books and References:

1. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.
2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
3. Myer, P.L. (1970): Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi

GENERIC ELECTIVE 2 (STG 2.12)
INTRODUCTORY PROBABILITY

Practical Credit: 2

PRACTICAL/LAB. WORK:

List of Practical

1. Fitting of binomial distributions for n and p = q = ½ given
2. Fitting of binomial distributions for n and p given
3. Fitting of binomial distributions computing mean and variance
4. Fitting of Poisson distributions for given value of lambda
5. Fitting of Poisson distributions after computing mean
6. Application problems based on binomial distribution
7. Application problems based on Poisson distribution
8. Problems based on area property of normal distribution
9. To find the ordinate for a given area for normal distribution
10. Application based problems using normal distribution

11. Fitting of normal distribution when parameters are given
12. Fitting of normal distribution when parameters are not given
13. Karl Pearson correlation coefficient
14. Partial and multiple correlations
15. Spearman rank correlation with and without ties.
16. Correlation coefficient for a bivariate frequency distribution
17. Lines of regression, angle between lines and estimated values of variables.

GENERIC ELECTIVE 3 (STG 3.11)
BASICS OF STATISTICAL INFERENCE

Theory Credit: 4

UNIT I Estimation Theory: parameter and statistic, estimator and estimate, properties of good estimator – consistency, unbiasedness, efficiency and sufficiency; Method of Maximum Likelihood Estimation (MLE).

UNIT II Testing of hypothesis: Hypothesis, Null and alternative hypothesis, Simple and Composite hypothesis, Type I and Type II errors, level of significance, p-value, power of a test, Tests of hypotheses for the parameters of a normal distribution (one sample and two sample problems).

UNIT III Categorical data: Tests of proportions, tests of association and goodness-of-fit using Chi-square test, Yates' correction, t-test for one and two sample mean, Tests for the significance of correlation coefficient; Non parametric tests:test of randomness, run test,Sign test, median test, Sign test for symmetry, Mann-Whitney-Wilcoxon U test.

UNIT IV Sample Survey: census and survey, basic principles of sample survey, principal steps in sample survey, sampling and non-sampling error, types of sampling-simple random sampling-with and without replacement, stratified random sampling and systematic sampling (concept only).

UNIT V Analysis of variance, one-way and two-way classification with one observation per cell, Design of experiment: treatment, plot and block, basic principles of design of experiments, completely randomized design (CRD) and randomized block design (RBD).

Recommended Books and References:

1. Daniel, Wayne W., Bio-statistics: A Foundation for Analysis in the Health Sciences. John Wiley (2005).
2. Goon, A.M., Gupta M.K. & Das Gupta, Fundamentals of statistics, Vol.-I & II (2005).
3. Dass, M. N. &Giri, N. C.: Design and analysis of experiments. John Wiley.
4. Dunn, O.J Basic Statistics: A primer for the Biomedical Sciences.(1964, 1977) by John Wiley.
5. Bancroft, Holdon Introduction to Bio-Statistics (1962) P.B. Hoebar New York.
6. Goldstein, A Biostatistics-An introductory text (1971). The Macmillion New York.

GENERIC ELECTIVE 3 (STG 3.12)
BASICS OF STATISTICAL INFERENCE

Practical Credit: 2

PRACTICAL/LAB WORK

List of Practical

1. Estimators of population mean.
2. Confidence interval for the parameters of a normal distribution (one sample and two sample problems).
3. Tests of hypotheses for the parameters of a normal distribution (one sample and two sample problems).
4. Chi-square test of proportions.
5. Chi-square tests of association.
6. Chi-square test of goodness-of-fit.
7. Z-test, t-test
8. Sign test for median.
9. Sign test for symmetry.
10. Wilcoxon two-sample test.
11. Analysis of Variance of a one way and two way classified data
12. Analysis of a CRD and RBD
13. Problems on SRS and Stratified random sampling

GENERIC ELECTIVE 4 (STG 4.11)
APPLIED STATISTICS

Theory Credit: 4

UNIT I Economic Time Series: Components of time series, Decomposition of time series-Additive and multiplicative model with their merits and demerits, Illustrations of time series, Methods of measuring trend, Measurement of seasonal variations by method of ratio to trend.

