BANARAS HINDU UNIVERSITY

SYLLABI

B.Sc. (Hons.) Courses

Offered by

FACULTY OF SCIENCE

(Effective from 2012-13)

Course content: B.Sc. (Hons.)

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BANARAS HINDU UNIVERSITY

Department of Botany

Faculty of Science

SYLLABI

B.Sc. (Hons.) Programme
in
Botany

B. Sc. (HONS.) BOTANY

DISTRIBUTION OF DIFFERENT COURSES AND CREDITS IN VARIOUS SEMESTERS

Semester-I

Course Code	Title	Credits
BOB101	Cryptogams	4
BOB102	Lab. work based on Course BOB101	2
	Total	**6**

Semester-II

Course Code	Title	Credits
BOB201	Microbiology, Plant Pathology, Cytology and Genetics	4
BOB202	Lab. work based on Course BOB201	2
	Total	**6**

Semester-III

Course Code	Title	Credits
BOB301	Plant Ecology and Physiology	4
BOB302	Lab. work based on Course BOB301	2
	Total	**6**

Semester-IV

Course Code	Title	Credits
BOB401	Phanerogams	4
BOB402	Lab. work based on Course BOB401	2
	Total	**6**

Semester-V

Course Code	Title	Credits
BOB501	Comparative studies of Cryptogams	4
BOB502	Comparative studies of Phanerogams	4
BOB503	Plant Ecology and Toxicology	4
BOB504	Lab. work based on Course BOB501	2
BOB505	Lab. work based on Course BOB502	2
BOB506	Lab. work based on Course BOB503	2
BOB 507	Field Study	4
	Total	**22**

Semester-VI

Course Code	Title	Credits
BOB601	Plant Metabolism, Biochemistry and Biotechnology	4
BOB602	Microbiology and Plant Pathology	4
BOB603	Cytogenetics and Evolutionary Processes	4
BOB604	Lab. work based on Course BOB601	2
BOB605	Lab. work based on Course BOB602	2
BOB606	Lab. work based on Course BOB603	2
BOB607	Dissertation based on review	4
	Total	**22**
	Grand Total	**68**

B.Sc. (HONS.) BOTANY

SEMESTER - I

BOB101: CRYPTOGAMS **Credits: 4**

General classification of Cryptogams; study of structure, reproduction and life history of the following representative forms included in various groups

Section A: Algae

1. General characteristics of Chlorophyceae, Xanthophyceae, Phaeophyceae, Rhodophyceae and Cyanophyceae
2. Chlorophyceae: *Volvox, Oedogonium, Draparnaldiopsis*
3. Xanthophyceae: *Vaucheria*
4. Phaeophyceae: *Ectocarpus, Sargassum*
5. Rhodophyceae: *Polysiphonia*
6. Cyanophyceae: *Nostoc, Scytonema*

Section B: Fungi

1. General characteristics of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina
2. Mastigomycotina: *Saprolegnia, Albugo*
3. Zygomycotina: *Rhizopus*
4. Ascomycotina: *Peziza*
5. Basidiomycotina: *Agaricus, Puccinia*
6. Deuteromycotina: *Alternaria, Cercospora*

Section C: Bryophytes

1. General characteristics of Hepaticopsida, Anthocerotopsida and Bryopsida
2. Hepaticopsida: *Marchantia*
3. Anthocerotopsida: *Anthoceros*
4. Bryopsida: *Funaria*

Section D: Pteridophytes

1. General characteristics of Psilophyta, Lycophyta, Sphenophyta and Filicophyta; Various types of steles
2. Lycophyta: *Selaginella*
3. Sphenophyta: *Equisetum*
4. Filicophyta: *Pteris*

BOB102: Lab. work based on Course BOB101 **Credits: 2**

Suggested readings:

1. Gangulee, H.C. and Kar, A.K., College Botany Vol. II- 2011 (Algae+Fungi+Brophyta+ Pteridophyta), New Central Book Agency, Kolkata
2. Singh, Pande, Jain, A Text Book of Botany, 2010 (Algae+Fungi+Brophyta+Pteridophyta) , Rastogi Publication, Meerut
3. Rashid, A., An Introduction to Pteridopyta by, 2nd edition, 2011 (Reprint), Vikas Publishing House Pvt. Ltd., Noida.
4. Lee, R.E., 2008, Phycology, Cambridge University Press, Cambridge

SEMESTER - II

BOB 201: MICROBIOLOGY, PLANT PATHOLOGY, CYTOLOGY and GENETICS

Section A: Microbiology and Plant Pathology **Credits: 4**

1. History and scope of Microbiology
2. Position of microorganisms in the living world; morphological, metabolic and molecular criteria for the classification of bacteria (scheme not required)
3. Structure of a bacterial cell: flagella, cell envelope, cell membrane, chromosome, plasmid and endospore
4. Structure of bacteriophages T4 and Lambda; Lysogenic and lytic cycles
5. A brief account of genetic recombination in bacteria (transformation, conjugation and transduction)
6. Role of microorganisms in cycling of nitrogen.
7. Microorganisms and the production of wines and antibiotics
8. General symptoms and control measures for the following plant diseases: Late blight of potato, Wilt of *Cajanus cajan*, Loose smut of Wheat, Covered smut of Barley, *Citrus canker*, TMV.

Suggested readings:

1. Prescott, Harley and Klein's Microbiology 7th edition (2008). Mc GRAW Hill. Singapore
2. Brock Biology of Microoranisms, 13th edition (2012)
3. Stainier, R.Y. General Microbiology 5th edition (2009) Mc Millan Press Ltd., Hound Mills
4. Singh, R.S. Plant diseases, 9th edition (2009). Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi

Section B: Cytology and Genetics

1. Basic tenets of cytogenetics: cell and cell theory, germplasm theory.
2. Ultrastructure of plant cell: Nucleus, cytoskeleton
3. Cell cycle: Euchromatin and heterochromatin, mitosis, meiosis; genetic significance of meiosis
4. Mendel's laws of inheritance: Law of segregation, law of independent assortment, deviations from Mendel's laws (Neo-Mendelism)
5. Interaction of genes: Intragenic and intergenic interactions, incomplete dominance, lethal genes, complementary genes, supplementary genes, inhibitory genes, duplicate genes, epistatic genes
6. Linkage and crossing over: Interrelationships and importance, crossing over and meiosis, cytological basis of crossing over, crossing over and linkage map.
7. Sex determination: Bases of sex determination, chromosome theory of sex determination, sex determination in plants
8. Synthetic theory of evolution

Suggested readings:

1. Gardner, Simmons and Snustad, John, Principles of Genetics Wiley & Son, India
2. Gupta, P.K., A Text Book of Cytology, Genetics and Evolution, , Rastogi Publication, Meerut
3. Robertis, E.D.P. De and Robertis, E.M.F. De Cell and Molecular Biology, Pub. Walters Kluwer (India) Pvt. Ltd.

BOB 202: Lab. work based on Course BOB 201 **Credits: 2**

SEMESTER - III

BOB 301: PLANT ECOLOGY AND PHYSIOLOGY **Credits: 4**

Section A: Ecology

1. Introduction to ecology
2. Abiotic environment: Atmosphere, Temperature, Water, Light and Soil (structure and soil profile)
3. Biotic environment: Interaction between plants, animals and man; Interactions among plants growing in a community; Interactions among plants and microorganisms
4. Plant adaptations in response to water availability
5. Population ecology: Population characteristics (Density, Dispersion, Age structure, Natality, Mortality Survivorship curves, Growth curves), Ecotypes and Ecads
6. Community Ecology: Analytical and Synthetic characters (Frequency, Density, Cover, IVI, Life forms, Biological spectrum, Phenology, Sociability)
7. Ecosystem ecology: Ecosystem structure (abiotic and biotic components, food chain (Grazing and Detritus), food web, ecological pyramids; ecosystem function (models of energy flows), biogeochemical cycles (carbon and phosphorus)
8. Ecological succession: General process, Mechanism and pattern (Hydrosere and Xerosere), Types and pattern

Suggested reading:

1. Odum and Barrett, Thomson, Ed. Brooks/Cole, Fundamentals of Ecology, Cengage Learning
2. Singh, Singh and Gupta Ed., Ecology, Environment and Resources Conservation, , Anamaya Pub., New Delhi
3. Odum, E.P., Basic Ecology, Ed. Saunders College Pub.

Section B: Physiology

1. Water relation of plants: Water potential, water absorption, water loss (transpiration, guttation) Cell Membrane: Structure, Ion transport Transport of solutes: Sugar translocation
2. Photosynthesis: Absorption of light, transfer of light energy, electron transport, photophospho-
3. rylation, C_3, C_4 and CAM pathways of carbon fixation, photorespiration
4. Respiration: Glycolysis, TCA cycle, electron transport, oxidative phosphorylation
5. Nitrogen metabolism: Assimilatory reduction of nitrate
6. Plant growth hormones: Physiological role of auxins, gibberellins, cytokinins, abscisic acid and
7. ethylene Phytochrome: Structure and function

Suggested readings:

1. Taiz, L & Zeiger, E., 2010, Plant Physiology, Fifth Edition, Sinauer Associates Inc. Publishers, Sunderland, Massachusetts, USA.
2. Hopkins, W.G., and Hunter, NPA, 2011, Introduction to Plant Physiology, Wiley International Edition, John Wiley & Sons, USA. Srivastava, H.S., 2008, Plant Physiology & Biochemistry, Rastogi publications, Meerut, India.
3. Buchanan, B., Gruissem,W., & Jones, R.L., 2002, Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists, USA.

BOB302: Lab. work based on Course BOB301 **Credits: 2**

SEMESTER - IV

BOB 401: PHANEROGAMS **Credits: 4**

Gymnosperms:

(a) Classification (Cf. Sporne) (b) Morphology, anatomy and reproduction of:

Cycas, *Pinus, Ephedra*

Angiosperms:

(a) Taxonomy:

1. Bentham and Hooker's system of classification: Principles, outline, merits and demerits
2. Distinguishing characteristics of the following families and their economic importance: Ranunculaceae, Papaveraceae, Rosaceae, Myrtaceae, Apiaceae, Cucurbitaceae, Rubiaceae, Asclepiadaceae, Apocynaceae, Acanthaceae, Solanaceae, Lamiaceae, Poaceae

(b) Anatomy of stems and roots with special reference to plants showing anomalies: Stem: *Nyctanthes, Bignonia, Strychnos, Boerhaavia* and *Dracaena* stem; Root *Tinospora*

(c) Embryology - General Account

1. Microsporangium and Microsporogenesis
2. Megasporangium and Megasporogenesis
3. Male gametophyte
4. Female gametophyte (monosporic embryosac)
5. Double fertilization
6. Endosperm (Different modes of development)
7. Embryogeny: (Classification, development of any typical dicot and monocot embryo)

BOB 402: Lab. work based on Course BOB401 **Credits: 2**

Suggested readings:

1. Singh, V. and Jain, D.K., Taxonomy of angiosperms. Rastogi Publication, Meerut
2. Pandey, B.P., Angiosperms-Taxonomy, Emrbyology and Anatomy, S. Chand and Co., New Delhi
3. Bhojwani, S.S. and Bhatnagar, S.P., Embryology of Angiosperms, Vikash Publishing House, New Delhi
4. Sporne, K.R., Morphology of Gymnosperms, B.I. Publication, New Delhi
5. Singh, Gurucharan, Plant Systematics- Theory and Practices, Oxford and I.B.H. Publishing Co. New Delhi
6. Judd,W.S.,Christopher,S.,Campbell.,Kellogg,A.E.,Stevens,P.F.,1999.Plant Systematics:A Phylogenetic Approach. Sinauer Associates Inc. Publishers.
7. Simpson, M. G., 2006 Plant Systematics. Elsevier Academic Press.

SEMESTER - V

BOB 501: COMPARATIVE STUDIES OF CRYPTOGAMS **Credits: 4**

Section A: Algae

1. Classification (Fritsch's system) of algae and general characteristics of major classes
2. Pigmentation and storage products
3. Thallus organization and evolutionary tendencies
4. Reproduction and life history types with reference to Chlorophyceae, Phaeophyceae,
5. Rhodophyceae and Cyanophyceae

Section B: Fungi

1. General features of fungi and their classification (Ainsworth's system)
2. Structure, reproduction and life cycle of representative classes of fungi
3. Types of fungal spores and mode of their liberation
4. Evolutionary trends in fungi
5. Economic importance of fungi

Section C: Bryophytes

1. Life histories of bryophytes with reference to *Cyathodium, Notothylus*, *Sphagnum* and *Polytrichum*
2. Vegetative propagation in bryophytes
3. General account of evolution of sporophyte

Section D: Pteridophytes

1. Classification of pteridophyta
2. Stelar evolution in pteridophyta
3. Life history of *Psilotum, Isoetes, Adiantum, Ophioglossum, Marselia*

Suggested readings:

1. Gangulee, H.C. and Kar, A.K., 2011, College Botany Vol. II Algae+Fungi+Brophyta+ Pteridophyta) , New Central Book Agency, Kolkata
2. Singh, Pande, Jain, 2010, A Text Book of Botany (Algae+Fungi+Brophyta+Pteridophyta) , Pub.Rastogi Publication, Meerut
3. Rashid, A, 2011, An Introduction to Pteridopyta , 2nd edition, (Reprint), Pub. Vikas Publishing House Pvt. Ltd., Noida.

BOB 502: COMPARATIVE STUDIES OF PHANEROGAMS Credits: 4

Section A: Gymnosperm

1. General account of morphology and reproduction of the following: *Zamia, Ginkgo*, *Biota* and *Gnetum*
2. General account of *Williamsonia* and *Pentaxylon*
3. Phylogenetic trends in Gymnosperms
4. Distribution of living Gymnosperms in India

Section B: Angiosperm

1. Classification of Angiosperms (Hutchinson) and general account of numerical and chemotaxonomy
2. Distinguishing characters of the following families and their economic importance: Annonaceae, Rutaceae, Asteraceae, Convolvulaceae, Scrophulariaceae, Verbenaceae, Polygonaceae, Euphorbiaceae, Zingiberaceae, Liliaceae, Cyperaceae
3. Embryology: General account of polyembryony, apomixis and experimental embryology with reference to anther and embryo culture

Suggested readings:

1. Singh, V. and Jain, D.K., Taxonomy of angiosperms. Rastogi Publication, Meerut
2. Sporne, K.R., Morphology of Gymnosperms, B.I. Publication, New Delhi
3. Bhojwani, S.S. and Bhatnagar, S.P., Embryology of Angiosperms, Vikash Publishing House, New Delhi

4. Singh, Gurucharan, Plant Systematics- Theory and Practices, Oxford and I.B.H. Publishing Co. New Delhi
5. Judd,W.S.,Christopher,S., Campbell.,Kellogg,A.E.,Stevens,P.F.,1999.Plant Systematics:A Phylogenetic Approach. Sinauer Associates Inc. Publishers.
6. Simpson M. G. 2006, Plant Systematics. Elsevier Academic Press.

BOB 503: PLANT ECOLOGY AND TOXICOLOGY **Credits: 4**

1. Population: Patterns of population dispersion, population growth, r and k-selection strategies, population regulation, mechanisms of differentiation
2. Community: Community characteristics and their analyses, species diversity and indices, concept of ecological niche
3. Ecosystem: Concept, components and organisation; primary productivity and its measurement; energy flow; nutrient cycling (C, N and P) in forest and grassland ecosystems
4. Mechanisms of ecological succession; Individualistic and Holistic models of succession; Trends of succession, concept of climax
5. Environmental pollution: Water Pollution: Sources and kinds, impact of pollution on aquatic ecosystems, eutrophication; Air Pollution: Sources and kinds, impact of air pollution on plants and ecosystems. Soil Pollution: Sources and kinds, impact on plants and ecosystems
6. Ecotoxicology: Concept of toxicity and its ecological implications, dose-response relationship; role of ecological factors in modifying toxicity, biomagnification.

Suggested readings:

1. Sharma, P.D., Ecology and Environment, 2009 (10th Revised Ed.), Rastogi Pub. FIP, Patparaganj, New Delhi-92
2. Edward J. Kormondy, Concepts of Ecology (4th Ed, 2008) Pearson Education Inc. & Dorling Kindersley Pub, Inc. Capital offset Press, New Delhi
3. Taize, L & Zeiger, E., 2011, Plant Physiology, Sinauer associates Inc. Publishers, Sunderland, Massachusetts, USA.
4. Hopkins, W.G. , Huner, N.P.A., 2011, Introduction to Plant Physiology, Wiley International Edition, John Wiley & Sons, USA.
5. Srivastava, H.S., 2008, Plant Physiology & Biochemistry, Rastogi publications, Meerut, India.
6. Smith, T.M. and Smith R.L., 2008, Elements of Ecology, Benjamin-Cummings, N.Y. (7th Edn.)
7. Miller, G.T., 2004, Essentials of Ecology, Brooks, Cole, N.Y. (3rd Edn.)

BOB 504: Lab. work based on Course BOB501 **Credits: 2**

BOB 505: Lab. work based on Course BOB502 **Credits: 2**

BOB 506: Lab. work based on Course BOB503 **Credits: 2**

BOB 507 Field Study **Credits: 4**

SEMESTER - VI

BOB 601: PLANT METABOLISM, BIOCHEMISTRY and BIOTECHNOLOGY **Credits: 4**

1. Biosynthesis of carbon compounds: Sucrose, Starch, Cellulose
2. Sulphur and phosphorus metabolism: Activation and assimilation of sulphur, energy-rich phosphorus compounds; ATP synthesis

3. Nitrogen metabolism: Biological nitrogen fixation: The enzyme nitrogenase, substrate for nitrogenase, mechanism; Nitrate metabolism: Uptake and reduction into ammonia, ammonia assimilation
4. Nucleic acids: Structure and properties of different forms of DNA and RNA, DNA replication
5. Protein structure and synthesis: Basic aspects of protein conformation, protein synthesis - transcription (mRNA processing), translation (activation of amino acids, initiation, elongation, termination & release of peptides), post-translational modification of proteins
6. Enzymes: Mechanism of enzyme action, coenzymes, allosteric enzyme, isozymes
7. Biotechnological tools and techniques: Basic principles of electrophoresis and blotting, cloning vectors, molecular cloning of nucleic acid fragments
8. Recombinant DNA technology: Transgenic plant production, genetically modified crops and their importance

Suggested Readings:

1. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007) Biochemistry (Sixth Edition) W.H. Freman & Company, New York.
2. Cox, M.M. and Nelson DL (2004) Lehniger Principle of Biochemistry (Third Edition) MacMillan Worth Publishers.
3. Dennis, D.T. & Turpin, D.H. (1993) Plant Physiology, Biochemistry and Molecular Biology. Longman Scientific & Technical, England.
4. Dennis, D.T., Turpin, D.H., Lefebvre, D.D. & Layzel, l D.B. (1997) Plant metabolism (Second Edition) Addison Wesley Longman Ltd., England.
5. Zubay, G.L. (1993) Biochemistry (Third Edition) WmC Brown Publishers.
6. Dubey, R.C. (2006) A Text Book of Biotechnology. S. Chand & Co. Ltd. , New Delhi
7. Lehniger, A.L. (1982) Principles of Biochemistry. CBS Publishers & Distributors, New Delhi

BOB 602: MICROBIOLOGY and PLANT PATHOLOGY Credits: 4

Section A Microbiology:

1. Introduction to Archaea and Bacteria: A general account of *Halobacterium*, *Thermoplasma, Agrobacterium* and Mycoplasmas.
2. Growth of microorganisms in batch culture, measurement of microbial growth.
3. General account of bacteriophages and their nucleic acids. Structure and replication of LPP1, TMV and retroviruses.
4. Mechanisms of transformation, conjugation and transduction in bacteria
5. Fermentation technology for production of lactic and acetic acid
6. Role of microorganisms in decomposition of aromatic hydrocarbons
7. Nitrogen fixation by free-living and symbiotic microorganisms.

Section B Plant Pathology:

1. Modes of infection
2. Physiology of parasitism
3. Defense mechanism in plants
4. Transmission and spread of plant diseases.
5. Principles of plant disease control
6. Causal organism, symptoms, disease cycle and control measures of the following plant diseases: Green ear disease of bajra, downy mildew of crucifers, powdery mildew of sheesham, rusts of pea and linseed, smut of bajra, wilt of tomato, bacterial blight of rice, mosaic of sugarcane and little leaf of brinjal

Suggested Readings:

1. Madigan, M.T., Martinko, J.M., Dunlap, P.V., Clark, D.P., 2011. Brock Biology of Microorganisms. 13th edition. Pearson Education Inc.
2. Stanier, R.Y., Ingraham, J.L., Wheelis, M.L., Painter, P.R., 1987. General Microbiology. Fifth edition, MacMillan.
3. Talaro, K.P., Chess, B., 2011. Foundation in Microbiology. 8th edition. McGraw-Hill
4. Agrios, G.N., 1988. Plant Pathology, Academic Press, London.
5. Lucas, John, A., 1998. Plant Pathology and Plant Pathogens, Wiley-Blackwell, CRC Press.

BOB 603: CYTOGENETICS AND EVOLUTIONARY PROCESSES Credits: 4

1. Chromosome structure: Physical, chemical, ultrastructural and molecular organisation
2. Chromosome rearrangements: meiotic configurations and genetic consequences of deletion, duplication, inversion and translocation; permanent translocation heterozygosity
3. Sources and consequences of numerical variations in chromosomes: Aneuploidy-monosomics, trisomics, nullisomics; Polyploidy-autopolyploids, allopolyploids, segmental allopolyploids, autoallopolypolids.
4. Mutation and mutagens: Types of mutation, molecular basis of mutation, physical and chemical mutagens and mechanism of their action
5. Karyotype: Concept and components of karyotype, trends of karyotype evolution, karyotypic changes in speciation and evolution of plant species
6. Gene mapping: Physical and genetic maps- deletion, linkage, somatic cell fusion and *in situ* hybridization, methods of gene mapping
7. Multiple alleles and multiple genes: Multiple allelism- ABO and Rh blood groups in man, eye colour in *Drosophila,* self sterility in plants; multiple gene inheritance- kernel colour in wheat, skin colour in human beings; quantitative characters
8. Cytoplasmic inheritance: Maternal influence- coiling in snail shells, kappa particles in *Paramecium*, plastid inheritance in *Mirabilis jalapa*, petites in fungi.

Suggested Readings:

1. Robertis, De., Cell and Molecular Biology (eighth edition).
2. Snustard and Simmons, Principles of Genetics. Gardner, (fifth edition)
3. Stebbins, G.L., Variation and Evolution in Plants.
4. Swanson, C. P., Mertz, T.F. and Young, W.J., Cytogenetics: The Chromosomes in Division, Inheritance and Evolution (2nd Edn).
5. Jackson, R.C., Karyotype in Systematics In: Annual review of Ecology and Systematics, Vol. 2.
6. Gupta, P.K., 2007, Genetics: Classical To Modern. Rastogi Publications, Meerut.

BOB 604:	Lab. work based on Course BOB601	**Credits: 2**
BOB 605:	Lab. work based on Course BOB602	**Credits: 2**
BOB 606:	Lab. work based on Course BOB603	**Credits: 2**
BOB 607:	DISSERTATION BASED ON REVIEW	**Credits: 4**

BANARAS HINDU UNIVERSITY

Department of Chemistry

Faculty of Science

SYLLABI

B.Sc. (Hons.) Programme
in
Chemistry

Course structure for B. Sc. (Chemistry) w.e.f. 2012-13 session

Paper	Credits	Total Credits
Semester-I		
CHB-101: Section A - Structure and Bonding Section B - Organic Chemistry- I	4	6
CHB-102/202: Chemistry Practical-I / Practical-II Practical-I: Quantitative Analysis (Physical & Volumetric) Practical-II: Qualitative Analysis (Organic & Inorganic)	2	
Semester-II		
CHB-201: Section A - Inorganic Chemistry-I Section B - Physical Chemistry-I	4	8
CHB-102/202: Chemistry Practical-I / Practical-II Practical-I: Quantitative Analysis (Physical & Volumetric) Practical-II: Qualitative Analysis (Organic & Inorganic)	2	
CHB-02A: Ancillary Chemistry-I	2	
Semester-III		
CHB-301: Section A - Organic Chemistry-II Section B - Physical Chemistry-II	4	6
CHB-302/402: Chemistry Practical-III / Practical-IV *Practical-III: Quantitative Analysis (Physical & Volumetric)* Practical-IV: Qualitative Organic Analysis / Preparations (Organic & Inorganic)	2	
Semester-IV		
CHB-401: Section A - Inorganic Chemistry-II Section B - Organic Chemistry-III	4	8
CHB-04A: Ancillary Chemistry-II	2	
CHB-302/402: Chemistry Practical-III / Practical-IV *Practical-III: Quantitative Analysis (Physical & Volumetric)* Practical-IV: Qualitative Organic Analysis / Preparations (Organic & Inorganic)	2	
Semester-V		
CHB-501: Analytical Chemistry-I	3	
CHB-502: Inorganic Chemistry-III	3	
CHB-503: Organic Chemistry-IV	3	

CHB-504: Physical Chemistry-III	3	
CHB-505: Section A - Environmental Chemistry Section B - Nuclear Chemistry	4	
CHB-506: Inorganic Chemistry Practical	2	
CHB-507: Organic Chemistry Practical	2	
CHB-508: Physical Chemistry Practical	2	**22**
Semester-VI		
CHB-601: Analytical Chemistry-II	3	
CHB-602: Inorganic Chemistry-IV	3	
CHB-603: Organic Chemistry-V	3	
CHB-604: Physical Chemistry-IV	3	
CHB-605: Section-A: Atomic and Molecular Structure *Section-B: Application of Spectroscopic Techniques*	4	
CHB-606: Inorganic Chemistry Practical	2	
CHB-607: Organic Chemistry Practical	2	
CHB-608: Physical Chemistry Practical	2	**22**
	Total	**72**

B.Sc. (HONS.) CHEMISTRY

Semester-I

CHB-101 **Credits: 4**

Section (A): Structure and Bonding: **Credits: 2**

1. **Atomic Structure:** Schrödinger wave equation; H atom: Radial and angular wave functions: quantum numbers and concept of orbital; Slater rules.
2. **Chemical Bonding**: VB and MO approach of H_2 molecule; MO treatment of homonuclear and heteronuclear (CO & NO) diatomic molecules; Concept of HOMO and LUMO. VSEPR theory; Structure of simple molecules and species of main group elements.
3. **Ionic Solids:** Close packing, Radius ratio rule and crystal coordination number. Examples of MX and MX_2 type ionic solids (NaCl and TiO_2)
4. **Metallic Bonding**: theories of bonding in metals: Free electron, VB and Band theories.
5. **Weak Interactions**: Hydrogen bonding and van der Waals' interactions.

Suggested Readings:

1. *Basic Inorganic Chemistry,* F. A Cotton, G. Wilkinson, and Paul L. Gaus, 3rd Edition (1995), John Wiley & Sons, New York.
2. *Concise Inorganic Chemistry,* J. D. Lee, 5th Edition (1996), Chapman & Hall, London.

Section (B): Organic Chemistry-I : **Credits: 2**

Hydrocarbons:

i. Alkenes: Addition reactions (electrophilic and free radical), hydration, hydroxylation, hydroboration, epoxidation, ozonolysis and polymerization. Conjugated and isolated dienes: 1,2- versus 1,4-addition. Diels - Alder reaction.

ii. Alkynes: Reduction, electrophilic addition, acidity and metal acetylides.

Alkyl Halides: Nucleophilic substitution: S_N1, S_N2 mechanisms. Eliminations reactions: E1and E2 mechanisms. Elimination versus substitution reactions, energy profile diagrams-transition states (general considerations). Grignard reagents: Preparation and synthetic applications.

Alcohols: Comparative study of substitution, dehydration, oxidation and esterification of primary, secondary and tertiary alcohols.

Stereochemistry: Fischer, Saw-horse and Newman projection formulae. Chirality-optical activity, enantiomerism and diasteroisomerism involving one and two chiral centres. Configuration: D/L, erythrose, threose, R/S nomenclatures, geometrical isomerism - E/Z nomenclatures. Conformations of n-butane.

Active methylene compounds: Preparation and synthetic applications of ethyl acetoacetate and diethyl malonate.

Suggested Readings:

1. Organic Chemistry, **R. T. Morrison and R. N. Boyd**, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
2. Organic Chemistry, **I. L. Finar,** Vol. I, 6th Edition (1973), ELBS and Longman Ltd., New Delhi.
3. Organic Chemistry, **Paula Y. Bruice**, 2nd Edition, (1998) Prentice-Hall, International Edition.
4. Organic Chemistry**, L.G. Wade Jr., M. S. Singh**, 6th Edition (2008) Dorling Kindersley (India) Pvt. Ltd.

CHB-102/202 **Practicals** **Credits: 2**

Practicals-I Quantitative Analysis & (Physical and Volumetric)

Kinetics of First Order reaction.

Redox titration: (a) Iodometry (b) Fe^{2+} / $K_2Cr_2O_7$

Determination of water equivalent of a calorimeter (cooling curve).

Heat of neutralization (strong acid-strong base).

Heat of dissociation of weak acid.

Heat of solution (NH_4NO_3, $CaCl_2$).

Basicity of an acid by thermochemical method.

Practicals-II Qualitative Analysis & (Organic and Inorganic):

1. Detection of the elements(N, S and halogens) and functional groups: PhOH, -COOH, RR'C=O, -CHO, Ar-NH_2, Ar-NO_2, -$CONH_2$
2. Qualitative Inorganic Mixture Analysis: Two anions (including an interfering anion) and two cations.

Note: Experiments may be added/ deleted subject to availability of time and facilities.

Semester-II

CHB- 201 **Credits: 4**

Section (A) - Inorganic Chemistry-I **Credits: 2**

1. Periodic trends and properties:

Size: Trends in the atomic/ionic radii, Ionization energy (IE): Definition, factors affecting IEs; trends in IEs; variation in the 1st IEs of the elements. Electron affinity(EA): Definition, some values; determination of EA (Born-Haber cycle); Electronegativity: Definition, Pauling's scale, graphical representation of % ionic character *vs*. E.N. differences; Mulliken's scale; relation between Pauling's and Mulliken's values; Allred Rochows method, Fajan's rules. Solubility of ionic solids - lattice and solvation energies. Use of reduction potentials. Reduction potential (Latimer) diagram, Specific illustrative examples.

2. Descriptive Chemistry of Main group elements:

i. Alkali Metal Family: Solutions of alkali metals in liquid ammonia. Chemistry of oxides: complexation tendency (complexes, crowns and **cryptands**).

ii. Alkaline earth metal family: Chemistry of hydrides; structure of BeH_2; complexation tendency of Be & Mg [examples of $[Be_4O(Ac)_6]$, $[Be_4O(NO_3)_6]$ and chlorophyll]. Stability of oxo-salts

iii. Boron Family: Hydrides: Structures of $Li[AlH_4]$, $Na[BH_4]$, $Al(BH_4)_3$, $Be(BH_4)_2$, B_2H_6; Halides: Structures of BF_3, BCl_3 and $AlCl_3$(dimer); Oxides / oxyacids: Structures of H_3BO_3 (with and without H-bonding), metaborate (chain, ring forms), Borax and peroxoborate ion.

iv. Carbon Family: Principles of silicate structures; structures of: orthosilicate, pyrosilicate, cyclic silicates ($Si_3O_9^{6-}$, $Si_6O_{18}^{12-}$);

v. Nitrogen Family: Hydrides: Electronic structures (VB Theory) of the tri-hydrides; structure of hydrazine, NH_2OH and HN_3. Halides: Structure of: PCl_5 (gas and solid). Oxides and oxo-acids: Structures of oxides of N (+I to +V states); P_4O_6, P_4O_{10}, Oxo-acids of P.

vi Oxygen Family: Oxides and oxo-acids: structures of (i) oxides (SO_2, SeO_2, SO_3), (ii) oxoacids of sulphur or their anions; (iii) H_2O_2(gas-phase), and (iv) halides (MX_6, MX_4, and MX_2 series) .

vii. Halogen Family: Structures of (i) oxygen fluorides (OF_2, O_2F_2, O_4F_2), (ii) halogen oxides (Cl_2O, Br_2O, ClO_2, BrO_2, I_2O_5, Cl_2O_6, ClO_3, Cl_2O_7), (iii) oxo-acids (HOX, HXO_2, HXO_3, HXO_4), (iv) Inter halogens [ClF_3, BrF_3, $(ICl_3)_2$, ClF_5, BrF_5, IF_5, IF_7] and (v) polyhalides (I_3^-, ICl_2^-, ICl_4^-)

viii Noble gases: Structures of Xe compounds: XeF_2, XeF_4, XeF_6, XeO_3, XeO_2F_2, $XeOF_4$, XeO_4, XeO_3F_2 and $[XeO_6]^{4-}$.

Suggested Readings:

1. *Basic Inorganic Chemistry*, **F. A Cotton, G. Wilkinson, and Paul L. Gaus**, 3rd Edition (1995), John Wiley & Sons, New York.
2. *Concise Inorganic Chemistry*, **J. D. Lee**, 5th Edition (1996), Chapman & Hall, London.

Section (B) – Physical Chemistry-I (Credits 2)

1. Gaseous and Liquid States: Kinetic theory of gases and ideal gas laws, collisions in a gas: collision number, collision diameter and mean free path, behaviour of real gases: van der Waals equation and its applicability, the critical state: critical constants and their determination, law of corresponding states, Surface tension of liquids: capillary action, measurement of surface tension, viscosity of liquids and its measurement, temperature effect on surface tension and viscosity.

2. **Thermodynamics:** Thermodynamic quantities (w, q, ΔU and ΔH) for isothermal and adiabatic reversible expansion of ideal gases, variation of heat of reaction with temperature (Kirchhoff's equation), Joule-Thomson effect, Joule-Thomson coefficient of real (van der Waals) gases, Second Law of Thermodynamics: entropy, entropy changes for an ideal gas, entropy changes at constant pressure and volume, entropy change in spontaneous processes, physical significance of entropy, Carnot cycle, free energy and maximum work functions, conditions for spontaneous changes and equilibrium, Maxwell relations, Gibbs-Helmholtz equation, van't Hoff equation, reaction isotherm.

3. **Chemical Kinetics:** Zero, first and second order kinetics, determination of rate constant and order of reactions, effect of temperature on rate constant, Arrheninus equation, collision and activated complex (transition state) theories of rate of reactions.

Suggested Readings:

1. Physical Chemistry, P. C. Rakshit, 5th Edition (1988), 4th Reprint (1997), Sarat Book House, Calcutta.
2. Principles of Physical Chemistry, B. R. Puri, L. R. Sharma and M. S. Pathania, 44th Edition (2009), Vishal Publishing Co., Jalandhar.
3. Physical Chemistry, K. J. Laidler and J. M. Meiser, 3rd Edition, (1999) Houghton Mifflin Comp., New York, International Edition.

BSC-02A Ancillary Chemistry-I (BASIC ASPECTS OF CHEMISTRY) Credits: 2

1. **Molecules and Materials:** Electronic basis of union of atoms leading to formation of molecules. Modes of atomic union (Ionic and Covalent bonding and their subsequent partial transformation into each other), Types of binding forces. Molecular association leading to formation of materials.
2. **Chemical reactions:** Thermodynamic basis of chemical changes. Enthalpy, Entropy and free energy change during a chemical change. Types of chemical reactions with special reference to redox reactions. The concept of oxidation number, Reducing and oxidizing agents.
3. **Laboratory techniques in Chemistry:** Distillation, fractional distillation, Reflux, Recrystallization, melting point as purity criterion of a crystalline substance. Determination of melting point of a compound, Chromatography and its few applications.
4. **Chemistry in service of mankind:**
    - **i.** Reagents and catalysts: Fehling's, Tollen's, Bendict's, and Nessler's reagents and their applications.
    - **ii.** Natural and man-made catalysts:
        - **a.** Natural catalysts: Enzymes and their types, Co-enzymes, Co-factor and Prosthetic group. Denaturation of enzymes.
        - **b.** Man-made catalysts: Raney nickel, vanadium peroxide

iii. **Polymers:** Natural and Synthesis

Natural polymers: Carbohydrates, Proteins and rubber

Synthetic polymers: Synthetic rubber, Nylon, Polyethene,

Polytetrafluoroethylene, Polyester, Rayon

iv **Metals and Metallurgy:** Role of metals in our life with special mention of Iron, Recovery of Iron from its ores, Stainless Steel, Rusting of Iron and its prevention.

Suggested Readings:

1. William R. Robinson, Jerome D. Odom and Henry F. Holtzclaw, Jr., 10th Edition 1998,
2. A.I.T.B.S. Publishers & Distributors (Regd.) J-5/6 Krishna Nagar, Delhi- 110051 (INDIA).
3. Darrell D. Ebbing and Mark S. Wrighton, 5th Edition 1998, A.I.T.B.S. Publishers & Distributors (Regd.) J-5/6 Krishna Nagar, Delhi-110051 (INDIA)
4. Abraham Mazur and Benzamin Harrow, W.B. Sannders Company, Philadelphia 1971, Toppan Company, Ltd. Tokyo, Japan.

CHB-202/102 Practicals **Credits: 2**

Practicals-I Quantitative Analysis & (Physical and Volumetric)

1. Kinetics of First Order reaction.
2. Redox titration: (a) Iodometry (b) Fe^{2+} / $K_2Cr_2O_7$
3. Determination of water equivalent of a calorimeter (cooling curve).
4. Heat of neutralization (strong acid-strong base).
5. Heat of dissociation of weak acid.
6. Heat of solution (NH_4NO_3, $CaCl_2$).
7. Basicity of an acid by thermochemical method.

Practicals-II Qualitative Analysis & (Organic and Inorganic)

1. Detection of the elements(N, S and halogens) and functional groups: PhOH, -COOH, RR'C=O, -CHO, Ar-NH_2, Ar-NO_2, -$CONH_2$
2. Qualitative Inorganic Mixture Analysis: Two anions (including an interfering
3. anion) and two cations.

Note: Experiments may be added/ deleted subject to availability of time and facilities.

Semester-III

CHB-301 **Credits : 4**

Section (A): Organic Chemistry-II **Credits: 2**

1. **Aromaticity:** A general concept of aromaticity. Molecular orbital picture of benzene.
2. **Polarity of bonds**: Electronic, steric effects, hyperconjugation and their influence on acidity and basicity of organic compounds.
3. **Aromatic electrophilic substitution:** Mechanism of nitration, halogenation, sulphonation, and Friedel-Crafts (alkylation and acylation) reactions. Effects of substituents on orientation and reactivity.
4. **Aryl halogen compounds:** Halobenzene - nucleophilic substitution, side chain chlorination of toluene, DDT and BHC.
5. **Chemistry of Carbonyl compounds:** Preparations and reactions - addition and condensation reactions, Knoevenagel, Cannizzaro, Perkin, Aldol, Benzoin, haloform, Mannich, oxidation, reduction and Beckmann rearrangement reactions. Important reactions of acids, HVZ reaction, relative reactivity of acid chlorides, acid anhydrides, amides, and esters. Comparative acidity of carboxylic and sulphonic acids. Hofmann rearrangement.

6. **Phenols:** General methods of preparation and reactions. Reimer-Tiemann and Kolbe reactions. Relative acidity of phenol, alcohol and carboxylic acid.

7. **Nitrogen Containing compounds:** Reduction of Nitronbenzene. Comparative basicity of aliphatic and aromatic amines. Diazonium salts: Preparation and synthetic applications.

Suggested Readings:

1. Organic Chemistry, **I. L. Finar,** [Vol. I, 6th Edition (1973), Reprinted in 1980 & Vol. II, 5th Edition (1975), Reprinted in 1996], ELBS and Longman Ltd., New Delhi.
2. Organic Chemistry", **R. T. Morrison and R. N. Boyd**, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
3. Organic Chemistry, **Paula Y. Bruice**, 2nd Edition, (1998) Prentice-Hall, International Edition.
4. Organic Chemistry**, L.G. Wade Jr., M. S. Singh**, 6th Edition (2008) Dorling Kindersley (India) Pvt. Ltd.

Section (B): Physical Chemistry-II (Credits 2)

1. **Electrochemistry:** Migration of ions: transference number and their determination (Hittorf method), molar and equivalent conductances and their measurements, Kohlrausch law of independent migration of ions, ionic mobilities, conductance measurements and applications to conductometric titrations, acid dissociation constant and solubility product determination. Free energy change and emf of cells, Nernst equation, single electrode potentials, reference electrodes (SHE, calomel, silver-silver chloride electrodes), emf measurements, potentiometric titrations (acid – base, redox), buffer solutions, pH determination using quinhydrone and glass electrodes, concentration cells, liquid junction potential, acid-base indicators, indicator constant.
2. **Phase Equilibria:** Thermodynamics of phase transition, Clapeyron-Clausius equation, phase rule, phase diagrams of one-component (water) and two component (phenol-water & Pb-Ag) systems, distribution law, application to cases for dissociation and association, determination of equilibrium constant ($KI + I_2 = KI_3$).
3. **Solid State:** Crystal lattices, space lattice, unit cell, crystal systems, law of rational indices, Miller indices, Bragg's equation, crystal structure of NaCl, graphite and diamond, Schottky and Frankel defects.

Suggested Readings:

1. Physical Chemistry, P. C. Rakshit, 5th Edition (1988), 4th Reprint (1997), Sarat Book House, Calcutta.
2. Principles of Physical Chemistry, B. R. Puri, L. R. Sharma and M. S. Pathania**,** 44th Edition (2009), Vishal Publishing Co., Jalandhar.
3. Physical Chemistry, K. J. Laidler and J. M. Meiser, 3rd Edition, (1999) Houghton Mifflin Comp., New York, International Edition.

CHB-302/402 **Credits: 2**

Chemistry Practicals-III / Practicals-IV

Practicals-III: Quantitative Analysis (Physical & Volumetric)

Practicals-IV: Qualitative Organic Analysis and Preparation of Organic & Inorganic compounds

Practicals-III: Quantitative Analysis (Physical and Volumetric)

1. Critical Solution Temperature of two components system (phenol-water).
2. Effect of impurity on Critical Solution Temperature.
3. Distribution of solute in two immiscible solvents (without association).
4. Distribution of solute in two immiscible solvents (with association in one solvent).

5. Coagulation of a sol.
6. Determination of Surface Tension of liquids.
7. Determination of viscosity coefficients of liquids.
8. Complexometric titrations: Zn^{2+}, Mg^{2+}, Ca^{2+}, Fe2+ with EDTA; Hardness of water.
9. Iodimetric titration.
10. Determination of pH of a given buffer.

Practicals-IV: Qualitative Organic Analysis and Preparation of Organic & Inorganic Compounds.

1. Identification of simple organic compounds (derivatives not included)
2. Preparation of Organic Compounds:

   (i) m-dinitrobenzene, (ii) Acetanilide, (iii) Bromoacetanilide, (iv) Oxidation of primary alcohols-Benzoic acid from benzylacohol, (v) azo dye
3. Preparation of Inorganic Compounds:

   (i) Potassium trioxalato chromate (III); (ii) CoHg(SCN)4; (iii) Cu(I) thiourea complex (iv) Bis (2, 4-pentanedionate) zinc hydrate; (v) Double salts (Chrome alum/ Mohr's salt)

Note: Experiments may be added/deleted subject to availability of time and facilities.

Semester-IV

CHB-401 **Credits: 4**

Section(A): Inorganic Chemistry-II **Credits: 2**

1. **Acids and bases**: Bronsted-Lowry, Lux-Flood, Solvent System and Lewis concepts of acids and bases; Factors affecting strengths of Lewis acids and bases. HSAB theory and applications.
2. **Non-aqueous solvents:** Physical properties of a solvent for functioning as an effective reaction medium, types of solvents and their general characteristics. Liq. NH_3 as a non-aqueous solvent.
3. **Coordination compounds:** Characteristics of *d*- block elements with special reference to 3*d* series elements and coordination compounds - Werner's theory. Isomerism, Nomenclature, Sidgwick's EAN concept and Valence Bond Theory. Stereochemistry of coordination compounds with coordination nos. 4, 5 and 6.
4. **Lanthanides:** Comparative study of lanthanide elements with respect to electronic configuration atomic and ionic radii, oxidation state, lanthanide contraction.

Suggested Readings:

1. *Recent Aspects in Inorganic Chemistry*, R. C. Aggarwal, 1st Edition (1987), Kitab Mahal, Allahabad.
2. *Inorganic Chemistry,* J.E. Huheey, E.A. Keiter and R.L. Keiter, 4th Edition (2006), Addison Wesley Publishing Co, NY.
3. *Basic Inorganic Chemistry,* F. A Cotton, G. Wilkinson, and Paul L. Gaus, 3rd Edition (1995), John Wiley & Sons, New York.
4. *Concise Inorganic Chemistry,* **J. D. Lee**, 5th Edition (1996), Chapman & Hall, London.

CHB-401 Section (B): Organic Chemistry III **Credits: 2**

1. **Heterocyclic Compounds:** Synthesis and chemistry of furan, pyrrole, thiophene and pyridine.
2. **Poly nuclear Hydrocarbons:** Chemistry of naphthalene and anthracene.
3. **Carbohydrates:** Characteristic reactions of aldoses and ketoses. Glucose-structure (Open and Cyclic), Mutarotation.