UNIT II Index numbers: Definition, Criteria for a good index number, Construction of index numbers, different types of index numbers, Time and Factor reversal test, consumer price index number, Uses and limitations of index numbers.

UNIT III Statistical Quality Control (SQC): definition, purpose and importance of SQC, Causes of variations in quality: chance and assignable, general theory of control charts, process and product control, Control charts for variables: X- bar and R-charts, Control charts for attributes: p and c-charts

UNIT IV Demographic Methods: Introduction, measurement of population, rates and ratios of vital events, Measurement of mortality: CDR, SDR, IMR, standardized death rates.
Life (mortality) tables: definition of its main functions and uses, Measurement of fertility: CBR, GFR, and TFR.

UNIT V Demand Analysis: Demand and supply functions, Price elasticity of demand and supply, income elasticity of demand; Pareto's law of income distribution; Engel's law and Engel's curve.

Recommended Books and References:

1. Mukhopadhyay, P. (1999): Applied Statistics, New Central Book Agency, Calcutta.
2. Gun, A.M., Gupta, M.K. and Dasgupta, B. (2008): Fundamentals of Statistics, Vol. II, 9th Edition World Press, Kolkata.
3. Gupta, S. C. and Kapoor, V.K. (2008): Fundamentals Of Applied Statistics, 4th Edition(Reprint), Sultan Chand & Sons
4. Montogomery, D. C. (2009): Introduction to Statistical Quality Control, 6th Edition, Wiley India Pvt. Ltd.

GENERIC ELECTIVE 4 (STG 4.12)
APPLIED STATISTICS

Practical Credit: 2

PRACTICAL/LAB WORK

List of Practical

1. Measurement of trend: Fitting of linear, quadratic trend, exponential curve and plotting of trend values and comparing with given data graphically.
2. Measurement of seasonal indices by Ratio-to-trend method and plotting of trend values and comparing with given data graphically.
3. Construction of price and quantity index numbers by Laspeyre's formula, Paasche's formula, Marshall-Edgeworth's formula, Fisher's Formula. Comparison and interpretation.
4. Construction of wholesale price index number, fixed base index number and consumer price index number with interpretation
5. Construction and interpretation of X bar & R-chart
6. Construction and interpretation p-chart (fixed sample size) and c-chart
7. Computation of measures of mortality
8. Construction of life table
9. Computation of measures of fertility and population growth
10. Problems on demand and supply functions.

GENERIC ELECTIVE
ZOOLOGY

SEMESTER	COURSE	COURSE NAME	COURSE CODE	CREDIT
I	Generic Elective 1	Aquatic Biology (Theory) OR Animal Diversity (Theory)	ZOG 1.11(a) ZOG 1.11(b)	4
		Aquatic Biology (Practical) OR Animal Diversity (Practical)	ZOG 1.12(a) ZOG 1.12(b)	2
II	Generic Elective 2	Environmental and Public Health (Theory) OR Insect Vectors and Diseases (Theory)	ZOG 2.11(a) ZOG 2.11(b)	4
		Environmental and Public Health (Practical) OR Insect Vectors and Diseases (Practical)	ZOG 2.12(a) ZOG 2.12(b)	2
III	Generic Elective 3	Human Physiology (Theory) OR Exploring the Brain: Structure and Function (Theory)	ZOG 3.11(a) ZOG 3.11(b)	4
		Human Physiology (Practical) OR Exploring the Brain: Structure and Function (Practical)	ZOG 3.12(a) ZOG 3.12(b)	2
IV	Generic Elective 4	Food, Nutrition and Health (Theory) OR Animal Cell Biotechnology (Theory)	ZOG 4.11(a) ZOG 4.11(b)	4
		Food, Nutrition and Health (Practical) OR Animal Cell Biotechnology (Practical)	ZOG 4.12(a) ZOG 4.12(b)	2

GENERIC ELECTIVE COURSES 1 (ZOG 1.11(A))
AQUATIC BIOLOGY

Theory Credits: 4

UNIT I **Aquatic Biomes**

Brief introduction of the aquatic biomes: Freshwater ecosystem (lakes, wetlands,streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marinebenthic zone.

UNIT II **Freshwater Biology-I**

Lakes: Origin and classification, Lake as an Ecosystem, Lake morphometry,Physico–chemical Characteristics: Light, Temperature, Thermal stratification,Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity;dissolved gases (Oxygen, Carbon dioxide). Nutrient Cycles in Lakes-Nitrogen,Sulphur and Phosphorous

UNIT III **Freshwater Biology-II**

Streams: Different stages of stream development, Physico-chemicalenvironment, Adaptation of hill-stream fishes.

UNIT IV **Marine Biology**

Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds.

UNIT V **Management of Aquatic Resources**

Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Sewage treatmentWater quality assessment- BOD and COD.

GENERIC ELECTIVE COURSES 1 (ZOG 1.12(A))
AQUATIC BIOLOGY

Practical Credits:2

1. Determine the area of a lake using graphimetric and gravimetric method.
2. Identify the important macrophytes, phytoplanktons and zooplanktonspresent in a lake ecosystem.
3. Determine the amount of Turbidity/transparency, Dissolved Oxygen, FreeCarbon dioxide, Alkalinity (carbonates & bicarbonates) in water collectedfrom a nearby lake/ water body.
4. Instruments used in limnology (Secchi disc, Van Dorn Bottle, Conductivitymeter, Turbidity meter, PONAR grab sampler) and their significance.
5. Project Report/Field Study.

Recommended Books and References:

1. Anathakrishnan : Bioresources Ecology 3rd Edition
2. Goldman : Limnology, 2nd Edition
3. Odum and Barrett : Fundamentals of Ecology, 5th Edition
4. Pawlowski: Physicochemical Methods for Water and Wastewater Treatment, 1st Edition

- Wetzel : Limnology, 3rd edition

- Trivedi and Goyal : Chemical and biological methods for water pollution studies
- Welch : Limnology Vols. I-II

GENERIC ELECTIVE COURSES 1 (ZOG 1.11(b))
ANIMAL DIVERSITY

Theory Credits: 4

UNIT I **Protista, Porifera, Radiata and Aceolomates**
General characters of Protozoa; Life cycle of Plasmodium
General characters and canal system in Porifera
General characters of Cnidarians and polymorphism
General characters of Helminthes; Life cycle of *Taenia solium*

UNIT II **Pseudocoelomates, Coelomate Protostomes**
General characters of Nemethehelminthes; Parasitic adaptations
General characters of Annelida ; Metamerism.

UNIT III **Arthropoda, Mollusca, Coelomate Deuterostomes**
General characters. Social life in insects.
General characters of mollusca; Pearl Formation
General characters of Echinodermata, Water Vascular system in Starfish.

UNIT IV **Protochordata, Pisces, Amphibia**
Salient features of protochordates
Osmoregulation and Migration of Fishes
General characters, Adaptations for terrestrial life and Parental care in Amphibia.

UNIT V **Reptiles, Aves and Mammalia**
Amniotes; Origin of reptiles. Terrestrial adaptations in reptiles.
The origin of birds; Flight adaptations
Early evolution of mammals; Primates; Dentition in mammals.

GENERIC ELECTIVE COURSES 1 (ZOG 1.12(b))
ANIMAL DIVERSITY

Practical Credits: 2

1. Study of following specimens:
   Non Chordates: *Euglena, Noctiluca, Paramecium, Sycon, , Physalia, Tubipora, Metridium, Taenia, Ascaris, Nereis, Aphrodite, Leech, Peripatus, Limulus, ,* Hermitcrab*, Daphnia,* Millipede, Centipede, Beetle*, Chiton, Dentalium, Octopus, Asterias, and Antedon.*
   Chordates*: Balanoglossus, Amphioxus, Petromyzon, Pristis, Hippocampus, Labeo, Icthyophis/ Uraeotyphlus, Salamander, Rhacophorus Draco, Uromastix, Naja, Viper, model of Archaeopteryx,* any three common birds-*(Crow, duck, Owl),* Squirrel and Bat.
2. Study of following Permanent Slides:
   Cross section of Sycon, Sea anemone and *Ascaris(*male and female*).* T. S. of Earthworm passing through pharynx, gizzard, and typhlosolar intestine. Bipinnaria and Pluteus larva.
3. Temporary mounts of

- Septal & pharyngeal nephridia of earthworm.
- Unstained mounts of Placoid, cycloid and ctenoid scales.