4. **Colour and Constitution:** Synthesis of malachite green, flurorescein, synthesis and structure of Indigotin.

Suggested Readings:

1. *Organic Chemistry",* **R. T. Morrison and R. N. Boyd**, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
2. *Organic Chemistry,* **I. L. Finar,** [Vol. I, 6th Edition (1973), Reprinted in 1980 & Vol. II, 5th Edition (1975), Reprinted in1996], ELBS and Longman Ltd., New Delhi.

BSC-04A Ancillary Chemistry-II (BASIC ASPECTS OF CHEMISTRY) Credits: 2

1. Union of elements and its electronic basis. Ionic, covalent and hydrogen bonds. Energetics of chemical bond formation. Bond energy, average bond energy, bond lengths and bond angles.

2. Conventional and non-conventional energy sources;

a. Petroleum products: their origin and separation into different fractions. Octane and Cetane number.

b. Brief discussion of hydrogen-hydride and lead storage battery.

3. Brief discussion of basic concept of electrode potential and its applications in the metallurgical operations with special reference to iron. The phenomenon of rusting of iron and its prevention through anodic protection.

4. The chemical basis of photosynthesis and respiration (only elementary treatments).

I . Natural:

a) Photosynthesis: Light reaction, Dark reaction, Factors affecting photosynthesis, Photorespiration.

b) Respiration: Discussion of the role of Heamoglobin and Myoglobin in carrying O_2. Aerobic and Anaerobic respiration, different steps in aerobic respiration (in brief), respiratory quotient (RQ).

II Polymers: Natural and synthetic polymers:

a) Polysaccharides: carbohydrates

b) Polypeptides: protein and enzymes, primary, secondary, tertiary and quarternary structures. Molecular disease and primary structure of protein.

c) Enzymes: types of enzymes, co-factor and prosthetic group, denaturation of enzyme.

d) Rubber and vulcanization of rubber.

III Synthetic: Polyneoprene and Bu-na-S rubber, Nylons, Polyesters, Bakelite and Teflon. Health hazards and environmental problems created by polymers.

5. Chemical Thermodynamics: Systems and surroundings. Extensive and intensive thermodynamic properties, Open, closed and adiabatic systems. Spontaneous and Non-spontaneous processes. Thermodynamic basis for the spontaneity of a process.

Suggested Readings:

1. William R. Robinson, Jerome D. Odom and Henry F. Holtzclaw, Jr., 10th Edition 1998, A.I.T.B.S. Publishers & Distributors (Regd.) J-5/6 Krishna Nagar, Delhi-110051

2. Darrell D. Ebbing and Mark S. Wrighton, 5th Edition 1998, A.I.T.B.S. Publishers & Distributors (Regd.) J-5/6 Krishna Nagar, Delhi-110051

3. Abraham Mazur and Benzamin Harrow, W.B. Sannders Company, Philadelphia,1971, Toppan Company, Ltd. Tokyo, Japan.

CHB-302/402 **Credits: 2**

Chemistry Practicals-III / Practicals-IV

Practicals-III: Quantitative Analysis (Physical & Volumetric)

Practicals-IV: Qualitative Organic Analysis and Preparation of Organic & Inorganic compounds

Practicals-III: Quantitative Analysis (Physical and Volumetric)

1. Critical Solution Temperature of two components system (phenol-water).
2. Effect of impurity on Critical Solution Temperature.
3. Distribution of solute in two immiscible solvents (without association).
4. Distribution of solute in two immiscible solvents (with association in one solvent).
5. Coagulation of a sol.
6. Determination of Surface Tension of liquids.
7. Determination of viscosity coefficients of liquids.
8. Complexometric titrations: Zn^{2+}, Mg^{2+}, Ca^{2+}, Fe2+ with EDTA; Hardness of water.
9. Iodimetric titration.
10. Determination of pH of a given buffer.

Practicals-IV: Qualitative Organic Analysis and Preparation of Organic & Inorganic Compounds

1. Identification of simple organic compounds (derivatives not included)
2. Preparation of Organic Compounds**:**

   (i) m-dinitrobenzene, (ii) Acetanilide, (iii) Bromoacetanilide, (iv) Oxidation of primary alcohols-Benzoic acid from benzylacohol, (v) azo dye
3. Preparation of Inorganic Compounds:

   (i) Potassium trioxalato chromate (III); (ii) CoHg(SCN)4; (iii) Cu(I) thiourea complex (iv) Bis (2, 4-pentanedionate) zinc hydrate; (v) Double salts (Chrome alum/ Mohr's salt)

Note: Experiments may be added/deleted subject to availability of time and facilities.

Semester-V

CHB-501: Analytical Chemistry-I **Credits : 3**

1. **Statistical Evaluation:** Determinant and indeterminant errors, Normal error curve, Accuracy and Precision, Relative and standard deviation, Methods for minimizing errors, Criteria for rejection of observation, Significant figures and computation rules, Error propagation.
2. **Precipitation:** Desirable properties of gravimetric precipitates, Formation of gravimetric precipitates, Conditions for quantitative precipitations, Contamination in precipitates, Method for removal of impurities in precipitates, Steps involved in quantitative precipitation, Organic precipitants (oxine, dithizone, **α-nitroso-(naphthol**, cupferon, dimethyl glyoxime) in chemical analysis.
3. **Analytical Reagents:** Theoretical and practical aspects of the use of EDTA, cerate, iodate, bromate, chloramine-T, Karl Fischer and Malaprade (periodate) reagents in chemical analysis.
4. **Recent trends for chemical analysis:** Method selection, method validation, sample preparation, Analytical validation of results, LOD and LOQ, Good lab practice, Good manufacturing practice.

Suggested Readings:

1. *Modern Methods of Chemical Analysis'*, R.L. Pecscock, L.D. Shields, T. Cairns, and I.C. Mc William, 2nd Edition (1976), John Willey, New York.

2. *Basic Concepts of Analytical Chemistry'*, S.M.Khopkar, 2nd edition (1998), New Age International Publications, New Delhi.

3. *Analytical Chemistry'*, G.D. Christian, (2001) John Willey & sons, New York

4. *Environmental Chemistry'*, A.K. De, 3rd edition (1994), Willey Eastern, New Delhi.

CHB-502 Inorganic Chemistry-III Credits : 3

1. ***Theories of Metal-Ligand bonding:*** Limitations of valence bond theory; Crystal-field theory and crystal-field splitting in octahedral, tetrahedral and square planar complexes. Jahn-Teller distortion. Factors affecting the crystal-field splitting.
2. ***Electronic Spectra of Transition Metal Complexes***: Types of electronic transitions, selection rules for *d-d* transitions, spectroscopic ground states. Explanation of electronic spectra on the basis of Orgel energy level diagrams for d^1, d^4, d^6 *and* d^9 states.
3. ***Thermodynamic and Kinetic aspects of Metal Complexes:*** A brief outline of thermodynamic and kinetic stabilities of metal complexes and factors affecting the stability. Substitution reactions of square-planar complexes – Trans effect.
4. ***Organometallic Chemistry:*** Definition, nomenclature and classification of organometallic compounds. Preparation, properties, bonding and applications of alkyls and aryls of Li, Al, Hg, Sn, and Ti. A brief account of metal-ethylenic complexes and homogeneous hydrogenation.

Suggested Readings:

1. *"Concise Inorganic Chemistry",* J. D. Lee, 5th Edition (1996), Chapman & Hall, London.
2. "*Inorganic Chemistry*", J.E. Huheey, E.A. Keiter and R.L. Keiter. , 4th Edition (2006), Addison Wesley Publishing Co, NY.
3. *"Modern Inorganic Chemistry",* R. C. Aggarwal, 1st Edition (1987), Kitab Mahal, Allahabad.
4. *"Basic Inorganic Chemistry",* F. A Cotton, G. Wilkinson, and Paul L. Gaus, 3rd Edition (1995), John Wiley & Sons, New York.
5. *"Inorganic Chemistry",* A. G. Sharpe, 3rd International Student Edition (1999), ELBS / Longman, U.K.
6. *"Inorganic Chemistry",* D. F. Shriver and P. W. Atkins, 3rd Edition (1999), ELBS, London.
7. *"Organometallic Chemistry - A Unified Approach",* R.C. Mehrotra and A. Singh*, 2nd Ed. (2000) New Age International.*
8. *"Basic Organometallic Chemistry: Concepts Syntheses and Applications*", B.D. Gupta and AJ Elias; (2010) Universities Press (India) Private Ltd. Hyderabad

CHB- 503 Organic Chemistry-IV Credits : 3

1. **Alicyclic compounds:** Cycloalkanes, general synthesis, Bayer's strain theory. Cyclohexane: chair and boat conformations, conformation of mono substituted and disubstituted cyclohexanes.
2. **Reactive intermediates**: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes.
3. **Isotope effect:** Isotopic substitution in a molecule, primary and secondary kinetic isotope effects, solvent isotopic effect and their importance in mechanistic studies.
4. **Stereochemistry:** Symmetry elements, symmetry operations. racemates, racemisation, resolution, pro-chirality, pro-stereoisomerism with suitable examples of one and two chiral centers. Regioselective, chemoselective and stereoselective reactions. Asymmetric induction, Cram's rule: Addition of nucleophile to carbonyl function. Aldol reaction (achiral-achiral).
5. **Photochemistry:** Principles of photochemistry, photochemical reactions of carbonyl compounds and olefins.

6. **Name reactions**: Wolff rearrangement, Birch reduction, Pinacol-pinacolone rearrangement, Baeyer Villiger oxidation, Michael addition, Robinson annulation, Curtius reaction, Wittig reaction, Mitsunobu reaction, dienone phenol rearrangement, benzidine rearrangement.

Suggested Readings:

1. *Organic Chemistry,* **I. L. Finar,** Vol. I and II, 5th Edition (1975), Reprinted in 1996, ELBS and Longman Ltd., New Delhi.
2. *A Guide Book to Mechanism in Organic Chemistry*, **Peter Sykes**, 6th Edition (1997), Orient Longman Ltd., New Delhi.
3. *Stereochemistry of Organic Compounds*, **D. Nasipuri**, 2nd Edition (1994), Wiley Eastern Ltd., New Delhi
4. *Stereochemistry of Organic Compounds,* **E.L. Eliel, S.H. Wilen and Mander**, (2004) Wiley Interscience, New York.
5. *Photochemistry and Pericyclic Reactions,* **Jagdamba Singh and Jaya Singh** *2nd edition.*(2012) New Age International (P) Ltd. Publishers, New Delhi
6. *Organic Chemistry,* **J. Clayden, N. Greeves, S. Warren, and E. Wothers**, (2001) Oxford Univ. Press, Oxford.

CHB- 504 Physical Chemistry III **Credits : 3**

1. **Thermodynamics of Solutions:** Partial molal quantities, chemical potential of a mixture of ideal gases, Gibbs-Duhem equation, chemical potential of real gases and fugacity, activity and activity coefficient, variation of fugacity with temperature and pressure, Lewis-Randall rule, thermodynamic functions of mixing (ΔG_{mix}, ΔS_{mix}, ΔV_{mix}, ΔH_{mix}), ideal solutions and their characteristic properties, Duhem-Margules equation and its applications, Henry and Raoult's laws, thermodynamics of colligative properties, relative lowering of vapour pressure, freezing point depression, elevation of boiling point and osmotic pressure, van't Hoff equation, measurement of osmotic pressure and determination of molecular weight of macromolecules.
2. **Surface and Photochemistry:** Gibbs Adsorption isotherm, Multi layer adsorption-BET equation (no derivation) and its application to surface area measurements; surface reactions: kinetics of unimolecular surface reactions, inhibition and activation energy, nature of surface. Kinetics of enzymatic reactions: Michaelis-Menten equation, effect of temperature and pH.

   Photochemical reactions: quantum efficiency, reasons for low and high quantum efficiency, kinetics of photochemical reactions: decomposition of HI, H_2-Br_2 reaction, photostationary state: dimerisation of anthracene, Stern-Volmer relation, chemical actinometers.
3. **Electrochemistry:** Theory of strong electrolytes: qualitative idea of Debye-Huckel theory of ion-ion interactions, Debye-Huckel limiting law for activity coefficient of ions in electrolyte solution (derivation not required), its modification for concentrated solutions, Debye-Huckel-Onsager (D-H-O) theory of electrolytic conductance: qualitative idea of electrophoretic and relaxation effects, D-H-O equation for conductance of electrolyte solutions, effect of high frequency and high field on conductance.

Suggested Readings:

1. *Physical Chemistry*, P. Atkins and J. De Paul, 8th Edition (2006), International Student Edition, Oxford University Press.
2. *Physical Chemistry*, K. J. Laidler and J. M. Meiser, 3rd Edition (International Edition, 1999), Houghton Mifflin Co., New York.
3. *Physical Chemistry*, I.N. Levine, 5th Ed., Tata McGraw Hill Pub. Co. Ltd., New Delhi.
4. Textbook of Physical Chemistry, K.L. Kapoor, vol. 5th (2005), Macmillan India Ltd, New Delhi.

CHB-505 Environmental & Nuclear Chemistry Credits : 4

Section A : Environmental Chemistry Credits: 2

Concept and scope of environmental chemistry, Pollution versus contamination, Receptor, Sink, and pathways of a pollutant. Terminology (DO, BOD, COD, TLV) used in environmental analysis and their estimation, Environmental segments: atmosphere, hydrosphere, lithosphere and biosphere. Natural cycles of the environment: hydrological cycle, oxygen cycle, nitrogen cycle, phosphate cycle and sulphur cycle. Atmospheric pollution, Source of air pollution, Global warming, Ozone-hole, Auto exhaust emission and its prevention. Air quality parameters, EL-Nino phenomenon, Water pollution, Acid rains, Waste –water treatment : domestic and industrial effluents, Fluoresis, Arsenic, mercury and MIC poisoning. Current environmental issues in the national and global context.

Suggested Readings:

1. *Environmental Chemistry'*, A.K. De, 3rd edition (1994), Willey Eastern, New Delhi.

Section: B Nuclear Chemistry Credits: 2

1. **Nuclear Chemistry**: Classification of nuclides, nuclear stability and binding energy, atomic energy. Radioactivity: general characteristics of radioactive decay kinetics, artificial radioactivity, detection and measurement of radioactivity: GM counter.
2. **Nuclear Reactions:** Types of nuclear reactions, conservation of linear momentum and mass- energy in nuclear reactions, nuclear reaction cross section. Compound nucleus theory and its experimental verification. Nuclear fission process, fission energy**.**
3. **Radio chemistry:** Probing by isotopes, preparation of radioisotopes, radiochemical principles in use of tracers, some typical applications: chemical, physicochemical and analytical applications, age determination.
4. **Radiation Chemistry:** Interaction of nuclear radiations with matter- charged particle, neutrons and gamma rays. Radiolysis of water and aqueous solutions, radiation dosimetry.

Suggested Readings:

1. *Essentials of Nuclear Chemistry*, H.J. Arnikar, 4th Edition, (2003) New Age International Publishers, New Delhi.

CHB-506 Inorganic Chemistry Practical Credits : 2

1. Chromatographic separation of metal ions.
2. Gravimetric estimation of Cations/Anions.

CHB-507: Organic Chemistry Practical Credits: 2

1. Systematic identification of organic compounds (monofunctional and bi-functional) and preparation of their derivatives.

CHB-508: Physical Chemistry Practical Credits: 2

1. Viscosity-composition curve for a binary liquid mixture.
2. Surface tension-composition curve for a binary liquid mixture.
3. Determination of indicator constant - colorimetry.
4. Determination of pH of a given solution using glass electrode.
5. Beer's Law - Determination of concentration of solution by colorimetry
6. Order of reaction of I2 / Acetone / H+.
7. Equilibrium constant of methyl acetate hydrolysis reaction

Note : Experiments may be added/deleted subject to availability of time and facilities.

Semester-VI

CHB-601 Analytical Chemistry-II **Credits : 3**

1. **Solvent Extraction:** Distribution law, Single extraction, Multiple extraction, Craig concept of counter-current distribution, Important solvent systems: chelate extraction, synergic extraction, extraction by solvation, ion-pair extraction
2. **Chromatography:** Classification of chromatographic methods, General principle and applications of adsorption, partition, ion exchange, thin layer, and paper chromatography.
3. **Radio-Analytical Methods:** Elementary theory, Isotope dilution and Neutron activation methods and applications.
4. **Spectrophotometry:** Beer's law and it's application, Nomenclature and units, General instrumentations for spectrophotometry, Spectrophotometric determinations of one Component (iron, chromium, manganese, nickel, titanium and phosphorus) and two components (overlapping and non overlapping) systems, Spectrophotometric determination of dissociation constants of indicator, Photometric errors and RINGBOM-AYRES plots.

Suggested Readings:

1. *Principles of Instrumental Analysis*, D.A. Skoog, F.J.Holler and T.A. Nieman, , 5th edition (l998), Horcourt Brace & Company, Florida.
2. *Analytical Chemistry*, G.D. Christian, (2001) John Willey & sons, New York. *Instrumental Methods of Analysis'*, H.H. Willard, L.L. Merritt, and J.A.Dean, 6th Edition (l986), CBS Publishers & Distributors, Shahdara, Delhi.
3. *Modem Methods of Chemical Analysis*, R.L. Pecscock, L.D. Shields, T .Cairns, and I.C. Mc William, 2nd Edition (l976), John Willey, New York.

CHB-602 Inorganic Chemistry-IV **Credits : 3**

1. ***Magnetic Properties of Transition Metal Complexes*:** Types of magnetic behaviour, methods of determining magnetic susceptibility, *L-S* and *J-J* coupling, orbital contribution to magnetic moments. Correlation of magnetic moment data and stereochemistry of Co(II) and Ni(II) complexes; anomalous magnetic moments.
2. ***Chemistry of Second and Third Transition Series:*** A general comparative treatment of 4*d* and 5*d* elements with their 3*d* analogues in respect of ionic radii, oxidation states, complex formation tendency. magnetic behaviour and electronic spectral properties.
3. ***Chemistry of f-block Elements*:** Brief account of separation of lanthanide and actinides (ion-exchange method). Complexation tendency of lanthanides. Comparative study of actinide elements with respect to electronic configuration, atomic and ionic radii, oxidation states and complex formation;
4. **Bioinorganic Chemistry**: Essential and trace elements in biological processes, oxygen transport with reference to haemoglobin and myoglobin; synthetic models of **O2** carriers, Biological role of alkali metal ions, Vitamin **B12**

Suggested Readings:

1. *Concise Inorganic Chemistry,* **J. D. Lee**, 5th Edition (1996), Chapman & Hall, London.
2. *Inorganic Chemistry*, **J.E. Huheey, E.A. Keiter and R.L. Keiter**. , 4th Edition (2006), Addison Wesley Publishing Co, NY.
3. *Modern Inorganic Chemistry,* **R. C. Aggarwal**, 1st Edition (1987), Kitab Mahal, Allahabad.
4. *Basic Inorganic Chemistry,* **F. A Cotton, G. Wilkinson**, **and Paul L. Gaus**, 3rd Edition (1995), John Wiley & Sons, New York.
5. *Inorganic Chemistry,* **A. G. Sharpe**, 3rd International Student Edition (1999), ELBS / Longman,U.K.
6. *Inorganic Chemistry,* **D. F. Shriver and P. W. Atkins**, 3rd Edition (1999), ELBS, London
7. *Elements of magnetochemistry*, **R.L. Dutta and A. Syamal,** (1993) Affiliated East-West Press P.Ltd.

CHB-603 Organic Chemistry-V Credits : 3

1. **Amino acids and Peptides:** Amino acids - preparations, physical properties, dipolar nature, chemical reactions and configuration. *Peptides:* peptide linkage, peptide synthesis and structure of poly peptides. *Proteins:* General characteristics and secondary structure.
2. **Carbohydrates:** Sucrose and cellulose (Structural aspects only).
3. **Polymers:** Types of polymers and polymerization process: Addition (radical, ionic), step growth (condensation) and stereo controlled (coordination) polymerization mechanisms. Synthesis and uses of following polymers: (i) Plastics: PVC, PE and Teflon, (ii) Specialty polymers: Conducting & electroluminescent (Organic light emitting diodes), Liquid crystals (iii) Natural and synthetic rubber (iv) Fibers: Rayon, Polyester, Polyamides (v) Foaming agent and plasticizers (vi) Biodegradable polymers.
4. **Terpenes:** Occurrence, isolation, classification. Isoprene rule. Structure and synthesis of Citral and α–terpinol.
5. **Vitamins and harmones?** Chemical constitution and synthesis of vitamin A, vitamin C and thyroxin.
6. **Heterocyclic compounds:** Synthesis and chemistry of indole and quinoline.

Suggested Readings:

1. *Organic Chemistry*, ***I.* L. Finar**, Vol. I & II, 5th Edition (1975) Reprinted in 1996, ELBS and Longman Ltd, New Delhi
2. *Organic Polymer Chemistry,* **K. J. Saunders**, 2nd Edition (1988), Chapman & Hall, London
3. *Introduction to Synthetic Polymers*, **Ian M. Campbell**, 2nd Edition (2000), Oxford University Press, USA
4. *Principles of Polymer Science*, **P. Bahadur and N.V. Sastry**, (2002) Narosa, New Delhi.
5. *Heterocyclic Chemistry: Syntheses, Reactions and Mechanisms*, **R.K. Bansal**, 3rd Edition (1999), New Age International, Publisher, New Delhi

CHB 604 Physical Chemistry-IV Credits : 3

1. **Quantum Mechanics of Simple Systems:** Schrödinger's wave equation, eigen functions, eigen values and quantum mechanical operators, expectation value of a physical quantity, orthogonality of wave functions, the particle in a one dimensional box problem and its solutions, particle in a three dimensional box, degeneracy, rigid rotor and harmonic oscillator.
2. **Molecular Spectroscopy:** Region of electromagnetic spectrum, emission and absorption spectra, signal to noise ratio and resolving power, width and intensity of spectral transitions, pure rotational spectra, diatomic rigid rotor molecules, effect of isotope substitution, vibrational and vibration- rotational spectra of diatomic molecules, harmonic oscillator-rigid rotor approximation, anharmonicity effect, normal modes of vibration, infrared spectra of linear and bent AB_2 molecules, electronic spectra of diatomic molecules, vibrational structure, Franck-Condon principle.
3. **Nuclear Magnetic Resonance Spectroscopy:** Introduction, chemical shifts, spin-spin splitting, relaxation times.
4. **Molecular Statistics:** The Boltzmann distribution, Maxwell distribution law for distribution of molecular speeds, Maxwell-Boltzmann distribution law for the distribution of molecular energies, partition functions, thermodynamic quantities from partition functions, Sackur-Tetrode equation for molar entropy of monatomic gases, rotational and vibrational partition functions, calculation of Gibbs free energy changes and equilibrium constant in terms of partition functions.

Suggested Readings:

1. Physical Chemistry - A Molecular Approach, D. A. Mc Quarrie and J. D. Simon, South Asian Edition (1998), University Science Books, Sausalito CA, by Viva Books, New Delhi.

2. Physical Chemistry, I.N. Levine, 5th Ed.(2010), Tata McGraw Hill Pub. Co. Ltd., New Delhi.

3. Physical Chemistry, P. Atkins and J. De Paul, 8th Edition (2006), International Student Edition, Oxford University Press.

4. Physical Chemistry, K. J. Laidler and J. M. Meiser, 3rd Edition (International Edition, 1999), Houghton Mifflin Co., New York.

CHB-605 Atomic and Molecular Structure and Spectroscopic Techniques Credits : 4

Section (A) Atomic and Molecular Structure: Credits 2

1. **Atomic Structure:** The Hydrogen atom, atomic orbitals, variation theorem, He-atom, electron spin, Slater determinant, antisymmetry rule and Pauli's exclusion principle.
2. **Molecular Symmetry:** Symmetry elements and operations, point groups, symmetry species of H_2O molecule.
3. **Molecular Structure:**Hydrogen molecule ion, LCAO- MO approach, molecular orbitals, diatomic MOs, VB approach, hybridization.

Suggested Readings:

1. Physical Chemistry by P.W. Atkins and J. De Paula, 8th Ed.(2006), Oxford University Press.
2. Physical Chemistry - A Molecular Approach, D. A. Mc Quarrie and J. D. Simon, South Asian Edition (1998), University Science Books, Sausalito CA, by Viva Books, New Delhi.
3. Physical Chemistry, I.N. Levine, 5th Ed.(2010), Tata McGraw Hill Pub. Co. Ltd., New Delhi.

Section (B) Applications of spectroscopic techniques: Credits 2

1. **UV-Vis spectroscopy:** π-π^* and n-π^* transitions, effects of substituents, conjugation and solvent polarity, effect of chain length on λ_{max} and ε_{max} of conjugated polyenes and polyones, Woodward- Feiser rules for calculating $\lambda_{max.}$ in conjugated systems.
2. **IR spectroscopy:** Molecular vibrations and IR absorption, the functional group and fingerprint regions, effect of bond orders on C-C, C-O, C-N bands, ring size and electronic effects on C=O bands using examples like 2-pentanone, 2-cyclohexanone, 2-Cyclopentanone, 2-cyclohexenone, 2-pentenone, acetophenone, methyl phenylacetate, ethylbenzoate, ethyl acetoacetate, O-H band and dilution effect in benzoic acid and an alcohol.
3. **NMR spectroscopy:** The chemical shifts and its scale, ^{1}H-^{1}H coupling and splitting pattern with examples (ethyl bromide, 1,2,2-trichloro ethane, n-propyl iodide), Interpretation of NMR spectra of limonene, [18]-annulene, acetaldehyde, benzaldehyde, methyl *p*-toluate, ethanol, phenol, methyl salicylate, salicylaldehyde, *o*-hydroxy acetophenone, acetylacetone, phenylacetic acid, *o*-chloro aniline and N-methyl acetamide, ^{13}C NMR chemical shifts and its scale, ^{1}H decoupled ^{13}C NMR spectra of fullerene, 1- and 2-butanols, methylbenzoate and phenylacetate.
4. **Mass spectrometry:** The mass spectrometer**,** EI and CI techniques, the mass spectra of straight and branched chain alkanes, the molecular ion, base and isotope peaks, fragmentation pattern of alkyl halides, ethers, alcohols and ketones, Mc Lafferty rearrangement.

Suggested Readings:

1. *Application of Absorption Spectroscopy of Organic Compounds*, J. R. Dyer, (1978) Prentice Hall, New Delhi.
2. *Organic Chemistry*, P.Y Bruice, 2nd Edition (1998) Prentice – Hall, New Delhi.
3. *Organic Reactions and their Mechanisms*, P.S. Kalsi, 1st Edition (1996), New Age International Publication, New Delhi.
4. *Organic Spectroscopy*, W. Kemp, 3rd Ed., (1991), Macmillan, London.

CHB 606 Inorganic Chemistry Practical **Credits : 2**

Preparation of coordination compounds.

Spectral and magnetic characterization of compounds

CHB 607 Organic Chemistry Practicals **Credits : 2**

Preparation of the following compounds: Suphanilic acid, dibenzal acetone, methyl orange, aspirin, m-dinitrobenzene from benzene, synthesis of azalactone, phthalimide, Identification of organic functional groups by I.R. spectroscopy.

CHB 608 Physical Chemistry Practicals **Credits : 2**

Dissociation constants of weak acid and base.

Conductometric titration: acid-base.

Potentiometric titration: acid-base.

Kinetics of catalytic decomposition of H_2O_2.

Kinetics of acid-catalysed hydrolysis of sugar (chemical method).

Determination of relative strengths of two acids by studying the kinetics of acid- catalysed ester hydrolysis.

Kinetics of enzymatic reaction (starch-amylase system).

Note: Experiments may be added/deleted subject to availability of time and facilities.

BANARAS HINDU UNIVERSITY

Department of Computer Science

Faculty of Science

SYLLABI

B.Sc. (Hons.) Programme
in
Computer Science

B.Sc. (Hons.) Computer Science Syllabus

Semester-wise Distribution of Courses and Credits

SEMESTER I		
Course Code	***Course Title***	***Credits***
BCS 101	Introduction to Computer Programming through C	4
BCS 102	*Lab. Exercises based on course BCS 101*	2
	Total	***6***
SEMESTER II		
BCS 201	Digital Logic and Circuits	4
BCS 202	*Basic Linux lab*	2
BCS 203A	Fundamentals of Computers	2
	Total	***8***
SEMESTER III		
BCS 301	Numerical Computing	4
BCS 302	*Lab. Exercises based on course BCS 301*	2
	Total	***6***
SEMESTER IV		
BCS 401	Computer Organization and Architecture	4
BCS 402	*Lab. Exercises based on course BCS 401*	2
BCS 403A	Fundamental of Computing	2
	Total	***8***
SEMESTER V		
BCS 501	Net Centric Computing	4
BCS 502	Operating System Concepts	4
BCS 503	Discrete Mathematical Structures	4
BCS 504(A-C)	Any one of the following Major Elective Course: A: System Analysis and Design B: Operation Research C: Graph Theory and Combinatorics	4
BCS 505	*Web Design Lab*	3
BCS 506	*Lab. Exercises based on course BCS502*	3
	Total	***22***
SEMESTER VI		
BCS 601	Database Management Systems	4
BCS 602	Data Structures	4
BCS 603	*Lab. Exercises based on course BCS601*	3
BCS 604	*Lab. Exercises based on course BCS602*	3
BCS 605	*Project*	8
	Total	***22***
	Grand Total	***72***

Detailed Curriculum

SEMESTER - I

BCS 101 Introduction to Computer Programming through C Credits: 4

Basic Programming Concepts: Problem solving steps using Computer.

Introduction to Programming Language C: Overview of C language, Lexical elements of C, Data Types, managing input/output operations, Operators and Hierarchy of Operations, Expressions in C, Decision Making and Repetitive Statements, break, continue, Array, Pointers, dynamic memory allocation, String handling, Functions: User Defined Functions and Library Functions, Parameter Passing, Storage Classes, enumerated data types, Command line arguments, C Preprocessors, Union & Structures, File handling in C.

Suggested Readings:

1. B.W. Kernighan and D.M.Ritchie, the C Programming Language, PHI.
2. R.C. Hutchinson and S.B. Just, Programming using the C Language, McGraw-Hill.
3. B.S. Gottfried, Schaum's Outline of Theory and Problems of Programming with C, McGraw-Hill.
4. H. Schildt, C Made Easy, Osborne McGraw-Hill.
5. Y. Kanetkar, Let Us C, BPB Publications.

BCS 102 Lab. Exercises based on course BCS101 Credits: 2

Programming exercises based on course BCS101.

SEMESTER - II

BCS 201 Digital Logic and Circuits Credits: 4

Number System: Binary, Octal, and Hexadecimal numbers; Fixed and Floating Point Number Representations, number base conversion, Complements, Binary Arithmetic: Addition, Subtraction, Multiplication and Division, Binary Codes.

Boolean algebra and Logic Gates: Introduction to Boolean algebra, laws of Boolean algebra, logic gates, universal logic gates, POS and SOP notations, Canonical logic forms, Logic families.

Simplification of Boolean Functions: Laws of Boolean algebra and K-Maps, Tabulation Method.

Combinational Circuits: Design Procedure of Combinational Circuits, Adders, Subtractors, Code Converters, Magnitude Comparator, Encoder, Decoder, Multiplexer, Demultiplexer, ROM, PLAs, PALs.

Sequential Circuits: Flip-Flops: SR, D, JK, T, Master/Slave F/F, Edge-trigerred F/F, Excitation Tables; Registers, Counters: synchronous and asynchronous, Shift Registers, RAM.

Logic Families: TTL, ECL, E^2L, CMOS, Characteristics of different logic families.

Suggested Readings:

1. M. M. Mano, Digital Logic and Computer Design, PHI.
2. M.M.Mano, Computer System Architecture, PHI.
3. M.M.Mano, Digital Design, Pearson Education.
4. M. M. Mano and C. R. Kime, Logic and Computer Design Fundamentals," 3rd ed., Prentice Hall, 2004.
5. Malvino, Leach, Digital Principles and Applications, McGraw-Hill.
6. V. Rajaraman, T. Radhakrishnan, An Introduction to Digital Computer Design, PHI, 2006.
7. Thomas C. Bartee, Digital Computer Fundamentals, McGraw-Hill.
8. B. Streetman, Integrated Digital Circuits, PHI

BCS 202 Basic Linux Lab Credits: 2

Basic Linux commands, vi editor and elementary Shell programming

BCS 203A Fundamentals of Computers Credits: 2

Introduction to Computer, Computer Generation and Classification, Computer System Hardware, Computer Memory and Storage Devices, Random Access Memory, Read Only Memory, Serial Access Memory, Input and Output Devices, Data Representation, Types of Software, Introduction to Operating System: History and Evolution and Main functions, Fundamentals of Database: Purpose and Organization of Database.

Suggested Readings:

1. V.Rajaraman, Fundamentals of Computers, PHI.
2. A.Goel, Computer Fundamentals, PHI.

SEMESTER - III

BCS 301 Numerical Computing Credits: 4

Errors in Computer Arithmetic, Normalization.

Bisection, Falsiposition and Newton-Raphson methods for solution of nonlinear equations. Errors in the solutions, Convergence of Solutions.

Gauss, Gauss-Siedel and Iterative methods for system of linear equations. Ill conditioned system, Pivotal Condensation, Matrix Inversion, Eigen-values, Eigen-vector, Diagonalization of Real Symmetric Matrix by Jacobi's Method.

Introduction to Finite Differences.

Polynomial Interpolation using Newton's and Lagrange's formulae.

Numerical Differentiation: Numerical Integration: Trapezoidal Rule, Simpson's Rule, Weddle's Rule, Gauss Quadrature Formula. Error in numerical Integration.

Numerical Solution of differential Equations: Picards Method, Taylor's Series Method, Euler's Method, Modified Euler's Method, Runge-Kutta Method, Predictor-Corrector Method.

Note: Emphasis is on computational methods

Suggested Readings:

1. V. Rajaraman, Computer Oriented Numerical Methods, PHI.
2. F. Acton, Numerical Methods that Work, Harper and Row.
3. S.D. Conte and C.D.Boor, Elementary Numerical Analysis, McGraw Hill.
4. S. S. Shastri, ''Introductory Methods of Numerical Analysis'', PHI.
5. C. F. Gerald and P.O. Wheatley Applied Numerical Analysis, Addison Wesley.

BCS 302 Lab. Exercises based on course BCS301 Credits: 2

Programming exercises based on course BCS-301

SEMESTER - IV

BCS 401 Computer Organization and Architecture Credits: 4

Basic Organization: Von Neumann Machine (IAS Computer), Operational flow chart (Fetch, Execute), Instruction Cycle, Organization of Central Processing Unit, Hardwired & micro programmed control unit, Single Organization, General Register Organization, Stack Organization, Addressing modes.

Memory Organization: Memory Hierarchy, Main memory (RAM/ROM chips), Associative memory, Cache memory, Virtual Memory, Memory Management Hardware.

I/O Organization: Peripheral devices, I/O interface, Modes of Transfer, Priority Interrupt, Direct Memory Access, Input-Output Processor, and Serial Communication. I/O Controllers, Asynchronous data transfer, Strobe Control, Handshaking.

Instruction Formats, Op Codes Mnemonics, Data Transfer, Arithmetic, Branch, Loop, Logical, Shift and Rotate Instructions, and String Instructions.

Stacks, Calls, Returns, Near and Far Procedures, Interrupts and their Routines, Directives, Pseudo-ops, Macros and Conditional Machine Instructions, Disk File Handling, Input and Output Instructions, Device Drivers.

Suggested Readings:

1. Y.C. Liu and G.A. Gibson : Microcomputer System – 8086/8088 Family (P.Hall)
2. P. Abel : IBM PC Assembly Language Programming (PHI)
3. M. Thorn : Programming the 8086/8088 (Benjamin)
4. J.P. Hayes, Computer Architecture and Organization, 3rd ed., McGraw Hill.
5. M. M. Mano, Computer System Architecture, PHI.
6. M. M. Mano, Digital Logic and Computer Design (PHI).
7. V. Rajaraman, T. Radhakrishnan, An Introduction to Digital Computer Design, PHI, 2006.
8. William Stallings, Computer Organization and Architecture: Designing For Performance, Prentice Hall, 2005.

BCS 402 Lab. Exercises based on course BCS401 Credits: 2

Programming exercises based on course BCS401

BCS 403A Fundamentals of Computing Credits: 2

Introduction: Characteristics of Computers, Evolution of Computing, Binary Number Systems, Types of Computer Software, Software Development Steps, Types of Programming Languages, Internet Evolution, Basic Internet Terminology, Getting Connected to Internet Applications. Problem Solving Techniques using Computers: Algorithm, Flow Charts, Pseudocode.

Suggested Readings:

1. E Balagurusamy: Computing Fundamentals & C programming, TMH.
2. A.P. Godse and D.A. Godse: Fundamental of Computing and Programming (Technical Publications).

SEMESTER - V

BCS 501 Net Centric Computing Credits: 4

Data Communication and Networking: Background and history of networking and the Internet, Network architectures, Network standards and standardization bodies, The ISO 7-layer reference model in general and its instantiation in TCP/IP; Circuit switching and packet switching, Streams and Datagrams.

Physical layer networking concepts (theoretical basis, transmission media, standards);Data link layer concepts (framing, error control, flow control, protocols); Internetworking and routing (routing algorithms, internetworking, congestion control); Transport layer services (connection establishment, performance issues).

Applications, Protocols at the application layer; Domain names and name services, Issues for Internet service providers (ISPs), Network Security, Overview of the issues of network management, Quality of service issues: performance, failure recovery, and World Wide Web.

Suggested Readings:

1. Comer, Douglas E. Computer Networks and Internets with Applications, 3/e Prentice Hall 2001.
2. Peterson & Davie *Computer Networks 2nd ed.* Morgan Kaufman 2000.
3. Stallings, William *Data & Computer Communications 7th ed.* Prentice-Hall 2003.
4. Tanenbaum, Andrew *Computer Networks* 4th ed. Prentice-Hall 2002.

BCS 502 Operating System Concepts Credits: 4

Introduction: Definition, Design Goals, Evolution; Batch processing, Multi-programming, Time sharing; Structure and Functions of Operating System.

Process Management: Process states, State Transitions, Process Control Structure, Context Switching, Process Scheduling, Threads.

Memory Management: Address Binding, Dynamic Loading and Linking Concepts, Logical and Physical Addresses, Contiguous Allocation, Fragmentation, Paging, Segmentation, Combined Systems, Virtual Memory, Demand Paging, Page fault, Page replacement algorithms, Global Vs Local Allocation, Thrashing, Working Set Model, Paging.

Concurrent Processes: Process Interaction, Shared Data and Critical Section, Mutual Exclusion, Busy form of waiting, Lock and unlock primitives, Synchronization, Classical Problems of Synchronization, Semaphores, Monitors, Conditional Critical Regions, System Deadlock, Wait for Graph, Deadlock Handling Techniques: Prevention, Avoidance, Detection and Recovery.

File and Secondary Storage Management: File Attributes, File Types, File Access Methods, Directory Structure, Allocation Methods, Free Space management; Disk Structure, Logical and Physical View, Disk Head Scheduling, Protection & Security.

Suggested Readings:

1. Silberschatz and Galvin, Operating System Concepts 6/ed, Addison Wesley.
2. William Stalling, Operating Systems: Internals and Design Principles 5/ed, PHI.
3. Tanenbaum, Modern operating Systems, PHI.
4. Peterson and Silberschatz, Operating System Concepts, Addison Wesley.
5. P. B. Hansen, Operating System Principles, PHI.
6. A. N. Haberman, Introduction to Operating System Design, Galgotia.

BCS 503 Discrete Mathematical Structures Credits: 4

Sets, Relations & Functions: Property of binary relations, equivalence, compatibility, partial ordering relations, hasse diagram, functions, inverse functions, composition of functions, recursive functions.

Mathematical Logic: Logic operators, Truth tables, Theory of inference and deduction, mathematical calculus, predicate calculus, predicates and quantifiers.

Boolean Algebra: Truth values and truth tables, the algebra of propositional functions, Boolean algebra of truth values.

Combinatorics & Recurrence Relations: Permutation, Combination, Principle of Inclusion and Exclusion, Recurrence Relations, Generating Functions

Graph theory: Basic Concepts of Graphs and Trees, Adjacency and Incidence Matrices, Spanning Tree, Transitive Closure, Shortest Path, Planar Graphs, Graph Coloring, Eularian and Hamiltonian graphs, Applications of Graph Theoretic Concepts to Computer Science

Suggested Readings:

1. J.P. Trembley and R.P. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw Hill.

2. Dornhoff and Hohn, Applied Modern Algebra, McMillan.
3. N. Deo, Graph Theory with Applications to Engineering and Computer Science, PHI.
4. R. Johnsonbaugh, Discrete Mathematics, Pearson Education, 2001.
5. R. P. Grimaldi, Discrete and Combinatorial Mathematics, Pearson Education, 1999.
6. C.L. Liu, Elements of Discrete Mathematics, McGraw-Hill.
7. Rosen, Discrete Mathematics, Tata McGraw Hill.

BCS 504A System Analysis and Design **Credits: 4**

Introduction to System Software: Software crisis, Software Characteristics, Development life cycle, Specification, Analysis, Design, Implementation and Testing.

Modular top-down analysis, design and testing, Project Feasibility, System Requirements Analysis, Fact Finding Techniques, Data Flow Diagram, Data Dictionary, Decision Tree, Decision Tables, Structured English, Systems Proposal.

System Design, CASE tools for system analysis and design, data modeling and process modeling (data flow diagrams, entity relationship diagrams), traditional and prototyping approaches, Object-Oriented Analysis and Modeling, design and development of relational database systems. I/O design, input validation and user interface design (GUI).

Suggested Readings:

1. Elias M. Awad, Systems Analysis and Design, McGraw-Hill Professional.
2. Jeffery L. Whitten, Lonnie D. Bentley and Kevin C. Dittman, Systems Analysis and Design Methods, McGraw-Hill.
3. Kenneth E. Kendall, Systems Analysis and Design, Pearson Education.
4. Valacich Joseph S., George Joey F., Hoffer Jeffrey A, Essentials of Systems Analysis And Design, Prentice Hall of India.
5. V. Rajaraman, "System Analysis and Design", Prentice Hall.
6. J.A. Sern, "Analysis & Design of Information System", McGraw Hill.

BCS 504B Operation Research **Credits: 4**

Network Analysis: Terminology of network, shortest route problem, minimal spanning tree problem and max-flow problem.

Project Scheduling by PERT, CPM: Diagram, representation, critical path calculation, construction of time chart and resource labeling, probability and cost consideration in project scheduling, project control.

Linear Programming: Simplex method, Revised simplex method, Duality in Linear programming, Application of Linear Programming to Economic and Industrial Problems.

Nonlinear Programming: The Kuhn-Tucker conditions, Quadratic programming, Convex programming.

Replacement Models: Introduction, Replacement policies for items whose efficiency deteriorates with time, Replacement policies for items that fail completely.

Sequencing Model: Classification of self problems, processing of n jobs through two machines, three machines, processing of two jobs through m machines.

Suggested Readings:

1. Taha, Operations Research, Macmillan.
2. B.E. Gillet, Introduction to Operations Research, McGraw-Hill.
3. S.S. Rao, Optimization Theory and Applications, Wiley Eastern.
4. G. Hadley, Linear programming, Addison-Wesley.

BCS 504C Graph Theory and Combinatorics **Credits: 4**

Graph Theory: Basic definitions, Trees, cycles, bipartite graphs and other basic concepts. Matchings in bipartite graphs; Hall's theorem and its variants. Euler circuits and Hamilton cycles. Turan's theorem. Planar graphs; the five colour theorem.

Combinatorics: Introduction to combinatorics, The Pigeonhole Principle, Permutations and Combinations Binomial identities, combinatorial proofs, binomial and multinomial theorems. The Principle of Inclusion and Exclusion, permutations with forbidden positions, circular permutations with forbidden relations.

Suggested Readings:

1. Richard A. Brualdi, Introductory Combinatorics, Prentice Hall, 4 edition, 2004.
2. Behzad M. and G. Chartrand, Introduction to the Theory of Graphs. Allyn and Bacon Inc., Boston.
3. G. Chartrand and L. Lesniak, Graphs and Digraphs, Chapman & Hall/CRC, 4 edition, 2004.
4. Bondy J.A. and U.S. R. Murty, Graph Theory with Applications, The Macmillan Press Ltd.
5. Deo Narsingh, Graph Theory with Applications to Engineering and Computer Science, Prentice-Hall, India, 1994.
6. Harary F., Graph Theory, Addison-Wesley publishing Co.
7. Swamy M. N. Sand K. Thulasiraman, Graphs, Networks and Algorithms, The wiley Inter-Science publication.
8. Wilson R.J., Introduction to Graph Theory, Addison Wesley; 4th edition, 1996.
9. Peter J. Cameron, Combinatorics: Topics, Techniques, Algorithms, Cambridge University Press, 1995.