4. Dissections of
   - Digestive and nervous system of Cockroach.
   - Urinogenital system of Rat

Recommended Books and References:

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

GENERIC ELECTIVE COURSES 2 (ZOG 2.11(a))
ENVIRONMENT AND PUBLIC HEALTH

Theory Credits: 4

UNIT I **Introduction**

Sources of Environmental hazards, hazard identification and accounting, fate oftoxic and persistent substances in the environment, dose Response Evaluation,exposure Assessment.

UNIT II **Climate Change**

Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effectof climate change on public health

UNIT III **Pollution**

Air, water, noise pollution sources and effects, Pollution control

UNIT IV **Waste Management Technologies**

Sources of waste, types and characteristics, Sewage disposal and its management,Solid waste disposal, Biomedical waste handling and disposal, Nuclear wastehandling and disposal, Waste from thermal power plants, Case histories onBhopal gas tragedy, Chernobyl disaster.

UNIT V **Diseases**

Causes, symptoms and control of tuberculosis, Asthma, Cholera, Minamatadisease, typhoid

GENERIC ELECTIVE COURSES 2 (ZOG 2.12(A))
ENVIRONMENT AND PUBLIC HEALTH

Practical Credits: 2

1. To determine pH, Cl, SO4, NO3 in soil and water samples from differentlocations.
2. Determine the hardness of water in the given sample.
3. Determine the organic carbon in Soil.

Recommended Books and References:

1. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
2. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff "Risk Assessmentand Management Handbook", McGraw Hill Inc., New York,1996.
3. Kofi Asante Duah "Risk Assessment in Environmental management",John Wiley and sons, Singapore, 1998.
4. Kasperson, J.X. and Kasperson, R.E. and Kasperson,R.E., Global Environmental Risks, V.N.University Press, New York, 2003.
5. Joseph F Louvar and B Diane Louver Health and Environmental RiskAnalysis fundamentals with applications, Prentice Hall, New Jersey 1997.

GENERIC ELECTIVE COURSES 2 (ZOG 2.11(b))
INSECT VECTORS AND DISEASES

TheoryCredits: 4

UNIT I **Concept of Vectors**

Morphological features of insects, Head – Eyes, Types of antennae, Mouth parts w.r.t. feeding habits.
Brief introduction of Carrier and Vectors (mechanical and biologicalvector),Reservoirs, Host-vector relationship, Vectorial capacity, Adaptations asvectors, Host Specificity

UNIT II **Dipteran as Disease Vectors**

Dipterans as important insect vectors – Mosquitoes, Sand fly, Houseflies;Study of mosquito-borne diseases – Malaria, Dengue, Chikungunya, Viralencephalitis, Filariasis;
Study of sand fly-borne diseases – Visceral Leishmaniasis, CutaneousLeishmaniasis, Phlebotomus fever; Control of Sand fly
Study of house fly as important mechanical vector, Myiasis, Control of house fly

UNIT III **Siphonaptera as Disease Vectors**

Fleas as important insect vectors; Host-specificity, Study of Flea-borne diseases – Plague, Typhus fever; Control of fleas

UNIT IV **Siphunculata as Disease Vectors**

Human louse (Head, Body and Pubic louse) as important insect vectors; Study oflouse-borne diseases –Typhus fever, Relapsing fever, Trench fever, Vagabond'sdisease, Phthiriasis; Control of human louse

UNIT V **Hempitera as Disease Vectors**

Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs asmechanical vectors, Control and prevention measures

GENERIC ELECTIVE COURSES 2 (ZOG 2.12(b))
INSECT VECTORS AND DISEASES

Practical Credits: 2

1. Study of different kinds of mouth parts of insects
2. Study of following insect vectors through permanent slides/ photographs:
   Aedes, Culex, Anopheles, *Pediculushumanus capitis, Pediculushumanus corporis, Phithirus pubis, Xenopsyllacheopis, Cimexlectularius, Phlebotomusargentipes, Musca domestica,* through permanent slides/ photographs
3. Study of different diseases transmitted by above insect vectors
4. Submission of a project report on any one of the insect vectors and disease transmitted

Recommended Books and References:

1. Imms, A.D. (1977). *A General Text Book of Entomology*. Chapman & Hall, UK
2. Chapman, R.F. (1998). *The Insects: Structure and Function.* IV Edition, Cambridge University Press, UK
3. Pedigo L.P. (2002). *Entomology and Pest Management.* Prentice Hall Publication
4. Mathews, G. (2011). *Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases*. Wiley-Blackwell

GENERIC ELECTIVE COURSES 3 (ZOG 3.11(a))
HUMAN PHYSIOLOGY

Theory Credits: 4

UNIT I **Digestion and Absorption of Food**

Structure and function of digestive glands; Digestion and absorption of carbohydrates, fats andproteins; Nervous and hormonal control of digestion (*in brief*)

UNIT II **Functioning of Excitable Tissue (Nerve and Muscle)**

Structure of neuron, Propagation of nerve impulse (myelinated and non-myelinated nervefibre); Structure of skeletal muscle, Mechanism of muscle contraction (Sliding filamenttheory), Neuromuscular junction

UNIT III **Respiratory Physiology**

Ventilation, External and internal Respiration, Transport of oxygen and carbon dioxide inblood, Factors affecting transport of gases.

UNIT IV **Renal and Cardiovascular Physiology**

Functional anatomy of kidney, Mechanism and regulation of urine formation.
Structure of heart, Coordination of heartbeat, Cardiac cycle, ECG

UNIT V **Endocrine and Reproductive Physiology**

Structure and function of endocrine glands (pituitary, thyroid, parathyroid,pancreas, adrenal, ovaries, and testes), Brief account of spermatogenesis and oogenesis, Menstrual cycle

GENERIC ELECTIVE COURSES 3 (ZOG 3.12(a))
HUMAN PHYSIOLOGY

Practical Credits: 2

1. Preparation of temporary mounts: Neurons and Blood film.
2. Preparation of haemin and haemochromogen crystals.
3. Estimation of haemoglobin using Sahli's haemoglobinometer.
4. Examination of permanent histological sections of mammalian oesophagus, stomach, duodenum, rectum, lung, kidney, thyroid, pancreas, adrenal, testis, ovary.

Recommended Books and References:

1. Tortora, G.J. and Derrickson, B.H. (2009). *Principles of Anatomy andPhysiology*, XII Edition, John Wiley and Sons, Inc.
2. Widmaier, E.P., Raff, H. and Strang, K.T. (2008). *Vander's HumanPhysiology*, XI Edition, McGraw Hill.
3. Guyton, A.C. and Hall, J.E. (2011). *Textbook of Medical Physiology*, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company.
4. Marieb, E. (1998). *Human Anatomy and Physiology*, IV Edition, Addison-Wesley.
5. Kesar, S. and Vashisht, N. (2007). *Experimental Physiology*, Heritage Publishers.
6. Prakash, G. (2012). *Lab Manual on Blood Analysis and Medical Diagnostics*, S. Chand and Company Ltd.

GENERIC ELECTIVE COURSES 3 (ZOG 3.11(b))
EXPLORING THE BRAIN: STRUCTURE AND FUNCTION

Theory Credits: 4

UNIT I **Introduction:**
Early and Nineteenth century views of the Brain; Neuroscience today; Neurons – Soma, Axon, Dendrite; Classification of Neurons;
Glia – Astrocytes, Myelinating Glia, Non-neuronal cells

UNIT II **Evolution and Adaptation of Brain:** Brain evolution and behavioral adaptation;
Theories of brain evolution – involving addition of structure or areas, involving new formation and reorganization of circuits.

UNIT III **Organization of the Brain:**
Anatomical references, Cerebrum, cerebellum, brain stem, spinal cord; Cranial nerves, Meninges, ventricular system; CT and MRI imaging of the brain.
Formation of neural tube, Primary brain vesicles; Differentiation of forebrain, midbrain and hindbrain.
Cerebral cortex – neocortical evolution and structure-function relationship

UNIT IV **Chemical Control of Brain and Behaviour:** Structure and connection of thesecretory hypothalamus; Diffuse modulatory systems of the brain – noradrenergic,serotonergic, dominergic and cholinergic system; Drugs and diffuse modulatory systems.