BCS 505 Web Design Lab **Credits: 3**

Creation of simple static and dynamic web pages using HTML, DHTML, Java Script

BCS 506 Lab. Exercises based on course BCS502 **Credits: 3**

This practical paper would carry the exercises based on course BCS502

SEMESTER - VI

BCS 601 Database Management Systems **Credits: 4**

Introduction: Database Systems, View of Data Models, Database Languages, DBMS Architecture, Database Users and Data Independence.

ER Modeling, relation types, role and Structural Constraints, Extended ER Modeling Features, Design of an ER Database Schema, Reduction of ER Schema to Tables.

Relational Model: Relational Model Concepts, Relational Algebra.

Introduction to SQL: SQL data types and literals, Types of SQL commands, SQL operators, Tables, views and indexes, Queries and sub queries, Aggregate functions.

Relational Database Design: Functional Dependencies, Desirable Properties of Decomposition, Normalization up to 3 NF and BCNF.

Selected Database Issues: Security, Transaction Management, Introduction to Query Processing and Query Optimization, Concurrency Control, and Recovery Techniques.

Suggested Readings:

1. C.J.Date, An Introduction to Database Systems, Vol I & II, Addison Wesley.
2. Korth Silberschatz, Data Base System Concepts, 4th ed., McGraw Hill.
3. J.D.Ullman, Principles of Database Systems, Golgotha, New Delhi.

4. Wiederhold, Database Design, McGraw Hill.
5. R. Elmasri, and S.B. Navathe, Fundamentals of Database Systems, Pearson Education Asia.
6. Raghu Ramakrishnan, Database Management Systems, McGraw-Hill Education.

BCS 602 Data Structures Credits: 4

Basic Data Structures: Arrays, Stacks, Queues, dequeue, Linked Lists, Trees, AVL tree, Priority Queues, and Heap. Basic algorithms for Creation, Manipulation and Applications of Data Structures

Hashing: Hash Functions, Hash Table, and Collision Resolution Techniques.

Algorithmic Complexity: Time-Space trade-off, and Asymptotic notations.

Searching Algorithms: Linear Search and Binary search.

Sorting Algorithms: Selection, Bubble, Insertion, Quick, Merge and Heap Sort

Suggested Readings:

1. Lipshutz, Data Structure, McGraw Hill.
2. Standish, Data Structure, Addison-Wesley.
3. B. Salzberg, File Structures - An Analytic Approach, Prentice-Hall.
4. A.L. Tharp, File Organization and Processing, John Wiley and Sons.
5. M. Tennenbaum, Y. Langsam and M. J. Augenstein, Data Structures using C, PHI, 1996.
6. S. Lipschutz, Data Structure, Schaum Series.
7. D. E. Knuth, Fundamental Algorithms, Narosa Publication.
8. N. Wirth, Algorithms+Data Structures= Program, Prentice Hall.
9. Robert Lafore, Data Structures and Algorithms in Java, Sams..

BCS 603 Lab. Exercises based on course BCS601 Credits: 3

Programming exercises based on course BCS601

BCS 604 Lab. Exercises based on course BCS602 Credits: 3

Programming exercises based on course BCS602.

BCS 605 Project Credits: 8

Students will be required to undertake a project work allotted, according to their preference, subject to the approval of their supervisor. They will have to submit a report on the project work done by them at the end of the semester and the work is evaluated by a panel of examiners.

BANARAS HINDU UNIVERSITY

Department of Geography

Faculty of Science

SYLLABI

B.Sc. (Hons.) Programme
in
Geography

B.Sc. (Hons.) Geography Syllabus

Semester-wise Distribution of Courses and Credits

I SEMESTER

Paper Code	Explanation	Title of the Paper	Credit
GRB101	Theory	Physical Basis of Geography	4
GRB102	Practical	Map: Reading and Interpretation	2
Total		**Semester I**	**6**

II SEMESTER

Paper Code	Explanation	Title of the Paper	Credit
GRB 201	Theory	Human Geography	4
GRB 202	Practical	Elementary Statistics	2
GRB 203A*	Theory	Man and Environment **(Ancillary Course)**	2
Total		**Semester II**	**8**

III SEMESTER

Paper Code	Explanation	Title of the Paper	Credit
GRB 301	Theory	Economic Geography	4
GRB 302	Practical	Map Projection and Weather Map	2
Total		**Semester III**	6

IV SEMESTER

Paper Code	Explanation	Title of the Paper	Credit
GRB 401	Theory	Regional Study of Developed and Developing Countries: U.S.A. and China	4
GRB 402	Practical	Surveying	2
GRB 403A*	Theory	Basics of Remote Sensing **(Ancillary Course)**	2
Total		**Semester IV**	**8**

V SEMESTER

Paper Code	Explanation	Title of the Paper	Credit
GRB 501	Theory	Geomorphology	4
GRB 502	Theory	Geography of India	4
GRB 503	Practical	Representation of Geographical Data	4
GRB 504	Practical	Field Study, Field Trip and Report Writing	4
Students may select any ONE from the following Elective (Theory) Papers			
GRB 505	Theory	Population Geography*	4
GRB 506	Theory	Social Geography	4
GRB 507	Theory	Agricultural Geography	4
GRB 508	Assignment-based Seminar	Paper offered in V semester	2
Total		**Semester V**	**22**

* Currently GRB 505 Elective Paper Will Be Offered Only

VI SEMESTER

Paper Code	Explanation	Title of the Paper	Credit
GRB 601	Theory	Climatology	4
GRB 602	Theory	Evolution of Geographical Thought	4
GRB 603	Practical	Geological Map and Map Projection	4
GRB 604	Practical	Elementary Remote Sensing	4
Students may select any ONE from the following Elective (Theory) Papers			
GRB605	Theory	Regional Development and Planning *	4
GRB606	Theory	Political Geography	4
GRB607	Theory	Industrial Geography	4
GRB 608	Assignment-based Seminar	Paper offered in VI semester	2
Total	**Semester VI**		**22**

* Currently GRB 605 Elective Paper will only be offered.

Semester - I

GRB 101 **Theory, Paper: 1** Physical Basis of Geography **CREDITS: 4**

Number of Lectures: 52

Unit I

Origin of the earth (James and Jeffrey, Russell, Lytileton, Lemaitre); Interior of the earth; Rocks: origin and classification; Earth's movements.

Unit II

Major landforms: mountains, plateaus and plains; Gradational processes: weathering and erosion; Works of running water, glacier and wind.

Unit III

Composition and structure of the atmosphere; Insolation; Temperature: vertical and horizontal distribution; Pressure and pressure belts; Winds: planetary, periodic and local.

Unit IV

Theories of origin of ocean basin (Tetrahedral); Physical properties of sea water: temperature and salinity; Ocean currents; Tides and Coral reefs.

Suggested readings:

1. Barry, R. G. and Chorley, R. J. (1998): Atmosphere, Weather and Climate. Routledge, London.
2. Bryant, H. Richard (2001): Physical Geography Made Simple, Rupa and Company. New Delhi
3. Bunnett, R.B. (2003): Physical Geography in Diagrams, Fourth GCSE edition, Pearson Education (Singapore) Private Ltd.
4. Garrison, T. (1998): Oceanography, Wordsworth Company., Belmont.
5. Lake, P. (1979): Physical Geography (English and Hindi editions), Cambridge University Press, Cambridge.
6. Leong Goh Cheng (2003): Certificate Physical and Human Geography, Oxford University Press, New Delhi.
7. Monkhouse, F.J. (1979): Physical Geography. Methuen, London
8. Singh, S. (2003): Physical Geography. (English and Hindi editions.). Prayag Pustak Bhawan, Allahabad;
9. Trewartha, G.T., Robinson, A.H., Hammond, E.H., and Horn, A.T. (1976/1990): Fundamentals of Physical Geography, 3rd edition. MacGraw-Hill, New York.
10. Singh, M.B. (2001): *Bhoutik Bhugol,* Tara Book Agency, Varanasi
11. Strahler, A.N. and Stahler, A.M. (1992): Modern Physical Geography. John Wiley and Sons, New York.
12. Wooldridge, S.W. and Morgan, R.S. (1939): The Physical Basis of Geography- An Outline of Geomorphology. Longman, London. Recent edition and Reprint.

Semester - I

GRB 102 **Practical, Paper: 1 Map: Reading and Interpretation** **Credits : 2**

Number of Lectures : 52

Construction of scale: simple, diagonal and comparative; Map reading and Interpretation of topographic sheets, Relief features and profiles (serial, superimposed, projected and composite); Reduction and enlargement of maps.

Suggested readings:

1. Monkhouse, F. J. and Wilkinson, F.J. (1985): Maps and Diagrams. Methuen, London
2. Raisz, E. (1962): General Cartography. John Wiley and Sons, New York. 5th edition.
3. Sarkar, A. K. (1997): Practical Geography: A Systematic Approach. Orient Longman, Kolkata.

4. Sharma, J. P. (2001): *Prayogik Bhugol.,* Rastogi Publication, Meerut 3rd. edition.
5. Singh, R.L. and Singh, Rana P.B. (1993): Elements of Practical Geography. (Hindi and English editions). Kalyani Publishers, New Delhi,.
6. Singh, L.R. (2006): Fundamentals of Practical Geography, Sharda Pustak Bhawan, Allahabad.

Semester - II

GRB 201 Human Geography **Credits : 4**

Number of Lectures : 52

Unit I

Meaning, nature and scope of human geography; Concepts of human geography; Man-environment relationships: determinism, possibilism and probabilism, and environmentalism.

Unit II

Evolution of man; Classification of races; Characteristics of races and their broad distribution; Human adaptation to environment: Eskimo, Masai and Bushman; Primitive people of India: Tharu, Naga and Bhil.

Unit III

Growth of population; Distribution of population; Major human agglomerations; Types of Migration; Trends of Urbanization.

Unit IV

Rural settlements: characteristics, types and regional pattern; Urban settlements: evolution and classification; Rural houses in India: types, classification and regional pattern.

Suggested readings:

1. Chisholm, M. (1985): Human Geography, 2nd edition, Penguin Books, London.
2. de Blij, H.J.(1996): Human Geography: Culture, Society and Space,. 2nd edition. John Wiley and Sons, New York,
3. Fellman, J. D., Arthur, G., Judith, G., Hopkins, J. and Dan, S. (2007): Human Geography: Landscapes of Human Activities. McGraw-Hill, New York. 10th edition.
4. Haggett, P. (2004): Geography: A Modern Synthesis. 8th edition, Harper and Row, New York.
5. Hussain, M. (1994): Human Geography, Rawat Publications, Jaipur.
6. Johnston, R. J., Gregory, D., Pratt, G. and Watts, M. (2009): The Dictionary of Human Geography. 5th edition, Basil Blackwell Publishers, Oxford.
7. Kaushik, S.D. and Sharma, A.K. (1996): Principles of Human Geography (in Hindi), Rastogi Publication, Meerut.
8. Norton, W. (2008): Human Geography, Oxford University Press, New York. 5th ed.
9. Singh, K. N. and Singh, J. (2001): *Manav Bhugol*. Gyanodaya Prakashan, Gorakhpur. 2nd edition.
10. Singh, L.R. (2005): Fundamentals of Human Geography, Sharda Pustak Bhawan, Allahabad
11. Smith, D. M.(1977): Human Geography- A Welfare Approach, Edward Arnold (Publishers) Ltd., London
12. Stoddard, R.H., Wishart, D.J. and Blouet, B.W. (1986): Human Geography. Prentice-Hall, Englewood Cliffs, New Jersey.

Semester - II

GRB 202 Practical Elementary Statistics **Credits : 2**

Number of Lectures : 52

Sources of data; classification and Tabulation of data.

Measures of central tendency: mean, median and mode, and quartile.

Measures of dispersion: mean deviation, standard deviation.

Correlation (Karl Pearson and Spearman).

Suggested readings:

1. Bhagwathi, V. and Pillai, R.S.N. (2003): Practical Statistics, Sultan Chand and Company, New Delhi
2. Ebdon, D. (1977): Statistics in Geography: A Practical Approach, Blackwell Publishers Inc., Massachusetts
3. Gregory, S. (1973): Statistical Methods and the Geographer, Longman, London.
4. Gupta, S.P. (1998): Advanced Practical Statistics, Sultan Chand and Company, New Delhi
5. Mahmood, A. (1986): Statistical Methods in Geographical Studies, Rajesh Publications, New Delhi
6. Zamir, A. (2002): Statistical Geography: Methods and Applications, Rawat Publications, Jaipur.

GRB 203 A* Ancillary Theory Paper -Man and Environment Credits: 2

Unit I :

Evolution of Man; Human Race: Bases and classification; Human Adaptation in different environment: selected tribes.

Unit II :

Man's interaction in environment, Biomes: Meaning and types; Major Biomes: Rainforest, Savannah, Tundra.

Unit III :

Environment: Meaning and Components; Food Pyramid; Forms and Functions of Ecosystems: Terrestrial, Aquatic; Biodiversity; Climatic Change; Environmental Conservation and Management.

Suggested readings:

1. Chisholm, M. (1985): Human Geography, 2nd edition, Penguin Books, London.
2. de Blij, H.J.(1996): Human Geography: Culture, Society and Space,. 2nd edition. John Wiley and Sons, New York.
3. Johnston, R. J., Gregory, D., Pratt, G. and Watts, M. (2000): The Dictionary of Human Geography. 4th edition, Basil Blackwell Publishers, Oxford.
4. Kaushik, S.D. and Sharma, A.K. (1996): Principles of Human Geography (in Hindi), Rastogi
5. Odum, P. E. and Barret, W. G. (2005): Fundamentals of Ecology, Thomson Asia Pvt Ltd, Singapur.
6. Huggett, R. J. (1998): Fundamentals of Biogeography, Routledge, London.
7. Saxena, H. M. (2000): Environmental Management. Rawat Publications., Jaipur and New Delhi.

III Semester

GRB 301 Economic Geography Credits: 4

Number of Lectures: 52

Unit I

Meaning and approaches to economic geography; Main concepts of economic geography; Resource: concept and classification; Resource conservation.

Unit II

Natural resources: soil, forest and water; Mineral resources: iron ore and bauxite; Power resources: coal and petroleum; Principal crops: wheat, rice and cotton.

Unit III

Agricultural regions of the world (Derwent Whittlesey); Theory of agricultural location (Von Thunen); Theory of industrial location (Weber); Major industries: iron and steel, and cotton textiles.

Unit IV

World transportation: major trans-continental railways, and sea routes; WTO and International trade: patterns and trends; Major trade blocs: EEC, ASEAN; Effect of globalization on developing countries.

Suggested readings:

1. Alexander, J. W. (1988): Economic Geography. Prentice-Hall, New Delhi.
2. Bryson, J., Henry, N., Keeble, D. and Martin, R. (eds.) (1999): The Economic Geography Reader: Producing and Consuming Global Capitalism. John Wiley and Sons, Inc, New York.
3. Clark,G. L., Gertler, M. S. and Feldman, M. P. (eds.) (2000): The Oxford Handbook of Economic Geography. Oxford University Press, USA.
4. Coe, N. (2007): Economic Geography: A Contemporary Introduction. Blackwell Publishers, Inc., Massachusetts.
5. Gautam, A. (2006): *Aarthik Bhugol Ke Mool Tattava,* Sharda Pustak Bhawan, Allahabad.
6. Guha, J. S. and Chattoraj, P.R. (2002): A New Approach to Economic Geography: A Study of Resources. The World Press Private Limited, Kolkata.
7. Hanink, D. M. (1997): Principles and Applications of Economic Geography: Economy, Policy, Environment. John Wiley and Sons, Inc, New York.
8. Hartshorne, T. A. and Alexander, J. W. (1988): Economic Geography (3rd revised edition) Englewood Cliff , New Jersey, Prentice Hall
9. Hudson, R. (2005): Economic Geographies: Circuits, Flows and Spaces. Sage Publications, London.
10. Knowles, R, Wareing, J. (2000): Economic and Social Geography Made Simple, Rupa and Company, New Delhi.
11. Sokal, Martin 2011. Economic Geographics of Globalisation: A short Introduction. Cheltenham, UK : Edward Elgar

Semester - III

GRB 302 Practical - Map Projection and Weather Map Credits: 2

Number of Lectures: 52

Map Projection: Conical: simple conic with one and two standard parallels, Bonne's; Cylindrical: simple and equal area; Zenithal (Polar case): equidistant and equal area.

Weather Map: Weather symbols, Representation of atmospheric features, Interpretation of Indian daily weather maps (July, October and January)

Suggested readings:

1. Monkhouse, F. J. and Wilkinson, F.J. (1985): Maps and Diagrams. Methuen, London.
2. Raisz, E. (1962): General Cartography. John Wiley and Sons, New York. 5th edition.
3. Robinson, A., Sale, R. Morrison, J. and Muehrcke, P. C. (1984): Elements of Cartography, John Wiley and Sons, New York
4. Sarkar, A. K. (1997): Practical Geography: A Systematic Approach. Orient Longman, Kolkata.
5. Sharma, J. P. (2001): *Prayogik Bhugol*. Rastogi Publication, Meerut 3rd edition.
6. Singh, R.L. and Singh, Rana P.B. (1993): Elements of Practical Geography. (Hindi and English editions). Kalyani Publishers, New Delhi,

IV Semester

GRB 401 Regional Study of Developed and Developing Countries: USA and China **Credits: 4**

Number of Lectures: 52

Unit I

Concepts, bases and characteristics of developed and developing countries; Indicators and Levels of development: Developed, Developing, Under-developed, and Least-developed worlds.

Unit II

Physical resource base: landforms, climate, soils, vegetation, power and mineral resources

Unit III

Cultural resource base: population, agriculture, industries.

Unit IV

Agricultural and industrial regions of USA; Agricultural and geographical regions of China.

Suggested readings:

1. di Blij, H. and Muller, O. (1993): Geography: Regions and Concepts. John Wiley and Sons, New York..
2. Jackson, R. H. and Husman, L. E. (1991): World Regional Geography: Issues for Today. John Wiley and Sons, New York.
3. Jones, P. and Bryan, P. (1954): North America: An Historical, Economic and Regional Geography, Methuen and Company. Ltd, London.
4. Kolb, A. (1971): East Asia, China, Japan, Korea, Vietnam, Methuen, London.
5. Rai, Gayatri (2007): *Vishwa Ka Pradeshik Bhugol,* Mishra Trading Corporation, Varanasi
6. Sharma, P. R. (ed.) (1991): Perspectives on Third World Development. Rishi Publication, Varanasi.
7. Stamp, L. D. (1976): Asia: A Regional and Economic Geography, Methuen, London.

IV Semester

GRB 402 Practical - Surveying **Credits: 2**

Number of Lectures: 52

Surveying: meaning, classification and significance.

Chain and Tape surveying; Plane Table surveying;

Prismatic Compass,

Abney Level and Indian Clinometer

Suggested readings:

1. Davis, R.E. and Foote, F.S. (1953): Surveying, 4th edition, McGraw Hill Publication, New York
2. Jones, P.A.(1968): Fieldwork in Geography, Longmans, Green and Company Ltd., First Publication, London
3. Kanetker, T.P. and Kulkarni, S.V.(1967): Surveying and Levelling, Vol I and II V.G. Prakashan, Poona.
4. Natrajan, V. (1976): Advanced Surveying, B.I. Publications., Mumbai.
5. Pugh, J.C. (1975): Surveying for Field Scientists, Methuen and Company Ltd., London, First Publication.
6. Punmia, B.C.(1994): Surveying, Vol I, Laxmi Publications Private Ltd, New Delhi.
7. Shephard, F.A. (1968): Surveying Problems and Solutions, Edward Arnold (Publishers) Ltd, London

8. Singh, R.L. and Singh, Rana P.B. (1993): Elements of Practical Geography. (Hindi and English editions), Kalyani Publishers, Ludhiana and New Delhi.
9. Venkatramaiah, C. (1997): A Text Book of Surveying, Universities Press, Hyderabad.

GRB 403 A* - Ancillary Theory paper

Basics of Remote Sensing **Credits : 2**

Unit I

Remote Sensing: Concept and Scope; Electro-magnetic Radiation: Characteristics, Spectral regions and Bands; Interaction with earth surface features and atmosphere; Spectral Signature

Unit II

Types of Remote Sensing: Air borne and Space borne; Aerial photos: Types and Characteristics; Remote Sensing satellites: Platforms and sensors

Unit III

Visual and Digital image processing techniques; Remote Sensing application in resource mapping and environmental monitoring

Suggested readings:

1. Curran, P.J. (1985): Principles of Remote Sensing, Longman, London
2. Lillesand, T.M. and Kiefer, R.W. (2000): Remote Sensing and Image Interpretation. 4th edition. John Wiley and Sons, New York
3. Campbell, J.B. (2002): Introduction to Remote Sensing. 5th edition, Taylor and Francis, London
4. Bhatta, B. (2010): Remote Sensing and GIS, Oxford University Press, New Delhi.
5. Nag Prithvish and Kudrat M. (1998): Digital Remote Sensing, Concept Publishing Company, New Delhi

V Semester

GRB 501 Geomorphology **Credits: 4**

Number of Lectures: 52

Unit I

Nature and scope of geomorphology; Principles and basis of geological time scale; Fundamental concepts: uniformitarianism and dynamic equilibrium, relief and differential rates of geomorphic processes.

Unit II

Cycle of erosion and slope evolution: contributions of Davis, Penck and King; Isostasy, Plate tectonics, Earthquakes; Folded structure and topography; Faulted structure and topography.

Unit III

Mass wasting and different geomorphic agents and processes— fluvial water, Aeolian, glacial, marine and karst.

Unit IV

Evolution and development of river valleys; Drainage patterns and their significance; concept of graded stream; river channels — form, pattern and dynamics; Regional geomorphology of Uttarakhand Himalaya and Middle Ganga Plain.

Suggested readings:

1. Bloom, A. L. (1992): Geomorphology–A Systematic Analysis. Prentice-Hall India, New Delhi.
2. Chorley, R. J., Schumm, S. A. and Sugden D.E.(1984): Geomorphology. Methuen, London
3. Holmes, A. (1987): Principles of Physical Geology. Nelson, New York, 3rd edition.

4. Sparks, B.W.(1969) : Geomorphology. Longman, London.
5. Stoddard, D. R. (ed.)(1996): Process and Form in Geomorphology. Routledge, London,.
6. Kale, V. and Gupta, A. (2001): Elements of Geomorphology. Oxford University Press, Delhi.
7. Thornbury, W. D. (1990): Principles of Geomorphology. Wiley Eastern Edition, New York,.
8. Singh, S. (2000): Geomorphology. (in Hindi). Vasundhra Prakashan, Gorakhpur.
9. Singh, S. (2004): Geomorphology, Prayag Pustak Bhawan, Allahabad
10. Skinner, B. J. and Porter, S.C. (1996): The Dynamic Earth. John Wiley and Sons, New York,.
11. Wooldridge, S.W. and Morgan, R.S. (1959): The Physical Basis of Geography: An Outline of Geomorphology. Longman, London, several reprints.

V Semester

GRB 502 Geography of India **Credits: 4**

Number of Lectures: 52

Unit I

Geology; Physiographic divisions; Drainage systems; Climate and climatic regions; Soil and vegetation

Unit II

Minerals and power resources (iron ore, and coal); Multipurpose projects: Damodar Valley, and Bhakhra Nangal; Irrigation; Major industries (iron and steel, cotton textile, and sugar).

Unit III

Crops (rice, wheat, cotton, sugarcane, and tea); Agricultural regions; Green revolution and its consequences

Unit IV

Meso-regions of India (Karnataka plateau, and Uttarakhand) and their characteristics; Transport and communication; Trade: composition and recent changes.

Suggested readings:

1. Chauhan, P.R. and Prasad, M. (2003): *Bharat Ka Vrihad Bhugol*, Vasundhara Prakashan, Gorakhpur.
2. Farmer, B.H. (1983): An Introduction to South Asia. Methuen, London
3. Gautam, A. (2006): Advanced Geography of India, Sharda Pustak Bhawan, Allahabad
4. Johnson, B.L.C. (1963): Development in South Asia. Penguin Books, Harmondsworth
5. Krishnan, M.S. (1982): Geology of India and Burma, CAS Publishers and Distributors, Delhi.
6. Khullar, D.R. (2007): India: A Comprehensive Geography, Kalyani Publishers, New Delhi
7. Nag, P. and Gupta, S. S. (1992): Geography of India, Concept Publishing Company, New Delhi.
8. Rao, B.P. (2007): *Bharat kee Bhaugolik Sameeksha*, Vasundhara Prakashan, Gorakhpur.
9. Sharma, T.C. and Coutinho, O. (2003): Economic and Commercial Geography of India, Vikas Publishing House Private Ltd. New Delhi.
10. Singh , J. (2003): India: A Comprehensive Systematic Geography. Gyanodaya Prakashan, Gorakhpur
11. Singh, J. (2001): *Bharat: Bhougolik Aadhar Avam Ayam*, Gyanodaya Prakashan, Gorakhpur.
12. Singh, R.L. (ed.) (1971): India: A Regional Geography. National Geographical Society of India, Varanasi.
13. Spate, O.H. K., Learmonth A. T. A. and Farmer, B. H. (1996): India, Pakistan and Sri Lanka. Methuen, London, 7th edition.

14. SukhwaI, B.L. (1987): India: Economic Resource Base and Contemporary Political Patterns. Sterling Publication, New Delhi
15. Tiwari, R.C. (2007): Geography of India, Prayag Pustak Bhawan, Allahabad.
16. Wadia, D. N. (1959): *Geology of India*. Mac-Millan and Company, London and student edition, Madras.

Semester V

GRB 503 Practical - Representation of Geographical Data Credits: 4

Number of Lectures: 52

Graphical Representation

Bar diagram, Frequency polygon, Frequency curve.

Rainfall dispersion diagram, Water balance graph, Climograph.

Cartographic Representation

Distribution maps: Dot, Isopleth, Choropleth; Pie diagram.

Cartogram: Traffic flow diagram, Isochronic cartogram.

Suggested readings:

1. Monkhouse, F. J. (1985): Maps and Diagrams. Methuen, London.
2. Raisz, E. (1962): Principles of Cartography, McGraw Hill, New York.
3. Robinson, A. H., Sale. R. D., Morrison, J. L. and Muehrcke, P. C. (1984): Elements of Cartography. 5th edition, John Wiley and Sons, Inc. New York.
4. Sarkar, A. K. (1997): Practical Geography: A Systematic Approach. Orient Longman, Kolkata.
5. Sharma, J. P. (2001): *Prayogik Bhugol.*, Rastogi Publication, Meerut 3rd. edition.
6. Singh, R.L. and Singh Rana P.B. (1993): *Elements of Practical Geography*. (Hindi and English editions). Kalyani Publishers, New Delhi.

Semester V

GRB 504 Practical - Geological Map and Map Projection Credits: 4

Number of Lectures: 52

Geological Map*: Conformable and folded geological structure and their description.*

Map Projection: Conical: Polyconic, and Sinusoidal; Cylindrical: Gall's and Mercator's; Zenithal: Gnomonic; International Map Projection

Suggested readings:

1. Hinks, A. R. (1921): Map Projection, Cambridge University Press, London.
2. Misra, R.P. and Ramesh A. (1989): Fundamentals of Cartography, Concept Publishing Company, New Delhi.
3. Raisz, E. (1962): Principles of Cartography, McGraw Hill, New York..
4. Robinson, A. H., Sale, R., Morrison, J. and Muehrcke, P. C (1984): Elements of Cartography. 5th edition, John Wiley and Sons, New York,
5. Singh, R.L. and Singh, Rana P.B. (1993): Elements of Practical Geography. (Hindi and English editions), Kalyani Publishers, New Delhi.
6. Steers, J. A. (1965): An Introduction to the Study of Map Projection. University of London Press, London.

Semester V

Optional Paper

GRB 505 Elective Theory Paper - Population Geography Credits: 4

Number of Lectures: 52

Unit I

Nature and scope of population geography; Sources and types of population data: census, sample survey and vital registration system.

Unit II

World population: growth, causes and consequences; Factors affecting population distribution; Migration: types and determinants; Urbanization: trends and pattern

Unit III

Population dynamics: fertility and mortality, age and sex structure; Occupational structure; Demographic transition theory; human resource development: indicators and patterns.

Unit IV

INDIA:- Population growth; Distribution of population; Density types; Population problems; Population Policy.

Suggested readings:

1. Chandna, R. C. (2006): Geography of Population. Kalyani Publishers, New Delhi.
2. Clarke, J.I. (1972): Population Geography. Pergamon Press, Oxford.
3. Demko, G.J., Rose, H.M., and Schnell, G.A. (1970): Population Geography: A Reader. McGraw-Hill, New York.
4. Dube, K.K. and Singh, M.B.(1994): *Jansankhya Bhoogol*, Rawat Publications, Jaipur.
5. Garnier, B.J. (1993): Geography of Population. 3rd edition. Longman, London.
6. Jones, H. R. (1981): A Population Geography. Harper and Row, New York.
7. Peters, G. L. and Larkin, R.P. (1983): Population Geography: Problems, Concepts and Prospects. Kendall/Hunt, Dubuque, IA.
8. Trewartha, G.T. (1985): A Geography of Population: World Patterns. John Wiley and Sons, New York.
9. Zelinsky, W. (1966): A Prologue to Population Geography. Prentice Hall, New Jersey.

Semester V

Optional Paper

GRB 506: Elective Theory Paper - Social Geography Credits: 4

Number of Lectures: 52

Unit I

Meaning and scope of social geography; Concept of social space; Social differentiation and stratification; Social morphology.

Unit II

Social differentiation and region formation: Bases of social region formation; Evolution of socio-cultural regions of India; Role of race, caste, tribe, religion and languages; India — unity in diversity

Unit III

Concept of social wellbeing; Physical quality of life; Human development: concept and measurements; Rural-urban interfaces in India: health care, education and shelter; Gender issues in India

Unit IV

Public policy and social planning in India; Appraisal of Five-Year Plans and social policies in India; Social policy and planning for drought and flood prone areas; Social impact assessment of development projects

Suggested readings:

1. Ahmad, A. (1999): Social Geography. Rawat Publications, Jaipur and New Delhi.
2. Anderson, K. (2006): Race and Crises of Human Development. Routledge, London and New Delhi.
3. Betizlle, A.(1983): Equality and Inequality, Oxford University Press, New Delhi
4. Brewer, J.D. (2000): Ethnography, Open University Press, Buckingham, Philadelphia, First Edition.
5. Coates, B.E., Johnston, R.J. and Knox, P.L. (1977): Geography and Inequality, Oxford University Press, Oxford, London.
6. Eyles, J. (ed.) (1986): Social Geography in International Perspective. Rowman and Littlefield, New Jersey and Los Angeles.
7. Dubey. S.C. (1991): Indian Society. National Book Trust, New Delhi.
8. Forde, C. D. (1934): Habitat, Economy and Society, Methuen and Company London
9. Gregory, D. and Larry, J. (eds.) (1985): Social Relations and Spatial Structures. McMillan, London
10. Gore, M.S. (1985): Social Aspects of Development, Rawat Publications, Jaipur
11. Jackson, P. and Susan, J. S. (1984): Exploring Social Geography, George Allan Unwin, Boston and Sydney.
12. Jones, E. (ed.) (1975) : Readings in Social Geography, Oxford University Press, London.
13. Haq, M. (2000): Reflections on Human Development. Oxford University Press, New Delhi.
14. Maloney, C. (1974): People of South Asia. Winston Norton, New York.
15. Moseley, W. G., Lanegran, D. A. and Pandit, K. (eds.) (2007): The Introductory Reader in Human Geography. Contemporary Debates and Classic Writings. Blackwell Publishers., Oxford.
16. Norton, W. (2006): Cultural Geography. Environments. Landscapes. Identities. Inequalities. Oxford University Press, Toronto. 2nd edition.
17. Planning Commission, Government of India (1981): *Report on Development of Tribal Areas*. New Delhi.
18. Sahlins, M. D. (1968): Tribesmen, Prentice Hall, New York.
19. Sharma, K.L. (1980): Essays on Social Stratification, Rawat Publications, Jaipur and New Delhi, first edition.
20. Smith, D. (1977): Geography: A Welfare Approach. Edward Arnold, London.
21. Sopher, D. (1980): An Exploration of India: Geographical Perspectives on Society and Culture, Cornell University Press, Ithaca, New York, first edition.
22. Subba, R. B. (1958): Personality of India: Pre- and Proto- Historic Foundation of India and Pakistan. 2nd edition. M.S. University Baroda, Vadodara.
23. Stump, Roger W. (2008): *The Geography of Religion: Faith, Place, and Space*. Rowman & Littlefield Publs., Lanham USA.
24. Valentine, G. (2001): Social Geographies: Space and Society. Prentice Hall, Harlow, UK.

Semester V

Optional Paper

GRB 507: Elective Theory Paper - Agricultural Geography **Credits: 4**

Number of Lectures: 52

Unit I

Meaning and scope of agricultural geography; Approaches to agricultural geography; Physical, cultural and institutional factors affecting agriculture.

Unit II

Crop concentration and crop diversification; Delineation of crop combination regions; Agricultural regions of the world; Detailed study of subsistence, plantation, commercial and mixed farming.

Unit III

Agricultural land-use and carrying capacity; Land use pattern with special reference to India; Measures of agricultural efficiency and agricultural productivity.

Unit IV

Agro-climatic regions of India, Green revolution in India; Second generation reforms in Indian agriculture: Land and institutional reforms; Organic and contract farming; Agricultural planning and policies in India.

Suggested readings:

1. Dumont, R.(1970): Types of Rural Economy: Studies in World Agriculture, Douglas Manin, London Methuen
2. Gregor, H. P. (1970): Geography of Agriculture. Prentice-Hall, New York.
3. Husain, M. (1996): Systematic Agricultural Geography, Rawat Publications, Jaipur.
4. Misra, R. P. (1967): Diffusion of Agricultural Innovations, University of Mysore, Mysore.
5. Mohammad, A.(1978): Studies in Agricultural Geography, Rajesh Publications, New Delhi
6. Morgan, W. B. and Norton, R.J.C. (1971): Agricultural Geography. Methuen, London.
7. Sauer, O. C. (1969): Agricultural Origins and Dispersals. MIT Press, Cambridge.
8. Shafi, M. (2006): Agricultural Geography, Pearson Education, New Delhi.
9. Sen, Sudhir (1975): Reaping the Green Revolution. Tata McGraw-Hill, New Delhi
10. Shafi, M.(2000): Agricultural Geography of South Asia, McMillan, Delhi
11. Singh, B.B. (1979) : *Krishi Bhugol*. Tara Publications, Varanasi.
12. Singh, J. and Dhillon, S.S. (2000): Agricultural Geography. Tata McGraw Hill, New Delhi.
13. Singh, S. (1994): Agricultural Development in India: A Regional Analysis, Kaushal Publications, Shillong.
14. Symons, L. (1967): Agricultural Geography. George Bell and Sons, London.
15. Tarrant J. R. (1974): Agricultural Geography. John Wiley and Sons, New York.

Semester V

GRB 508: Assignment-based Seminar **Credits: 2**

Semester VI

GRB 601 - Climatology **Credits: 4**

Number of Lectures: 52

Unit I

Meaning and scope of climatology; Atmosphere: Composition and structure; Insolation: determinants and distribution; Temperature: Controlling factors and Distribution; Processes of heating and cooling of the atmosphere.

Unit II

Heat budget of earth and atmosphere; Temperature change; Air stability and its importance; Laws of Horizontal Motion and general Atmospheric Circulation, Monsoon, Jet Stream and their significance with reference to India

Unit III

Precipitation: Theories of Precipitation Formation, forms and types; Air Masses: classification and modification; Fronts: source regions, types and associated weather

Unit IV

Cyclones: tropical and temperate; Climatic classification: Köppen and Thornthwaite; Climatic change: evidences and theories; Global Warming: causes and consequences.

Suggested readings:

1. Barry, R.G. and Carleton, M. (2001): Synoptic and Dynamic Climatology, Routledge, London.
2. Chorley, R.J. (2001): Atmosphere, Weather and Climate. Methuen, London.
3. Critchfield, H.J. (2002): General Climatology. Prentice-Hall of India, New Delhi..
4. Finch, J. C. and Trewartha, G. T.: Elements of Weather and Climate. Prentice-Hall, London.
5. Kendrew, W.C. (1998): Climatology. Edward Arnold, London. 5th edition.
6. Lal, D.S.(1986): Climatology. Chaitanya Publications, Allahabad.
7. Oliver, J.E. and Hidore, J.J. (2003): Climatology: An Atmospheric Science, Pearson Education Private Ltd, Patparganj, Delhi.
8. Robinson, P. J. and Henderson, S. (1999): Contemporary Climatology, 2nd edition, Pearson Education Ltd., Harlow, UK.
9. Singh, M.B. (1998): *Jalvayu Avam Samudra Vigyan*. Tara Book Agency, Varanasi.
10. Singh, M.B. (1999): *Jalvayu Avam Jal Vigyan*. Tara Book Agency, Varanasi,.
11. Singh, S. (2005): Climatology. Prayag Pustak Bhawan, Allahabad.
12. Singh, S. (2006): *Jalvayu Vigyan*. Prayag Pustak Bhawan, Allahabad.

Semester VI

GRB 602 Evolution of Geographical Thought **Credits: 4**

Number of Lectures: 52

Unit I

The field of geography; Geography as a discipline: natural science vs. social science; Approaches to geography; Relevance of geography

Unit II

Classical contributions to geographical thought: Greek, Roman, Indian, Arab; Geography rethought: Varenius and Immanuel Kant.

Unit III

Foundations of geography: major contributions of Alexander von Humboldt, Carl Ritter, and Frederick Ratzel; Dualism and Unity in geography

Unit IV

Schools of geographical thought: French, British and American; Recent trends in geography; Evolution of geography in India: formative periods, establishments and emerging scenario.

Suggested readings:

1. Ali, S.M. (1960): Arab Geography, Institute of Islamic Studies, Aligarh Muslim University, Aligarh, First Edition.
2. Daniel, P., Bradshaw, M., Shaw, D. and Sidaway, J. (2000): Human Geography. Issues for the 21st Century. Prentice Hall, London.
3. Diddee, J. (ed.) (1990): Indian Geography, Institute of Indian Geographers, Pune, first edition.
4. Dikshit, R. D. (2003): Geographical Thought. A Critical History of Ideas. Prentice-Hall of India, New Delhi. (in English and Hindi).
5. Dube, B. (1967): Geographical Concepts in Ancient India, National Geographical Society of India, Varanasi
6. Getice, A., Getis, J. and Fellman, J. D. (2007): Introduction to Geography. 10th edition. McGraw Hill, New York.
7. Hartshorne, R. (1959): Perspective on the Nature of Geography, John Murray, London
8. Harvey, D. (1969): Explanations in Geography. Arnold, London.

9. Holt-Jensen, A. (1980): Geography: Its History and Concepts. Harper and Row Publishers, London.
10. Husain, Majid. (2002): Evolution of Geographical Thought, Rawat Publications, Jaipur.
11. Johnston, R., Gregory, D., Pratt, G., Watts, M. and Whatmore, S. (2003): The Dictionary of Human Geography. Blackwell Publishers, Oxford. 5th edition.
12. Johnston, R. and Sidaway, J.D. (2004): Geography and Geographers: Anglo-American Human Geography Since 1945, Arnold Publishers, London.
13. Rawling, E. and Daugherty, R. (eds.) (2005): Geography into the Twenty-first Century. 2nd edition. John Wiley and Sons, Chichester.
14. Singh, Rana P.B. 2009: Uprooting Geographic Thoughts in India: Toward Ecology and Culture in 21st Century. Planet Earth & Cultural Understanding Series, Pub. 1. Cambridge Scholars Publishing, New Castle upon Tyne (UK).
15. Singh, Rana P.B. 2009: Geographical Thoughts in India: Snapshots and Vision for the 21st Century. Planet Earth & Cultural Understanding Series, Pub. 2. Cambridge Scholars Publishing, Newcastle upon Tyne (UK).
16. Singh, Ravi S. (ed.) 2009: Indian Geography in the 21st Century: The Young Geographers Agenda. Cambridge Scholars Publishing, New Castle upon Tyne (UK).
17. Singh, Ravi S. (ed.) 2009: Indian Geography: Perspectives, Concerns and Issues. Rawat Publications, Jaipur/New Delhi.
18. Taylor, G. (ed.) (1953): Geography in the Twentieth Century. Methuen and Company, London.

Semester VI

GRB 603: Practical - Field Study, Field Trip and Report Writing Credits: 4

Number of Lectures: 52

Fieldwork: Meaning, types and objectives of fieldwork; Fieldwork methods and techniques; Importance of fieldwork in geography, Field work-based report writing.

Field Trip: Uttarakhand, Vindhyan Plateau, Thar Desert.

Suggested readings:

1. Archer, J.E. and Dalton, T.H. (1968): *Field Work in Geography*. William Clowes and Sons Ltd. London and Beccles.
2. Bolton, T. and Newbury, P.A. (1968): *Geography through Fieldwork*. Blandford Press, London.
3. Jones, P. A. (1968): *Field Work in Geography*. Longmans, Green and Company Ltd., London and Harlow.
4. Lousenbury, J. F. and Aldrich, F.T. (1986): *Introduction to Geographic Field Methods and Techniques*. Charles E. Merrill Publishing. Company, Colombus.
5. Pugh, J.C. (1975): *Surveying for Field Scientists*. Methuen and Company Ltd. London.
6. Knight, Peter G. and Parsons, Tony (2003): *How to do your Essays Exams & Coursework in Geography and Related Disciplines*. Nelson Thornes, Cheltenham U.K.
7. Parsons, Tony and Knight, Peter G. (2005): *How to do your Dissertation in Geography and Related Disciplines*. Routledge, London. 2nd Ed.
8. Kitchen, Rob and Tate, Nicholas J. (2009): *Conducting Research into Human Geography: Theory, Methodology & Practice*. Prentice Hall-Pearson, Harlow U.K. 2nd Ed.
9. Kitchen, Rob and Fuller, Duncan (2005): *The Academic's Guide to Publishing*. Vistaar Publs. (Sage), New Delhi.
10. Hay, Iain (ed.) (2005): *Qualitative Research Methods in Human Geography*. Oxford University Press, Melbourne. 2nd Ed.
11. Hay, Iain (ed.) (2004): *Communicating in Geography and the Environmental Sciences*. Oxford University Press, Melbourne. 2nd Ed.
12. Stoddard, Robert H. (1982): *Field Techniques and Research Methods in Geography*. Kendall/Hunt Pub. Dubuque IO.

Semester VI

GRB 604: Practical - Elementary Remote Sensing **Credits: 4**

Number of Lectures: 52

Fundamentals of remote sensing; Interpretation of aerial photographs and satellite imageries; Determination of scale, Basic principles of photogrammetry; Elements of photo/image interpretation; Identification of geomorphic features from stereogram; Application of remote sensing in natural resource studies and monitoring environmental changes.

Suggested readings:

1. Campell, J. B. (2003): Introduction to Remote Sensing. 4th edition. Taylor and Francis, London.
2. Chaunial, D. D. (2004): Remote Sensing and Geographical Information System(in Hindi), Sharda Pustak Bhawan, Allahabad
3. Cracknell, A. and Ladson, H. (1990): Remote Sensing Year Book. Taylor and Francis, London.
4. Curran, P.J. (1985): Principles of Remote Sensing. Longman, London.
5. Deekshatulu, B.L. and Rajan, Y.S. (ed.) (1984): Remote Sensing. Indian Academy of Science, Bangalore.
6. Floyd, F. and Sabins, Jr. (1986): Remote Sensing: Principles and Interpretation. W.H. Freeman, New York.
7. Gautam, N.C. and Raghavswamy, V. (2004). Land Use/ Land Cover and Management Practices in India. B.S. Publication., Hyderabad.
8. Jensen, J.R. (2004): Remote Sensing of the Environment: An Earth Resource Perspective. Prentice-Hall, Englewood Cliffs, New Jersey. Indian reprint available.
9. Lillesand, T.M. and Kiefer, R.W. (2000): Remote Sensing and Image Interpretation. John Wiley and Sons, New York.
10. Nag, P. (ed.) (1992): Thematic Cartography and Remote Sensing. Concept Publishing Company, New Delhi.
11. Rampal, K.K. (1999): Handbook of Aerial Photography and Interpretation. Concept Publishing. Company, New Delhi.

Semester VI

GRB 605: Elective Theory Paper

Regional Development and Planning **Credits: 4**

Number of Lectures: 52

Unit I.

Meaning, concepts and scope of regional development and planning; Approaches to Regional Development; Approaches to Regional Planning; Theories of regional development (Myrdal and Perroux).

Unit II

Evolution of Regional Planning in India; Concepts and types of regions; Schemes of regionalization; Macro micro planning regions of India; Multi-level planning; Participatory planning.

Unit III

Regional development in India: patterns and imbalances; Planning for regional development; Role of agriculture, industry and infrastructure (transport and power) in regional development.

Unit IV

Area development and planning: National Capital Region; Local-level planning and Panchayati Raj; Planning for Eastern Uttar Pradesh and North-East India.