UNIT V **Rhythms and Mental illness of the Brain:**
Electroencephalogram; Sleep – why do we sleep, Non-REM and REM sleep, neural mechanisms of sleep; Circadian rhythms. Psychosocial and biological approaches to mental illness; Anxiety disorders; Mood disorders; Schizophrenia.

GENERIC ELECTIVE COURSES 3 (ZOG 3.12(b))
EXPLORING THE BRAIN: STRUCTURE AND FUNCTION

Practical Credits: 2

1. Dissection and study of Drosophila nervous system using GFP reporter.
2. Observation and quantitation of Drosophila photoreceptor neurons in healthy and diseased condition.
3. Project work/ Home assignment

Recommended Books and References:

1. Neuroscience: Exploring the Brain by Mark F. Bear, Barry W. Connors and Michael A. Paradiso.
2. Comparative vertebrate Neuroanatomy by Ann B. Butler and William Hoods.

GENERIC ELECTIVE COURSES 4 (ZOG 4.11(a))
FOOD, NUTRITION AND HEALTH

Theory Credits: 4

UNIT I **Basic concept of food and nutrition**
Food Components and food-nutrients
Concept of a balanced diet, nutrient needs and dietary pattern for various Groups adults, pregnant and nursing mothers, infants, school children, adolescents and elderly

UNIT II **Nutritional Biochemistry**:
Definition and Classification of Carbohydrates, Lipids, Proteins; their dietary sourcesand roles
Vitamins- Fat-soluble and Water-soluble vitamins- their dietary source and importance
Minerals- Iron, calcium, phosphorus, iodine, selenium and zinc: their biologicalfunctions

UNIT III **Health-I**
Introduction to health- Definition and concept of health
Major nutritional Deficiency diseases- Protein Energy Malnutrition (kwashiorkorand marasmus), Vitamin A deficiency disorders, Iron deficiency

disorders, Iodinedeficiency disorders- their causes, symptoms, treatment, prevention and
government programmes.

UNIT IV **Health-II**

Life style related diseases- hypertension, diabetes mellitus, and obesity- theircauses and prevention through dietary and lifestyle modifications.
Social health problems- smoking, alcoholism, drug dependence and Acquired Immuno Deficiency Syndrome (AIDS) - their causes, treatment and prevention
Common ailments- cold, cough, and fevers, their causes and treatment

UNIT V **Food hygiene:**

Transmission, causative agent, sources of infection, symptoms and prevention of Food and Water borne infections: **Bacterial infection**: Cholera, typhoid fever, dysentery; **Viral infection**: Hepatitis, Poliomyelitis, **Protozoan infection**: amoebiasis, giardiasis; **Parasitic infection**: taeniasis and ascariasis.

GENERIC ELECTIVE COURSES 4 (ZOG 4.12(a))
FOOD, NUTRITION AND HEALTH

Practical Credits: 2

1. To detect adulteration in a) Ghee b) Sugars c) Tea leaves and d) Turmeric
3. Estimation of Lactose in milk
4. Ascorbic acid estimation in food by titrimetry
5. Estimation of Calcium in foods by titrimetry
6. Study of the stored grain pests from slides/ photograph(*Sitophilus oryzae*,*Trogodermagranarium*, *Callosobruchuschinensis*and*Triboliumcastaneum*): their identification, habitat and food sources, damage caused andcontrol. Preparation of temporary mounts of the above stored grain pests.
7. Project- Undertake computer aided diet analysis and nutrition counseling for different age groups.