Suggested readings:

1. Bhat, L.S. (1972): Regional Planning in India, Indian Statistical Institute, Calcutta.
2. Bhat, L.S. (2003): Micro Planning: A Case Study of Karnal Area, KB Publications, New Delhi.
3. Chand, M. and Puri, V.K. (2004): Regional planning in India; Allied Publishers, New Delhi, reprint.
4. Chandana, R. C. (2005): Regional Development and Planning. Kalyani Publishers, New Delhi.
5. Dube, K.K. and Singh, M.B. (1986): *Pradeshik Niyojan*. Tara Book Agency, Varanasi.
6. Friedman, J. and Alonse, W. (eds.) (1968): Regional Development and Planning, M.I.T. Press, Cambridge-Massachusetts.
7. Gopalakrishnan, R. 1991.*North-East India: Land, Economy and People.* New Delhi: Har-Anand Publication.
8. Gopalakrishnan, R. 1990. *Political Geography of North-East India.* New Delhi: Har-Anand Publication.
9. Kuklinski, A.R. (ed.) (1975): Regional Development and Planning: International Perspectives, Sijthoff-Leyder.
10. Kuklinski, A.R. (1972): Growth Centres in Regional Planning. Mounton and Company, Paris.
11. Misra, R.P, Sundaram, K.V., and Prakasarao, V.L.S. (1976): Regional Development Planning in India, Vikas Publishers., New Delhi.
12. Misra, R.P. (1969): Regional Planning. University of Mysore, Mysore.
13. Misra, R.P. (2002): Regional Planning, Concepts, Techniques, Policies and Case Studies. Concept Publishing Company, New Delhi.
14. Sharma, P.R. (ed.) (1993): Regional Policies and Development in the Third World. Rishi Publication., Varanasi.
15. Singh, Ravi S. 2005. Paths of Development in Arunachal Pradesh. New Delhi: Northern Book Centre.
16. Sundaram, K.V. (1977): Urban and Regional Planning in India, Vikas Publishers. New Delhi.
17. Sundaram, K.V. (1997): Decentralized Multilevel Planning: Principles and Practice. Asian and African Experience. Concept Publishing Company, New Delhi

Semester VI

Optional Paper

GRB 606 Elective Theory Paper - Political Geography **Credits: 4**

Number of Lectures: 52

Unit I

Meaning, approaches, historical development, recent trends in political geography; geopolitics.

Unit II

Nations, states and nation states; Frontiers and boundaries; Capital cities, core and periphery regions.

Unit III

Geographical basis of international relations; Conflict resolution; Strategic locations, routes and raw material; Geostrategic regions of the world; Theories of Heartland and Rimland

Unit IV

Geopolitical and geo-economic significance of:- Indian Ocean, West Asia and Central Asia; Problems of nation building in India; Geopolitics of energy and resources.

Suggested readings:

1. Cohen, Samuel (1964): Geography and Politics in Divided World. Random House, New York.
2. De Blijj, H. J. and Glassner, M. (1968): Systematic Political Geography. John Wiley and Sons, New York.
3. Dikshit, R.D. (1987): Political Geography and Geopolitics. Tata McGraw Hill, New Delhi.
4. Dikshit, R.D. (2000): Political Geography: A Contemporary Perspective. Prentice-Hall, New Delhi.
5. Siddiq, M. (1997): Indian in the Indian Ocean: A Geopolitical Study, Rawat Publications, Jaipur
6. Moddie, A.E. (1961): Geography Behind Politics. Hutchinson, London.
7. Pannikar, K.M. (1959): Geographical Factors in Indian History. 2 vols. Asia Publishing House, Bombay.
8. Pearcy, G. E. and Fifield, R. (1948): World Political Geography, Thomas Y Crowell, New York
9. Pounds, N.J.G. (1972): Political Geography. McGraw Hill Publication., New York.
10. Short, John R. (1982): An Introduction to Political Geography. Routledge, London
11. Singh, T. D. (1988): *Hind Mahasagar Avam Parimandaliya Rashtra: Ek Bhougolik Adhyayan*, Tara Book Agency, Varanasi.
12. Sukhwal. B.L. (1987): Modern Political Geography of India. Sterling Publication, New Delhi.

Semester VI

GRB 607: Elective Theory Paper - Industrial Geography **Credits: 4**

Number of Lectures: 52

Unit I

Meaning and scope of industrial geography; Industrialization; Concept of industrial revolution with reference to Britain and India.

Unit II

Factors of industrial location; Theories of industrial location: Weber, Hoover, Lösch and Smith.

Unit III

Distribution, growth, production trends and problems of: iron and steel, cotton textile, and sugar industries; Industrial policies in India; Role of industries in regional development.

Unit IV

Concept and methods of industrial regionalization; Major industrial regions of the world; Structure of major industrial complexes: Mid -Atlantic coastal region of USA, Rühr Industrial region, Mumbai -Ahmedabad industrial region.

Suggested readings:

1. Alexanderson, C. (1967): Geography of Manufacturing. Prentice-Hall of India, New Delhi.
2. Hoover, E. M. (1948): Location and Space Economy. McGraw Hill, New York.
3. Lodha, R.M.(2005): *Audyogika Bhoogol*, Rajasthan Hindi Granth Academy, Jaipur
4. Miller, E. (1962): A Geography of Manufacturing. Prentice-Hall, Englewood Cliffs, New Jersey.
5. Riley, R. C. (1973): Industrial Geography, Chatto and Windus Ltd. London.
6. Singh, M. B. (1990): New Perspectives in Industrial Geography. Lotus Publication, Varanasi.
7. Singh, M. B. (1988): Industrial Geography. Lotus Publication, Varanasi.

Semester VI

GRB 608 Assignment-based Seminar **Credits: 2**

BANARAS HINDU UNIVERSITY

Department of Geology

Faculty of Science

SYLLABI

B.Sc. (Hons.) Programme
in
Geology

B.Sc. (Hons.) GEOLOGY SYLLABUS

The B.Sc. (Hons.) Geology shall be imparted to students for three academic sessions consisting of six semesters as given below. Candidates will be examined and evaluated on grade basis at the end of each semester in the different courses of theory and practical as per credits given (see table) against each course. The BSc(Hons) Geology will consisit of (a) Core Course and (b) Geological Field Training.

(a) The core course will be compulsory for all the admitted students. There will be seven core courses , each of 5.5 credits (4 credits for theory and 1.5 credit for practical) covering major branches of Geology.

(b) * The compulsory geological field training includes a few days field work. The field training will be conducted by faculty members. Geological field training for semesters I to IV is included in the respective practicals. Compulsory Geological field training (course GLB507) may by undertaken any time during the combined duration of semester (V &VI) inclusive of semester break.

B.Sc. (Hons.) Geology Syllabus

(Effective from 2012-13)

SEMESTER – I		
Course Code	**Title**	**Credits**
GLB 101	Elementary Physical and Structural Geology	4
GLB102	Practicals connected with GLB101(inclusive of Geological Field Training*)	2
	Total	**6**
SEMESTER - II		
GLB 201	Elements of Mineralogy and Crystallography	4
GLB 202	Practicals connected with GLB201	2
	Total	6
	Ancillary –Elements of Geology-I	2
	TOTAL	**8**
SEMESTER - III		
GLB 301	Petrology and Economic Geology	4
GLB 302	Practicals connected with GLB301(inclusive of Geological Field Training*)	2
	Total	**6**

SEMESTER - IV		
GLB 401	Paleontology and Stratigraphy	4
GLB 402	Practicals connected with GLB401	2
	Total	6
	Ancillary –Elements of Geology-II	**2**
	TOTAL	**8**
SEMESTER - V		
GLB 501	Physical and Structural Geology	4
GLB 502	Igneous Petrology, Mineralogy and Crystallography	4
GLB 503	Sedimentary and Metamorphic Petrology	4
GLB 504	Practicals connected with GLB501	1.5
GLB 505	Practicals connected with GLB502	1.5
GLB 506	Practicals connected with GLB503	1.5
GLB 507	Compulsory Geological Field Training*	4.5
	Total	**21**
SEMESTER – VI		
GLB 601	Paleontology	4
GLB 602	Stratigraphy	4
GLB 603	Hydrogeology, Environmental Geology, Exploration Geology and Computer Application	4
GLB 604	Economic Geology	4
GLB 605	Practicals connected with GLB601	1.5
GLB 606	Practicals connected with GLB602	1.5
GLB 607	Practicals connected with GLB604	1.5
GLB 608	Assignment	2.5
	Total	**23**
	Grand Total	**72**

B.Sc. (Hons.) Geology Syllabus

SEMESTER – I

GLB 101: ELEMENTARY PHYSICAL AND STRUCTURAL GEOLOGY Credit:4

Section – A: Physical Geology

Unit-1

Introduction to geology, scope, subdisciplines and relationship with other branches of science; Earth in the solar system, origin, size, shape, mass, density, rotational and evolutional parameters.

Internal constitution of the earth, core, mantle and crust; Convections in the earth's core and production of magnetic field; Composition of earth in comparison to other bodies in the solar system; Origin of hydrosphere and atmosphere, biosphere; Origin of oceans, continents and mountains; Age of the earth; Radioactivity and its application in determining the age of the earth; Rocks, minerals and fossils.

Unit-2

Earthquakes - causes, geological effects and their measurement, distribution of earthquake belts;Volcanoes - types, causes and geological effects, distribution of volcanic belts; Relationship of earthquakes with volcanic belts; Weathering and erosion; Soil, soil formation, soil profile and soil type; Geological time scale; Major events in the earth's history.

Section – B: Structural Geology

Unit-3

Topography and its representation; Dip and strike; Outcrop, effects of topography on outcrop; Forms of igneous rocks; Clinometer compass and its use; Folds, parts of fold, nomenclature and description of folds and causes of folding.

Unit-4

Faults - parts of faults, types of faults and causes of faulting; Joints- their geometric classification; Unconformity, its kinds and significance; Overlap; Outlier and inlier.

Books Recommended:

Physical Geology and Structural Geology

1. Billings, M.P. (1972): Structural Geology, Prentice Hall.
2. Dennis, J.G. (1972): Structural Geology, Ronald Press Company, NewYork.
3. Hills, E.S. (1963): Elements of Structural Geology, Farrold and Sons, London.
4. Holmes, Arthur (1992): Principles of Physical Geology, Vol. 1, Chapman and Hall, London.
5. Leet, L.D. and Judson, S. (1969): Physical Geology, Prentice Hall.
6. Ramsay, J.G. and Huber, M.I. (2000): Techniques of Modern Structural Geology, Vol. III, Academic Press.
7. Ruhe, R.V. (1975): Geomorphology, Houghton Miffin Co., Boston.
8. Singh, R. P. (1995): Structural Geology, A Practical Approach, Ganga Kaveri Publ., Varanasi.
9. Sparks (1960): Geomorphology, Longmans, London.

GLB 102: Practicals (connected with GLB101)
(inclusive of Geological Field Training) Credit: 2

Physical Geology:

Study of important geomorphological models; Reading topographical maps of the Survey of India; Elementary study of aerial photographs.

Structural Geology:

Study of clinometer compass; Exercises on structural problems; Completion of outcrops; Drawing and interpretation of sections across elementary representative geological structures.

SEMESTER – II

GLB 201: ELEMENTS OF MINERALOGY AND CRYSTALLOGRAPHY Credit:4

Section – A: Introductory Mineralogy

Unit-1

Minerals, definition and classification; Processes of mineral formation (magmatic, post-magmatic, pegmatitic, weathering, sedimentary and metamorphic); Common physical properties of minerals (form and shape, colour, streak, luster, cleavage, fracture, hardness, tenacity, transparency, specific gravity, magnetic nature).

Unit-2

Chemical composition and diagnostic physical properties of rock forming minerals mentioned below:

quartz, orthoclase, microcline, albite, labradorite, nepheline, muscovite, biotite, augite, hypersthene, tremolite, hornblende, olivine, serpentine, talc, chlorite, apatite, calcite, dolomite, garnet, kyanite, sillimanite, andalusite, staurolite, topaz, tourmaline, corundum, gypsum, graphite and kaolinite.

Section – B: Optical Mineralogy

Unit-3

Polarizing microscope, its parts and functioning; Nicol Prism and its construction; Optically isotropic and anisotropic substances; Ordinary and polarized lights; Common optical properties observed under ordinary and polarized lights and crossed nicols; Optical properties of some common rock forming minerals (quartz, orthoclase, microcline, plagioclase, garnet, biotite, muscovite, augite, hypersthene, hornblende, olivine and calcite).

Section – C: Introductory Crystallography

Unit-4

Crystal, elementary idea of crystal structure; Parts of crystal - face, edge, apex, solid angle and interfacial angle; Crystallographic axes and angles; Parameters and indices; Common crystal forms - dome, prism, pyramid and pinacoid; Elements of crystal symmetry; Introduction to different crystals systems.

Books Recommended:

Elements of Mineralogy and Crystallography

1. Berry, L.G., Mason, B. and Dietrich, R.V. (1982): Mineralogy, CBS Publ.
2. Dana, E.S. and Ford, W.E.(2002): A textbook of Mineralogy (Reprints).
3. Nesse, D.W. (1986): Optical Mineralogy, McGraw Hill.
4. Phillips, F.C (1971): Introduction to Crystallography,Longman Group Publ.
5. Read, H.H. (1968): Rutley's Element of Mineralogy (Rev. Ed.), Thomas Murby and Co.

Course No.GLB202: Practicals (connected with GLB201) Credit:2

Mineralogy and Crystallography

Study of physical properties of minerals mentioned in theory course; Study of elements of symmetry of representative crystals from each system; Use of polarizing microscope; Study of optical properties of important rock forming minerals.

SEMESTER – III

GLB 301: PETROLOGY AND ECONOMIC GEOLOGY Credit:4

Section – A: Petrology

Unit-1: Igneous Petrology

Magma and its composition; Phase rule application to H_2O system; Common textures; Magmatic differentiation and assimilation; Introduction to mineralogical classification; Brief petrographic

description of common igneous rocks (granite, diorite, syenite, gabbro, dolerite, basalt, rhyolite, trachyte, pyroxenite and peridotite)

Unit-2: Sedimentary Petrology

Weathering and denudation of supra-crustal rocks; Origin of clastic and nonclastic sediments and genesis of sedimentary rocks; Primary sedimentary structures; Elementary idea about texture and mineral composition of clastic and nonclastic sedimentary rocks; General classification of sedimentary rocks; Descriptive petrography of fundamental rock types such as - conglomerate, breccia, sandstone, limestone and shale.

Unit-3: Metamorphic Petrology

Definition, types and agents of metamorphism; Classification of metamorphic rocks; Metamorphic textures and structures; Metamorphic zones and isograde; Progressive, regional and thermal metamorphism of pelitic, calcareous and basic igneous rocks; Common metamorphic rocks and their protoliths as given below:

slate, phyllite, schist, gneiss, hornfels, marble, quartzite.

Section – B: Economic Geology

Unit-4

Definition of ore, ore mineral and gangue; Classification of ore deposits; Chemical composition, diagnostic characters, uses and distribution in India of the following minerals:

magnetite, hematite, chromite, psilomalane, pyrolusite, chalcopyrite, galena, sphalerite, native gold, magnesite, bauxite, pyrite, diamond, muscovite, beryl, fluorite, gypsum, barite, halite, phosphorite, talc, kyanite, graphite, asbestos, monazite and corundum; Elementary idea regarding origin, uses and distribution of coal and petroleum in India.

Books Recommended:

Petrology and Economic Geology

1. Best, Myron G.(2002): Igneous and Metamorphic Petrology, Blackwell Science.
2. Blatt, H. and Tracy, R.J. (1996): Petrology (Igneous, Sedimentary, Metamorphic), W.H. Freeman and Co., NewYork.
3. Brown, C. and Dey, A.K. (1955): Indian Mineral Wealth, Oxford Univ.
4. Ehlers, E.G. & Blatt, H (1982): Igneous, Sedimentary and Metamorphic Petrology, CBS Publ.
5. Huang: (1962): Petrology, McGraw Hill Book Co.
6. Jense, M.L., Bateman, and A.M. (1981): Economic Mineral Deposits, John Wiley and Sons.
7. Krishnaswamy, S. (1979): India's Minerals Resources, Oxford and IBH Publ.
8. Nockold, Knox and Chinner (1978): Petrology for students, Cambridge Univ. Press.
9. Sharma, N.L. and Ram, K.V.S. (1972): Introduction to India's Economic Minerals, Dhanbad Publ.
10. Winkler, H. G.F. (1967): Petrogenesis of Metamorphic Rocks, Springer–Verlag.

GLB 302: Practicals connected with GLB301

(inclusive of Geological Field Training) Credit:2

Petrology

Megascopic and microscopic study of the following rock types:

granite, syenite, nepheline syenite, diorite, gabbro, peridotite, rhyolite, trachyte, dolerite, basalt, sandstone, limestone, conglomerate, breccia, gneiss, schist, quartzite, marble.

Economic Geology

Study of ore and economic minerals in hand specimens as detailed in the theory syllabus; Preparation of maps showing distribution of important metallic and non-metallic deposits and important coal and oil fields of India.

SEMESTER – IV

GLB 401: PALEONTOLOGY AND STRATIGRAPHY Credit:4

Section – A: Palaeontology

Unit-1

Palaeontology, definition, subdivisions and scope, its relationship with other sub-disciplines of geology; Fossils, definition, characters, kinds (body and trace fossils); Conditions of fossilization; Incompleteness of fossils record; Elementary ideas about origin of life; their adaptation to various kinds of environments; Bathymetric distribution of organisms.

Unit-2

Systematic classification of organisms; A detailed study of the morphology and geological distribution of the following classes/orders - Trilobita, Graptoloidea, Anthozoa and Echinoidea.

Section – B: Stratigraphy

Unit-3

Stratigraphy: Definition, its scope and relationships with other subdisciplines of geology; Principles of stratigraphy; Geological time scale; Elements of stratigraphic classificaton; Rock units, time units and time-rock units; Physical and structural subdivisions of India and their characteristics.

Unit-4

Study of the following supergroups of Indian Precambrian rocks with special reference to classification, lithology and economic significance - Dharwar of Karnataka, Mahakoshal (Bijawars) of Central India, Cuddapah of Andhra Pradesh and Vindhyan of Son valley.

Books Recommended:

Palaeontology and Stratigraphy

1. Black, R.M. (1988): The Elements of Palaeontology, Cambridge Univ.
2. Boggs, S. (2001): Principles of Sedimentology and Stratigraphy, Prentice Hall.
3. Krishnan, M.S. (1968): Geology of India and Burma, Higgibothon, Madras.
4. Kumar, R. (1985): Historical Geology and Stratigraphy of India, Wiley Eastern Ltd.
5. Moore, R.C., Lalicker, C.G. and Fischer, A.G.(1997): Invertebrate Fossils, CBS Publ.
6. Nield, E.W. and Tucker, V.C.T. (1985): Palaeontology: An Introduction, Pergmon Press.
7. Prothero, D.R. (2004): Bringing Fossil to Life – An Introduction to Paleontology (2nd Ed.), McGraw Hill.
8. Shrock, R.R. and Twenhoffel,W.H. (1952): Principles of Invertebrate Paleontology, CBS Publ.
9. Wadia, D.N. (1966): Geology of India, English language Publ.
10. Weller, J.M. (1960): Stratigraphic Principles and Practices, Universal Book.
11. Woods, H. (1985): Palaeontology Invertebrate, CBS Publ.

GLB 402: Practicals connected with GLB401 Credit:2

Palaeontology

Study of modes of preservation of fossils; Study of morphological characters of about 30 genera pertaining to Trilobita, Graptoloidea, Echinoidea and Anthozoa.

Stratigraphy

Preparation of lithostratigraphic maps of India showing distribution of the following -

Dharwar Supergroup, Cuddapah Supergroup and Vindhyan Supergroup.

Study of important rock types of the above mentioned stratigraphic units.

SEMESTER – V

GLB 501: PHYSICAL AND STRUCTURAL GEOLOGY Credit:4

Section –A: Physical Geology

Unit-1

Exogenic and endogenic geomorphic processes; Evolution of landscape; A detailed account of the geological work of natural agencies - groundwater and springs, rivers, glaciers, lakes, ocean and wind.

Unit-2

Origin and classification of mountains; Concept and theories of isostasy; Origin and significance of mid oceanic ridges and trenches; Sea floor spreading & continental drift; Brief idea about plate tectonics and distribution of plates; Mitigation of environmental hazards - earthquakes, landslides, floods, basic concepts of remote sensing; Indian space mission; elements of photogeology.

Section –B: Structural Geology

Unit-3

Geological significance and recognition of unconformities; Fold morphology, geometric and genetic classifications, mechanics and causes of folding; Geometric and genetic classification of faults.

Unit-4

Effects of faulting on the outcrops; Geometric and genetic classification of joints; Foliation, descriptive terminology, origin and relation to major structures; Stereographic projection and its use in structural analysis.

Books Recommended:

Physical Geology and Structural Geology

1. Billings, M.P. (1972): Structural Geology, Prentice Hall.
2. Ghosh, S.K. (1993): Structural Geology, Pergamon Press, New York.
3. Holmes, Arthur (1992): Principles of Physical Geology, Vol. 1, Chapman and Hall, London.
4. Leet, L.D. and Judson, S. (1969): Physical Geology, Prentice Hall.
5. Mallory, B.F and Cargo, D.N. (1979): Physical Geology, McGraw Hill.
6. Monrow, James S. (1986): Physical Geology: Exploring the Earth, Booke Cole, Australia.
7. Ramsay, J.G. and Huber, M.I. (2000): Techniques of Modern Structural Geology, Vol. III, Academic Press.
8. Ritter, Dale F. (1986): Processes of Geomorphology. Wm C. Brown Publ.
9. Singh, S (2001): Geomorphology, Prayag Pustak Bhandar, Allahabad
10. Sitter, L.U. De (1959): Structural Geology, Mc Graw Hill Publ.
11. Strahler, A. N. and Strahler, A.H. (1973): Environmental Geoscience, Hamilton Publ. Co.
12. Turner, F.J. and Weiss, L.E. (1963): Structural Analysis of Metamorphic Tectonites McGraw Hill Book Co.

GLB 502: IGNEOUS PETROLOGY, MINERALOGY, AND CRYSTALLOGRAPHY

Credit:4

Section - A: Igneous Petrology

Unit-1

Physical properties, genesis, evolution and types of magma; Concepts of rock series and rock association; Phase equilibrium in one (SiO_2), two (Di-An, Fo-Silica, Ab-An) and three (Di-Ab-An and Di-Fo-An) component silicate systems.

Unit-2

IUGS mineralogical (QAPF) and chemical (total alkali-silica diagram) classification schemes; Common igneous textures; Detailed petrographic description of granite, granodiorite, diorite, syenite, phonolilte, gabbro, norite, dolerite, basalt, andesiste, dunite, pyroxenite, peridotite, komatite, trachyte, rhyolite and dacite.

Section – B: Mineralogy and Crystallography

Unit-3

Classification of minerals; Introduction to crystal chemistry - Ionic size, packing, radius ratio and coordination number, solid solution; Isomorphism, polymorphism, diadochy, pseudomorphism, chemical bonds, Pauling's rules; Structural classification of silicates; Study of the following group of minerals with reference to chemical and structural formulae; Classification and occurrences - olivine, garnet, alumino-silciates, pyroxene, amphibole, mica, silica and feldspar.

Unit- 4

Introduction to 32 crystals classes of crystallography and description of the holosymmetric class; Contact goniometer; Angular measurement of crystal faces; Different types of crystal projections – spherical and stereographic and their uses; Electromagnetic spectrum, light, optics of light (reflection, refraction, Snell's law), dispersion, double refraction, sample preparation techniques for optical microscopy, refractive index liquids, Becke effect, relief, birefringence, retardation, pleochroism, extinction and interference colours; Classification of minerals into uniaxial and biaxial minerals.

Books Recommended:

1. Berry, L.G., Mason, B. and Dietrich, R.V. (1982): Mineralogy, CBS Publ.
2. Best, Myron G.(2002): Igneous and Metamorphic Petrology, Blackwell Science.
3. Blatt, H. and Tracy, R.J. (1996): Petrology (Igneous, Sedimentary, Metamorphic), W.H. Freeman and Co., NewYork.
4. Dana, E.S. and Ford, W.E.(2002): A textbook of Mineralogy (Reprints).
5. Kerr, P. F. (1977): Optical Mineralogy, McGraw Hill.
6. Moorhouse, W.W. (9151): Optical Mineralogy, Harper and Row Publ.
7. Ness, D.W. (1986): Optical Mineralogy, McGraw Hill.
8. Phillips, F.C. (1971): Introduction to Crystallography.
9. Read, H.H. (1968): Rutley's Element of Mineralogy (Rev. Ed.), Thomas Murby and Co.
10. Verma, A.R. and Srivastava, O.N. (1991): Crystallography of solid state Physics, New Age Int. Publ.

GLB 503: SEDIMENTARY AND METAMORPHIC PETROLOGY **Credit:4**

Section – A: Sedimentary Petrology

Unit-1

Processes of formation of sedimentary rocks; Classification of rudaceous, arenaceous, argillaceous and calcareous rocks; Structures of sedimentary rocks; Mineralogical characteristics, textures, and diagenesis of sedimentary rocks; Heavy minerals and provenance interpretations.

Unit-2

Petrographic details of important siliciclastic and carbonate rocks such as - conglomerate, breccia, quartz-arenite, arkose, lithic arenite, quartzwake, felspathicwacke, lithicwacke, mudrocks / shale, limestones: crystalline, micritic and sparitic.

Section – B: Metamorphic Petrology

Unit-3

Phase rule and Goldschmidt's mineralogical phase rule; Principles of metamorphic reactions, metamorphic facies and metamorphic facies series; Graphical representation of mineral assemblages in ACF, AKF, AFM diagrams; Prograde, retrograde and polymetamorphism.

Unit-4

Progressisve metamorphism of (a) Pelitic rocks in K_2O – FeO-MgO-Al_2O_3-SiO_2 system, (b) Basic rocks in CaO – FeO – MgO – Al_2O_3 – SiO_2 system, (c) Calcareous rocks in CaO – MgO –SiO_2 – CO_2 – H_2O system; (d) Ultramafic rocks in MgO – Al_2O_3 – SiO_2 – H_2O system.

Books Recommended:

1. Bucher, K. and Martin, F. (2002): Petrogenesis of Metamorphic Rocks (7th Rev. Ed.), Springer–Verlag.
2. Ehler, E.G. and Blatt, H. (1982): Igneous, Sedimentary and Metamorphic Petrology, CBS Publ.
3. Greensmith, J. T. (1984): Petrology of Sedimentary rocks, Thomas Murby Publ.
4. Hatch, F.H., Rastall, R.H. and Black, M. : Petrology of Sedimentary Rocks, Thomas Murby Publ.
5. Mason, R. (1978): Petrology of Metamorphic Rocks, CBS Publ.
6. Pettijohn, F.J. (1957): Sedimentary rocks (3rd Ed.), Oxford Book Co.
7. Winkler, H.G.C. (1967): Petrogenesis of Metamorphic Rocks, Narosa Publ.
8. Yardlley, B.W.D. (1989): An introduction to Metamorphic Petrology, Longman Scientific and Technical, New York.

GLB 504: Practicals (connected with GLB501) Credit:1.5

Physical Geology

Slope analysis from Topographical Maps. Interpretation of aerial photographs.

Structural Geology

Exercises on structural geology problems; Stereographic projection of structural data; Geometrical problems on folds and faults; Drawing and interpretation of profile sections across the geological maps.

GLB 505: Practicals (connected with GLB502) Credit: 1.5

Igneous Petrology

Megascopic and microscopic study of the igneous rocks as per list given in the theory paper.

Mineralogy

Study of the following silicate minerals with regards to their diagnostic physical properties -

Olivine Group, Garnet Group, Aluminosilicate Group, Staurolite, Topaz, Zircon, Epidote Group, Tourmaline, Beryl, Pyroxene Group, Amphibole Group, Mica Group, Talc, Serpentine, Chlorite, Kaolinite, Silica Group, Feldspar Group, Feldspathoid Group, Zeolite Group; A study of few models of silicate and non-silicate structures.

Optical Mineralogy

Optical study of few rock-forming minerals; Determination of length fast and length slow characters of minerals; Scheme of pleochroism, extinction.

Crystallography

A study of about 12 crystal models belonging to the seven crystal systems; Determination of axial ratio and face symbols of orthorhombic and monoclinic crystals, Stereographic projection of olivine and hornblende.

GLB 506: Practicals (connected with GLB503) Credit:1.5

Megascopic and microscopic examination of conglomerate, breccia, quartz arenite, arkose, lithic arenite, quartzwacke, feldspathicwacke, lithicwacke (grewacke), mudrocks/shale and carbonates (micrite, sparite and accretionary limestones).

Examination of some common heavy minerals in grain mounts; Megascopic and microscopic study of metamorphic rocks - slate, phyllite, schist, gneiss, marble, quartzite, charnockite, hornfels, khondalite

GLB 507: COMPULSORY GEOLOGICAL FIELD TRAINING Credit:4.5

SEMESTER – VI

GLB 601: PALEONTOLOGY Credit:4

Unit-1

Application of paleontology with special reference to problems of geological refinement, sequence stratigraphy, correlation, paleoecology and paleobiogeographic reconstructions; Organic evolution - ancient and modern concepts, evidences, theories of organic evolution: Lamarckism, Darwinism, Synthetic theory.

Unit-2

Binomial nomenclature and procedures in taxonomy; Species concept; Skeletons and their compositions; Types of fossils; Collection and preparation of macro- and micro– fossils; Identification of fossils; Describing a fossil specimen.

Unit-3

Detailed study of morphological characters and geological distribution of the following invertebrate fossil groups -

Brachiopoda, Bivalvia, Gastropoda, Cephalopoda, Crinoidia and Bryozoa.

Stratigraphic significance of Trilobites, Graptolites, Ammonites and Conodonts; Elementary ideas about different types of microfossils (calcareous, siliceous, phosphatic, chitinous, organic walled and agglutinated).

Unit-4

Modes of preservation of plant fossils; Classification and broad characteristics of major plant groups; elementary knowledge of Gondwana flora.

Origin and general characteristic of vertebrates; Elementary ideas about vertebrate classes; Elementary knowledge of Siwalik vertebrate fauna.

Books Recommended:

1. Black, R.M. (1988): The Elements of Palaeontology, Cambridge Univ..
2. Clarkson, E.N.K. (1986): Invertebrate Palaeontology and Evolution, Allen and Unwin Publ.
3. Jain, P.C. and Anantharaman, M.S. (1983): Palaeontology: Evolution and Animal Distribution, Vishal Publ.
4. Lehmann, U. (1983): Fossils Invertebrate, Cambridge Univ. Press.
5. Moore, R.C., Lalicker, C.G. and Fischer, A.G.(1997): Invertebrate Fossils, CBS Publ.
6. Nield, E.W. and Tucker, V.C.T. (1985): Palaeontology: An Introduction, Pergmon Press.
7. Prothero, D.R. (2004): Bringing Fossil to Life – An Introduction to Paleontology (2nd Ed.), McGraw Hill.
8. Rastogi (1988): Organic Evolution, Kedarnath and Ramnath Publ.

9. Raup, D.M. and Stanley, S.M. (1985): Principles of Palaeontology, CBS Publ..
10. Shrock, R.R. and Twenhoffel,W.H. (1952): Principles of Invertebrate Paleontology, CBS Publ.
11. Stebbins (1979): Process of Organic Evolution (3rd Ed.) Prentice Hall.
12. Woods, H. (1985): Palaeontology Invertebrate, CBS Publ.

GLB 602: STRATIGRAPHY Credit:4

Unit-1

Historical advancement in stratigraphy; Stratigraphic classification and terminology; Methods of collecting stratigraphic data; Identification of stratigraphic contact.

Unit-2

Criteria for stratigraphic refinement and correlation; Outline of sequence stratigraphy; Elements of facies concept in stratigraphy.

Unit-3

A detailed study of succession, lithology, age, economic importance and fossil content of the following –

Palaeozoic of Kashmir, Gondwana Supergroup, Triassic of Spiti, Jurassic of Kachchh, Cretaceous of Tiruchirapalli.

Unit-4

A detailed study of succession, lithology, age, economic importance and fossil content of the following:

Deccan Trap and equivalents, Paleogene of Assam, Kachchh and Andaman, Siwaliks of Jammu and Himachal Pradesh and Karewas of Kashmir.

Books Recommended:

1. Boggs, S. (2001): Principles of Sedimentology and Stratigraphy, Prentice Hall.
2. Dunbar, C.O. and Rodgers, J. (1957): Principles of Stratigraphy, John Wiley and Sons.
3. Krishnan, M.S. (1968): Geology of India and Burma, Higgibothon, Madras.
4. Kumar, R. (1985): Historical Geology and Stratigraphy of India, Wiley Eastern Ltd.
5. Wadia, D.N. (1966): Geology of India, English language Publ.
6. Weller, J.M. (1960): Stratigraphic Principles and Practices, Universal Book.

GLB 603: HYDROGEOLOGY, ENVIRONMENTAL GEOLOGY, EXPLORATION GEOLOGY AND COMPUTER APPLICATIONS Credit:4

Unit-1

Definition of hydrogeology, geohydrology and hydrology; Hydrological cycle and groundwater in the hydrological cycle; Hydrological parameters - Precipitation, evaporation, transpiration and infiltration; Origin and age of groundwater; Vertical distribution of groundwater; Types of aquifers; Water bearing properties of rocks - Porosity and Permeability; Retention of water in rocks and yield of water from rocks; Different types of springs and their formations; Darcy's law and its validity; Dissolved constituent of groundwater; Salinization of groundwater; Groundwater provinces of India.

Unit-2

Definition and dimensions of environment; General idea about components and composition of different environmental domains such as atmosphere, hydrosphere and biosphere; Types of environmental pollution; Introduction to weather and climate; Past-climates in the earth history; Concept and origin of monsoon; Elements of natural hazards.

Unit -3

Fundamentals of geological, geochemical and geophysical techniques employed in exploration of mineral deposits.

Unit-4

Elementary idea of computer knowledge in geological sciences; Use of MS-Excel and Power Point; Basic knowledge to graphics and drawing softwares (Adobe Illustrator, CorelDraw, Photoshop).

Books Recommended:

1. Arogyaswamy, R.N.P. (1973): Courses in Mining Geology, Oxford and IBH Publ.
2. Bryant, E. (1985): Natural Hazards, Cambridge Univ. Press.
3. Chaussier, Jean – Bernard and Morer, J. (1987): Mineral Prospecting Manual., North Oxford Academic.
4. Davies, S. N. and De Wiest, R. J. N. (1966): Hydrogeology, John Wiley and Sons.
5. Dobrin, M. B., and Savit, C. H., (1988): Introduction to Geophysical Prospecting, McGraw-Hill Book Co.
6. Karanth, K. R. (1989): Hydrogeology, Tata McGraw Hill Publ.
7. Keller, E.A. (1978): Environmental Geology, Bell and Howell, USA.
8. Lal, D. S. (2007): Climatology, Sharda Pustak Bhawan, Allahabad.
9. Nagabhushaniah, H. S. (2001): Groundwater in Hydrosphere, CBS Publ.
10. Raghunath, H. M. (1990): Groundwater, Wiley Eastern Ltd.
11. Rajendran S. et al (2007) : Mineral Exploration : Recent Strategies.
12. Telford, W.M., Geldart, L.P, Sheriff, R.E. and Keys, D.A. (1990): Applied Geophysics, Cambridge Univ. Press.
13. Todd, D. K. (1995): Groundwater hydrology, John Wiley and Sons.
14. Tolman, C. F. (1937): Groundwater, McGraw Hill Book Co.
15. Valdiya, K.S. (1987): Environmental Geology – Indian Context, Tata McGraw Hill.

GLB 604: ECONOMIC GEOLOGY **Credit: 4**

Unit-1

Concept of ore, ore minerals and gangue in economic geology; Tenor of ores; Ore forming minerals – metallic and non-metallic; Common forms and structures of ore deposits; Paragenesis, paragenetic sequence and zoning in metallic ore deposits.

Unit-2

Processes of formation of ore deposits; Magmatic, contact metasomatic, pegmatitic, hydrothermal, sedimentation, residual concentration, mechanical concentration, oxidation and supergene suphide enrichment and metamorphism.

Unit-3

Study of important industrial minerals of India with particular reference to the industries - cement, glass and ceramics, refractory, fertilizer and building stones, chemicals and gemstones.

Unit-4

Processes of formation, geological occurrence, uses and distribution of coal and petroleum in India; A brief study of atomic fuels.

Books Recommended:

1. Brown, C. and Dey, A.K. (1955): Indian Mineral Wealth, Oxford Univ.
2. Gokhale, K.V.G.K. and Rao, T.C. (1983): Ore Deposits of India, East West Press Pvt. Ltd.
3. Jense, M.L., Bateman, and A.M. (1981): Economic Mineral Deposits, John Wiley and Sons.
4. Krishnaswamy, S. (1979): India's Minerals Resources, Oxford and IBH Publ.
5. Mookherjee, A. (2000): Ore Genesis-A Holistic Approach, Allied Publisher.
6. Sharma, N.L. and Ram, K.V.S. (1972): Introduction to India's Economic Minerals, Dhanbad Publ.

GLB605: Practicals (connected with GLB601) Credit:1.5

Study of morphological characters, systematic positions and age of about 30 representative genera belonging to the following groups - Brachiopoda, Bivalvia, Cephalopoda, and Gastropoda.

A detailed systematic description of the following genera -

Rhynchonella, Terebratula, Arca, Modiolus, Perisphinctes, Nautilus, Natica and Conus.

GLB606: Practicals (connected with GLB602) Credit: 1.5

Distribution of following geological formations on sedimentary basin map of India -

Marine Lower Permian, Gondwana Supergroup, Marine Mesozoics, Deccan Traps and equivalents, Marine Cenozoic and Siwalik Group.

Preparation of land/sea distribution on sedimentary basin map of India during Late Precambrian/Early Cambrian, Early Permian, Jurassic, Cretaceous and Eocene; Study of rocks from important Indian stratigraphic horizons.

GLB607: Practicals (connected with GLB604) Credit:1.5

Study of ore and economic minerals in hand specimen as detailed in the theory syllabus; Preparation of maps showing distribution of important metallic and non-metallic deposits and important coal and oil fields of India.

GLB608: Assignment Credit:2.5

Assignment will be given to each student based on the marks/index of allotment in Honors in Geology.

ANCILLARY COURSE OFFERED BY DEPARTMENT OF GEOLOGY

Elements of Geology-I **Credit:2**

Unit 1:

Introduction to Earth Sciences, Scope, sub-disciplines and relationship with other branches of Science; Introduction to Geological Time Scale; Mass extension, Ice ages; Earthquakes: Type of seismic waves, focus, epicenter, types of earthquakes, causes of earthquakes, intensity and magnitude.

Unit 2:

Weathering and erosion; Geological work of river, wind and glaciers; Geological structures: Bedding, foliation, dip, struke; Folds and faults their parts, major types and geological significance; Plate tectonics and mountain building.

Unit 3:

A brief introduction and elementary classification of Igneous, sedimentary and metamorphic rocks; Minerals; Definition and elementary classification; physical properties of minerals; Diagnostic physical properties and chemical composition of some common rock forming minerals (Quartz, plagioclase, orthoclase, muscovite, biotite, augite, hornblende, tourmaline, garnet, calcite and olivine) and their varieties.

Elements of Geology-II **Credit:2**

Unit-I

Physical Divisions of India, Geological Time Scale, Principales of stratigraphy; stratigraphic units Representative lives of different geological periods, Mass extinction.

Unit-II

Paleontology-definition and scope; fossils-definition, conditions for fossilization, mode of occurrances and uses of fossils. Siwalik vertebrate fauna and their significance in paleoclimatic interpretations.

BANARAS HINDU UNIVERSITY

Department of Home Science

Faculty of Science

SYLLABI

B.Sc. (Hons.) Programme
in
Home Science

B.Sc. Home Science

DISTRIBUTION OF DIFFERENT COURSES AND CREDITS IN VARIOUS SEMESTERS

Semester - I		
Course Code	**Title**	**Credits**
HSB 101	**(A)**Introduction to Foods *(Credit – 2)*, and **(B)** Human Development *(Credit – 2)*	4
HSB 102	*Practicals based on course* HSB101	2
	Total	**6**
Semester – II		
HSB 201	**(A)** Introduction to Clothing Textiles, *(Credit – 2)* and **(B)** Family Resource Management *(Credit – 2)*	4
HSB 202	*Practicals based on course* HSB201	2
	Total	**6**
Semester – III		
HSB 301	**(A)** Home Science Extension Education, *(Credit – 2)* and **(B)** Human Nutrition *(Credit – 2)*	4
HSB 302	*Practicals based on course* HSB301	2
	Total	**6**
Semester – IV		
HSB 401	**(A)** Interior Design, *(Credit – 2)* and **(B)** Clothing Construction *(Credit – 2)*	4
HSB 402	*Practicals based on course* HSB401	2
	Total	**6**
Semester – V		
HSB 501	Home Science Extension Education and Rural Development	3
HSB 502	Consumer Economics	3
HSB 503	Fundamental of Human Development	3
HSB 504	Diet Therapy I	3
HSB 505	Fashion Designing	3
HSB 506	*Practicals based on course* HSB501 & HSB502	3
HSB 507	*Practicals based on course* HSB504	2
HSB 508	*Practicals based on course* HSB505	2
	Total	**22**

Semester – VI		
HSB 601	Advanced Home Science Extension and Communication	3
HSB 602	Diet Therapy II	3
HSB 603	Advanced Human Development	3
HSB 604	Consumer and Business Legislation	3
HSB 605	Statistics and Research Methods (Elective)	4
HSB 606	*Practicals based on course* HSB601	2
HSB 607	*Practicals based on course* HSB602	2
HSB 608	*Practicals based on course* HSB603	2
	Total	**22**
	Grand Total	**68**

SEMESTER – I

Paper – I

HSB 101: INTRODUCTION TO FOODS AND HUMAN DEVELOPMENT (Credit 4)

Section A: INTRODUCTION TO FOODS (Credit 2)

Foods History: Composition and function of food, classification, Food hygiene, cost availability; quality, and quantity of foods, food tables, food groups. Energy foods, body building foods, protective food. Cookery Kitchen; Layout, arrangements, fuel, sanitation & cleanliness. Kitchen and dining equipments. Principles and objects of cooking. Methods of preparation prior to cooking. Comparative study of cooking. Comparative study of various methods of cooking. Effect of cooking on nutritive value, colour, appearance and palatability, serving of food.

Cereals & Cereal Products: Importance, composition and structure of cereal grains, Processing of cereals & storage; methods & their limitations, Germination. Enrichment and fortification of cereals. **Pulses and legumes:** Importance, composition, processing of pulses **Vegetables & Fruits:** Classification, composition, pigments, flavour compounds, selection, purchase, storage and Home Care. **Milk & Milk Products :** Composition, processing, uses in cookery, effect of heat, enzymes, acids and salts on milk & milk products, **Flesh Foods:** Egg; Structure, composition, quality of eggs, uses in cooking. Meat, Fish, Poultry; Classification, structure, composition, ripening, ageing, factors affecting tenderness of meat, buying and care in Home. Gelatin; composition, properties & uses. **Beverages**; Tea, coffee, chocolate & cocoa powder. Other Beverages; aerated beverages, juices. **Nuts & Oilseeds**; Composition, role in the diet. **Spices & Condiments**; Properties, uses & abuses in diet.

Food Safety and Standard Regulation: Adulteration, ISI, Agmark, FPO, MPO, PFA, HACCP, Additives, food laws.

Food Microbiology: Brief history of food microbiology and introduction to important micro-organisms in foods. Food Spoilage; Contamination and micro-organisms in the spoilage of different kinds of foods & their prevention, Cereal & cereal products, vegetable & fruits, fish and other sea foods, meat & meat products, Egg & poultry, milk & milk products, canned foods. Public Health hazard due to contaminated foods; Food borne infections and intoxications; symptoms, mode and source of transmission and methods of prevention. Fundamentals of control of micro-organism in foods; extrinsic and intrinsic parameters affecting growth and survival of microbes, use of high & low temperature, dehydration, freezing, freeze drying, irradiation and preservatives in food preservation.

Section B: HUMAN DEVELOPMENT (Credit 2)

Concept of Human Development: Meaning and importance of Human Development, Principles of Development, meaning of terms "Growth" and "Development".

Stages of Human Development, Major characteristics of different stages of lifespan (Prenatal, Infancy, Baby hood, early middle and late childhood, puberty, early and late adolescence, young, middle and late adulthood and old age). Developmental task and milestones.

Physiology of Pregnancy & Postnatal case of Mother & Child: Reproductive System (Male and Female)conception, Stages of Prenatal Development, Genetic and Environmental factors, Birth process and complications, Maternal Health and Care during pregnancy Immunization schedule

Hazards during prenatal development, Immediate care of new born, Types of feeding Natural and Artificial, Weaning, Infant and mother mortality and morbidity, Child rearing Practices.