   OR

   Identify nutrient rich sources of foods **(fruits and vegetables),** their seasonal availability and price

   OR

   Study of nutrition labeling on selected foods

Recommended Books and References:

1. Mudambi, SR and Rajagopal, MV. Fundamentals of Foods, Nutrition and Diet Therapy;Fifth Ed; 2007; New Age International Publishers
2. Srilakshmi B. Nutrition Science; 2002; New Age International (P) Ltd.
3. Srilakshmi B. Food Science; Fourth Ed; 2007; New Age International (P) Ltd.
4. Swaminathan M. Handbook of Foods and Nutrition; Fifth Ed; 1986; BAPPCO.
5. Bamji MS, Rao NP, and Reddy V. Text Book of Human Nutrition; 2009; Oxford &IBHPublishing Co. Pvt Ltd.
6. Wardlaw GM, Hampl JS. Perspectives in Nutrition; Seventh Ed; 2007; McGraw Hill.
7. Lakra P, Singh MD. Textbook of Nutrition and Health; First Ed; 2008; AcademicExcellence.
8. Manay MS, Shadaksharaswamy. Food-Facts and Principles; 1998; New AgeInternational (P) Ltd.
9. Gibney et al. Public Health Nutrition; 2004; Blackwell Publishing

GENERIC ELECTIVE COURSES 4 (ZOG 4.11(b))
ANIMAL CELL BIOTECHNOLOGY

Theory Credit: 4

UNIT I **Techniques in Gene manipulation**

Concept and Scope of Biotechnology; Outline process of genetic engineering and recombinant DNA technology, Isolation of genes, Concept of restriction and modification: Restriction endonucleases, DNA modifying enzymes
Cloning Vectors: Plasmids, Phage vectors, Cosmids, Phagemids, BAC, YAC, HAC. Shuttle and Expression Vectors. Construction of Genomic libraries and cDNA libraries Transformation techniques: microbial, plants and animals.

UNIT II **Animal cell Culture**

Basic techniques in animal cell culture and organ culture, Primary Culture and Cell lines, Culture media- Natural and Synthetic, Stem cells, Cryopreservation of cultures. Agarose and Polyacrylamide Gel Electrophoresis, Southern, Northern and Western blotting, DNA sequencing: Sanger method, Polymerase chain reaction, DNA Fingerprinting and DNA microarrays.

UNIT III **Fermentation**

Different types of Fermentation: Submerged & Solid state; batch, Fed batch &Continuous; Stirred tank, Air Lift, Fixed Bed and Fluidized. Downstream Processing: Filtration, centrifugation, extraction, chromatography, spray drying and lyophilization.

UNIT IV **Transgenic Animal Technology**

Production of transgenic animals: nuclear transplantation, Retroviral method, DNA microinjection method, Dolly and Polly.

UNIT V **Application in Health**

Development of recombinant Vaccines, Hybridoma technology, Gene Therapy. Production of recombinant Proteins: Insulin and growth hormones. Bio safety Physical and Biological containment.

GENERIC ELECTIVE COURSES 4 (ZOG 4.12(b))
ANIMAL CELL BIOTECHNOLOGY

Practical Credit: 2

1. Packing and sterilization of glass and plastic wares for cell culture.
2. Preparation of culture media.
3. Preparation of genomic DNA from *E. coli*/animals/ human.
4. Plasmid DNA isolation (pUC 18/19) and DNA quantitation using agarose gel electrophoresis (by using lambda DNA as standard).
5. Restriction digestion of lambda (λ) DNA using EcoR1 and Hind III.
6. Preparation of competent cells and Transformation of *E. coli* with plasmid DNA using CaCl2, Selection of transformants on X-gal and IPTG (Optional).
7. Techniques: Western Blot, Southern Hybridization, DNA Fingerprinting, PCR, DNA Microarrays

Recommended Books and References:

1. Animal Cells Culture and Media, D.C. Darling and S.J. Morgan, 1994. BIOS Scientific Publishers Limited.
2. Methods in Cell Biology, Volume 57, Jennie P. Mathur and David Barnes, 1998. Animal Cell Culture Methods Academic Press.
3. P.K. Gupta: Biotechnology and Genomics, Rastogi publishers (2003).
4. B.D. Singh: Biotechnology, Kalyani publishers, 1998 (Reprint 2001).
5. T.A. Brown: Gene cloning and DNA analysis: An Introduction, Blackwell Science (2001).
6. Bernard R. Click & Jack J. Pasternak: Molecular Biotechnology, ASM Press, Washington (1998).
7. Methods in Gene Biotechnology, W. Wu, M.J. Welsh, P.B. Kaufman & H.H. Zhang, 1997, CRC Press, New York
8. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An introduction to genetic analysis. IX Edition. Freeman & Co., N.Y., USA