Study of developmental patterns: Physical motor, social, emotional, cognitive and language development in different stages of lifespan (Prenatal, Infancy, Baby hood, early middle and late childhood, puberty, early and late adolescence, young, middle and late adulthood and old age)

Problems and adjustments during lifespan: Problems of infancy, preschool period, adolescence and old age. Physical, psychological, behavioral, social and family adjustment during different stages of lifespan.

PRACTICAL

HSB 102: INTRODUCTION TO FOODS AND HUMAN DEVELOPMENT (Credit 2)

Part A: Introduction to Food

Preparing different food items by using different cooking methods and calculation of nutrients based on food composition table.

Study of the effect of cooking on carbohydrates (dextrinization- sujihalwa, caramalization-sugar), fats, protein(egg-coagulation, paneer), texture and colour of vegetables.

Methods of food processing-popping, germination/sprouting, malting, baking preparation and serving.

Study of Microorganism through permanent slides.

Part B: Human Development

Study of Reproductive system.

Visit to any one pre-school center situated in Varanasi city

Study of all developmental patterns in different age groups

- Infancy
- Baby hood
- Pre-school child
- School going child
- Child in puberty
- Adolescents
- Adult
- Old age person

Suggested readings:

1. Tauro P., Kapoor K.K., Yadav K.S., 1996, An Introduction to Microbiology, Wiley Eastern Limited.
2. Wilson E.D., Fisher K.H. and Garcia P.A., Principles of Nutrition, John Wiley & Sons, New York, 1980.
3. Potter N.N., Hotchkiss J.H. (1996) : Food Science, Edition 5, CBS Publishers and Distributors, New Delhi.
4. MacMillan M. (1984) : Experimental Foods Laboratory Manual, Surjeet Publications.
5. Frazier W.C. and Westroff D.C. (1988) : Fourth Edition, Food Microbiology, McGraw Hill INC.
6. Prevention of Food Adulteration Act (1994) : Govt. of India.
7. Schiambery L.N. (1988), Child & Adolescent Development, McMillan Publising Company, New York
8. Papalia, D.E. & Olds S.W. (1978), Human Development, Mcgraw Hill, New York
9. Child Development – A Topical Approach, Alison-Clarke-Stewart, Susan-Friedman-Joanne Kock
10. Berk, L.E. (1996), Child Development, New Delhi, Prentice Hall

SEMESTER – II

Paper – II

HSB 201: INTRODUCTION TO CLOTHING TEXTILES AND FAMILY RESOURCE MANAGEMENT (Credit 4)

Section A: INTRODUCTION TO CLOTHING TEXTILES (Credit 2)

Introduction: Concepts and classification of textile fibres; Natural fibres; Cotton, flax, jute, hemp, remie, silk, wool, asbestos, mineral fibres (structure, properties and formation). Man made fibres; Rayon, acetate, nylon, polyster, acrylic and glass fibres. Blends and mixture.

Yarn: Classification; Simple yarn, complex yarn, fancy yarn, spun yarn, filament yarn. Twist, crimp, yarn numbering system, tex, denier, count. Methods of fabric formation.

Weaving: Introduction to weaving, Loom, its parts and working, Basic weaves and its derivatives, Fabric count. Non woven fabric construction; felts and non woven. Knitted fabric; Warp knitting, weft knitted & circular knitting.

Fabric finishes: Processes of removing impurities from fabric; scouring, degumming, carbonizing. Basic finishes that alter texture; felting, singering, stiffening, decatazing. Surface finishes; Bleaching- Classification, application of bleaches to various fibres & fabric, delustering, calendering, beetling, napping, flocking, burnt out design, tentering, shearing and brushing.

Functional finishes – water proofing, water repellent, shrinkage control, flame retardation, mildew proof, moth proof, antibacterial, anti-static.

Dyes and Dyeing: Classification of dyes & their applicability; Natural and synthetic dyes; Direct dye, acid dye, basic dye, Vat dye, sulphur dye, azoic dye, mordant dye, disperse dye, reactive dye, pigments. Stages of dyeing, fiber, yarn and fabric, Colour fastness of fabric for washing, perspiration & light.

Printing: Hand printing methods; block printing, stencil, screen printing, spray printing, tie & dye, batik, warp printing. Machine printing; roller, screen printing, heat transfer printing, flock printing.

Laundry: Introduction to laundry process, materials and equipments in laundry.

Hard and soft water; Temporary and permanent hardness, methods of softening water, chelating and sequestering agents. Soap and detergents; Definition, chemical nature, manufacturing, properties and cleansing action. Additives used in laundry; optical brightener, bluing agent. Starches, stiffening and softeners. Principles of laundering; Hand washing methods, washing machine.

Dry cleaning & Label. Disinfections of clothes.

Stain removal: Classification of stains, principles of removal, types of stain removers, techniques of removal. Care & Storage of apparel and household linen.

Traditional Embroidery: Types & techniques, traditional embroidery of India, Kashida of Kashmir & Bihar, Kantha of Bengal, Kasuti of Karnataka, Embroidery of Kutch & Kathiavar, Phulkari of Punjab, Chikankari of Lucknow, Manipuri Embroidery, Chamba Rumal, Quilting of Bihar, Orissa. Value addition of fabric (with respect to entrepreneurship)

Section B: FAMILY RESOURCE MANAGEMENT (Credit 2)

Management as a discipline and Science: Interdisciplinary nature of management, Stages of development, Classical Organization Theory, Behavioral theory, Qualitative. Relevance to family resource management; Meaning, Nature and scope. Management Abilities; Principles of Management:- Technical, Conceptual, Human. Process of Management & functions; Planning, controlling and Evaluation. Motivation for Management; Values, goals & standards. Decision Making; Meaning, Types of decision, Mode of decision making, Cost-benefit analysis, Decision tree

Resources: Type of Resources. Classification and Characteristics of Resources; National & global, human, material, economic & non-economic. Principles in the use of resources; Scarcity utility, accessibility, exchange, transferability, substitution, reverse & investment, exchange linkage. Management of Resources; Time and Energy Management, Time as a resource, time orientation and perception, planning & using time resources effectively. Energy as resource; Identifying energy resources and factor affecting energy consumption, work simplification

Financial Management: Money as a resource in economic welfare; Planning, Family life stages & use of money, Budget ; Types, steps, advantages and disadvantages, Income**;** Productive income, money income, hidden income, Savings & Capital Investment; Objective, types of saving & investment; Saving Institution Schemes, Credit; Types, sources, rural, urban use of credit and credit instrument to increase level of living of urban or rural households.

Concept of Ergonomics: Scope of Ergonomics in Home and other occupation, nature of work in household and other occupations.

Introduction to foundation of art: Elements of design; Line, Size, Form, Structure, Space, Pattern, Shape, Light, characteristics & classifications

Designs: Definition & types of structural & decorative, Principles of design; Definition & their characteristics & types, Balance, Harmony, Scale, Proportion, Rhythm, Emphasis. Study of Colours; Classification dimensions, colour schemes & effect

PRACTICALS

HSB 202: INTRODUCTION TO CLOTHING TEXTILES AND FAMILY RESOURCE MANAGEMENT (Credit 2)

Part A: Introduction to Clothing Textiles

1. Identification of fibres – Visual inspection, burning, microscopic and solubility test.
2. Identification of yarns.
3. Demonstration on part of looms & motion of loom.
4. Preparation of basic weaves sample.
5. Warp and weft yarn counting in fabric.
6. Identification of fabric finishes and collection of samples.
7. Dyeing of cotton, wool & silk with natural & synthetic dyes i.e. Direct, napthol, acid, reactive etc.
8. Preparation of sample by Tie & Dye Techniques & Batik.
9. Preparation of samples by Block printing, Stencil printing, screen printing & spray printing.
10. Bleaching, whitening & starching.
11. Stain removal.
12. Laundry of cotton, silk, wool & synthetic.
13. Making samples by using contemporary embroidery & samples of traditional embroidery.
14. Visit to weaving centre & any one museum.

Part B: Family Resource Management

1. Preparation of colour wheel & colour scheme
2. Flower arrangement/Different areas
3. Study of elements of arts
4. Study of principles of design
5. Study of various types of cheques and sawing schemes
6. Work simplification techniques

Suggested readings:

1. Dulekar Durga (1976) : Household Textles & Laundry Work, Delhi, Atmaram & Sons
2. flag o`Unk % oL= foKku ,oa ifj/kku
3. lkfo=h iafMr ,oa 'kf'kdyk f'kans] Hkkjrh; d'khnkdkjh] xksfoUn oYyHk iar d`f"k ,oa izkS|ksfxd fo'ofo|ky;] iaruxj
4. Hallen & Saddler, Textiles, Macmillan Company, New York.

5. Nickell and Dorsey, 1976. Management in Family Living (4th Ed.) Wiley Eastern Limited, New Delhi
6. Gross, Crandall & Knoll, 1980, Management for Modern Families, Prentice – Hall, Inc. Englewood cliffs, New Jersy
7. Grossack, I.M. & Martin, D.D. (1980) : Managerial Economics, Little Brawn & Co.
8. Adhikari, M. (1978), Economic Environment of Business, Sultan Chand
9. Shukul & Gandotra: Home Management and Family Finance
10. डॉ. मंजू पाटनी ' गृह प्रबंध
11. डॉ. मंजू पाटनी : आवास गृह सज्जा एवं घरेलू उपकरण
12. करुना शर्मा : आवास एवं आंतरिक सज्जा
13. डॉ. रीना खनूजा : गृह प्रबंध, साधन व्यवस्था एवं आंतरिक सज्जा
14. डॉ. जी.पी. शैरी : गृह व्यवस्था एवं गृह कला

SEMESTER – III

Paper – III

HSB 301: HOME SCIENCE EXTENSION EDUCATION AND HUMAN NUTRITION

(Credit 4)

Section A: HOME SCIENCE EXTENSION EDUCATION (Credit 2)

Extension Education: Concept, meaning, philosophy, principles, aims & objectives of extension education. Brief History of extension activities in India (present and past Independence), Extension Teaching Methods, Difference between formal & extension education, Steps in extension teaching

Classification of extension teaching methods according to different criterias; according to use, form & nature, function, steps in extension teaching, Learning Objectives, Innovation Decision Process, Adoption process, Adopter's Category, Combined use of extension teaching methods (purpose, significance & types of combinations), Types of demonstrations (method, result & combined demonstration), Group Discussion, Campaign, Teaching Through Village Leaders, Criteria for Selection of Extension Teaching Methods, Factors affecting Extension Teaching Methods. Traditional Folk programmes, Educational Psychology & its application to extension education, Concept, meaning & aim of education psychology, Relationship between educational psychology & extension education, Objective and contribution of Psychology, Intelligence, emotions & motivation (concept, related Theories, types, importance, use in extension teaching), Psychology of Learning; Definition, meaning & concept of Teaching, Principles of Teaching; Qualities of a good Teacher, Guidelines for the teacher, Teaching plan (method of preparation, essentials & precautions), Teacher evaluation (concept & criterias), Some psychological terms & their definition; Attention & Perception, Thinking, Conflicts, Psychological barriers, Propaganda

Communication: Concept of communication – meaning, functions, problems & barriers, Elements of communication process, Communication media – meaning, classification, advantages & limitations, Importance of communication in extension work, Communication Models, Functions of Communication, Communication Channels, Communicator – Communicate relationships; Orientation, Empathy, Feedback, Physical Interdependence, Credibility, Interaction, Homophily, Heterophily, Feedback in communication & role of feedback in Extension Education, Communication and extension approaches; Individual approach, Group approach, Mass approach.

H.Sc. Extension: Concept, meaning of H.Sc. extension, History of H.Sc. extension education, History of H.Sc. extension education in India.

Section B: HUMAN NUTRITION (Credit 2)

Concept of Nutrition: Relation of nutrition to health, optimum nutrition, adequate nutrition, malnutrition, growth of the Science of nutrition with particular reference of India. Composition of human body, structure and functions of digestive organs, excretion of waste products, study of urine, sweat and faeces, blood body fluids and hormones, Microscopic study of stomach, tissues of human body, digestion absorption and metabolism of foods. Brief history of Nutritional

Science, Scope of Nutrition. Minimal Nutritional requirements & RDA – Formation of RDA and Dietary guidelines – Reference Man and Reference Woman. Human Body Composition and Changes through the life cycle. Energy in Human Nutrition – Energy Balance, Assessment of Energy Requirements, Deficiency & Excess.

Introduction to Biochemistry – Definition, objectives, scope

Carbohydrates: Definition, classification, structure and properties, Digestion and Absorption, Blood glucose and effect of different carbohydrates on blood glucose, Glycemic Index, Significance of Dietary Fibre.

Proteins – Definition, classification, structure & properties of : amino acids – Essential & non-essential & proteins : Assessment of protein quality (BV, PER, NPU), Protein Energy Malnutriton (PEM).

Lipids – Definition and classification, structure, properties, significance of acid value, iodine value and saponification value, Digestion & absorption.

Vitamins: Fat soluble and Water soluble Physiological role, broavailability, requirements, sources, deficiency and excess.

Minerals & Trace Elements – Physiological role, bio-availability and requirements, sources, deficiency and excess (Calcium, Phosphorus, Magnesium, Iron, Fluoride, Zinc, Selenium, Iodine, Chromium).

Water & Electrolyte: Functions, Requirements.

Enzymes: Definition, Types & Classification of Enzymes

Community Nutrition: Community Nutrition or a field; Public Health Nutrition, Goals for Nutrition programmes, planning, implementation and evaluation of nutrition education programme, food fads & food habits. Introduction to national nutrition programmes & policies; Integrated Child Development Services (ICDS); National Rural Development Programme (NRDP); National Rural Employment Programme (NREP); Miscellaneous monofocal programmes. Role of international agencies and programmes in community nutrition; Food & Agriculture Organization (FAO); World Health Organization (WHO); United Nations Childrens Fund (UNICEF); Other voluntary & government agencies. Direct nutritional assessment of human groups; Nutritional anthropometry; Biochemical tests; biophysical tests; clinical signs; individual nutrient deficiencies. Diet Survey methods at national, institutional, family and individual level. Indirect nutritional assessment of human groups : Indicators and their use; health policy indicators; social and economic indicators, indicators of the provision of health care; coverage by primary health care; basic health status indicators.

PRACTICAL

HSB 302: HOME SCIENCE EXTENSION EDUCATION AND HUMAN NUTRITION

(Credits 2)

Part A:- Home Science Extension Education

1. Preparation and use of following aids; Circular letter, Lealflet and Pamphlet, News paper, Flash cards, Poster, Chart.
2. Visiting Exhibition/media in community and preparation of report.
3. To get familiar with use and care of projected aids.

Part B:- Human Nutrition

1. Preparation of dishes rich in : Energy, protein, fat, fiber, calcium, iron, vitamin A, vitamin C, thiamine, riboflavin and niacin.
2. Reaction of mono, Di and polysaccharides and their identification in unknown mixtures, Iodine test for cooked and uncooked starch & dextrin.
3. Reactions of different types of fats (saponification and iodine value)
4. Reactions of proteins
5. Study of microscopic structure of tissues, liver, kidney, stomach, intestine, blood
6. Evaluation of nutritional status : By Anthropometry survey, Dietary survey

7. Other determinants of family nutrition : Socio-economic status survey, using SES scale, Weaving practices, Immunization practices, Sanitary practices.
8. Dietary practices, fads and fallacies during illness, pregnancy, lactation and other special conditions.
9. Assessment of nutritional status using above criteria in a community set up and report writing.

Suggested readings:

1. Reddy A, Extension Education, Bapatia, India, Shree Laxmi Press
2. Pillai K.S., ABC of Non-formal Education, ITB Indraprastha Estate, New Delhi, India Adult Education Association
3. Dhama O.P. & Bhatnagar O.P., Education & Communication for Development, Oxford & I.B.H. Publishing Co. Pvt. Ltd., New Delhi
4. Sampath K., Pannirselvam A., Santhanam S., Introduction to Educational Technology, New Delhi, Sterling Publishers
5. Swaminathan M. (1985) : Essentials of Food and Nutrition, Vols. I & II, Ganesh & Co., Madras
6. Indian Council of Medical Research (1989) : Recommended Dietary Intakes for Indians
7. Indian Standards Institution (1985) : ISI Handbook of Food Analysis, Parts I to XI, Manak Bhawan, New Delhi
8. Sundararaj P and Siddhu A. (1995) : Quantitative tests and Quantitative procedures in Bio-chemistry – A practical manual, Wheeler Publishing
9. Lehninger A.K., Nelson D.L. and Cox M.M. (1993), 2nd Ed. Principles of Biochemistry, CBS Publishers and Distributors
10. Guyton A.C., Hall J.E. (1996) : Textbook of Medical Physiology, 9th Ed. Prism Books (Pvt.) Ltd., Bangalore
11. Obert J.C. (1986) Community Nutrition, 2nd Edition, MacMillan Publishing Co., New York

SEMESTER – IV

Paper – IV

HSB 401: INTERIOR DESIGN AND CLOTHING CONSTRUCTION (Credit 4)

Section A: INTERIOR DESIGN (Credit 2)

Housing: Family's Housing Needs, Protective, economic, affectional, social standard of living housing goals, style, function, occupation, Factors influencing selection and purchase of site for house building, Legal aspects, location, physical features, soil conditions, cost, services, House Planning, Reading house plans Grouping of rooms, orientation, circulation, flexibility, privacy, spaciousness, services, aesthetics, economy light and ventilation

Planning different rooms: Living room, dining room, bedrooms, kitchen, store room, toilet, passage, staircase, Financial Consideration, Availability of funds for housing, Housing Development Finance Corporation, Cooperative Housing Society, Life Insurance Corporation, Cooperative Banks, Loan from Provident Fund, Finance Corporation of India, Residential structural features of architecture

Foundations, footing, plinth, beams, columns, walls, slabs, floor, ceiling, window, doors, staircase, Types of building materials and its characteristics & uses, Gardening plan & indoor gardening, State & Central Housing Scheme; National Housing Policy, Urban Land (Ceiling & Regulation) Act, 1976, Rent Control Act and Govt. Policies & Programmes, Housing problems, causes and remedial measures, Housing Standards & Legislation

Interior Planning & Decoration: Introduction to interior planning & decorations

Application of elements and principles of design in interior planning and decoration, Furniture; Furniture design based on anthropometric dimensions

Styles of furniture; Traditional, contemporary and modern, Selection of furniture for comfort, rest & relaxation for work, for storage, Arrangement of furniture for living, sleeping, dining and multipurpose rooms, Upholstered furniture materials, techniques and designs, Furnishing Fabrics, Types of curtains; Draperies, floor coverings, rugs and carpets, cushion covers, slip covers, bed linen and table linen

Selection and use, Functional & decorative accessories for interiors, painting, sculpture, pots etc., Lighting in interior; Lighting plans for illumination and special effects, Lighting sources; Developing a lighting plan for different areas, Kitchen Modular Design; Types of kitchen, Kitchen Geometry; Work height of different work areas and storage areas, space dimensions of different work centres and work areas, Materials; Floor, walls, sink, ceiling and its characteristics, platforms, storage etc., Types of finishes, Essetial services needed in a kitchen,

Water supply, Hot & cold, tap fittings, water purifiers, Electricity services; electricity current, air purifier, MCB fuses, exhaust, Drainage services; Waste water drainage system, waste disposal, cleaning agents & equipments

Light: Introduction to light, properties of light, velocity of light. To study the different type household equipments (mixer greider, electric iron, toster, geyser, water heater, washing machine and microven)

Cleaning and care of different materials; Metal, glass, wood, paints, upholstery, floor & floor coverings.

Section B: CLOTHING CONSTRUCTION (Credit 2)

Traditional textiles and costumes of India, Dyed & Printed textiles of India; Kalamkari, Patola, Pochampalli, Ikat of Orissa, Tie & Dye of Tamil Nadu, Woven Textiles of India; Brocades, Shawals of Kashmir, Muslins of Bengal, Silk of Karnataka, Cotton of Kerala, Woven sarees of different states of India, Traditional Costumes of India; Costumes of Men & Women & Traditional marriage costumes of different states of India (Details of costumes, jewellery & accessories), Elements and Principles of design as applied to apparel designing, Figure types, silhouettes, Sewing equipments and other tools required for drafting, cutting, stitching, sewing machine; Part of machine, their use, care & remedy, Body measurement; Anthropometric measures and method of taking body measurement for different garment, General construction techniques for garment; Drafting, folding, lay out, marking and cutting of pattern pieces, Essentials of Children's Clothing , Importance of Clothing, Psychological effect of clothing on children, Effect of clothes and child's growth, Sociological & Psychological aspects of clothing, Drafting of Jhabla, Baby frock, plain frock, shirt, trouser.

Pattern Making: Techniques of flat pattern making, Principles and application of flat pattern for different styles of bodies, skirt and sleeves, slash & spread method. Fabrics for garment making; Handling of different types of fabrics, selection of fabric for different garment, study of texture, surface, colour in relation to garment design, material required for different garment. Sources of inspiration for apparel designing fashion and current fashion trends.

Seams: Types of seam, seam finishes (Darts, Tucks, Pleats, Gather, Yokes, Pockets, Collars, Loops & fastners, Trimmings, Stay Stitching, Lining, Neckline, Interlining, Top Stitching, Facing, Interfacing), Sewing supplies.

PRACTICAL

HSB 402: INTERIOR DESIGN AND CLOTHING CONSTRUCTION (Credits 2)

Part A :- Interior Designing

Learning architectural symbols

Drawing of house plans for different income levels

Planning of different kitchen layouts (considering various kitchen sizes)

Study of furniture detailing

Furniture layout for different rooms & drawing of designs

Interior design for small flat/large residential space/different rooms

Visit to hotels, restaurant, conference hall to study interior designing pattern (any one)

Part B:- Clothing Construction

Visit to museum & report writing on traditional textiles of India.

Group Discussion on traditional costumes of India.

Illusion of different garment on Silhoultee.

Preparation of Bodice block, adult.

Drafting of sleaves basic & variation.

Drafting of collar & its variation

Construction of frocks, trouser, shirt.

Preparation of samples of seams dart, tucks, pleats, pockets, collars, loops, fastner.

Sketching of designs of variation in frocks.

Suggested readings:

1. Cherunilam, Frances & Heggade, Odeyan; D (1987) : Housing in India, Bombay, Himalaya Publishing House
2. Again Tessie (1970) : The House : Its Plan & use, New York, J.B. Lippincott Co.
3. Deshpande R.S. (1980) : Modern Ideal Homes for India (9th Ed), Smt. L.S.Deshpande for Deshpande Publications Trust
4. Deshpande R.S. (1980) : Building your own House, United Book Corporation
5. National Building Organization – Monograph of Housing Statistics
6. Ball Victoria Kloss (1982) : Art of Interior Design, John Wiley & Sons
7. Ruth Morton : The Home and its furnishings, U.S.A. McGraw-Hill, 1953
8. Complete Guide to Sewing, The Reader's Digest Association, Inc., Pleasantville, New York/Montreal, Canada
9. Pandit Savitri, Manual for Children's Clothing, Orient Longman Limited, Bombay
10. Zarakkar K.R. : Zarakkar System of Cutting, Bombay
11. Doongaji (1975) : Basic Process & Clothing Construction, New Delhi, Raj Book Dep.
12. Brij Bhushan, Jamila : The Crafts of Weavers, The Costumes & Textiles of India, D.E. Tarapore Valla Sons & Co.
13. Gandotra & Patel: Housing for Family Living
14. डॉ. मंजू पाटनी : गृह प्रबंध
15. डॉ. मंजू पाटनी : आवास गृह सज्जा एवं घरेलू उपकरण
15. करुना शर्मा : आवास एवं आंतरिक सज्जा
16. डॉ. रीना खनूजा : गृह प्रबंध, साधन व्यवस्था एवं आंतरिक सज्जा
17. डॉ. जी.पी. शैरी : गृह व्यवस्था एवं गृह कला

SEMESTER – V

Paper – I

HSB501: HOME SCIENCE EXTENSION EDUCATION AND RURAL DEVELOPMENT

(Credit 3)

Community Development: Meaning, objectives, organization of Community Development, Scope of Community Development Programme Types of Community Development Programme; Various community development programmes, Govt. sponsored programmes for family development; DWCRA, IRDP, NREP, RLEGP, TRYSEM etc. (source of funding), Panchayati Raj & Democratic Decentralization, Concept & evolution of Panchayati Raj, Organization of Panchayati Raj Institutions, Functions & Importance of Panchayat in rural development, Five Year Plans; Concept & evolution of Five Year Plans, Major contribution of Five Year Plans in rural development, Leadership Development, Concept & definition of leader & leadership, Types of leaders; Principles of democratic leadership, Personality Dynamics of leader, Functions of a leader, Factors determining effectiveness of leader, Role of leader in group mobilization, Gender and Development, Concept of development, Indicators for development, Women as a partner in

the developmental process & national planning, Approaches of Development, Shifts from welfare approach to development & empowerment approaches, National efforts for Development of Women; National Policy on Women, Role of National Commission for Women

Rural Sociology: Concept, meaning, definition of Rural Sociology, Nature & scope of Rural Sociology**,** Rural Sociology in India; Origin & development**,** Importance of Rural Sociology in India**,** Subject matter of Rural Sociology**,** Study methods of Rural Sociology**,** Functions & utility of rural Sociology**,** Rural Social System**,** Indian Village (meaning & concept)**,** Characteristics of Rural Society**,** Rural and Urban life, Rural Social Problems, Indian rural social structure, Rural development and programme; Integrated Rural Development Programme, Rural Reconstruction & Planning

Suggested readings:

1. Patnayak Rama, Rural Development in India, New Delhi, Vikas Publishing House Pvt. Ltd.
2. Thingalaya N.K., Rural India – Real India, Bombay, Himalaya Publishing House
3. Indian Journal of Extension Education, The Indian Society of Extension Education, Division of Agricultural Extension, IARI, New Delhi – 110012
4. Desai, Vasanth, Rural Development Programme & Strategies, Bombay, Himalaya Publishing House

Paper – II

HSB 502: CONSUMER ECONOMICS (Credit 3)

Family organization : Family as a basic institution, Suructure of Indian Families-urban and Rural family. Family as an economic family, family and society.

Consumer Economics: Definition, usefulness and importance of the subject. Survey of living standards of any given group.

Standards: Principle of family's standard of living. Concept of standard of living method to raise standard of living.

Human wants & Utility of commodities: Factors governing wants. Theory of wants, classification of wants, Principles of substitution of relation, utility-law of diminishing marginal utility. The principle of equimarginal utility as the object of household expenditure, consumers, surplus.

Family Finance: Type of income-money, real, psychic

1. Sources of money income wages and salaries, Profit. Interest and Rent. Transfer Payments. Royalties, Gifts.
2. Sources of real income. Money spent in exchange economy. Household production. Free goods and services.
3. Regular and irregular income. Substitutions of other resources for money. Methods of handling income in families.

Expenditure: Family budget its main items, Engle's law of consumption, kinds of household consumption.

Market: Recognition, type of markets functions distribution, role of consumer in market. Price determination under monopoly and competition. Rationing and price control.

Price of Commodities: Fundamental ideas. Fixation of price. Price as a guide to quality. The role of consumer in in-crease and decrease of prices. Causes of inflation-role of consumer in influencing inflation.

Market, Supply & demand: Market Schedule, law of demand electricity of demand.

Types of advertising: Newspaper, magazines direct advertising, radio and television, Outdoor advertising; Advantages & disadvantages of each

Entrepreneurship: Concept and frame work, features, classification of entrepreneurship, entrepreneurship theories, contribution of entrepreneurship and economic development.

Suggested readings:

1. Gordon Lee (1972), Economics for Consumers, D. Van Nostrand Company, New York
2. Singh Gurbax (Comp) (1990) : Law of Consumer Protection, Jaipur, Bharat Law Publishers
3. Kewal Krishan Dewett & Adarsh Chand (1981) : Modern Economic Theory, 12th Ed., Shyamlal Charitable Trust
4. Gupta B.D. (1973), Consumption Pattern in India, Tata McGraw Hill
5. Smt. B. K. Bakhshi: Consumer Economics (Hindi)
6. Dr. Tripathi: Consumer Economics (Hindi)
7. Dr. Naresh Tripathi: Consumer Economics (Hindi)
8. Dr. Dubey and Sinha: Consumer Economics (Hindi)
9. Smt. B. K. Bakshi: Consumer Economics (Hindi)
10. Dr. Tripahi: Consumer Economics (Hindi)

PRACTICAL

HSB 506: (BASED ON HSB501 AND HSB502) (Credit 3)

Part A: HOME SCIENCE EXTENSION EDUCATION AND RURAL DEVELOPMENT

Visit to a village to gain knowledge through standard questionnaire about;

(a) The Rural Society

(b) The Gram Panchayat, Regional Committee ¼{ks=h; lfefr½ at block level and their functioning.

To know about different programmes running for rural development and interaction with villagers.

Observation of development programmes running in the village and intraction with villagers and personnel of implementing agency.

Educational tour to institutions related to the course.

Part B: CONSUMER ECONOMICS

Study of merits and demerits of unclear family and joint family.

Impact of advertising on consumer buying on children and women/ society.

Collection of various advertisements and classification by identifying intended consumer appeal.

Make a list of sources of income in your family. Draw up a personal budget.

Assignments- Assign projects to the students to present new idea of enterpreneurship.

Paper – III

HSB 503: FUNDAMENTAL OF HUMAN DEVELOPMENT (Credit 3)

Methods of studying Human Development: (case study interview, naturalistic observation and laboratory observation). Experimental methods, Data collection methods (cross sectional and longitudinal and sequential studies). Ethics of Research (ethical issues and standards).

Introduction to theories of Human Development:. Piagets's theory of Cognitive Development. Psycho; sexual theory of Sigmund frued (Defense Mechanisms, stages of Psychosexual development, Id, ego and super ego). Psychosocial theory of Erik, Erik son. Traditional learning theories (Pavlov, Watson and Skinner). Social learning theory (Bandura): Kohlberg's Theory of Moral Development. Theories of language acquisition. Maslow's self actualization Theory. Attachment theory of Bowlby. The psychology of behaviour perception, concept formation, reasoning and thinking. Imagination, creativity memory, remembering and forgetting. Intelligence Motivation and Learning

Early Childhood Education and Management: Meaning, importance and origin in India, objectives and Principle of ECCE, philosophy of Early Childhood education (Pre-basic Education of Gandhiji, Maria Montessori, Giju Bhai Vadika, Frobel). Early childhood education centers: Infrastructure and Administration, Staff building and Equipment, record keeping, parent teachers meeting, Curriculum for ECCE centers, Importance of Science, nature, music, role plays and stories in ECCE programme, Understanding and guiding children.

Child Guidance & Counseling: Meaning, nature, scope & objectives of child guidance & counseling service, principals of Guidance & Counseling, types of Guidance & Counseling, Educational, Vocational, Occupational, Personal and Behavioural, pre-marital and marital counseling, different stages of guidance and counseling, role of counselor, ethics of guidance and counseling.

Assignment on any one topic selected from theory course and presentation of the same. (For theory sessional only)

Suggested readings:

1. Gangrae K.D. (1971), Community Organization in India, Popular Prakashan, New Delhi
2. State of World Children, UNICEF, Annual Publication
3. Parakesh B.S. (1985), Population Education – Inception to Institutionalization, NCERT, New Delhi
4. Bernard H.W. & Fullner D.W., Principles of Guidance, Bombay, Allied Publishers
5. Verma Hildebrand (1985) Guiding Young Children, New York, MacMillan Publishing Company
6. Hallan D.P. & Kauffman T.M. (1991), Introduction to Exceptional Children (5th Ed.), Boston, Allyn & Bacon

Paper – IV

HSB 504: DIET THERAPY I (Credit 3)

Basic concepts of diet therapy: Therapeutic adaptations of normal diet, principles and classification of therapeutic diets. Team approach to health care. Assessment of patient's needs. Routine Hospital Diets; Regular, light, soft, fluid, parenteral and enteral feeding.

Energy modifications and nutritional care for weight management, Identifying the overweight and obese, etiological factors contributing to obesity, prevention and treatment, low energy diets, balanced energy reduction. Underweight; Aetiology and assessment, high energy diets for weight gain, anorexia nervosa and bulimia, Diets for Febrile conditions, infections and surgical conditions

Etiological factors, symptoms, diagnostic tests and management of GI tract disease – Diseases of oesophagus, gastric and duodenal ulcers, diarrhoea, steatorrhoea, diverticular disease, inflammatory Bowel Disease, Ulcerative Colitis. Flatulence, Constipation, Irritable Bowel Syndrome, Hemorrhoids, Celiac sprue, Tropical sprue. Nutritional Anemias, Sickle cell Anemias. Viral Hepatitits, Cirrhosis of Liver, Hepatic Encephalopathy, Wilson's disease. Dietary care and management in diseases of Gall Baldder and pancreas – Cholelithiasis, cholecystitis, cholecystectomy, Pancreatitis etc.

PRACTICAL

HSB 507: DIET THERAPY I (Credit 2)

- Planning and preparation of Normal diet.
- High-Risk Management (hospital based) – Nutrition assessment.
- Planning and preparation of fluid food preparations.
- Clear fluid preparations. Full fluid preparations. Planning and preparation of fluid diet-clear and full fluid.
- Planning and preparation do Recipes of soft/semi-solid diet,

- Mechanical, pureed, Planning and Preparation of soft diet.
- Planning and preparation of recipes using protein concentrates, sugar substitutes, low fat and low calorie recipes, high fibre recipes, bland diet recipes and diets for the following conditions:
- Constipation, malabsorption, syndrome, viral hepatitis, liver
- Cirrhosis, cholecystitis, nutritional anaemias

Suggested readings:

1. Anderson, L., Dibble, M.V., Turkki, P.R., Mitchall, H.S., and Rynbergin, H.J. (1982): Nutrition in Health and Disease, 17th Ed., J.B. Lippincot & Co. Philadelphia.
2. Antia, F.P. (1973): Clinical Dietetics and Nutrition, Second Edition, Oxford University Press, Delhi
3. Mahan, L.K., Arlin, M.T., (1992): Krause's food, Nutrition and Diet Therapy, 8Th Ed. W.B. Saunders Company, London.
4. Robinson, C.H., Lawler, M.R., Chenoweth, W.L. and Garwich, A.E. (1986): Normal and Therapeutic Nutrition, 17th Ed., Macmillan Publishing Co.
5. Williams, S.R. (1989): Nutrition and Diet Therapy, 6th Ed. Times Mirror/Mosby College Publishing, St. Louis.
6. Raheena, Begum (1989): A textbook of foods, nutrition and dietetics. Sterling Publishers, New Delhi.
7. Joshi, S.A.(1992): Nutrition and Dietetics, Tata Mcgraw Hill Publications, New Delhi.

Paper – V

HSB 505: FASHION DESIGNING (Credit 3)

1. Pattern making:

i. Techniques of flat pattern - principles and application of flat pattern for different styles

ii. Introduction to draping & draping of bodice block or dress form Developing paper pattern, pattern envelop, guide sheet and understanding the commercial paper pattern

iii. Fitting**;** Factors affecting good fit, problems and remedies Dart manipulation

iv. Principles of figure drawing & sketching of body features, block figure. Drawing the form with different angles, Front, side, back

v. Drafting and stitching of salvar, kurta, blouse, petticoat, night suit (any three)

vi. Dart-manipulation

vii. Component of fashion; Silhouttee, details, colour, fabric, texture, seams, trims.

viii. Study of Fashion Terminology, concept, fashion cycle

ix. Fashion forecasting

x. Portfolio development

xi. Detailed study of Industrial machine & equipments used for Cutting, Sewing, Finishing, Embellishment.

PRACTICAL

HSB508: FASHION DESIGNING (Credit 2)

1. Preparation of bodice block
2. Preparation of patterns by draping
3. Preparation of patterns by flat pattern
4. Dart manipulation
5. Preparation of block figures
6. Sketching of fashion figures with different angles

7. Sketching of fashion figure & designing of garments using fashion components
8. Portfolio development
9. Study of industrial machine and equipments related to sewing, cutting and finishing
10. Preparation of two designer garments

Suggested readings:

1. Armstrong, Helen Joseph : Pattern making for Fashion Design, Harper Collins Publishers, New York
2. Bane A. : Flat Pattern Design, Mcgraw Hill
3. Goldsworthy, M. : Simple Dress-making, London, Mills & Boon Ltd.
4. Allen, Anne & Seaman, Jullian : Fashion Drawing : Basic Principles, B.T. Batsford, London

SEMESTER – VI

Paper – I

HSB 601: ADVANCED HOME SCIENCE EXTENSION AND COMMUNICATION

(Credit 3)

Adult Education (A.E.): Formal, non-formal & Informal system of education, Concept, background, meaning & definition of A.E., Aim & objectives and goals of A.E., Role of Adult education in National Development, History of adult education in Post-Independent India; Gram Shikshan Mohim, Farmer's functional literacy project, Non-formal education for youth (NAEY), National adult education programme (NAEP), State adult education programme (SAEP), Adult education through voluntary agencies, National Literacy Mission (Achievement & Problems), Literacy scenario of nation, state, district & local areas. Choice of language for literacy, dialects Vs standard.

Community participation in A.E.: Training for Development, Concept, meaning & types of training; Institutional, Interactive, Participatory, Various Training Approaches; Creativity Training, Field Training, Group dynamics, Laboratory Training, Motivation Training, Self-awareness & self development, Techniques of Training including RRA, PRA.

Genesis & growth of Folk and Electronic media in India: Types of folk media, folk music & dances, street theatre & its educational value, role of puppetry & different types of puppets, importance of folk media in development context & criteria for selection of folk media. Concept, meaning & role of electronic media, various forms of electronic media (broadcast media, T.V., film media), their development in India, Types of programmes, their use in extension work, feedback mechanism for all types of electronic media.

Advertisement and Visual Publicity: Meaning, importance & role of visual communication and print media, type of printing (Design & layout), press & public relations, law related to press, agencies governing regulations & ensuring freedom of press, concept & meaning of graphic art, editorials, principles of editing. Advertising as a mass communication process, Need for advertising communication, economic & social effect of advertising, Types of advertising media; print media, broadcast media, outdoor advertisement (hoardings, posters, bill board, bulletin board, electronic signs, litterbins, aerial methods, wall magazines), transportation media (mobile vehicles), exhibitions & trade fairs, non-media advertising, Techniques of Advertising; choosing content, layout & design, media planning, Ethics in Advertising, Programme Planning, Meaning, need & principles, Steps in programme planning, Criteria for good programme planning, Execution, monitoring & evaluation of extension programme

Project Planning & Management: Meaning & concept of project, Components of project management system, Steps for designing the project, Proposal writing, Cost estimation & financial management, Fund raising.

PRACTICAL

HSB 606: ADVANCED HOME SCIENCE EXTENSION AND COMMUNICATION

(Credit 2)

1. Plan a programme keeping in mind the steps of Programme Planning.
2. Proposal writing
3. Organizing a Fair/Mela/Exhibition.
4. Excursion Tour

Suggested readings:

1. McGivney, Veronica & Murray, Frances : Adult Education in Development – Methods & Approaches for Changing Societies, 19 B, De Mant Fort Street Leicester LE, U.K. National Institute of Adult & Continuing Education
2. Lynton Rolf P. & Pareek Uday, Training for Development Homewood, Iwrois, Dorsey Press
3. Jain R, Mass Media & Rural Development, Vol. II, New Delhi, Mank Publication Pvt. Ltd.

Paper – II

HSB 602: DIET THERAPY II **(Credit 3)**

Diabetes Mellitus: Classification, Symptoms, diagnosis, Insulin therapy, Oral hypoglycemic agents, Glucose monitoring at home. Dietary care and nutritional therapy, meal plan (with and without insulin). Special dietetic foods, Sweeteners and sugar substitutes. Diabetes in pregnancy, elderly, surgery, illness, Diabetic coma, Insulin reaction. Juvenile Diabetes. Patient education, hypoglycemia.

Diseases of the cardiovascular system; Atherosclerosis: Etiology and risk factors, Hypertension; Etiology, prevalence, nutritional management and prevention. Diet in kidney diseases; Classification, etiology, characteristic symptoms and dietary management in: Glomerulonephritis; Acute and chronic, Nephrotic syndrome, Use of sodium and potassium exchange lists.

Allergies: Definition, symptoms, diagnosis and dietary management. Food selection. Food allergy in infancy.

Cancer: Nutritional and non-nutritional etiological factors,

Surgery, trauma and burns: Physiological changes in relation to trauma**.** Assessment of the nutritional status in surgical and burns patients. Pre-operative and post-operative nutritional care. Nutritional care in trauma. Nutritional management of burns patients.

Inborn errors of metabolism: Thyroid and parathyroid glands. Gout. Interactions between drugs.

Suggested readings:

1. Anderson, L., Dibble, M.V., Turkki, P.R., Mitchall, H.S., and Rynbergin, H.J. (1982): Nutrition in Health and Disease, 17th Ed., J.B. Lippincot & Co. Philadelphia.
2. Antia, F.P. (1973): Clinical Dietetics and Nutrition, Second Edition, Oxford University Press, Delhi
3. Mahan, L.K., Arlin, M.T., (1992): Krause's food, Nutrition and Diet Therapy, 8Th Ed. W.B. Saunders Company, London.
4. Robinson, C.H., Lawler, M.R., Chenoweth, W.L. and Garwich, A.E. (1986): Normal and Therapeutic Nutrition, 17th Ed., Macmillan Publishing Co.
5. Williams, S.R. (1989): Nutrition and Diet Therapy, 6th Ed. Times Mirror/Mosby College Publishing, St. Louis.
6. Raheena, Begum (1989): A textbook of foods, nutrition and dietetics. Sterling Publishers, New Delhi.
7. Joshi, S.A.(1992): Nutrition and Dietetics, Tata Mcgraw Hill Publications, New Delhi.

PRACTICAL

HSB 607: DIET THERAPY II (Credit 2)

1. Review of existing practices in hospitals. Oral supplements indigenous/home based and commercial for stressed patients – burns, surgery, cancer, debilitated patients. Management of patients with feeding problems. Tube feeds – all forms, elemental and parenteral.
2. Planning and preparation of diets. Without Insulin, with insulin, adult and juvenile, diabetes in pregnancy, diabetes and illness.
3. Diseases of Cardiovascular system-
4. Formulation of low cholesterol and low sodium recipes, planning and preparation of diets for hypertension, CHD, congestive heart failure during acute, chronic and convalescent conditions.
5. Protein and mineral modification for patients with renal disease
6. Planning and preparation of diet for glomerulonephritis – acute and chronic, nephritic syndrome, dialysis.
7. Elimination diets for allergy.
8. Low purine diet.
9. Overweight and obesity, underweight, fevers, ulcers, diarrhoes,

Paper – III

HSB 603: ADVANCED HUMAN DEVELOPMENT (Credit 3)

Family and Child Welfare: Family in India (concept, family composition & structure, changing pattern of family, causes & effects of family disharmony, Implications of family changes). Marital discord**,** Children's right & National Policy for children, Demographic Profile of child in India. Family & child welfare services working at National & International level (CSWB, ICCW, ICDS, NIPCCD, WHO, UNICEF, CARE). Concept, meaning and coping strategies for violence against women, youth, disabled & others, types of violence. Marriage & Family dynamics**,** Physiological, social, psychological, financial readiness for marriage**,** Preparation for Marriage; Selecting a suitable partner, Premarital counseling. Technological advancement and family

Legal Aspects: Laws regarding marriage (Hindu Marriage Act, Muslim Marriage Act, Christian Marriage Act, Special Marriage Act), Divorce, Adoption, Inheritance Dowry) Contemporary issues in family life, dual career families, non-traditional families, influence of extra familial factors-films, TV, peer group, neighbourhood & school on development of children.

Family life education: Meaning, Need, Importance & objectives of Family life education, determination of sex techniques, fertilization techniques (Amnio centesis, sonography, Gift, IVF & A.I. Pregnancy & its management)**.,** Need & concept of family planning, contraceptive technology**,** Planned parenthood-spacing between children, size of family.

Parent Education: Meaning, Need, Importance & objectives of parent education

Child with Special Needs: Definitions, Terminology, History of studying disability in India & Abroad. Issues in Classification & labelling, Mainstreaming. Education and Rehabilitation facilities. Government & Non-government efforts (Schemes for Physically & Mentally Challenged people). Different Type of disabilities, their definition, classification, statistics, genetic & environmental, causes, prevention, Rehabilitation facilities; Mental Retardation, Sensory Deficits (Auditory Impairment, Visual Impairment), Learning difficulty & disability**,** Cerebral Palsy & orthopaedic disability**,** Communication disorders**,** Behavioural disorders.

Family Support Services: Meaning, Nature & Scope of Family Support Services**,** Support Services for children (crèches, day care centers, kishore sadan, observation home & Juvenile Jails). Support Services for Women: Mahila Ashram, Nari Niketan, Govt, Praveshalaya & Shriahalya, Vidhwa Ashrams, Women Study Centers. Support Services for elderly; Old age homes, day care for aged, Support Services for family; Family courts, family guidance centers.

PRACTICAL

HSB 608: ADVANCED HUMAN DEVELOPMENT (Credit 2)

Visit to various institutions related to special need children.

- vaÙ fo|ky;
- Deaf and Dumb school
- Deva Centre

Study of marital adjustment in couples of different time span of marriage

- After 5 year of marriage
- After 20 year of marriage
- After 35 year of marriage

Study of family relationship in different types of families

- Nuclear family
- Joint family
- Extended family
- Working and non-working women
- Single parent family

Suggested readings:

1. Gangrae K.D. (1971), Community Organization in India, Popular Prakashan, New Delhi
2. State of World Children, UNICEF, Annual Publication
3. Parakesh B.S. (1985), Population Education – Inception to Institutionalization, NCERT, New Delhi
4. Bernard H.W. & Fullner D.W., Principles of Guidance, Bombay, Allied Publishers
5. Verma Hildebrand (1985) Guiding Young Children, New York, MacMillan Publishing Company
6. Hallan D.P. & Kauffman T.M. (1991), Introduction to Exceptional Children (5th Ed.), Boston, Allyn & Bacon

Paper – IV

HSB 604: CONSUMER AND BUSINESS LEGISLATION (Credit 3)

Consumer Protection: Consumer rights, problems of Indian consumers, Legislations protecting interest of consumers, measures to promote consumerism, Consumer Protection Act, 1986 – rights of consumers, objectives, Scope, authorities-councils.

Essential Commodities Act, 1955: Introduction, essential commodities, Powers of Central Government, Seizure and Confiscation, Sale of seized commodities, Paenalty provisions in case of contravention.

Contract Act, 1872: Definition, Essentials of a valid contract, kinds of contract, Offer and acceptance, Consideration-concept to consideration, Capacities of parties and contract by a minor.

Sale of Goods Act. 1930: Sales and agreement to sale, Essentials of contract of sale, Subject matters, Conditions and warranties, implies conditions, Shipping documents, Rights of Unpaid seller.

Local Government: Characteristics, importance and advantages; Problems before local government. Powers, authority and responsibilities of Panchayats, Election to Panchayats; Constitution of Municipalities, Powers, authorities and responsibility of Municipalities.

Suggested readings:

1. Meena, Malik and Junja: Business Environment, Kalyani Publishers
2. Sharama, Sadana: Public Administration, Kitab Mahal

3. Upadhyay, Sharma & Dayal: Business Environment, Ramesh Book Depo
4. Tulsian, P.C.: Business Law, Tata McGraw Hill
5. Bose Chandra, D: Business Law, PHI Learning Pvt Ltd
6. Kapoor,, N.D.: Elements of Mercantile Law, Sultan Chand & Sons

Paper – V

HSB605: STATISTICS AND RESEARCH METHODS (Elective) (Credit 4)

Elementary Statistics: Nature of investigation, scope, objectives. Sources of data, study tools and Techniques of Research, Frequency distributions, Mean, mode, Median, Probability, Standard deviation, Graphs., Research and Documentation, Different types of research and their application, types all data (Primary and Secondary), methods of data collection, classification and organization of data, editing and coding the data, representation of data diagrammatic and graphic presentation, techniques of construction of diagrams and graphs. Techniques of Research Writing

Seminar- 25 marks

Suggested readings:

1. Bhandarkar, P.L. and Willanson T.S. 2000 Methodology and Techniques of Social Research, Himalaya Publishing House, Mumbai.
2. Bhatnagar, G.L. (1990): Research Methods and Measurements in Behavioural and Social Sciences, Agri. Cole Publishing Academy, New Delhi.
3. Stranss, A. and Corbin, H. (1990): Basis of Qualitative Research: Grounded Theory Procedures and Techniques, Saga Publications, California.
4. चित्र एंव मनोविज्ञान में सांख्यिकी रू गेरेट हेनरीई

BANARAS HINDU UNIVERSITY

Department of Mathematics

Faculty of Science

SYLLABI

B.Sc. (Hons.) Programme
in
Mathematics

B. Sc. (Hons) in MATHEMATICS

Approved Syllabus(by BoS meeting on 09.5.2012)

Department of Mathematics, Faculty of Science, Banaras Hindu University

Semester –I		
Course Code	**Title**	**Credits**
MTB 101	Calculus – I	3
MTB 102	Geometry	3
	Total	**6**
Semester –II		
MTB 201	Calculus – II	3
MTB 202	Statics & Dynamics	3
MTB AM203	Ancillary-I	2
	Total	**8**
Semester –III		
MTB 301	Algebra	3
MTB 302	Differential Equations	3
	Total	**6**
Semester –IV		
MTB 401	Partial Differential Equations	3
MTB 402	Mathematical Methods	3
MTB AM403	Ancillary-II	2
	Total	**8**
Semester -V		
MTB 501	Mathematical Analysis	3
MTB 502	Abstract Algebra	3
MTB 503	Programming in C	3+1P*
MTB 504	Differential Geometry	3
MTB 505	Mechanics	3
MTB 506	Operations Research	3
	ELECTIVE – I (**Any one** of the following courses, each of 3 credits)	3
MTB 507	Combinatorial Mathematics	
MTB 508	Business Mathematics	

MTB 509	Special Theory of Relativity-I	
MTB 510	Computational Mathematics Lab-I	
MTB 511	Probability	
	Total	**22**
Semester –VI		
MTB 601	Set Theory and Metric Spaces	3
MTB 602	Linear Algebra	3
MTB 603	Numerical Analysis	3+1P*
MTB 604	Discrete Mathematics	3
MTB 605	Vector & Tensor Analysis	3
MTB 606	Complex Analysis	3
	ELECTIVE – II (**Any one** of the following courses, each of 3 credits)	3
MTB 607	Number Theory	
MTB 608	Global Differential Geometry	
MTB 609	Special Theory of Relativity-II	
MTB 610	Computational Mathematics Lab-II	
MTB 611	Dynamical Systems	3
	Total	**22**

*Practical based on the concerned paper.

Semester – I

MTB 101: Calculus-I **Credits : 3**

Differential Calculus: Sequences and series, Notion of convergence, Limit (ε-δ definition), Continuity, Discontinuity, Properties of continuous functions. Intermediate value theorem. Differentiability, Chain rule of differentiation, Successive differentiation and Leibnitz theorem, Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems. Asymptotes, Tracing of plane curves.

Integral Calculus: Definite Integral as the limit of sum.

Suggested readings:

1. Gorakh Prasad, Differential Calculus, Pothishala Pvt. Ltd. Allahabad, 2000.
2. Gorakh Prasad, Integral Calculus, Pothishala Pvt. Ltd. Allahabad, 2000.
3. Gabriel Klambauer, Mathematical Analysis, Marcel Dekkar, New York, 1975.
4. Shanti Narayan, Elements of Real Analysis, S. Chand & Company, New Delhi.

MTB 102: Geometry **Credits : 3**

Polar equations of a conic, Plane and straight line (using vector method). **Sphere:** Plane section of sphere, equations of circle, equation of tangent plane, Angle of intersection of two sphere. **Cone:** cone and plane through its vertex, Intersections of two cones, Right circular cone. **Cylinder**: Enveloping cylinder, Right circular cylinder. Paraboloids, Central Conicoids and their properties.

Suggested readings:

1. R. J. T. Bell, An Elementary Treatise on Co-ordinate geometry of three
2. dimensions, Macmillan India Ltd., New Delhi, 1994.
3. Shanti Narayan, P.K. Mittal, Analytical Solid Geometry, S. Chand & Company, New Delhi, 2008.
4. M.M. Tripathi, Coordinate Geometry: Polar Coordinates Approach, Narosa Publishing House, New Delhi.

Semester – II

MTB 201: Calculus- II **Credits : 3**

Functions of two Variables: Limit, Continuity, Differentiability. Partial differentiation, Young's theorem, Schwarz's theorem, Change of variables, Euler's, Jacobian, Taylor's theorem. Maxima and minima. Double and triple integrals, Change of order and change of variables in double integrals, Applications to area, volume and surface area. Dirichlet's theorem.

Suggested readings:

1. Shanti Narayan, A Text Book of Vector Calculus, S. Chand & Company, New Delhi.
2. S. C. Mallik, Mathematical Analysis, Wiley Eastern Ltd, New Delhi.
3. Gabriel Klaumber, Mathematical Analysis, Marcel Dekkar, New York 1975.
4. G. B. Thomas, R. L. Finney & M. D. Weir, Calculus and Analytic Geometry, Pearson Education Ltd, 2003.
5. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley, 1999.

MTB 202: Statics & Dynamics **Credits : 3**

Statics: Analytic condition of equilibrium for coplanar forces. Equation of the resultant force. Virtual work.

Dynamics: Rotation of a vector in a plane. Velocity and acceleration components in Cartesian, polar and intrinsic systems. Central orbit, Kepler's laws of motion, Rectilinear simple harmonic motion. Vertical motion on circular and cycloidal curves. Motion with respect to linearly moving and rotating plane. Coriolis force and centrifugal force.

Suggested readings:

1. R.S. Verma - A Text Book on Statics, Pothishala Pvt. Ltd., Allahabad.
2. S.L. Loney - An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies, Kalyani Publishers, New Delhi.
3. J.L. Synge & B.A. Griffith - Principles of Mechanics, Tata McGraw-Hill, 1959.
4. M. Ray and G. C. Sharma – A Text Book on Dynamics, S. Chand & Company, New Delhi.

MTB AM203: Ancillary-I **Credits : 2**

Elements of Set Theory: Sets, functions and relations (including equivalence relations).

Matrices and Determinants: Matrices, matrix addition and multiplication. Determinants. Elementary row and column operations, Echelon form, rank of a matrix. Inverse of a matrix. Solution of system of linear equations using matrices and determinants.

Suggested readings:

1. D.T. Finkbeiner, *Introduction to Matrices and Linear transformations*, CBS Publishers, New Delhi, 1986
2. Shanti Narayan, *A Text Book of Matrices,* S. Chand & Co., New Delhi, 2004

Semester –III

MTB 301: Algebra-I **Credits : 3**

Matrix Algebra: Hermitian and Skew-Hermitian Matrices, Adjoint of a Matrix, Elementary operations of matrices. Inverse of a matrix. Rank of a matrix. Application of matrices to the system of linear equations, Consistency of the system.

Algebra: Definition of a group with examples and simple properties, Subgroups, Generation of groups, Cyclic groups, Coset decomposition, Lagrange's theorem and its consequences. Homomorphism and Isomorphism. Permutation groups and Cayley's theorem. Normal subgroups, Quotient group, Fundamental theorem of Homomorphism. Isomorphism theorems for groups.

Suggested readings:

1. I. N. Herstein , Topics in Algebra, Wiley Eastern Ltd, New Delhi, 1975.
2. D.T. Finkbeiner, Introduction to Matrices and Linear transformations, CBS Publishers, New Delhi, 1986.
3. P. B. Bhattacharya, S. K. Jain and S. R. Nagpal, First Course in Linear Algebra, Wiley Eastern Ltd., New Delhi, 1983.
4. S. Singh and Q. Zameeruddin, Modern Algebra, Vikas Publication House, India.

MTB 302: Differential Equations **Credits : 3**

Ordinary differential equations of first order, initial and boundary conditions, homogeneous equations, linear equations, Exact differential Equation. First order higher degree equations solvable for x, y, p. Singular solution and envelopes.

Linear differential equations with constant coefficients, homogeneous linear differential equations, linear differential equations of second order with variable coefficients.

Series solutions of differential equations. Bessel and Legendre functions, Rodrigue's formula, Generating functions, Recurrence relations.

Suggested readings:

1. Gorakh Prasad, Integral Calculus, Pothishala Private Ltd. Allahabad,2000.
2. S. Balachandra Rao & H.R. Anuradha, Differential Equations with Applications and Programmes, University Press, Hyderabad, 1996.
3. D.A. Murray, Introductory Course in Differential Equations, Orient Longman , 1967.
4. E. A. Codington, An Introduction to Ordinary Differential Equations, Prentice Hall of India, 1961.
5. B. Rai, D.P. Choudhary & H.I. Freedman, Ordinary Differential Equations, Narosa Publications, New Delhi, 2002.

Semester –IV

MTB 401: Partial Differential Equations **Credits : 3**

Linear partial differential equations of first order and its classifications, Lagrange's method. Non linear PDE of first order: Charpit's method.

Linear partial differential equation of second and higher order of homogeneous and non homogeneous forms with constant coefficients, Linear partial differential equations reducible to equations with constant coefficents. Second order PDE with variable coefficients, Classifications of second order PDE, Reduction to canonical or normal form. Monge's method. Solution of heat and wave equations in one and two dimensions by method of separation of variables.

Suggested readings:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Son Inc., New York, 1999.
2. Ian N. Sneddon, Elements of Partial Differential Equations, McGraw-Hill Book Company, 1988.
3. S. B. Rao and H. R. Anuradha, Differential Equations, University Press, 1996.
4. W. T. H. Piaggio, Elementary Treatise on Differential Equations and their applications, CBS Publishers, New Delhi, 1985.

MTB 402: Mathematical Methods **Credits : 3**

Integral Transforms: Laplace Transformation, Laplace Transforms of derivatives and integrals, shifting theorems, Dirac's delta function, differentiation and integration of transforms, convolution theorem. Integral equations, Application of Laplace transform in solution of ordinary differential equations. Fourier series expansion, Half-range expansions, Fourier integrals

Calculus of Variations: Functionals, Deduction of Euler's equations for functionals of first order and higher order for fixed boundaries. Shortest distance between two non-intersecting curves. Isoperimetric problems. Jacobi and Legendre conditions (applications only).

Suggested readings:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Son Inc., New York, 1999.
2. N. Kumar, An Elementary Course on Variational Problems in Calculus, Narosa Publications, New Delhi.
3. A. S. Gupta, Text Book on Calculus of Variation, Prentice-Hall of India, New Delhi.
4. S. G. Deo, V Lakshmikanthna and V. Raghavendra, Text Book of Ordinary Differential Equations, Tata McGraw-Hill.
5. F. B. Hilderbrand, Advanced Calculus for Applications, PHI, New Delhi, 1997.
6. B. Rai, D. P. Choudhary, H.I. Freedman, Ordinary Differential Equations, Narosa Publications, New Delhi, 2002.

MTB A403: Ancillary-II **Credits : 2**

Calculus: Continuity and derivative of a function. Finding derivatives (of simple functions only). Maxima and minima.

Definite integrals with some simple applications.

Differential equations (simple types only), their solutions and applications.

Suggested readings:

1. Gorakh Prasad, *Differential Calculus,* Pothishala Pvt. Ltd., Allahabad, 2000
2. Gorakh Prasad, *Integral Calculus,* Pothishala Pvt. Ltd., Allahabad, 2000

Semester –V

MTB 501: Mathematical Analysis **Credits : 3**

Sequences, Theorems on limits of sequences, Monotone convergence theorem, Cauchy's convergence criterion. Infinite series, series of non-negative terms. Comparison test, Ratio test, Rabbe's, logarithmic test, De Morgan and Bertrand's tests. Alternating series, Leibnitz's theorem, Cauchy's integral test, Dini-Kummer Test, Root test.

Riemann Integral, Integrability of continuous and monotonic functions, Fundamental theorem of integral calculus, Mean Value theorems of integral calculus.

Improper integrals and their convergence. Comparison test, Abel's and Dirichlet's test, Integral as a function of a parameter and its applications.

Suggested readings:

1. Shanti Narayan, A Course of Mathematical Analysis. S. Chand & Company, New Delhi.
2. T. M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.
3. R. R. Goldberg, Real Analysis, Oxford & IBH Publishing Company, New Delhi, 1970.
4. S. Lang, Undergraduate Analysis, Springer-Verlag, New York, 1983.
5. P. K. Jain and S. K. Kaushik, An Introduction to Real Analysis, S. Chand & Company, New Delhi, 2000
6. W.Rudin, Principles of Mathematical Analysis, McGraw-Hill.

MTB 502: Algebra-II **Credits : 3**

Automorphism and inner automorphism, Automorphism groups and their computations. Normalizer and centre, Group actions, stabilizers and orbits. Finite groups, Commutator subgroups. Rings, Integral Domains and Fields. Ideal and quotient Rings. Ring Homomorphism and basic isomorphism theorems. Prime and maximal ideals. Fields of quotients of an integral domain. Principal ideal domains. Polynomial Rings, Division algorithm. Euclidean Rings, The ring Z[i].

Suggested readings:

1. P. B. Bhatacharya, S. K. Jain and S. R. Nagpal, Basic Abstract Algebra (2^{nd} Edition)

   Cambridge University Press, Indian Edition, 1977.
2. N. Herstain, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
3. N. Jacobson, Basic Algebra, Vol I & II, W.H. Freeman, 1980 (also published by Hindustan Publishing Company).

MTB 503: Programming in C **Credits: 3+1P**

C fundamentals. Constants, Variables and Data types, Operators and expression, formatted input and output. Decision makings, Branching and Looping. Arrays. User defined functions. Structures. Pointers. File handling. Programming based on above.

Suggested readings:

1. B. W. Kernighan and D. M. Ritchie, The C Programming Language 2^{nd} Edition, (ANSI features) Prentice Hall, 1989.
2. V. Rajaraman, Programming in C, Prentice Hall of India, 1994.
3. Byron S. Gotfried, Theory and Problems of Programming with C, Tata McGraw-Hill, 1998.

4. Henry Mullish & Herbert L. Cooper, Spirit of C: An introduction to Modern Programming, Jaico Publishers, Bombay.
5. E. Balagurusamy, Programming in ANSI C, Tata McGraw Hill New Delhi.

MTB 504: Differential Geometry **Credits : 3**

Curves in R^2 and R^3: Basic Definitions and Examples. Arc Length. Curvature and the Frenet-Serret Apparatus. The Fundamental Existence and Uniqueness Theorem for Curves. Non-Unit Speed Curves.

Surfaces in R^3: Basic Definitions and Examples. The First Fundamental Form. Arc length of curves on surfaces. Normal curvature. Geodesic curvature. Gauss and Weingarten Formulas. Geodesics, Parallel Vector Fields Along a Curve and Parallelism. The Second Fundamental Form and the Weingarten Map, Principal, Gaussian and Mean Curvatures. Isometries of surfaces, Gauss's Theorema Egregium, The Fundamental Theorem of Surfaces, Surfaces of Constant Gaussian Curvature. Exponential map, Gauss Lemma, Geodesic Coordinates. The Gauss-Bonnet Formula and the Gauss-Bonnet Theorem (description only).

Suggested readings:

1. Christian Bär, Elementary Differential Geometry, Cambridge University Press, 2010.
2. M. P. do Carmo, Differential geometry of curves and surfaces, Prentice Hall 1976.
3. A. Gray, Differential Geometry of Curves and Surfaces, CRC Press, 1998.
4. R. S. Millman and G. D. Parkar, Elements of Differential Geometry, Prentice Hall 1977.
5. S. Montiel and A. Ros, Curves and Surfaces, American Mathematical Society, 2005.
6. B. O'Neill, Elementary Differential Geometry, Elsevier 2006
7. John Oprea, Differential Geometry and its applications, Prentice Hall 1997.
8. A. Pressley, Elementary Differential Geometry, Springer 2010.
9. John A. Thorpe, Elementary Topics in Differential Geometry, Springer, 1979.
10. V. A. Toponogov, Differential geometry of curves and surfaces - A concise guide, Birkhauser, 2006.)

MTB 505: Mechanics **Credits : 3**

Satatics: Analytic conditions of equilibrium in 3-dimension. Poinsot's central axis. Stable and unstable equilibrium.

Dynamics: Moment of inertia, Equimomental systems, Principle axes. D'Alemdert's principle for motion of rigid body-linear and rotation for finite and impulsive forces. Conservation of momentum and energy. Compound pendulum. Reaction of axis of rotation. Kinetic energy and angular momentum for motion in two dimensions.

Suggested readings:

1. S. L. Loney, An Elementary Treatise on Statics, Kalyani Publishers, New Delhi.
2. S. L. Loney, An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies, Kalyani Publishers, New Delhi.
3. J. L. Synge and B. A. Griffith, Principles of Mechanics, McGraw-Hill, 1959.
4. N. C. Rana and P. S. Joag, Classical Mechanics, Tata McGraw-Hill, 1991.

MTB 506: Operations Research **Credits : 3**

Linear Programming problem, Convexity, Simplex and Revised Simplex algorithm, Duality theory, Dual simplex. Transportation, Assignment and Traveling Salesman problems. Portfolio Theory, Principle of Optimality and its applications.

Recommended Books:

1. G. Hadley, Linear Programming, Narosa Publishing House, 1995.
2. S. I. Gass, Linear Programming: Methods and Applications (4^{th} edition) McGraw-Hill, New York, 1975.

3. Kanti Swaroop, P.K. Gupta and Man Mohan, Operations Research, Sultan Chand & Sons, New Delhi, 1998.
4. Hamdy A. Taha, Operations Research, Prentice-Hall of India, 1997.

ELECTIVE -I (**Any one** of the following **3 credit** courses: MTB 507 - MTB 511)

MTB 507: Combinatorial Mathematics

Introduction to basic ideas. Selection and Binomial Coefficients: Permutations, Ordered selections, Unordered selections, Remarks on Binomial theorem.

Pairing problems: Pairing within a set, Pairing between sets, an optimal assignment problem, Gale's optimal assignment problem.

Recurrence: Fibonacci type relations, using generating functions, Miscellaneous methods.

Inclusion-Exclusion principle: The Principle, Rook polynomials.

Block Diagram and Error- correction Codes: Block designs, Square block designs, Hadanard Configurations, Error Correcting Codes. Steiner Systems. Golay's Perfect code.

Suggested readings:

1. Ian Anderson, A First course in Combinatorial Mathematics, Springer, 1989.

MTB 508: Business Mathematics

Financial Management: Financial Management. Goals of Financial Management and main decisions of financial management. Time Value of Money: Interest rate and discount rate. Present value and future value-discrete case as well as continuous compounding case. Annuities and its kinds.

Meaning of return. Return as Internal Rate of Return (IRR). Numerical Methods like Newton Raphson Method to calculate IRR. Measurement of returns under uncertainty situations. Meaning of risk. Difference between risk and uncertainty. Types of risks. Measurements of risk. Calculation of security and Portfolio Risk and Return-Markowitz Model. Sharpe's Single Index Model Systematic Risk and Unsystematic Risk.Taylor series and Bond Valuation. Calculation of Duration and Convexity of bonds.

Mathematics in Insurance: Insurance Fundamentals - Insurance defined. Meaning of loss. Chances of loss, peril, hazard, and proximate cause in insurance. Costs and benefits of insurance to the society and branches of insurance-life insurance and various types of general insurance. Insurable loss exposures-feature of a loss that is ideal for insurance. Life Insurance Mathematics. Construction of Mortality Tables. Computation of Premium of Life Insurance for a fixed duration and for the whole life.

Suggested readings:

1 Aswath Damodaran, Corporate Finance - Theory and Practice. John Wiley & Sons. Inc.
2. John C. Hull, Options, Futures, and Other Derivatives, Prentice-Hall of India Private Limited.
3. Sheldon M. Ross, An Introduction to Mathematical Finance, Cambridge University Press.
4. Mark S. Dorfman, Introduction to Risk Management and Insurance, Prentice Hall, Englwood Cliffs, New Jersey.
5. C. D. Daykin, T. Pentikäinen and M Pesonen, Practical Risk Theory for Actuaries, Chapman & Hall.

MTB 509: Special Theory of Relativity-I

Review of Newtonian mechanics: Inertial frames. Speed of light and Gallilean relativity. Michelson-Morley experiment. Lorentz-Fitzgerold contraction hypothesis. Relative character of space and time. Postulates of special theory of relativity. Lorentz transformation equations and its geometrical interpretation. Group properties of Lorentz transformations.

Relativistic kinematics: Composition of parallel velocities. Length contraction. Time dilation. Transformation equations for components of velocity and acceleration of a particle and Lorentz contraction factor.

Geometrical representation of space-time: Four dimensional Minkowskian space-time of special relativity. Time-like, light-like and space-like intervals. Null cone, Proper time. World line of a particle. Four vectors and tensors in Minkowiskian space-time.

Suggested readings:

1. C. Moller, The Theory of Relativity, Oxford Clarendon Press, 1952.
2. P. G. Bergmann, Introduction to the Theory of Relativity, Prentice Hall of India, 1969.
3. J. L. Anderson, Principles of Relativity Physics, Academic Press, 1967.
4. W. Rindler, Essential Relativity, Van Nostrand Reinhold Company, 1969.
5. V. A. Ugarov, Special Theory of Relativity, Mir Publishers, 1979.
6. R. Resnick, Introduction to Special Relativity, Wiley Eastern Pvt. Ltd. 1972.
7. J. L. Synge, Relativity: The Special Theory, North-Holland Publishing Company, 1956.
8. W. G. Dixon, Special Relativity: The Foundation of Macroscopic Physics, Cambridge University Press, 1982.

MTB 510: Computational Mathematics Lab-I

The student is expected to familiarize with popular software's for numerical computation. Real life problems requiring knowledge of numerical algorithms for linear and nonlinear algebraic equations, Eigen value problems/ writing computer program in a programming language. To this end software's like MATLAB, MATHEMATICA, MAPLES can be adopted with the following course outline.

1. Plotting of functions.
2. Matrix operations, vector and matrix manipulations, Matrix Computation and its applications.
3. Data analysis and curve fitting.
4. Solution of equations.
5. 2-D Graphics and 3-D Graphics - general purpose graphics functions, colour maps and colour controls.
6. Examples : Number theory,

Suggested readings:

1. MATLAB - High performance numeric computation and visualization software: User's Guide.
2. MATHEMATICA - Stephen Wolfram, Cambridge.

MTB 511: Probability

Notion of probability: Random experiment, sample space, axiom of probability, elementary properties of probability, equally likely outcome problems.

Random Variables: Concept, cumulative distribution function, discrete and continuous random variables, expectations, mean, variance, moment generating function.

Discrete random variables: Bernoulli random variable, binomial random variable, geometric random variable, Poisson random variable.

Continuous random variables: Uniform random variable, exponential random variable, Gamma random variable, normal random variable.

Conditional probability and conditional expectations, Baye's theorem, independence, computing expectation by conditioning; some applications - a list model, a random graph, Polya's urn model.

Bivariate random variables: Joint distribution, joint and conditional distributions, the correlation coefficient.

Functions of random variables: Sum of random variables, the law of large numbers and central limit theorem, the approximation of distributions.

Uncertainty, information and entropy, conditional entropy, solution of certain logical problems by calculating information.

Suggested readings:

1 S. M. Ross, Introduction to Probability Models (Sixth edition) Academic Press, 1997.

2. I. Blake, An Introduction to Applied Probability, John Wiley & Sons, 1979.

3. J. Pitman, Probability, Narosa, 1993.

4. A. M. Yagolam and I.M. Yagolam, Probability and Information, Hindustan Publishing Corporation, Delhi, 1983.

Semester –VI

MTB 601: Set Theory and Metric Spaces **Credits : 3**

Set Theory: Countable and uncountable sets, cardinal numbers, Schroeder-Berstiein theorem, partially ordered sets, Zorn's lemma, Axiom of choice.

Metric spaces: Introduction. Neighbourhood, limit points, interior points, open and closed set, closure and interior, boundary points. Subspace of a metric space, Completeness. Cantor's intersection theorem. Construction of real numbers as the completion of the incomplete metric space of rationals.

Dense subsets. Separable metric spaces. Continuous functions. Uniform continuity, Isometry and homeomorphism. Equivalent metrics.

Suggested readings:

1. P.R. Halmos, Naïve Set Theory, Springer, 1974.

2. E. T. Copson, Metric Spaces, Cambridge University Press, 1968.

3. P. K. Jain and K. Ahmad, Metric Spaces, Narosa Publishing House, New Delhi, 1996.

MTB 602: Linear Algebra **Credits : 3**

Vector spaces, subspaces and linear spans, linear dependence and independence. Quotient vector space. Finite dimensional vector spaces. Linear transformations and their matrix representations. Algebra of linear transformations, the rank and nullity theorem. Change of basis. Dual spaces, bidual space and natural isomorphism. Eigen values, eigen vectors, and eigenspaces. Diagonalization, Cayley -Hamilton theorem.

Inner product spaces, Cauchy-Schwarz inequality, orthogonal vectors. Orthonormal basis, Bessel's inequality, Gram-Schmidt orthogonalization process.

Suggested readings:

1. N. Herstain, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.

2. K. Hoffman and R. Kunze, Linear Algebra, Prentice-Hall of India, New Delhi, 1971.

3. N. Jacobson, Basic Algebra, Vols I & II, W.H. Freeman, 1980 (also published by Hindustan Publishing Company).

4. K. B. Dutta, Matrix and Linear Algebra, Prentice Hall of India, New Delhi, 2000.

MTB 603: Numerical Analysis **Credits : 3+1P**

Errors and their computations; Numerical solutions of algebraic equations: Bisection, Regula-Falsi, Newton-Raphson, Rate of convergence of iterative methods; Roots of Polinomials: Birge-Vieta method; System of linear equations: Gauss elimination method, Gauss-Jordan method, Jacobi iterative method, Gauss-Seidal iterative method. Eigen value computation: Power method, Jacobi's method. Finite differences; Interpolation: Newton's forward and backward interpolation, Lagrange's interpolation, Newton's divided difference interpolation; Numerical differentiation.

Numerical Quadrature: Newton's cotes quadrature formula, Trapezoidal rule, Simpson's one-third and three-eighth rules, Weddle's rule; Errors in quadrature formulae. Numerical solution to ordinary differential equations of first order: Picard's method, Euler's method, Modified Euler's method, Taylor's method, Runge-Kutta second and fourth order, Implicit Runge-Kutta second order; Predictor Corrector methods: Milne- Simpson method, Adams-Bashforth method.

Practical based on above methods using 'C' Language.

Suggested readings:

1. M. K. Jain, S. R. K. Iyengar, R. K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International, New Delhi, Sixth edition.
2. C. F. Gerald, P. O. Wheatley, Applied Numerical Analysis, Pearson Education, 2009.
3. S. D. Conte, C de Boor, Elementary Numerical Analysis, McGraw-Hill, 1980.
4. C. E. Froberg, Introduction to Numerical Analysis, (Second Edition), Addition-Wesley, 1979.
5. Melvin J. Maron, Numerical Analysis A Practical Approach, Macmillan Publishing Company Inc., New York, 1982.
6. S. S. Sastry, Introductory Methods of Numerical Analysis, PHI Learning Private Limited, New Delhi, 2010.

MTB 604: Discrete Mathematics **Credits : 3**

Logic: Propositional and predicate logic. Inference.

Lattices as partially ordered sets and as algebraic systems. Duality, Distributive, complemented and complete lattices. Boolean algebras and their basic properties. Boolean functions and expressions. Application of Boolean algebra to switching circuits(using AND, OR and NOT gates)

Graphs and Planar Graphs: Graphs, Multi-graphs, Weighted Graphs, Directed graphs. Paths and circuits. Matrix representation of graphs. Eulerian paths and circuits. Planar graphs. Euler's formula. Trees and spanning trees.

Suggested readings:

1. C. L. Liu, Elements of Discrete Mathematics, (Second Edition), McGraw Hill, International Edition, 1986.
2. J. P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 199
3. S. Wiitala, Discrete Mathematics: A Unified Approach, McGraw-Hill Book Co.
4. N. Deo, Graph Theory with Applications to Computer Science, Prentice-Hall of India,

MTB 605: Vector and Tensor Analysis **Credits : 3**

Differential operators: The concept of Gradient, Divergence and Curl.

Vector Integration: Line, surface and volume integrals.

Integral Theorems: Green's theorem in the plane, Gauss divergence theorems, Stokes' theorem, Green's formulas and application of these theorems/formulas.

Curvilinear Coordinates: Curvilinear and orthogonal curvilinear coordinate systems and unit vectors. Arc lengths. Volume elements. Gradient, Divergence and Curl in curvilinear coordinate systems. Some special orthogonal curvilinear coordinate systems

Tensor Analysis: Contravariant and covariant tensors, mixed tensors, coordinate transformation and physical laws. Contraction, symmetric and skew symmetric tensors. metric tensor, length, angle between two curves. Christoffel symbols. Transformation laws of Christoffel symbols. Geodesics. Gradient, Divergence and Curl in tensor form, Derivation.

Suggested readings:

1. David C. Kay, Tensor Analysis, Schaum's Outline Series, McGraw Hill 1988.
2. R. S, Mishra, A Course in Tensors with Applications to Reimannian Geometry, Pothishala Pvt. Ltd, Allahabad.
3. M. R. Spiegel, Vector Analysis, Schaum's Outline Series, McGraw Hill 1959.

MTB 606: Complex Analysis **Credits : 3**

Complex numbers, their representation and the algebra of complex numbers.

The complex plane and open set, domain and region in a complex plane. Stereographic projection.

Complex functions and their limits, continuity, differentiability and analyticity. The C-R equations and sufficient conditions for differentiability and analyticity.

Harmonic functions. The exponential and trigonometric functions.

Complex integration: Line integration, path independence, Green's theorem, anti-derivative theorem, Cauchy-Goursat theorem, Cauchy's integral formula, Cauchy's inequality, derivative of analytic functions, Liouville theorem, fundamental theorem of algebra, maximum modulus theorem.

Sequences, series and their convergence, power series, radius of convergence, Taylor and Laurent series.

Suggested readings:

1. J.E. Brown, R.V. Churchill, *Complex Variables & Applications,* McGraw-Hill, 2004.
2. J.B. Conway, *Functions of Complex Variables*, Springer-Verlag,
3. W. Rudin, *Real & Complex Analysis,* Tata-McGraw-Hill,
4. T.W. Gamwlin, *Complex Analysis,* Springer-Verlag, 2001.
5. L.V. Ahlfors, *Complex Analysis,* McGraw-Hill,
6. E.C. Titchmarsh, *The Theory of Functions,* Oxford Univ. Press,

ELECTIVE -II **Credits : 3**

(Any one of the following 3 credit courses: MTB 607 - MTB 611)

MTB 607 Number Theory

Primes and factorization. Division algorithm. Congruence and modular arithmetic. Chinese remainder theorem. Euler phi function. Primtive roots of unity. Quardratic law of reciprocity, application. Arithmetical functions. Mobius inversion formula. The Diophantine equations $x^2 + y^2 = z^2$, $x^4 + y^4 = z^4$. Farey sequences.

Suggested readings:

1 David M. Burton, Elementary Number Theory, Wm. C. Brown Publishers, Dubuque, Iowa 1989.

2 K. Ireland, and M. Rosen, A Classical Introduction to Modern Number Theory, GTM Vol. 84, Springer-Verlag, 1972.

3 G. A. Jones, and J. M. Jones, Elementary Number Theory, Springer-Verlag, 1998.

4 W. Sierpinski, Elementary Theory of Numbers, North-Holland, Ireland, 1988.

5 Niven, S.H. Zuckerman, and L.H. Montgomery, An Introduction to the Theory of Numbers, John Wiley, 1991.

6 H. B. Mann, Addition Theorems, Krieger, 1976.

7 Melvyn B. Nathanson, Additive Number Theory: Inverse Problems and the Geometry of Sumsets, Springer-Verlag, 1996.

MTB 608 Global Differential Geometry

Global Theory of Plane Curves: The Rotation Index of a Plane Curve, Convex Curves, The Isoperimetric Inequality, Mukhopadhyay Theorem (The Four-Vertex Theorem).

Global Theory of Space Curves: Fenchel's Theorem, The Fary-Milnor Theorem, Total Torsion.

Global Theory of Surfaces: Simple curvature results. The Gauss-Bonnet Formula. Gauss-Bonnet Theorem and Euler characteristic. Theorems of Jacobi and Hadmard.

Suggested readings:

1. M. P. do Carmo, Differential geometry of curves and surfaces, Prentice Hall 1976.
2. W. Klingenberg, A Course in Differential Geometry, Springer Verlag, 1978.
3. R. S. Millman and G. D. Parkar, Elements of Differential Geometry, Prentice Hall 1977.
4. S. Montiel and A. Ros Curves and Surfaces, American Mathematical Society, 2005.
5. B. O'Neill, Elementary Differential Geometry, Elsevier 2006.
6. Pressley, Elementary Differential Geometry, Springer 2010.)

MTB 609 Special Theory of Relativity-II

Relativistic mechanics - Variation of mass with velocity. Equivalence of mass and energy. Transformation equations for mass momentum and energy. Energy-momentum four vector. Relativistic force and Transformation equations for its components. Relativistic Lagrangian and Hamiltonian. Relativistic equations of motion of a particle. Energy momentum tensor of a continuous material distribution.

Electromagnetism - Maxwell's equations in vacuo. Transformation equations for the densities of electric charge and current. Propagation of electric and magnetic field strengths. Transformation equations for electromagnetic four potential vector. Transformation equations for electric and magnetic field strengths. Gauge transformation. Lorentz invariance of Maxwell's equations. Maxwell's equations in tensor form. Lorentz force on a charged particle. Energy momentum tensor of an electromagnetic field.

Suggested readings:

1. C. Moller, The Theory of Relativity, Oxford Clarendon Press, 1952.
2. P. G. Bergmann, Introduction to the Theory of Relativity, Prentice Hall of India, 1969.
3. J. L. Anderson, Principles of Relativity Physics, Academic Press, 1967.
4. W. Rindler, Essential Relativity, Van Nostrand Reinhold Company, 1969.
5. V. A. Ugarov, Special Theory of Relativity, Mir Publishers, 1979.
6. R. Resnick, Introduction to Special Relativity, Wiley Eastern Pvt. Ltd. 1972.
7. J. L. Synge, Relativity: The Special Theory, North-Holland Publishing Company, 1956.
8. W. G. Dixon, Special Relativity: The Foundation of Macroscopic Physics, Cambridge University Press, 1982.

MTB 610 Computational Mathematics Lab-II

The student is expected to get familiarized with popular software's for numerical computation and optimization. Numerical algorithms for linear and nonlinear algebraic equations, Eigen value problems, Finite difference methods. Differentiation; Integration Ordinary differential equations etc. should be attempted.. The objective of such a laboratory is to equip students to model and simulate systems using optimization modelling languages/programming languages. To this end software's like MATLAB, LINDO, MATHEMATICA, MAPLES can be adopted with the following course outline.

1. Numerical integration.
2. Nonlinear Equations and Optimization functions.
3. Differential equations.
4. Sparse Matrices - Iterative methods for sparse linear equations, Eigen values of sparse matrices, Game of life.
5. Linear Programming, Integer Programming and Quadratic Programming - Modelling and Simulation Techniques.

Suggested readings:

1. MATLAB - High performance numeric computation and visualization software : User's Guide.
2. MATHEMATICA - Stephen Wolfram, Cambridge.
3. Optimization Modelling with LINDO : Linus Scharge.

MTB 611 Dynamical Systems

Linear dynamical systems: preliminary concepts, autonomous and non-autonomous systems, diagonalization, fundamental theorem of linear systems, Jordan canonical forms, stability, stable, unstable and center subspaces, nonhomogeneous linear systems.

Non-linear dynamical systems: solutions to initial value problem, existence and uniqueness of solutions, linearization, phase space, classification of critical points.

Suggested readings:

1. Lawrence Perko, Differential equations and dynamical systems, Springer-Verlag, 2001.
2. F. Verhulst, Non-linear Differential Equations and Dynamical Systems, Springer, 1990.

BANARAS HINDU UNIVERSITY

Department of Physics

Faculty of Science

SYLLABI

B.Sc. (Hons.) Programme
in
Physics

Semester-wise Distribution of Courses and Credits

Semester	Course	Title	Credits	Remarks
I	BPT-101	Mechanics and Relativity	4	Minor Change
	BPL-101	Practical	2	
		Total	**6**	
II	BPT-201	Thermal Physics	4	
	BPL-201	Practical	2	
	Ancillary Physics I		2	Paper of 2 credits introduced
		Total	**8**	
III	BPT-301	Optics	4	Minor Change
	BPL-301	Practical	2	
		Total	**6**	
IV	BPT-401	Electronics and Modern Physics	4	Major Change
	BPL-401	Practical	2	
	Ancillary Physics - II		2	Paper of 2 credits introduced
		Total	**8**	
V	BPT-501	Mathematical Physics	3	
	BPT-502	Classical Mechanics	3	
	BPT-503	Quantum Mechanics	3	
	BPT-504	Electronic Devices and Circuits	3	
	BPT-505	Electromagnetic Theory	4	New Paper of 4 credits introduced
	BPL-501	Practical	3	
	BPL-502	Practical	3	
		Total	**22**	
VI	BPT-601	Statistical Mechanics	3	
	BPT-602	Solid State Physics	3	
	BPT-603	Elements of Nuclear Physics	3	
	BPT-604	Atomic Physics and Laser	3	
	BPE 601	Topics in Modern Physics	4	
		Or		
	BPE-602	Elementary Nano Science and Exotic Materials	4	
	BPL-601	Practical	3	
	BPL-602	Practical	3	
		Total	**22**	

BPT-101: MECHANICS AND RELATIVITY **Credits: 4**

Mechanics:

Inertial and non-inertial frames of reference, Effect of centrifugal and Coriolis forces due to earth's rotation, Center of mass (C.M), Lab and C.M frame of reference, motion of CM of system of particles subject to external forces, elastic, and inelastic collisions in one and two dimensions, Scattering angle in the laboratory frame of reference, Conservation of linear and angular momenta.

Relativity:

Postulates of special theory of relativity, Derivation of Lorentz transformation and physical significance of Lorentz invariance, Length contraction and time dilation, Concept of simultaneity, Relativistic velocity transformation relations, mass energy relation, Concept of zero rest mass of photon, Relativistic relation between energy and momentum.

Mechanical Properties of Matter:

Modulus of rigidity, Poisson's ratio, relation connecting different elastic- constants, twisting couple of a cylinder(solid and hallow), Statical method (Barton's method), Dynamical method (Maxwell's needle) for determining the modulus of rigidity, Bending moment, Cantilever (neglecting mass), Young modulus by bending of beam, Viscosity, Poiseulle's equation of liquid flow through a narrow tube, Damped harmonic oscillations, Compound pendulum, Ballistic galvanometer.

Suggested readings:

1. Physics Part –1: Resanick and Halliday.
2. Mechanics : D.S.Mathur.
3. Concept in Physics Vol. I : H.C.Verma.
4. Mechanics : R.K.Shukla and Anchal Srivastava.

BPT-201: THERMAL PHYSICS **Credits: 4**

Kinetic Theory:

Maxwell's speed distribution, Mean free path, Elementary treatment of transport phenomena, Viscous flow and Thermal conducion in gases. Real gases, Andrew's curves, Equation of state, Virial coefficients, Van der Waals equation, Critica constants.

Thermodynamics:

Reversible and irreversible processes, Examples of thermal, mechanical and chemical irreversibility, Carnot's cycle and Carnot's theorem. Second law of thermodynamics, Thermodynamic scale of temperature.

Concept of entropy, Entropy change in reversible and irreversible processes. Entropy and disorder, Principle of increase of entropy, Entropy and unavailable energy, Entropy of ideal gases, Entropy as a thermodynamic variable, S-T diagram.

Thermodynamic functions, Internal energy, Enthalpy, Helmholtz function and Gibb's free energy, Maxwell's thermodynamical equations and their applications, TdS equations, Energy and heat capacity equations Clapeyron equations.

Application to sublimation, vaporization and freezing processes, Heat capacity of saturated vapours, Thermodynamics of liquid surfaces and paramagnetic solids. Adiabatic demagnetization, Third law of thermodynamics, Nernst heat theorem.

Criterion of equilibrium of a system, Isolated system, System in contact with constant temperature reservoir. System in contact with constant temperature and pressure reservoir, Phase transition, Coexistence of phases, Triple point.

Joule-Thomson effect, Thermodynamic analysis, Inversion temperature, Thermodynamic equations for a Van der Waals gas. Liquefaction of gases. Regenerative principle, Properties of liquid helium, Introduction to superfluidity and superconductivity.

Radiation:

The blackbody spectrum, Wien's displacement law, Rayleigh-Jean's law, Planck's quantum theory of radiation.

Suggested readings:

1. Heat and Thermodynamics: K.W. Zeemansky.
5. Thermal Physics: B.K. Agarwal.
6. Heat and Thermodynamics: Brij Lal and N. Subramanyam.
7. Heat and Thermodynamics: Dayal, Verma and Pandey.
8. A Treatise on Heat: M.N. Saha and B.N. Srivastava.

BPL-101 & BPL-201: LIST OF EXPERIMENTS* **Credits: 2**

Group I

1. Determination of Stefan's constant.
2. PN junction diode and Zener diode characteristics.
3. Determination of Young's modulus, modulus of rigidity and Poisson's ratio of material of a wire using Searle's method.
4. Determination of absolute capacity of a condenser.
5. Determination of Young's modulus of material of a metallic bar by bending of beam method.
6. To study series and parallel resonant L. C. R. circuit.
7. Determination of acceleration due to gravity using compound pendulum.
8. Determination of focal length of combination of lenses and nodal distance using nodal slide assembly.
9. Solar cell experiment.

Group II

1. Determination of internal resistance of micro ammeter and conversion of micro ammeter into voltmeter, milliammeter and Ohmmeter.
2. Determination of modulus of rigidity using Bortron's apparatus.
3. Construction of two-input 'OR' and 'AND' gates using diode logic and preparation of their truth tables.
4. Determination of viscosity of liquid using Poiseuille's method.
5. To study variation of magnetic field along the axis of Helmholtz Galvanometer and to determine reduction factor.
6. Determination of resistance per unit length and an unknown resistance using C. F. Bridge.
7. Determination of dispersive power of material of a prism.
8. Determination of temperature coefficient of resistance of material of a given coil.
9. Determination of thermal conductivity of a card-board by Lee's disc method.

* In Semester-I, half of the students will do the experiments of Group-I and the other half will do the experiments of Group-II. In Semester II, the students will exchange their groups. Addition and deletion in the list of experiments may be made from time to time by the department.

SEMESTER -II

ANCILLARY PHYSICS COURSE - I: FOR NON-PHYSICS STUDENTS

Mechanics and General Properties of Matter: **Credits: 2**

Elasticity: Strain and stress, elastic limit, Hooke's law; Moduli (Young's, Bulk, Rigidity) and Poisson's ratio, Surface tension: Surface tension and surface energy, angle of contact, capillary action, Flow of liquids and gases: Streamline and turbulent flow, Equation of continuity, Bernoulli's theorem and its application to biological system, Torricelli's theorem; Coefficient of viscosity, Stoke's law.

Radiation Effects on Biological Systems:

Electromagnetic spectrum, Ionizing radiations and their effect on biological systems, Effects of radiation relevant to Biology: Photosynthesis, Green House Effect, DNA Damage and Depletion of Ozone.

Suggested readings:

1. University Physics: Sears and Zemansky.
2. The Feynman Lectures on Physics (Vols. 1 and 2): Feynman, Leighton and Sands.
3. Biological Physics: Nelson.

BPT-301: OPTICS **Credits: 4**

Interference:

Conditions for sustained interference, Theory of interference, Lloyd's mirror, Achromatic fringes. Interference in parallel and wedge shaped films, Colour of thin films. Newton's rings and Michelson interferometer and their applications. Multiple beam interference in parallel film and Fabry-Perot interferometer.

Diffraction:

Frenel's diffraction, Zone plate, diffraction due to straight edge. Fraunhoffer diffraction due to single and double slits, plane transmission grating Resolving power of grating, telescope and Microscope.

Polarization:

Polarized light and its mathematical representation, Production of polarized light by reflection, refraction and scattering. Polarization by double refraction and Huygen's theory, Nicol prism, Retardation plates, Production and analysis of circularly and elliptically polarized light. Optical activity and Fresnel's theory, Biquartz polarimeter.

Basic concepts of Laser

Suggested readings:

1. Physical Optics: B. K. Mathur and T. P. Pandya.
2. A textbook of Optics: N. Subrahmanyam, Brijlal and M. N. Avadhanulu.
3. Geometrical and Physical Optics: Longhurst.
4. Introduction to Modern Optics: G. R. Fowels.
5. Optics: P. K. Srivastav.

BPT-401 ELECTRONICS AND MODERN PHYSICS **Credits: 4**

Properties of Materials

Dielectic constant, Polar and Non Polar dielectics, Dielectics and Gauss's Law, Dielectic Polarization, Electric Polarization vector P, Electric displacement vector D. Relation between three electric vectors, Dielectic susceptibility and permittivity, Polarizability and mechanism of Polarization, Lorentz local field, Classius Mossotti equation, Debye equation, Ferroelectric and paraelectric dielectics.

Magnetization and magnetization vector M, three magnetic vectors and their relationship, Magnetic permeability and susceptibility, Diamagnetic, paramagnetic and ferromagnetic substances. B.H. Curve, cycle of magnetization and hysteresis, Hysteresis loss.

Network Analysis:

Thevenin and Norton's theorems, concept of current and voltage sources, Transient response of LCR circuits. Differentiating and integrating circuits. High-pass, low–pass and band-pass filters. Analysis of series and parallel resonance circuits, quality factor.

Physics of Semiconductors:

Qualitative treatment of band formation in solids. Difference between metal, insulator and semiconductor. Intrinsic and extrinsic semi conductors. Concept of Fermi level. Generation and recombination of electron hole pairs in semiconductors. Mobility of electrons and holes, drift and diffusion currents.

p-n junction diode, depletion width and potential barrier, junction capacitance, I-V characteristics. Rectifiers, ripple factor, filter circuits, rectification efficiency and percentage regulation. Clipping and clamping circuits, Zener diode and voltage regulation.

Bipolar Junction Transistors:

Transistor circuits, Input and Output characteristics in CB and CE configurations, Early effect, α and β parameters; DC load line, operating point, biasing and bias-stabilization circuits; Transistor as an amplifier (CE Mode) and frequency response.

Cathode Ray Oscilloscope (CRO)

Cathode ray tube, deflection sensitivity, time-base and wave form display.

Modern Physics

Wave-particle duality, Photoelectric effect, Compton Effect, Matter waves and de-Brogle wavelength. X-ray and neutron diffraction and Bragg's Law. Electron waves and Davisson Germer experiment. Rutherford scattering and concept of nucleus, Elementary ideas of atomic and molecular spectra, Rydberg's constant and isotope effect.

Suggested readings:

1. Electronic devices : T.L. Floyd
2. Modern Physics : A.P. Arya
3. Device and Circuits : J. Millman and C. Halkias.
4. Concepts of Modern Physics : A. Beiser
5. Electronic Fundamental and Applications: D. Chatopadhyay and P.C. Rakshit.
6. Electricity and Magnetism : K.K. Tiwari.

BPL-301 & BPL-401: LIST OF EXPERIMENTS* **Credits: 2**

Group-I

1. Determination of wavelength of sodium yellow line by Fresnal's Biprism.
2. Determination of specific rotation of cane sugar by polarimeter.
3. Determination of wavelength of mercury lines by diffraction grating.
4. Determination of minimum resolution power of a telescope to distinguish two close objects at a large distance.
6. Determination of self inductance of a coil by Anderson's bridge.
7. To draw characteristic curves of a triode valve.

Group-II

1. Determination of wavelength of sodium yellow line by Newton's rings.
2. To determine the Planck's constants by Wein's radiation formula using an LDR.
3. To determine diameter/thickness of a thin wire by diffraction method.
4. Measurement of energy band gap of Si using a p-n junction diode.
5. Determination of mutual inductance of a pair of coils.
6. Phase shift between the current and the applied voltage in (a) C.R., (b) L.R. (c) L.C.R. circuits using a CRO and an oscillator.
7. To draw the input and output characteristics of a p-n-p transistor.

* In Semester-III, half of the students will do the experiments of Group-I and the other half will do the experiments of Group-II. In Semester IV, the students will exchange their groups. Addition and deletion in the list of experiments may be made from time to time by the department.

SEMESTER - IV

Ancillary Physics Course - II: FOR NON- PHYSICS STUDENTS **Credits: 2**

Thermal Physics:

Thermodynamics: Laws of thermodynamics and interpretation, Relevance to biological systems, Entropy and disorder, free-energy and chemical potential. Elementary ideas of Brownian motion, equipartition energy, Phenomenon of Diffusion, Mean free path and drift speed.

Optics:

Light: Fermat's principle of least time, reflection and refraction.

Geometrical optics: Focal length of a spherical surface, Concave and convex mirror and lenses, magnification, compound lenses, telescope and microscope, Resolving power

(i) Interference: Young's double-slit experiment its application (ii) Diffraction: Fraunh offer and Fresnel diffraction; Grating and its resolving power (iii) Refractive index, dispersion and absorption (iv) Polarization and Polarisers, Birefringence Optical activity and its relevance to biological systems.

Suggested readings:

1. University Physics: Sears and Zemansky.
2. The Feynman Lectures on Physics (Vols. 1 and 2): Feynman, Leighton and Sands.
3. Fundamentals of Optics: Jenkins and White.
4. Biological Physics: Nelson.

BPT-501: MATHEMATICAL PHYSICS **Credits: 3**

Curvilinear Coordinates:

Orthogonal curvilinear coordinates; differential operators, concept of a metric, spherical and cylindrical coordinates and their unit vectors.

Tensor Analysis:

Introduction to tensors, Cartesian, covariant and contravariant tensors; contractions and direct products, Examples: pseudo, dual, isotropic, symmetric and anti-symmetric tensors.

Matrices:

Hermitian, orthogonal and unitary matrices, inverse of a matrix, similarity transformations, Eigenvalue problems and diagonalization of matrices (Examples: non-degenerate and degenerate cases).

Differential Equations:

Second order homogeneous differential equations and their series solution (example: Bessel equation), linear independence of two solutions (Wronskian), Integral and power series methods for second solution.

Special Functions:

Bessel, Legendre (spherical harmonics), Hermite and Laguerre: generating functions and recurrence relations, orthonormality conditions, Dirac delta function.

Fourier Analysis:

Fourier theorem, Fourier analysis of square wave, saw-tooth wave, plucked strings, half wave/full wave rectifier wave forms

Suggested readings:

1. Mathematical Methods for Physicists: Arfken and Weber.
2. Mathematical Physics: P. K. Chattopadhyay.
3. Mathematical Methods in Physical Sciences: Boas.
4. Mathematics for Physicists and Engineers: Pipes.

BPT-502: CLASSICAL MECHANICS **Credits: 3**

System of particles, Constraints, Generalized coordinates, D'Alemberts principle and Lagrange's equation, Velocity dependent potential of electro-magnetic field.

Calculus of Variation, Hamilton's principle, Lagrange's equation, Lagrangian for simple systems, Cyclic coordinates, symmetries and conservation laws. Advantages of Lagrangian: electro-mechanical analogies, Lagrange's undetermined multipliers, Lagrange's equation for nonholonomic systems, Virial theorem, Principle of mechanical similarity.

Legendre transformations and Hamilton's equations of motion, Hamiltonian for a charge particle in Electro-magnetic field, Cyclic coordinates and conservation laws, Poisson Brackets, Jacobi Identity, Canonical transformation.

Hamilton-Jacobi theory, Action-Angle variables, related problems.

Two body central force problem, reduction to the equivalent one body problem, Differential equation for the orbit and integrable power law potentials, Condition for stable circular orbit, Kepler problems.

Suggested readings:

1. Classical Mechanics: H. Goldstein.
2. Mechanics: L . D. Landau and E. M. Lifshitz
3. Introduction to Classical Mechanics: R. G. Takwale and Puranik.
5. Classical Mechanics of Particles and Rigid Bodies: K. C. Gupta.
6. Introduction to Classical Mechanics: N. C. Rana and P. Joag.

BPT-503: QUANTUM MECHANICS **Credits: 3**

Limits of Classical Physics:

Black body radiation (without derivation), Photoelectric effect, Compton effect.

Wave Packets and Uncertainty Relation:

de Broglie hypothesis, Wave-particle duality, Davisson-Germer experiment, Wave packets, Group velocity and phase velocity, Uncertainty principle, Complimentarity.

Wave Mechanics:

Schrödinger equation, Physical interpretation of wave function, Probability current density and conservation of probability, Free particle wave function, Schroedinger equation in the presence of a potential, Linear operators, Hermitian operators, Observables, Eigenvalues and Eigenfunctions, Expectation values, Ehrenfest's theorem, Stationary states, Superposition principle, Commutation relations, Commuting observables and compatibility.

Application of Schrödinger Wave Equation:

Particle in one dimensional Box, Square well, Rectangular potential barrier and tunnelling, Linear harmonic oscillator, Spherically symmetric potential, Angular momentum operators and their eigen functions, Concept of spin, Hydrogen atom.

Suggested readings:

1. Quantum Physics: S. Gasiorowicz.
2. Quantum Mechanics: B. H. Bransden and C. J. Joachain.
3. Quantum Physics of Atoms, Molecules, Nuclei and Solids: R. M. Eisberg and R. Resnick.
4. Quantum Mechanics: V. Devanathan.
5. Quantum Mechanics: C. S. Chaddha.

BPT-504: ELECTRONIC DEVICES AND CIRCUITS **Credits: 3**

Electronic Devices:

Field effect transistors, I-V Characteristics of JFET and MOSFET, FET biasing, FET as an amplifier. Silicon controlled rectifier, I-V Characteristics, phase controlled rectifier. Unijunction transistor, I-V Characteristics , relaxation oscillator. Operational amplifier (block diagram),characteristics parameters, inverting and noninverting amplifier. Cathode ray oscilloscope. Photo diode, Light emitting diode and solar cell.

Analog Circuits:

Hybrid parameter model of transistor, analysis of transistor amplifier (with and without RS and RL) using h- parameters, simplified hybrid model, brief idea about hybrid model. Single stage amplifier in CE,CB and CC modes. RC coupled CE amplifier and its frequency response, tuned voltage amplifier. Power amplifier classification, distortion and efficiency, push pull amplifier, Feedback in amplifiers, positive and negative feedback, effect of negative feedback on the characteristics of different types of amplifiers, voltage and current series feedback circuits.

Barkhausen criterion of oscillations, tuned collector oscillator, Hartley / Colpitt oscillator, phase shift oscillator and multiuvibrators.

Need and types of modulation, amplitude modulation, analysis of A.M. wave, modulator and demodulator circuits.

Digital Circuits:

Boolean algebra, logic gates, NAND and NOR gates as universal gates. Simplification of Boolean expressions using K- maps. Half and full adders and subtractors.

Suggested readings:

1. Electronics Fundamental and Application: Chattopadhyay and Rakshit.
2. Principle of Digital Electronics: Malvino and Leach.
3. A Text Book of Electronics: Kakani and Bhandari.
4. Electronic Devices: T.L. Floyd.
5. Integrated Electronics: Millman and Halkias.

BPT-505: ELECTROMAGNETIC THEORY Credits: 4

Vector Calculus:

Concept of gradient, divergence and curl operators; Gauss divergence theorem, Stokes theorem and related problems.

Boundary Value Problems

Laplace & Poisson's equation, boundary condition, solution through method of images.

Electromagnetism:

Laws of Electromagnetism (Gauss law of electricity, Gauss law of magnetism, Faraday' law of electromagnetic induction, Ampere's circuital law); Concept of different charge and current densities (free charges, bound charges); Displacement current and generalized Ampere's law; Equation of continuity, Maxwell's equations in differential form; Electric and magnetic polarization vectors and their mutual relationship; Vector and scalar potentials, Poynting theorem and energy conservation (qualitative idea of momentum conservation).

EM wave propagation:

EM wave equation and their solutions; Polarization of EM wave; Propagation of plane EM waves in different media: free space, dielectrics and conductors; Laws of reflection, transmission at normal and oblique incidence in linear media and conducting media (Fresnel's equations), total internal reflection and Brewster angle, Problems.

Guided E.M. Wave Propagation:

Propagation of e.m. wave through transmission line, reflection coefficient, standing wave, characteristic impedance, propagation constant. Rectangular waveguides. Expressions for field components, TE, TM & TEM modes. Propagation properties, cutoff frequency, group & phase velocity, Problems.

Suggested readings:

1. Introduction to Electrodynamics (3rd Edition): David J. Griffiths.
2. EM Waves and Fields: P. Lorrain and O. Corson.

BPT-601: STATISTICAL MECHANICS Credits: 3

Random Walk Problem:

Probability distribution, calculation of mean and dispersion (as a measure of fluctuation), and simple numerical problems.

Basics of Statistical Mechanics:

State of a system (Microscopic and Macroscopic); Phase space, density of states and Liouville's theorem; Postulates of statistical mechanics; Relation between statistical and thermodynamic parameters.

Classical Statistical Mechanics:

Ensemble theory (Micro-canonical, Canonical and Grand-canonical), applications to classical ideal gas and simple numerical problems; Gibbs paradox; Statistical equivalence of three ensembles.

Quantum Statistical Mechanics:

Introduction to Bose-Einstein and Fermi-Dirac statistics; Maxwell-Boltzmann statistics as a classical limit; Comparison of the three statistics; Qualitative features of degenerate Fermi and Bose gases.

Suggested readings:

1. Fundamentals of Statistical and Thermal Physics: Frederick Reif.
2. Statistical Mechanics (2nd Edition): R.K. Pathria.
3. Equilibrium Statistical Physics: Michael Plischke and Birger Bergersen.
4. Statistical Mechanics: (Wiley): Kerson Huang.

BPT-602: SOLID STATE PHYSICS Credits: 3

Structure and Symmetry:

Elements of external symmetry of crystals, space lattice, Bravais lattices, Miller indices for direction and planes, Common crystal structures: NaCl, CsCl, ZnS and Diamond, Close packed structures, elementary idea of quasicrystals and amorphous materials.

Diffraction of x-rays, Laue equations and Braggs law, reciprocal lattice, Brillouin Zones and Ewald construction, atomic scattering and structure factors.

Elementary idea of bonding in solids, Lennard Jones potential.

Lattice Vibrations:

Vibrational modes of continuous medium, Density of states, Einstein's and Debye's theory of specific heat, Vibrations of one dimensional monoatomic and diatomic chain, Phonons.

Electronic Properties:

Theory of free electron gas, Fermi surface, Electrons in periodic potential, Kronig-Penny model, Bloch theorem, energy bands, metals, insulators and semiconductors, Motion of electron in electric and magnetic fields, Hall Effect.

Magnetic Properties:

Origin of magnetism, Langevin's theory, Quantum theory of paramagnetism, Curie-Brilloun law, Weiss Molecular theory, ordering of spins, Heisenberg model, spin waves, dispersion relation of magnons, ferromagnetic domains.

Suggested readings:

1. Crystalloraphy for Solid State Physics: A. R. Verma and O.N. Srivastava.
2. Introduction to Solids: Azaroff.
3. Solids State Physics: C. Kittel.
4. Solids State Physics: Ashcroft and Mermin.
5. Solids State Physics: Decker.
6. Solid State Physics ---An Introduction to principles of Materials Science: H. Ibach & H. Luth (Springer)

BPT-603: ELEMENTS OF NUCLEAR PHYSICS Credits: 3

Properties of Nuclei and Models:

Introduction to the nucleus, Fermi gas model, Binding energy, Bethe-Weizsaecker mass formula and its application to explain most stable isobars and nuclear fission, Inferences of nuclear size from elastic electron-nucleus experiments (no derivation).

Nuclear Force and Two-nucleon System:

Properties of nucleon-nucleon interaction, General forms of N-N potential, Description of low energy neutron-proton scattering to show the spin dependence of nuclear force, Ground state properties of deuteron, Simple consideration of deuteron using central potential (square well).

Nuclear Stability:

Nucleon emission, separation energy, Alpha decay and its energy spectrum, Q-value, Gamow's theory of alpha decay (no derivation), Beta decay and its energy spectrum (for example, 137Cs), Need for neutrinos, Q-value for beta decay, Gamma decay, Selection rules for gamma transitions (no derivation).

Accelerators and Detectors:

Van de Graaff and Linear accelerators, Synchrotrons, Geiger-Mueller detector, Scintillation detector.

Elementary Particles:

Classification of particles and their interactions, Quantum numbers, Quarks as the building blocks of hadrons, colour degree of freedom.

Suggested readings:

1. Introductory Nuclear Physics: S. S. M. Wong.
2. Nuclear Physics: V. Devanathan.
3. Concepts of Nuclear Physics: B. L. Cohen.
4. Fundamentals of Nuclear Physics: B. B. Srivastava.
5. Introduction to Nuclear Physics: H. A. Enge.

BPT-604: ATOMIC PHYSICS AND LASERS Credits: 3

Atomic Physics:

Brief review of Bohr and Sommerfeld model of atom. Effect of finite nuclear mass in relation to Rydberg constant. Idea of discrete energy levels and electron spin: Fanck – Hertz and Stern – Gerlach experiments Significance of four quantum numbers and concept of atomic orbitals.

One valence electron atom:

Orbital magnetic dipole moment, Orbital, spin and total angular momenta, Larmor precession, Vector model of atom, Electronic configuration and atomic states, Spin-orbit interaction and fine structure, Intensity of spectral lines, General selection rules. Normal Zeeman Effect. Two valence electron atoms: LS and JJ coupling schemes and resulting spectra. Idea of normal and inverted doublet. Basics of stark effect.

Lasers and Non-Linear Optics:

Einstein coefficients, Threshold condition for LASER action, Rate equation for three level laser system, Characteristics of laser radiation. He-Ne and Nd-YAG Laser. Significance of non-linear polarization of lasers and some applications: Second harmonic generation using non-linear optical methods.

Suggested readings:

1. Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles: Robert Eisberg and Robert Resnick.
2. Introduction to Atomic Spectra: H.E. White.
3. Principles of Lasers: Orazio Svelto.
4. Atom, Laser & Spectroscopy : S.N.Thakur and D.K.Rai

BPE – 601: TOPICS IN MODERN PHYSICS Credits: 4

Theory of Relativity:

Gravitational red-shift, Doppler effect in relativity, Four dimensional space and concept of fourvector, Transformation properties of four-momentum and four-force, Vector and scalar potentials and Gauge transformation, Four-potential and four-current, Transformation relations for E and B, Invariance of Maxwell's equations.

Astrophysics and Cosmology:

Introduction to the Universe, Expansion of the Universe, The Hertzprung-Russell Diagram, The cosmic microwave background radiation, The Big Bang Hypothesis, Nucleosynthesis: formation of nuclei and atoms, Formations of Galaxies and Stars, Thermal Nuclear Reaction, Astrophysical processes : H and He burning, the r-process, the rp-process, Chandrashekhar-limit, White Dwarf, Neutron star and Black Hole, Dark Matter and Dark Energy.

Atoms, Nuclei and Solids:

Rutherford scattering (detailed derivation), Compton scattering and comparison with Raman scattering, Mössbauer effect, Solid state detectors, Mass spectrometer (illustrated by Bainbridge and Aston spectrometer), Charge particles in magnetic field, Landau levels.

Suggested readings:

1. Elementary Modern Physics: A.P. Arya.
2. Introduction to Special Relativity : Robert Resnick.
3. Modern Physics: K.S. Krane.
4. Modern Physics: J. Bernstein, P.M. Fisshbane, Stephen Gasiorowicz.
5. Solid State Physics: N.W. Ashcroft and N.D. Mermin.
6. Cauldrons in the Cosmos: Nuclear Astrophysics: Clous E Rolf and William S. Rodney.

BPE-602: ELEMENTS OF NANOSCIENCE AND EXOTIC MATERIALS **Credits: 4**

Background Physics for Nano and Exotic Materials :

Electron Band Structure and Its Modification due to change in dimensionality. Phonon absorption in Nanomaterials.

Nano Materials:

Physical, Chemical and Bio-routes for Synthesis of Nanomaterials, Experimental Techniques for Characterization of Nanomaterials, Metal Nanoparticles, Carbon Nanostructures, Electronic Properties of Nanomaterials, Some applications of Nano Materials.

Exotic Materials:

High Temperature Superconductors and Colossal Magnetoresistance Materials. Meissner Effect, Discovery of HTSC Materials, Structure and Properties of HTSC Materials, Elements of Proposed Mechanisms of high temperature superconductivity, Elementary Concepts of CMR Materials, Double Exchange Mechanism , Some Application of CMR material based devices.

Quasicrystals:

Basic definition of quasicrystal, Fibonaci Sequence, Penose Tiling and its Relevance to Structure of Quasicrystals.

Suggested readings:

1. Introduction to Solid State Physics (VI Edition): Charles Kittel.
2. Introduction to Nanotechnology: C.P. Poole and F.J. Owens.
3. Nanobiotechnology : Concepts, Applications and Perspectives (Eds. C.M. Niemeyer and C.A. Mikin).

LIST OF EXPERIMENTS*

Group – I

BPL-501 **Credits: 3**

1. To determine the ionic magnetic moment of Ni-ion in $NiSO_4$ solution (Magneticsusceptibility)
2. To determine the wavelength and speed of ultrasonic wave by method of Acoustic grating.
3. To draw the dispersion curve for the constant deviation prism spectrograph using the spectral lines of iron as standard and to determine the wave length of Copper lines.
4. To determine the Cauchy's constant for the material of a given prism using the spectrometer.

5. (a) To determine the angle of a given wedge using given laser beam.
   (b) To determine the refractive index of water using hollow prism.
6. To study the Hall Effect and to calculate the different parameter like Hall Coefficient, carrier density & mobility.

BPL-502 **Credits: 3**

1. Experiment on logic gates- Verification of laws of Boolean algebra.
2. Transient response of LCR circuit and determination of quality factor.
3. Experiment of negative feedback amplifier.
4. Power supply and filter characteristics.
5. Design of Zener regulated power supply.
6. Characteristics of SCR and its application as phase control rectifier

Group –II

BPL-601 **Credits: 3**

1. To determine Planck's constant 'h' using a photoelectric cell and a direct reading potentiometer.
2. (a) To draw the operating characteristic of Geiger Muller counter.
   (b) To determine the dead time of the counter by the two source Method.
3. To draw the Hysteresis loop of the given specimen and to determine the Energy loss per unit volume per cycle of magnetization with Universal B-H curve Tracer.
4. To determine the wavelength of yellow line of sodium and the wavelength Difference between the two components of this line using Michelson Interferometer.
5. To draw the dispersion curve for the grating spectrograph using the Spectral lines of iron as standard and to determine the wavelength of the Bands of ALO and to compare them with the standard value given in the Chart.
6. To calibrate the given constant deviation spectrometer (CDS) with the help of mercury lines and to calculate the Rydberg constant and series limit of Balmer series using hydrogen lamp.
7. To calculate the Numerical aperture and the bending loss using the fiber optics kit.

BPL-602 **Credits: 3**

1. Positive feedback- Hartley and phase shift oscillator.
2. Amplitude modulation and demodulation characteristics.
3. Characteristics of FET and MOSFET and their application as amplifier.
4. Wave shaping circuits.
5. Characteristics of UJT and its application as relaxation oscillator.

***** In Semester-V, half of the students will do the experiments of Group-I and the next half will do the experiments of Group-II. In Semester- VI the students will exchange their groups. Addition and deletion in the list of experiments may be made from time to time by the department.

BANARAS HINDU UNIVERSITY

Department of Statistics

Faculty of Science

SYLLABI

B.Sc. (Hons.) Programme
in
Statistics

SIX – SEMESTER B.Sc. (Hons.) PROSPECTUS

IN

STATISTICS

The B. Sc. (Hons.) Programme in Statistics shall be spread over three years; each year consisting of two semesters. The details of the distribution of courses in semesters, credits assigned to papers, full marks assigned, etc., are given as follows:

1. There shall be ONE THEORY paper and ONE PRACTICAL paper of 100 marks each in Semester – I, Semester – II, Semester – III and Semester - IV. The Theory paper and the Practical paper shall be of 4 credits and 2 credits respectively in each of these semesters.

2. The theory papers in each of the I, II, III and IV semesters shall be of THREE HOURS duration consisting of eight full length questions in all out of which a student will be required to answer any five questions.

3. The Practical paper in Semester – I and Semester - II shall be of THREE HOURS duration. Each Practical paper will be of 100 marks out of which 30 marks will be assigned on sessionals / tutorials / class tests / seminars in class / group discussions and 70 marks will be assigned on the end semester examination out of which 50 marks will be on the performance in practical examination and 10 marks will be assigned each on practical record book and viva – voce.

4. The Practical paper in Semester – III and Semester – IV shall be of THREE HOURS duration. Each Practical paper will be of 100 marks out of which 30 marks will be assigned on sessionals / tutorials / class tests / seminars in class / group discussions and 70 marks will be assigned on the end semester examination out of which 50 marks will be on the performance in practical examination and 10 marks will be assigned each on practical record book and viva – voce.

5. There shall be FOUR THEORY papers and TWO PRACTICAL papers of 100 marks each in Semester - V and Semester – VI. Each Theory paper in Semester V shall be of 4 credits and Practical paper shall be of 3 credits. In Semester VI all theory as well as Practical paper is of 3 credits. Besides this, there shall be ONE PROJECT of 4 credits in Semester – VI.

6. The theory papers in each of the V and VI semesters shall be of THREE HOURS duration consisting of eight full length questions in all out of which a student will be required to answer any five questions.

7. The Practical paper in Semester – V and Semester – VI shall be of THREE HOURS duration. Each Practical paper will be of 100 marks out of which 30 marks will be assigned on sessionals / tutorials / class tests / seminars in class / group discussions and 70 marks will be assigned on the end semester examination out of which 50 marks will be on the performance in practical examination and 10 marks will be assigned each on practical record book and viva – voce.

8. The Project work shall be spread over the whole semester. A project is undertaken by a group of students. However, the project report shall be submitted by each member of the group separately. A project report shall clearly state the problem addressed, the methodology adopted, the assumptions and the hypotheses formulated, any previous reference to the study undertaken, statistical analyses performed and the broad conclusion drawn. There shall be an external examiner and an internal examiner (preferably the supervisor of the student) for the evaluation of the project work. Out of total 100 marks assigned to the project, 60 marks will be assigned on the evaluation of the project report separately by both the examiners and 40 marks will be assigned on the oral presentation and viva – voce.

9. Besides the Core Courses in Statistics, the Department will offer TWO ANCILLARY THEORY Papers of 100 marks each; ONE in each of the Semesters – II and IV. These Minor Elective papers will be of 2 credits each. The Ancillary courses will be offered by the students of Mathematics and Biology streams of the Faculty who have not opted Statistics as a subject in any of the semesters.

10. The Ancillary Theory papers in Semester – II and Semester – IV shall be of Three Hours duration consisting of eight full length questions in all out of which a student will be required to answer any five questions.

11. Examination questions papers will be in English in all the semesters.

The titles and contents of Theory papers as well as Practical papers shall be as follows :

PROPOSED COURSE FOR B .Sc. (HONOURS) STATISTICS

Distribution of different courses and Credits in various semesters

SEMESTER - I

Course Code	Title	Credit
STB – 101	Statistical Methods and Probability	4
STB – 102	Practicals based on Course No. STB – 101	2
	Total	**6**

SEMESTER - II

Course Code	Title	Credit
STB – 201	Descriptive Statistics and Distribution Theory	4
STB – 202	Practicals based on Course No. STB – 201	2
	Total	**6**

SEMESTER - III

Course Code	Title	Credit
STB – 301	Statistical Inference	4
STB – 302	Practicals based on Course No. STB – 301	2
	Total	**6**

SEMESTER - IV

Course Code	Title	Credit
STB – 401	Sample Surveys and Design of Experiments	4
STB – 402	Practicals based on Course No. STB – 401	2
	Total	**6**

SEMESTER - V

Course Code	Title	Credit
STB – 501	Applied Statistics	4
STB – 502	Statistical Inference and Decision Theory	4
STB – 503	Programming with C	4
STB – 504	Operations Research	4
STB – 505	Practicals based on Course Nos. STB – 501 and STB – 502	3
STB – 506	Practicals based on Course Nos. STB – 503 and STB – 504	3
	Total	**22**

SEMESTER - VI

Course Code	Title	Credit
STB – 601	Numerical Methods	3
STB – 602	Demand Analysis, Analysis of Income Distribution and Queuing Theory	3
STB – 603	Elements of Stochastic Processes	3
STB – 604	Reliability	3
STB – 605	Practicals based on Course Nos. STB – 601 and STB – 603	3
STB – 606	Practicals based on Course Nos. STB – 602 and STB – 604	3
STB – 607	Project	4
	Total	**22**
	GRAND TOTAL	**72**

ANCILIARY SUBJECTS

Course Code	Title	Credit
	SEMESTER II	
BSC07A	Statistics – I : Descriptive Statistics	2
	SEMESTER IV	
BSC13A	Statistics – II : Statistical Inference, Sampling and Design of Experiments	2
	TOTAL	**4**

B. Sc. (HONS.) IN STATISTICS

SEMESTER – I

STB – 101 : STATISTICAL METHODS AND PROBABILITY Credits : 4

Types of data: Discrete and continuous data, Frequency and non-frequency data, Different types of scales, Primary data (designing a questionnaire and schedule), Secondary data (major sources including some government publication).

Construction of tables (with one or more factors), diagrammatic and graphical representation of grouped data, frequency and cumulative frequency distribution and their applications, histogram, frequency polygon, ogives, stem and leaf charts, box plot.

Concept of central tendency and its measures, partition values, dispersion and relative dispersion, moments, Sheppard's correction for moments (without derivation), skewness, kurtosis and their measures.

Random experiment: Trial, sample point, sample space, definitions of equally likely, mutually exclusive and exhaustive events, definition of probability, classical and relative frequency approach to probability, axiomatic approach to probability and its properties, merits and demerits of these approaches, total and compound probability theorems, conditional probability, independence of events, Bayes theorem and its applications.

Random Variable: Concept of discrete random variable, probability mass function and distribution function, joint probability mass function of several discrete random variables, marginal and conditional probability mass functions. Expectation of random variables and its properties, conditional expectation, moments in terms of expectation.

Continuous random variable: Probability density function, distribution function, joint density function of two continuous variables, marginal and conditional probability density functions.

Suggested readings:

1. Bhat B.R., Srivenkataramana T. and Rao Madhava K.S. (1996): Statistics, A Beginner's Text, Vol. I and II, New Age International (P) Ltd.
2. Snedecors G.W. and Cochran W.G. (1967): Statistical Methods, Iowa State University Press.
3. Mood A.M., Greybill F.A. and Bose D.C. (1974): Introduction to the Theory of Statistics, McGraw Hill.
4. Spiegel M.R. (1967): Theory and problem of Statistics, Schaum's Publishing Series.
5. Goon A.M., Gupta M.K. and Das Gupta B. (1991): Fundamental of Statistics, Vol. I, World Press, Calcutta
6. Meyer P.L. (1970): Introductory Probability and Statistical Applications, Addision Wesley.
7. Parzen E. (1960): Modern Probability Theory and its Applications, Wiley Eastern.
8. Hogg R.V. and Craig A.T. 91972): Introduction to mathematical Statistics, Amerind Publishing Co.
9. Hoel P.G. (1971): Introduction to Mathematical Statistics, Asia Publication.
10. Rohtagi, V.K. (1967) An Introduction to Probability Theory and Mathematical
11. Statistics, John Wiley and Sons.
12. Croxton F.E., Cowden D.J. and Karlin S. (1973) Applied General Statistics.

STB – 102: PRACTICALS BASED ON COURSE No. STB - 101 Credits : 2

(The Practical Paper shall be of THREE HOURS duration. Out of total 70 marks, 50 marks will be assigned to the performance in practicals, 10 marks on the practical record book and 10 marks on the viva – voce).

Students will be required to do practicals, listed below (based on the contents of the theory paper STB – 101), using MS Excel :

1. Presentation of data by frequency tables, diagrams and graphs.
2. Measures of central tendency, partition values,
3. Measures of dispersion, relative measure of dispersion.
4. Moments, measures of skewness and kurtosis.

STB – 201 : DESCRIPTIVE STATISTICS AND DISTRIBUTION THEORY **Credits : 4**

Bivariate data: Scatter diagram, product moment correlation coefficient and its properties, coefficient of determination, correlation ratio, interclass correlation, concept of error in regression, principle of least square, fitting of linear regression and related results, rank correlation.

Partial and multiple correlation in three variables, their measures and related results.

Theory of attributes: Independence and Association of attributes, various measures of association for two way classified data.

Moment generating function of a random variable, their properties and uses, probability generating function.

Tchebycheff's inequality and its applications, basic ideas of convergence in probability and convergence in distribution.

Standard discrete and continuous distributions: degenerate, uniform, binomial, Poisson, geometric, negative Binomial, hypergeometric, normal, beta, gamma, bivariate Normal distributions and their applications.

Suggested readings:

1. Goon A.M., Gupta A.K. and Das Gupta B. (1999): Fundamental of Statistics, Vol. I, World Press, Calcutta.
2. Mood A.M., Greybill, F.A. and Bose D.C. (1974): Introduction to the Theory of Statistics, McGraw Hill.
3. Hogg R.V. and Craig A.T. (1972): Introduction to Mathematical Statistics, Amerind Publishing Co.
4. Mukhopadhyay, P. (1996): Mathematical Statistics, New Central Book Agency.
5. Rohtagi V.K. (1967) : An Introduction to Probability Theory and Mathematical Statistics, John Wiley and Sons.
6. Hoel P.G. (1971): Introduction to Mathematical Statistics, Asia Publishing House.

STB - 202 : PRACTICALS BASED ON COURSE No. STB - 201 **Credits : 2**

(The Practical Paper shall be of THREE HOURS duration. Out of total 70 marks, 50 marks will be assigned to the performance in practicals, 10 marks on the practical record book and 10 marks on the viva – voce).

The students will be required to do the practicals, listed below (based on the contents of the theory paper STB – 201), using MS Excel :

1. Product moment correlation coefficient, correlation ratio, interaclass correlation coefficient.
2. Fitting of curves by least square method.
3. Regression of two variables.
4. Rank correlation.
5. Partial and Multiple correlations and regressions.
6. Fitting of discrete and continuous distributions.

ANCILLARY PAPER:

Paper No. BSC07A : STATISTICS – I : DESCRIPTIVE STATISTICS **Credits : 2**

Nature and scope of Statistics: Measurement scales, primary and secondary data, Methods of Collection of primary data, methods of data representation, text, tabular, diagrammatic and graphical representation.

Frequency distribution and principles governing their representation, graphical representation of frequency distributions.

Measures of central tendency and their properties, uses and limitations, partition values : quartiles, deciles and percentiles.

Dispersion and its various measures with their properties and uses. Coefficient of variation.

Central and raw moments up to fourth order. Skewness, kurtosis and their measures.

Bivariate Data: Scatter diagram, correlation, product moment correlation coefficient, regression lines and their uses, rank correlation.

Suggested readings:

1. Goon, A.M., Gupta, M.K., Dasgupta, B. : Fundamental of Statistics Vol.-I
2. Kapoor, V.K. and Saxena, H.C. : Mathematical Statistics
3. Yule, G.V. and Kendall, M.G. : Introduction to the Theory of Statistics
4. Kenny, J.F. and Keeping, E.S. : Mathematics of Statistics ,Vol.-I

SEMESTER - III

STB – 301 : STATISTICAL INFERENCE **Credits : 4**

Concept of random sample from a distribution, statistic and its sampling distribution, standard error of an estimate, standard errors of sample mean and proportion, sampling distribution of sum of Binomial, Poisson random variables and mean of normal distribution.

Simple, composite null and alternative hypotheses, critical region, types of error, level of significance, p-values, size and power of a test, chi-square, t and F distributions and their properties (without proof), testing of equality of two means and two variances of two normal distributions, testing for the significance of sample correlation coefficient and testing the equality of means and variances of bivariate normal distributions.

Statement of weak law of large number and central limit theorem, use of central limit theorem for testing a single mean, single proportion equality of two means and two proportions, Fisher's Z transformation and its uses, Pearson's chi-square test for goodness of fit, test of independence of two attributes.

Definition of order statistics and their distributions, sign test, run test, median test, Spearmen's rank correlation test, Wilcoxon Mann-Whitney test, Kolmogorov Smirnov - one sample and two sample tests.

Suggested readings:

1. Mood A.M., Greybill F.A. and Bose D.C. (1974) : Introduction to the Theory of Statistics, McGraw Hill.
2. Freund J.E. (2001) : Mathematical Statistics, Prentice hall of India.
3. Goom A.M., Gupta M.K. and Das Gupta B. (1991) : Fundamental of Statistics, Vol. I, World press, Calcutta.
4. Rohtagi V.K. (1967): An Introduction to Probability Theory and Mathematical Statistics, John Wiley and Sons.
5. Rao C.R. (1973) : Linear Statistical Inference and its Applications, Revised edition, Weley Eastern.
6. Hoges J.L. and Lehmann E.L. (1964): Basic Concepts of Probability and Statistics, Holden Day.
7. Snedecor G.W. and Cochran W.G. (1967) : Statistical Methods, Iowa State University Press.

STB – 302 : PRACTICAL BASED ON COURSE No. 301 Credits : 2

(The Practical Paper shall be of THREE HOURS duration. Out of total 70 marks, 50 marks will be assigned to the performance in practicals, 10 marks on the practical record book and 10 marks on the viva – voce).

1. Test of significance based on t, chi-square and F.
2. Testing of significance of sample correlation coefficient.
3. Use of Z transformation.
4. Large sample tests for means and proportion, tests of goodness of fit and independence of attributes in contingency tables.
5. Sign, run, median, Wilcoxon – Mann Whitney non-parametric test.
   <u>All these practicals will be done using Excel</u>.

SEMESTER - IV

STB – 401 : SAMPLE SURVEYS AND DESIGN OF EXPERIMENTS Credits : 4

Concept of population and sample, need for sampling, complete enumeration versus sampling, Basic concepts in sampling, sampling and Non-sampling errors, Acquaintance with the working (questionnaires, sampling design, methods followed in field investigation, principal findings, etc.) of NSSO and other agencies under taking sample surveys.

Simple random sampling with and without replacement, estimation of population mean, population proportions and their standard errors. Stratified random sampling, proportional and optimum allocation, comparison with simple random sampling for fixed sample size.

Ratio, product and regression methods of estimation, estimation of population mean, evaluation of bias and variance to the first order of approximation, comparison with simple random sampling.

Systematic sampling (when population size (N) is an integer multiple of sampling size (n)). Estimation of population mean and standard error of this estimate, comparison with simple random sampling. Elementary idea of cluster sampling.

Analysis of variance for one way and two way classifications one observation per cell, need for design of experiments, basic principle of experimental design: randomization, replication and local control, complete analysis and layout of completely randomized design, randomized block design and Latin square design.

Suggested readings:

1. Cochran W.G. (1977) :Sampling Techniques, John Wiley and Sons, New York.
2. Sukhtme P.V., Sukhatme B.V., Sukhatme S. and Asok C. (1984) : Sampling Theory of Surveys with Applications, Indian Society of Agricultural Statistics, New Delhi.
3. Goon A.M., Gupta M.K. and Das Gupta B. (1986) : Fundamentals of Statistics, Vol. II, world Press, Calcutta.
4. Sampath S. (2000) : Sampling Theory and Methods, Narosa Publishing House, New Delhi.
6. Des Raj (2000) : Sample Survey Theory, Narosa Publishing House, New Delhi.
7. Murthy M.N. (1967) : Sampling Theory and Methods, Statistical Publishing Society, Calcutta.
8. Kish L (1965): Survey Sampling, John Wiley and Sons, New York.
9. Hansen M.H., Hurwitz W.N. and Madow W.G. (1975) : Sample Survey Method and Theory, Vol. I, Methods and Applications, Vol. II, New York and London, Wiley Publication.
10. Cochran W.G. and Cox G.M. (1957) : Experimental Design, John Wiley and Sons.
11. Das, M.N. and Giri J. (1986) : Design and Analysis of Experiments, Springer Verlag.
2. Kempthorne O. (1965) : The Design and Analysis of Experiments, Wiley Eastern.

STB – 402 : PRACTICALS BASED ON COURSE No. 401 Credits : 2

(The Practical Paper shall be of THREE HOURS duration. Out of total 70 marks, 50 marks will be assigned to the performance in practicals, 10 marks on the practical record book and 10 marks on the viva – voce).

1. Selection of sample and determination of sample size.
2. Simple random sampling and stratified random sampling.
3. Allocation problems in stratified random sampling
4. Ratio, Product, Regression method of estimation and comparison with simple random sampling.
5. Analysis of variance for one way and two way classifications.
6. Analysis of CRD, RBD and LSD.

All these practicals will be done using Excel.

BSC13A : STATISTICS - II : STATISTICAL INFERENCE,

SAMPLING AND DESIGN OF EXPERIMENTS **Credits : 2**

Concept of probability, classical and statistical definition of probability, additive and multiplicative theorem of probability (Statement only), conditional probability and Baye's theorem (elementary idea only)

Random variable, probability mass function, probability density function and distribution function. Definition and important applications of binomial, Poisson and normal distributions.

Testing of hypotheses, large sample tests for mean and proportions, chi-squire, application of t and F tests.

Concept and scope of sampling: Population, complete enumeration verses sampling, sampling frame.

Methods of sampling: Simple Random Sampling & Stratified Random Sampling.

Suggested readings:

1. Goon, A.M., Gupta, M.K. Dasgupta, B.: Fundamental of Statistics
2. Cochran, W.G. : Sampling Techniques
3. Sukhatme, P.V. Sukhatme, B.V. : Sampling Theory of Surveys with Applications

SEMESTER - V

STB – 501 : APPLIED STATISTICS **Credits : 4**

Demographic Methods: Sources of demographic data, census, registration, ad hoc surveys, hospital records, demographic profiles of the Indian census.

Measurement of Mortality and Life Table: Crude death rate, Standardized death rates, Age-specific death rates, Infant Mortality rate, Death rate by cause, Complete life table and its main features, Uses of life table.

Measurement of Fertility: Crude birth rate, general fertility rate, age specific birth rate, total fertility rate, gross reproduction rate, net reproduction rate.

Index Numbers: Price relatives and quantity or volume relatives, Link and chain relatives composition of index numbers; Laspeyre's, Paasche's, Marshal Edgeworth's and Fisher's index numbers; chain base index number, tests for index number, cost of living index number.

Time Series Analysis: Economic time series, different components, illustration, additive and multiplicative models, determination of trend, seasonal and cyclical fluctuations.

Statistical process and product control: Quality of a product, need for quality control, basic concept of process control, process capability and product control, general theory of control charts, causes of variation in quality, control limits, sub grouping summary of out of control criteria. Charts for attributes : p chart, np chart, c-chart, Charts for variables: R, ($\bar{X}$, R), ($\bar{X}$, σ) charts.

Suggested readings:

1. Mukhopadhyay, P. (1994) :Applied Statistics, new Central Book Agency Pvt. Ltd., Calcutta.
2. Srivastava O.S. (1983) : A Text Book of Demography, Vikas Publishing House, new Delhi.
3. Benjamin B. (1959): Health and Vital Statistics, Allen and Unuwin.
4. Goon A.M., Gupta M.K. and Das Gupta B. (1986): Fundamentals of Statistics, Vol. II, World Press, Calcutta.
5. Duncan A.J. (1974) : Quality Control and Industrial Statistics, IV Edision, Taraporewala and Sons.
6. Montomery, D.C. (1991): Introduction to the Statistical Quality Control, IInd Editions, John Wiley and Sons.
7. Brown R.G. (1963): Smoothing, Forecasting and Prediction of Discrete Time Series, Prentice Hall.
8. Chatfield C. (1980) : The Analysis of Time Series, IInd Edision Chapman and Hall.

STB – 502 : STATISTICAL INFERENCE AND DECISION THEORY Credits :4

Parametric model, parameter, random sample and its likelihood, statistics and its sampling distribution.

Point estimation : properties of estimators, mean square and minimum mean square error estimator, unbiasedness and minimum variance unbiased estimator, Cramer-Rao lower bound, amount of information, consistency of estimators and sufficient conditions for consistency, relative efficiency of an estimator, asymptotic efficiency, sufficiency, factorization theorem (without proof), concept of complete sufficient statistics, Rao-Blackwell theorem.

Methods of estimation : moments, maximum likelihood, minimum chi-square, least square with examples, BAN and CAN estimators, point estimates of measures of location, dispersion, regression, correlation and other useful parameters.

Concepts of confidence interval and confidence coefficient, confidence intervals for the parameters of univariate normal, two independent normal distributions and exponential distributions.

Statistical hypotheses, critical region, size and power of a test, most powerful test, randomized and non randomized test, Neyman Pearson lemma and its applications, uniformly most powerful unbiased test, power likelihood ratio test and its applications, functions of UMP with simple illustration.

Elements of decision problems: Loss function, risk function, estimation and testing viewed as decision problems. Bayes rule.

Suggested readings:

1. Freund J.E. (2001) : Mathematical Statistical, Prentice Hall of India.
2. Hogg R.V. and Craig A.T. (1978) : Introduction of Mathematical Statistics, Fourth Edition, Collier Macmillon Publishers.
3. Mood A.M., Graybill E.A. and Bose D.C. (1974) : Introduction to the Theory of Statistics, McGraw Hill.
4. Rao, C.R. (1973) : Linear Statistical Inference and its Applications, Revised edition Wiley Eastern.
5. Rohtagi V.K. (1967) : An Introduction to Probability Theory and Mathematical Statistics, John Wiley and Sons.
6. Goon A.M., Gupta M.K. and Dasgupta B. (1980) : An Outline of Statistical Theory, Vol. 2, The World Press Publishers Pvt. Ltd. Calcutta.
7. Kale B.K. and Sinha S.K. : Life Testing and Reliability.

STB - 503 : PROGRAMMING WITH C Credits : 4

History and features of C language, components of C language, structure of a C program. Data type: Basic data types, enumerated data types, derived data types. Variable declaration, local, global, parametric variables, assignment of variables, numeric, character, real and string constants, arithmetic relation and logical operators, assignment operators, increment and decrement operators, conditional operators, Bitwise operators, type modifiers and expressions, writing and interpreting expressions, using expressions in statements. basic input / output.

Control Construct. I Control statements, conditional statements, if . . . . . else, nesting of if . . . . . else, elself ladder, swith statements. Loops in C: for, while, do . . . . . while loops

Control Constructs II

Break, continue, exit ( ), go to and label declarations.

One dimensional two dimensional and multidimensional arrays.

Storage classes: Automatic variables, External variables, Static variables, Scope and lifetime of declarations.

Functions, classification of functions, functions definition and declaration, assessing a function, return statement, parameter passing in functions, rewise on in Functions.

Structure: Definition and declaration; structure (initialization) comparison of structure variable array of structures : array within structures, structures within structures, passing structures to functions, unions accessing a union member, union of structure, initialization of a union variable, uses of union.

Suggested readings:

1. Balagurusamy E. :Programming in ANSI C Tata McGraw Hill.
2. Kanetkar Y.P.: working with C. BPB Publication.
4. Gottfried Byron S. : Theory and problems of Programming with CTMH.
5. Schildt, Herbest:: C The Complete Reference, III ED TMH.
6. Schildt, Herbert : C Made Easy, McGraw Hill.

STB – 504 : OPERATIONS RESEARCH Credits :4

Definitions and scope of operation research, different types of models in operations research – their construction and general method of solution.

Elements of linear programming problem (LPP): Canonical and standard forms, formulation of LPP, graphical method to solve two variable LPP, solution of LPP using simplex procedure, use of artificial variables in LPP, generation of extreme point solutions, principle of duality in LPP, statement and proof of duality theorem, simple problems based on duality theorem.

Allocation Models: Transportation problem (T.P.), different methods of finding initial feasible solution of a T.P., UV method of finding optimal solution of a T.P., solution of assignment problem using Hungarian method.

Inventory Control: Definitions of various costs involved in inventory control. Deterministic Economic Lot Size problems with and without shortages.

Theory of games: Two person zero-sum games, pure and mixed strategies, saddle point, maximin-minimax principle of rectangular games, games without saddle point, dominance and modified dominance principles, graphical solution of 2xN and Mx2 games, reduction of game problems to a L.P.P.

Suggested readings:

1. Taha, H.A. (1999): Operations Research, Macmillan Publishing Company.
2. Hiller F.S. and Libermann G.J. (1995): Introduction to Operations Research, McGraw Hill.
3. Hadley G. (1965) : Linear programming, Addison Wesley.
4. Gass G.I. (1958): Linear Programming- Methods and Applications, McGraw Hill.
5. McKinsey J.C.C. (1952): Introduction to the Theory and Games, McGraw Hill Book Co.
6. Kanti Swaroop, Gupta P.K. and Singh M.M. (1985) : Operations Research, Sultan Chand and Sons.

STB – 505 : PRACTICALS BASED ON COURSE Nos . STB – 501 AND STB – 502 Credits : 3

(The Practical Paper shall be of THREE HOURS duration. Out of total 70 marks, 50 marks will be assigned to the performance in practicals, 10 marks on the practical record book and 10 marks on the viva – voce).

1. CDR, STDR, CBR, Age specific death rates, life tables, GRR, NRR, Logistic curve and related practicals.
2. Laspeyre's, Passche's, Fisher's index numbers.
3. Problems related to trend, seasonal and cyclical fluctuations.
4. Charts: p, np, c, R, ($\bar{X}$, R), ($\bar{X}$, σ).
5. Practicals on moment, maximum likelihood, Minimum chi-square, least squares methods of estimation.
6. Testing of hypothesis for mean, variance, correlations, etc.

STB – 506 : PRACTICALS BASED ON COURSE Nos. STB – 503 AND STB – 504 Credits : 3

(The Practical Paper shall be of THREE HOURS duration. Out of total 70 marks, 50 marks will be assigned to the performance in practicals, 10 marks on the practical record book and 10 marks on the viva – voce).

The practical will be based on the contents of Course Nos. STB – 503 and STB - 504.

SEMESTER – VI

STB – 601 : NUMERICAL METHODS Credits : 3

Finite differences of different orders, Δ, E and D operators, factorial representation of a polynomial, separation of symbols, differences of zero.

Concept of interpolation and extrapolation: Newton Gregory's forward and backward interpolation formulae for equal intervals, divided differences and their properties, Newton's formula for divided difference, Lagranges formula for unequal intervals, central difference formula due to Gauss, Stirling, Bessel, Laplace and Everett, remainder terms in interpolation formula.

Inverse interpolation: Different methods of inverse interpolation.

Numerical differentiation.

Numerical Quadrature : Trapezoidal rule, Simpson's one-third and three-eight rules, Weddle's rule, Newton-Cotes formula, Euler-Maclaurine's formula and its uses.

Summation of series: Series whose general term (i) is the first difference of a function (ii) is in geometric progression and is a product of two functions.

Difference equation: Linear difference equations (homogeneous and non-homogeneous) with constant coefficients.

Numerical solutions of differential equations: Euler's method, Milne's method, Picard's method and Runge-Kutta method. Method of solving linear and transcendental equations.

Suggested readings:

1. Scarborough J.B.: Numerical Mathematical Analysis, Oxford University, Press and Oxford Book Co.
2. Saxena, H.C.: Calculas of finite Differences,
3. Freeman. H.: Finite Differences for Actuarial Students, Cambridge University Press.
4. Aitkinson U.: Eementary Numerical Analysis.
5. Sastry S.S.: Introductory Methods of Numerical Analysis, Fourth Edition, Prentice Hall of India.
6. Kunz, K.S.: Numerical Analysis, McGraw Hill.

STB – 602 : DEMAND ANALYSIS, ANALYSIS OF INCOME DISTRIBUTION AND QUEUING THEORY Credits : 3

Theory and analysis of consumer's demand, law of demand, price elasticity of demand, estimation of demand curves, forms of demand functions, Engel's curve, income elasticity of demand.

Analysis of income and allied distributions : Pareto distribution, graphical test, fitting of Pareto law, illustration, lognormal distribution and properties, Lorenz curve, Gini's coefficient.

Elements of queuing theory, characteristics of queues, Poisson process, distribution of inter-arrival time, definition of steady state condition, (M/M/1) : (∞ / FIFO) and (M/M/1) : (N/ FIFO models, birth and death process, (M/M/K) : (∞ / FIFO) and (M/M/K) : (N / FIFO) models.

Finite and infinite length models with associated distribution of queue length and waiting time, steady – state solutions of (M/E_k / 1) and (E_k / 1) queues, machine interface problem.

Suggested readings:

1. Kanti Swaroop, Gupta P.K. and Singh M.M. (1985) : Operations Research, Sultan Chand and Sons.
2. Hiller F.S. and Libermann G.J. (1995): Introduction to Operation Research, McGraw Hill.
3. Taha H.A. (1999) : Operation Research, Macmillan Publishing Company.
4. Mukhopadhyay P. (1999): Applied Statistics, New Central Book Agency Pvt. Ltd., Calcutta.
5. Goon A.M., Gupta M.K. and Dasgupta B. (1986): Fundamentals of Statistics, Vol.II, World Press, Calcutta.
6. Croxton F.E. and Cowden, D.F.: Applied General Statistics.
7. Asthana B.N. and Srivastava S.S.: Applied Statistics in India.

STB – 603 : ELEMENTS OF STOCHASTIC PROCESSES Credits : 3

Definition and examples of stochastic process: classification of general stochastic processes into discrete/continuous time, discrete/continuous state spaces, types of stochastic processes elementary problems, random walk, gambler's ruin problem.

Markov chains: Definition and examples of Markov chain, transition probability matrix, classification of states, recurrence, simple problems, basic limit theorem of Markov Chain (statement only).

Continuous time Markov Chain: Poisson process and related inter-arrival time distribution, pure birth process, pure death process, birth and death process, problems.

Branching process: Definition and examples of discrete time branching process, probability generating function, mean and variance, probability of extinction problems.

Suggested readings:

1. Karlin S. and Taylor H.M. (1995): A First Course in Stochastic Process, Academic Press
2. Hoel P.G., Port S.C. and Stone C.J. (1991): Introduction to Stochastic Process, Universal Book Stall.
3. Parzen E. (1962): Stochastic Process, Holden-Day
4. Cinlar E. (1975) : Introduction to Stochastic Processes, Prentice Hall.
5. Adke S.R. and Manjunath S.M. (1984) : An Introduction to Finite Markov Processes, Wiley Eastern.
6. Medli J. (1996) : Stochastic Processes, new Age International (P) Ltd.
7. Ross S.M. (1983) : Stochastic Process, John Wiley.
8. Taylor H.M. and Karlin S. (1999) : Stochastic Modeling, Academic Press.

STB – 604 : RELIABILITY Credits : 3

Life testing and reliability theory : Basic concepts of life testing experiments, reliability, hazard function and their relationship.

Elementary notion of censored data, type I and type II censoring schemes, Poisson process.

Parametric distributions : Weibull, gamma, lognormal, exponential as life time distributions, point and interval estimation procedures for the above distributions.

Testing reliability hypothesis for exponential and Weibull distributions.

System reliability concepts: Parallel system, series system and k out of n system.

Elementary idea of reliability models for non – maintained systems.

Suggested readings:

1. Bain, L. J. and Engelhardt, M. : Statistical Analysis of Reliability and Life Testing Models, Marcel Deckker.

2. Zack, S.: Introduction to Reliability Analysis : Probasbility Model and Statistical Methods, Springer Verlag.
3. Barlow, R. E. and Proschan, F. : Statistical Theory of Reliability and Life Testing : Probability Models, Holit Rinechart and Winston.
4. Gnedenko, Bylyayer and Solovyer : Mathematical Methods of Reliability Theory.
5. Kale, B. K. and Sinha, S. K. : Life Testing and Reliability.

STB – 605 : PRACTICALS BASED ON COURSE Nos. STB – 601 Credits : 3

(The Practical Paper shall be of THREE HOURS duration. Out of total 70 marks, 50 marks will be assigned to the performance in practicals, 10 marks on the practical record book and 10 marks on the viva – voce).

STB – 606 : PRACTICALS BASED ON COURSE Nos. SBT – 602 AND STB – 604 Credits : 3

(The Practical Paper shall be of THREE HOURS duration. Out of total 70 marks, 50 marks will be assigned to the performance in practicals, 10 marks on the practical record book and 10 marks on the viva – voce).

STB – 607 : PROJECT Credits : 4

The project work shall be spread over the whole semester. A project be undertaken by a group of students. However, the project report shall be submitted by each member of the group separately. A project report shall clearly state the problem addressed, the methodology adopted, the assumptions and the hypotheses formulated, any previous reference to the study undertaken, statistical analyses performed and the broad conclusion drawn. There shall be an external examiner and an internal examiner (preferably the supervisor of the student) for the evaluation of the project work. Out of total 100 marks assigned to the project, 60 marks will be assigned on the evaluation of the project report separately by both the examiners and 40 marks will be assigned on the oral presentation and viva – voce.

BANARAS HINDU UNIVERSITY

Department of Zoology

Faculty of Science

SYLLABI

B.Sc. (Hons.) Programme
in
Zoology

B.Sc. (HONS.) ZOOLOGY

Department of Zoology, Banaras Hindu University

DISTRIBUTION OF DIFFERENT COURSES AND CREDITS IN VARIOUS SEMESTERS

Semester –I		
Course Code	**Title**	**Credits**
ZOB 101	**(A)** Animal Diversity *(Credit -2)* **(B)** Fundamentals of Cell Biology *(Credit-2)*	4
ZOB 102	*Lab. exercises based on course ZOB101*	2
	Total	**6**
Semester –II		
ZOB 201	**(A)** Animal Form & Function *(Credit-2)* **(B)** Elementary Biochemistry *(Credit-2)*	4
Z0B 202	*Lab. exercises based on course ZOB201*	2
ZOB 203 A* #	Ancillary Biology: Animal Biology (for Non-Biology students- Credit 2) Ancillary Course (for Biology Students- Credit 2)	
	Total	**6**
Semester –III		
ZOB 301	**(A)** Genetics & Evolution *(Credit-2)* **(B)** Economic Zoology *(Credit-2)*	4
ZOB 302	*Lab. Exercises based on course ZOB301*	2
	Total	**6**
Semester –IV		
ZOB 401	**(A)** Fundamental Endocrinology *(Credit-2)* **(B)** Developmental Biology *(Credit-2)*	4
ZOB 402	*Lab. Exercises based on course ZOB401*	2
ZOB 403 A* #	Ancillary Biology: Applied Zoology (for Non-Biology students- Credit 2) Ancillary Course (for Biology Students- Credit 2)	
	Total	**6**
Semester –V		
ZOB 501	Functional Anatomy of Non Chordates	3
ZOB 502	Functional Anatomy of Chordates	3
ZOB 503	Biochemistry and Molecular Biology	3
ZOB 504	Biotechniques	3
ZOB 505	Environmental Biology & Systematics (2 + 1)	3

ZOB 506	*Lab. exercises based on courses ZOB501 & 502*	2
ZOB 507	*Lab exercises based on courses ZOB 503 & 504*	2
ZOB 508	*Lab exercises based on course ZOB 505*	1
ZOB 509	*Field Study*	2
	Total	**22**
	Semester –VI	
ZOB 601	Mammalian Physiology	3
ZOB 602	Mammalian Endocrinology	3
ZOB 603	Cell Biology & Genetics	3
ZOB 604	Evolution & Animal Behaviour	3
ZOB 605	Immunology & Parasitology	3
ZOB 606	*Lab. exercises based on courses ZOB601 & 602*	2
ZOB 607	*Lab. exercises based on courses ZOB603 & 604*	2
ZOB 608	*Lab. exercises based on course ZOB605*	1
ZOB 609	Term Paper	2
	Total	**22**
	Grand Total	**68**

* Zoology Department will offer two Ancillary Biology Courses (2 Credit each in Semester II- Animal Biology and in Semester IV- Applied Zoology) to the B.Sc. (Hons) students of other Non-Biology Departments.

B.Sc. (Hons.) Zoology students will opt two Ancillary Courses (2 Credit each in Semester II and Semester IV) offered by other Non-Biology Departments.

B.Sc. (Hons.) Zoology

SEMESTER I

ZOB 101: Animal Diversity & Fundamentals of Cell Biology (Credit 4)

Section A: Animal Diversity (Credit 2)

Hours of teaching

1. Criteria for classification of multicellular animals **3**

1.1 Symmetry

1.2 Early development: spiral and radial cleavage

Protostomes and Deuterostomes

1.3 Body cavities: acoelomates, pseudocoelomates, coelomates

(schizo- and enterocoelomates)

1.4 Homology and analogy

2. Non Chordates: General characters and classification of the following up to classes with examples showing distinctive/adaptive features **11**

2.1 Protozoa

2.2 Porifera

2.3 Cnidaria

2.4 Ctenophora

2.5 Platyhelminthes

2.6 Nematoda

2.7 Annelida

2.8 Arthropoda

2.9 Mollusca

2.10 Echinodermata

3. Hemichordates: General characters and classification up to sub -classes **1**

4. Chordates: General characters and classification of the following up to sub-classes with examples showing distinctive/adaptive features **11**

4.1 Protochordates: Urochordates, Cephalochordates

4.2 Cyclostomes

4.3 Pisces

4.4 Amphibians

4.5 Reptiles

4.6 Aves

4.7 Mammals

Section B: Fundamentals of Cell Biology (Credit 2)

Hours of teaching

1. The Cell **3**

1.1 Introduction to cell theory

1.2 Comparison of a generalized pro- and eukaryotic cell

1.3 Methods in Cell Biology: Elementary idea of microscopy and cell fractionation

2. Organization of cell **14**

2.1 Elementary knowledge of structure and function of plasma membrane

2.2 Introduction to endomembrane system (endoplasmic reticulum, Golgi complex, lysosome), peroxisome

2.3 Introduction to cytoskeleton

2.4 Structure and functions of mitochondria

2.5 Nuclear envelope, nucleolus and biogenesis of ribosome

2.6 Interphase chromatin and its compaction into metaphase chromosome

2.7 Introduction to polytene and lampbrush chromosomes

3. Cell reproduction **6**

3.1 Basic features of cell cycle

3.2 Mitosis, mitotic spindle and chromosome movement

3.3 Process and phases of meiosis and its significance

4. Elementary knowledge of cell transformation and cancer **2**

5. Introduction to the cellular basis of immunity **1**

Suggested readings:

Animal Diversity

1. Dalela & Sharma: Animal Taxonomy and Museology (1976, Jai Prakash Nath).
2. Kapoor: Theory and Practicals of Animal Taxonomy (1988, Oxford & IBH).
3. Simpson: Principles of Animal Taxonomy (1962, Oxford).
4. Roymahoney: Laboratory Techniques in Zoology (1966, Butterworths).
5. Mayer & Ashlock: Principles of Systematic Zoology (1991, McGraw Hill).
6. Boolotian & Stiles: College Zoology (10th ed 1981, Macmillan)
7. Campbell & Reece: Biology (7th ed 2005, Pearson)
8. Dorit, Walker & Barnes: Zoology (1991, Saunders)
9. Taylor,.Green & Stout : Biological Sciences (3rd ed. 2005, Cambridge)
10. Mader: Biology (9th ed. 2007, W.C. Brown)

Fundamentals of Cell Biology

9. Alberts et al: Molecular Biology of the Cell (2008, Garland)
10. Cassimeris et al: Lewin's Cells (2011, Jones and Bartlett)
11. Karp: Cell and Molecular Biology (2010, John Wiley)
12. Lodish et al: Molecular Cell Biology (2008, Freeman)

LABORATORY EXERCISES

ZOB 102: Animal Diversity & Fundamentals of Cell Biology ***(Credit 2)***

Part A: Animal Diversity ***(Credit 1)***

1. Study of transverse sections/chart of the following:

   Sycon (as an example of Parazoa to show its structure, spicules and canal system), *Hydra* (as an example of diploblastic animal), *Fasciola* (as an example of triploblastic acoelomate animal), *Ascaris* (as an example of triploblastic pseudocoelomate animal), *Hirudinaria (*as an example of triploblastic schizocoelomate animal), Frog (as an example of triploblastic enterocoelomate animal)

2. Study of salient features and classification up to classes of the following non-chordates with special emphasis on their adaptive characters:

   *Amoeba, Euglena, Plasmodium, Paramecium, Euplectella, Physalia, Corallium, Hormiphora, Taenia, Ascaris (*male and female), *Nereis* (including heteronereid stage), *Hirudinaria, Bonellia, Chiton, Mytilus,* Octopus*, Limulus, Eupagurus, Sacculina, Asterias, Echinus, Holothuria.*

3. Salient features and classification up to Orders of the following with special emphasis on their adaptive characters:

   Balanoglossus, Herdmania, Amphioxus *Lamprey, Trygon,* Lung Fish, *Uraeotyphlus, Alytes, Hyla, Chameleon,* Tortoise, poisonous and non-poisonous snakes, Duck, Kiwi, Duck-billed Platypus.

Part B: Cell Biology ***(Credit 1)***

1. Drawing of ultrastructure of cell and different organelles (from photographs provided)
2. Familiarization with the student's light microscope and stereobinocular microscope
3. Application of centrifuge – separation of sperm from other testicular cells by low speed centrifugation
4. Diversity of eukaryotic cells – methylene blue staining of buccal epithelium, sperm, neurons, striated muscle cells; Leishman staining of mammalian blood cells
5. Permeability of plasma membrane – effect of isotonic, hypotonic and hypertonic solutions on mammalian RBC
6. Staining of nucleolus (RNA) and chromatin (DNA) with methyl green-pyronin Y
7. Staining of mitochondria with Janus green in buccal epithelium
8. Mitosis in onion root tips
9. Meiosis in grasshopper testis (from slides/photographs provided)

SEMESTER II

ZOB 201: Animal Form and Function & Elementary Biochemistry (Credit 4)

Section A: Animal Form and Function (Credit 2)

Hours of teaching

1. Nutrition & Digestion **4**

1.1 Intracellular and extracellular digestion: food vacuole and gastrovascular cavity

1.2 Feeding mechanisms: suspension, deposit, cropping and sucking (herbivorous) and raptorial (carnivorous)

2. Gas exchange and internal transport **4**

2.1 Structure and function of gills, trachea, book lungs and vertebrate lungs

2.2 Pattern of circulation in non chordates and chordates

3. Types of excretory organs in non chordates and chordates **4**

3.1 Open tubular: metanephridia

3.2 Closed saccular: protonephridia, malpighian tubules and kidney

4. Nervous system **4**

4.1 Patterns of nervous system in non chordates

4.2 Organization of nervous system in vertebrates: central and autonomic system

5. Receptors and Sense organs **5**

5.1 Phonoreception in fish and mammals

5.2 Photoreception in insects and mammals

6. Reproduction **5**

6.1 Types of asexual reproduction: fission, regeneration and parthenogenesis

6.2 Sexual reproduction: primary and accessory sex organs

6.3 Parental care (with reference to amphibians)

Section B: Elementary Biochemistry (Credit 2)

Hours of teaching

1. Introduction **3**

1.1 Chemistry of living system: scope and importance

1.2 Biomolecules: organizational principle, configuration and conformation

1.3 Water as biological solvent

2. Amino acids **1**

2.1 Structure and classification

2.2 Properties of peptide bond

3. Proteins **3**

3.1 Functions and diversity

3.2 Structural organization

4. Enzymes **4**

4.1 General properties

4.2 Major classes of enzymes

4.3 Mechanism of enzyme action (ES complex & lowering of activation energy, concept of chemical catalysis)

5. Carbohydrates **3**

5.1 Classification and nomenclature

5.2 Structure and conformation of monosaccharides

5.3 Reducing and non-reducing sugars

5.4 Oligosaccharides (disaccharides) and polysaccharides

6. Lipids **2**

6.1 Biological significance and classification

6.2 Fatty acids

6.3 Formation of lipid bilayer

7. Nucleic acids **10**

7.1 Bases, nucleosides and nucleotides

7.2 DNA structure: DNA double helix (Watson and Crick model)

7.3 DNA and RNA as genetic material

7.4 DNA replication

7.4.1 Semi-conservative replication

7.4.2 Basic mechanism of replication (Prokaryotes)

7.5 Transcriptional unit and basic concept of transcription (Prokaryotes)

7.6 Genetic code and basic mechanism of translation (Prokaryotes)

7.7 Introduction to recombinant DNA techniques and their applications

Suggested readings:

Animal Form and Function

1. Miller & Harley: Zoology (6th ed. 2005, W.C. Brown)
2. Nigam: Biology of Non-chordates (1997, S Chand)
3. Nigam: Biology of Chordates (1997, S Chand)

4. Parker & Haswell: Text Book of Zoology, Vol. II (2005, Macmillan)
5. Purves et al: Life-the Science of Biology, (7th ed. 2004, Sinauer)
6. Tortora and Anagnostakos: Principles of Anatomy and Physiology (6th ed. 1986, Harper & Row).
7. Schmidt Nielson: Animal Physiology (5th ed. 2005, Cambridge)
8. Hoar: General and Comparative Physiology (7th ed. 2005)
9. Arms and Camp: Biology (4th ed. 1995)

Elementary Biochemistry

1. Boyer: Concepts in Biochemistry (3rd ed. 2006, Brooks/Cole)
2. Lehninger, Nelson & Cox: Principles of Biochemistry (4th ed, 2007, Worth),
3. Murray *et al*: Harper's Biochemistry (25th ed. 2000, Appleton & Lange)
4. Stryer: Biochemistry (6th ed. 2006, Freeman)
5. Conn, Stumpf, Bruening & Doi: Principles of Biochemistry (5th ed. 1987, Wiley)

LABORATORY EXERCISES

ZOB 202: Animal Form and Function & Elementary Biochemistry (Credit 2)

Part A: Animal Form and Function

1. Animal nutrition

1.1 Study and mounting of cephalic appendages of *Palaemon*

1.2 Dissection of digestive system of *Palaemon* and mounting of Hastate plate

1.3 Study of mouth parts of *Periplaneta americana*

1.4 Dissection of alimentary canal of *Periplaneta americana*

2. Internal transport: Dissection of afferent and efferent branchial arteries of *Mystus*

3. Nervous system, receptors and sense organs

3.1 Dissection of nervous system of *Palaemon*

3.2 Mounting of statocyst of *Palaemon*

3.3 Dissection of 5th, 7th, 9th and 10th cranial nerves of *Mystus*

4. Reproduction

4.1 Permanent preparation of gemmules of sponges

4.2 Study of the following through permanent slides/museum specimens:

Conjugation in *Paramecium,* Sporocyst of *Fasciola* with developing Redia, Cercaria and Metacercaria larvae, Trochophore larva, Nauplius and Zoea larvae, Bipinnaria, Auricularia and Pluteus larvae, Tornaria, Ammocoetes and Tadpole (frog); Axolotl

5. Demonstration of animal dissections through VCDs

Part B: Elementary Biochemistry

1. Preparation of models of amino acids and dipeptides
2. Ninhydrin test for α-amino acids
3. To demonstrate catalase activity and its inactivation by heat
4. Benedict's test for reducing sugars
5. Iodine test for starch
6. Determination of acid value of oil
7. Preparation of models of nitrogenous bases, nucleosides and nucleotides

SEMESTER III

ZOB 301: Basic Genetics and Evolution & Economic Zoology **Credit 4)**

Section-A: Basic Genetics and Evolution (Credit 2)

Hours of teaching

1. Elements of heredity and variation **4**

1.1 Mendel's laws of inheritance

1.2 Chromosomal basis of inheritance

1.3 Application of laws of probability to Mendelian inheritance

2. Extension of Mendelism **4**

2.1 Dominance relationships

2.2 Multiple allelism

2.3 Lethal alleles

2.4 Pleiotropy

2.5 Epistasis

2.6 Penetrance and expressivity

2.7 Phenocopy

2.8 Polygenic inheritance

3. Cytoplasmic and infective inheritance **1**

4. Linkage and crossing-over **1**

5. Sex chromosomes and sex-linkage **2**

5.1 Sex chromosome systems: XX/XO, XX/XY, ZZ/ZW and haploidy/diploidy types

5.2 Sex-linkage

6. Structural and numerical alterations of chromosomes; meiotic monsequences in structural heterozygotes

7. Human genetics **4**

7.1 Karyotype, banding, nomenclature of chromosome subdivisions and genetic map

7.2 Genetic disorders

7.2.1 Chromosomal aneuploidy (Down, Turner and Klinefelter syndromes)

7.2.2 Chromosome translocation (chronic myeloid leukemia) and deletion ("cry of cat" syndrome)

7.2.3 Gene mutation (cystic fibrosis)

7.3 Genetic counseling

8. Concept of organic evolution **1**

9. Evidence of organic evolution **3**

9.1 Comparative anatomy

9.2 Comparative embryology

9.3 Palaeontology

9.4 Biochemistry and genetics

9.5 Zoogeography

10. Theories of organic evolution **3**

10.1 Lamarckism

10.2 Darwinism

10.3 Development and concept of synthetic theory

10.4 Natural selection in action (industrial melanism, antibiotic and DDT resistance)

11. Evolution of man **1**

Section B: Economic Zoology **(Credit 2)**

Hours of teaching

1. Aquaculture **6**

1.1 Aquaculture resources in India

1.1 Fish culture

1.2 Fish by-products

1.3 Prawn culture

1.4 Pearl culture

2 Sericulture **4**

2.1 Types of silk

2.2 Silkworms and their host plants

2.3 Mulberry silk worm culture

2.4 Natural enemies and their control

3 Apiculture **5**

3.1 Species of honey bees in India

3.2 Life history of *Apis*

3.3 Bee products and their uses

3.4 Natural enemies and their control

4 Lac culture **2**

4.1 Lac insect and its life cycle

4.2 Cultivation of lac insect host plants, processing and uses of lac

5 Animal husbandry **4**

5.1 Introduction to common dairy animals

5.2 Techniques of dairy management

6 Poultry **5**

6.1 Types of breeds

6.2 Rearing method

6.3 Diseases and control measures

Suggested readings:

Basic Genetics and Evolution

1. Gardner et al: Principles of Genetics (2006, John Wiley)
2. Griffith et al: An Introduction to Genetic Analysis (2008, Freeman)
3. Hartl & Jones: Essential Genetics - A Genomic Perspective (2009, Jones & Bartlet)
4. Pierce: Genetics – A Conceptual Approach (2012, Freeman)
5. Russell: Genetics (2010, Benjamin Cummings)
6. Snustad & Simmons: Principles of Genetics (2012, John Wiley)
7. Hall and Hallgrimsson: Strickberger's Evolution (2008, Jones and Bartlett)
8. Moody: Introduction to Evolution (1978, Kalyani).
9. Rastogi: Organic Evolution (2007, Kedarnath & Ramnath)

Economic Zoology:

1. Shukla and Upadhyaya : Economic Zoology (Rastogi Publishers, 1999-2000)
2. Shrivastava: Test book of Applied Entomology, Vol. I &II (Kalyani Publishers, 1991)
3. Mani: Insects, NBT, India, 2006.
4. Jabde: Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture, Lac culture, Agricultural Pests and their Control , 2005 Publisher Vedams eBooks (P) Ltd. New Delhi

LABORATORY EXERCISES

ZOB 302: Basic Genetics and Evolution & Economic Zoology (Credit 2)

Part A: Basic Genetics and Evolution

1. Application of probability in the law of segregation with coin tossing
2. Frequency of the following genetic traits in human: widow's peak, attached ear lobe, dimple in chin, hypertrichosis, colour blindness, PTC tasting
3. Study of mode of inheritance of the following traits by pedigree charts – attached ear lobe, widow's peak.
4. Familiarization with techniques of handling *Drosophila*, identifying males and females; observing wild type and mutant (white eye, wing less) flies, and setting up cultures.
5. Demonstration of sex-linked inheritance in *Drosophila* making a cross between white eye and wild type flies (criss-cross inheritance).
6. Demonstration of lethal alleles using Curly (Cy) mutant in *Drosophila*.
7. Demonstration of multiple allelism by showing mutants of white eye series in *Drosophila*.
8. Study of structural chromosome aberrations (dicentric, ring chromosomes and inversions in polytene chromosomes) from prepared slides/photographs.
9. Study of human karyotypes and numerical alterations (Down syndrome, Klinefelter syndrome and Turner syndrome).
10. Adaptive modifications in feet of birds and mouth parts of insects (from slides)
11. Embryological evidence of evolution (through charts)
12. Analogy and homology (wings of birds and insects, forelimbs of bat and rabbit)
13. Serial homology in appendages of *Palaemon*

Part B: Economic Zoology

1. Study of life cycle of silkworm through chart/specimens
2. Study of life cycle of honey bee through chart/specimens
3. Study of external morphology of different castes of honey bee
4. Dissection of sting apparatus of honey bee
5. Study of life cycle of lac insect through chart.
6. Visit to the local dairy farm to study the pests of cattle
7. Visit to the local dairy farm to study the dairy management
8. Visit to local poultry to study the rearing methods
9. Visit to local fish culture site to study the fish culture methods

SEMESTER IV

ZOB 401: Fundamental Endocrinology & Developmental Biology (Credit 4)

Section A: Fundamental Endocrinology (Credit 2)

Hours of teaching

1. Introduction to endocrinology **5**

1.1 Definition, classification and characteristics of chemical messengers (hormones, neurohormones, neurotransmitters, cytokines, pheromones)

1.2 Hormone delivery: Endocrine, paracrine and autocrine modes

1.3 Hormone feedback mechanisms

2. Structure and functions of: **16**

2.1 Pituitary

2.2 Thyroid

2.3 Parathyroid

2.4 Adrenal

2.5 Endocrine pancreas

2.6 Testis

2.7 Ovary

3. Endocrine glands in insects **5**

3.1 Pars intercerebralis-corpus cardiacum-corpus allatum complex

3.2 Prothoracic gland

Section B: Developmental Biology **(Credit 2)**

Hours of teaching

1. Historical perspective and scope of developmental biology **1**

2. Gametogenesis **4**

2.1 Spermatogenesis

2.2 Oogenesis

3. Fertilization **4**

3.1 External fertilization: sea urchin

3.2 Internal fertilization

4. Cleavage **3**

4.1 Patterns and types

4.2 Cleavage in frog and chick embryo

5. Fate map and gastrulation in frog and chick **4**

6. Primary organizer and axis formation in frog **3**

7. Concept of competence, determination and differentiation **2**

8. Extra embryonic membranes **2**

9. Hormonal control of metamorphosis in frog **2**

10. Concept of regeneration **1**

Suggested readings:

Fundamental Endocrinology

1. Hadley: Endocrinology (5th ed. 2000, Prentice Hall)
2. Turner and Bagnara: General Endocrinology, 6th ed.1984, Saunders)
3. Norris: Vertebrate Endocrinology, Fourth Edition, 2007, Academic Press

Developmental Biology

1. Alberts et al: Molecular Biology of the Cell (2008, Garland)
2. Balinsky: An Introduction to Embryology (1981, CBS)
3. Gilbert: Developmental Biology (8th ed., 2006, Sinauer)
4. Wolpert: Principles of Development (3rd ed. 2007, Oxford)

LABORATORY EXERCISES

ZOB 402: Fundamental Endocrinology and Developmental Biology (Credit 2)

Part A: Fundamental Endocrinology

1. Handling, sexing, numbering and maintenance of rat
2. General survey of endocrine glands in rat
3. Study of vaginal smear preparation in rat
4. Demonstration of the following surgical operations in rat: orchidectomy, ovariectomy
5. Study of histological slides of the following endocrine glands in rat: pituitary, thyroid, adrenal, endocrine pancreas, testis and ovary
6. Demonstration of endocrine glands in cockroach
7. Demonstration of frog metamorphosis by models and charts

Part B: Developmental Biology

1. Study of different types of eggs
2. Demonstration of sperm motility in rat
3. Study of eggs and tadpoles of frog from collected/preserved material
4. Study of frog development through models
5. Window preparation on hen's egg
6. Demonstration of chick embryonic development making window preparation of fertilized egg
7. Study of whole mount preparations of chick embryos of 16-18 , 24-28, 33-36 and 42-48 hrs of development

SEMESTER V

ZOB 501: Functional Anatomy of Non Chordates (Credit 3)

Hours of teaching

1. Protozoa: Study of *Euglena* and *Monocystis* (locomotion, nutrition and reproduction) **4**

2. Origin of Metazoans **3**

2.1 Germ layers, diploblastic and triploblastic organization

2.2 Theories on the origin of Metazoans

3. Porifera: Study of *Leucosolenia* and *Sycon* (structure, skeleton and aquaferous/canal system) **3**

4. Cnidaria and Ctenophora **6**

4.1 Study of *Obelia* and *Aurelia (*structure and reproduction)

4.2 Salient features of ctenophores and comparison with cnidarians

5. Platyhelminthes: *Fasciola* and *Taenia*- structure, reproduction, life-cycle and parasitic adaptations **5**

6. Nemathelminthes: *Ascaris*- Structure, reproduction and life-cycle **2**

7. Annelida **3**

7.1 *Nereis:* Structural features and reproduction

7.2 Trochophore larva and its evolutionary significance

8. Arthropoda: *Palaemon:* Structural features and reproduction **2**

9. Mollusca **5**

9.1 *Unio:* Structural features and reproduction

9.2 Torsion and detorsion in gastropods

9.3 Modification of foot in molluscs

10. Echinodermata **6**

10.1 *Asterias*: Structural features and hydrostatic system

10.2 Larval forms of Echinoderms and their significance

10.3 Origin and evolution of echinoderm larvae

Suggested readings:

1. Barnes: Invertebrate Zoology (4th ed. 1980, Holt-Saunders)
2. Barnes: The invertebrate (3rd ed. 2001Blackwell)
3. Barrington: Invertebrate Structure and Function (1967Nelson)
4. Moore: An introduction to the invertebrartes (2001Cambridge)
5. Ekambaranath Ayar: A manual of Zoology, Part I – Invertebrata, (1973, S. Vishwanathan)
6. Kotpal, Agarwal and Khetrapal: Modern Textbook of Zoology: Invertebrate, (1976, Rastogi)
7. Marshall: Parker and Haswell Textbook of Zoology, Vol. I (7th ed. 1972, Macmillan)
8. Nigam: Biology of Non-chordates (1985, S. Chand)
9. Jordon and Verma: Invertebrate Zoology (1995, S. Chand)

ZOB 502: Functional Anatomy of Chordates **(Credit 3)**

Hours of teaching

1. Origin of vertebrates **2**

2. Integument and its derivatives **4**

2.1 Structure of integument

2.2 Scales, feathers, hair, claws, nails, hoofs, horns, antlers, glands

3. Endoskeleton **5**

3.1 General plan of neurocranium and dermatocranium.

3.2 Jaw suspensorium

3.3 Vertebrae

4. Digestive system **5**

4.1 Modifications in relation to feeding habits:

length and surface area, internal folds and supplementary diverticulae

4.2 Stomach: modifications in ruminants

4.3 Dentition in mammals

5. Respiratory system **6**

5.1 Aquatic respiration

5.2. Aerial respiration

5.2.1 Accessory respiratory organs in fish

5.2.2 Lungs

5.2.3 Air-sacs in birds

6. Circulatory system **5**

6.1 Aortic arches

6.2 Portal systems

6.3 Lymphatic system

7. Nervous system **5**

7.1 Evolution of cerebral hemispheres and cerebellum

7.2 Neuromast organs of lower vertebrates

8. Urinogenital system **7**

8.1 Excretory system

8.1.1 Types and evolution of kidney tubules

8.1.2 Urinary duct and bladder

8.2. Reproductive system: General plan of gonads

Suggested readings:

1. Hildebrand: Analysis of Vertebrate Structure (1995, John Wiley)
2. Kotpal: Modern Text Book of Zoology Vertebrates (2003, Rastogi)
3. Nigam: Biology of Chordates (1983, S Chand)
4. Romer & Parsons: The vertebrate Body (6^h ed. 1986, Saunders)
5. Walter & Sayles: Biology of the Vertebrates (1959, Macmillan)
6. Young: The Life of Vertebrates (1981 Clarendon)
7. Young: The Life of Mammals (1975 Clarendon)

ZOB 503: Biochemistry and Molecular Biology **(Credit 3)**

Hours of teaching

1. Proteins: Composition and organization **5**

1.1 Amino acids: Ionization, titration curve, pK and pI

1.1.1 Reactions involving α amino group (Sanger and Edman's reactions)

1.1.2 Concept of protein sequencing

1.2 Functional organization of proteins

2. Enzymes **7**

2.1 Kinetics (determination of Km and Vmax using Michaelis-Menten and Lineweaver-Burk plots)

2.2 Acid-base and covalent catalysis

2.3. Concept of regulation of enzyme activity

2.3.1 Inhibition

2.3.2 Allosteric regulation

2.3.3 Role of covalent modifications

2.4 Introduction to ribozymes and abzymes

3. Carbohydrates **7**

3.1. Polysaccharides

3.1.1 Homopolymers

3.1.2 Heteropolymers (peptidoglycans and glycosaminoglycans)

3.2. Catabolism of carbohydrates and ATP production

3.2.1 Glycolysis

3.2.2 Krebs cycle

3.2.3 Electron transport chain and ATP synthesis

4. Lipids : Structural and functional significance **4**

4.1 Triglycerides

4.2 Phospholipids

4.3 Sphingolipids

4.5 Cholesterol

4.6 Prostaglandins

5. Nucleic acids **12**

5.1 Conformation of DNA (A, B and Z)

5.2 Structure of nucleosomes

5.3 Mechanism of DNA replication

5.4. Transcription

5.4.1 Basic mechanism (prokaryotic model)

5.4.2 Transcription initiation complex in eukaryotes

5.4.3 Processing of RNA Pol II transcript

5.4.4 Genetic code

5.4.5 Mechanism of translation

6. Genetic engineering **4**

6.1 Tools: Restriction enzymes, vectors

6.2 Construction of recombinant DNA

6.3 Concept of gene cloning

6.4 Production of recombinant protein

Suggested readings:

1. Boyer: Concepts in Biochemistry (3rd ed. 2006, Brooks/Cole)
2. Lehninger, Nelson & Cox: Principles of Biochemistry (4th ed, 2007, Worth),
3. Murray *et al*: Harper's Biochemistry (25th ed. 2000, Appleton & Lange)
4. Stryer: Biochemistry (6th ed. 2006, Freeman)
5. Zubay: Biochemistry (1998, McGraw-Hill)

ZOB 504: Biotechniques **(Credit 3)**

Hours of teaching

1. Principles and application of analytical instruments **6**

1.1 pH meter

1.2 UV-visible spectrophotometer

1.3 Centrifuge

2. Microtomy and microscopy **10**

2.1. Tissue preparation and microtomy

2.1.1 Fixation

2.1.2 Block preparation

2.1.3 Microtomy (paraffin and frozen tissue sectioning)

2.2. Types of Microscope

2.2.1 Bright field

2.2.2 Dark-field

2.2.3 Phase contrast

2.2.4 Fluorescence

2.2.5 Confocal

2.2.6 Scanning and transmission electron microscopes

3. Cell and tissue culture techniques **6**

3.1 Sterilization: laminar flow, media and glasswares

3.2 Types of culture media

3.3 Cell viability testing

3.4 Cryopreservation

4. Separation techniques **10**

4.1. **Chromatography**

4.1.1 Paper chromatography

4.1.2 Thin layer chromatography

4.1.3 Gel-filtration chromatography

4.2. **Electrophoresis**

4.2.1 Electrophoresis of proteins

4.2.2 Electrophoresis of nucleic acids

5. Radiotracer techniques **7**

5.1 Nature of radioactivity

5.2 Unit of radioactivity and measurement of radioactivity

5.3 Safety aspects

Suggested readings:

1. Boyer: Modern Experimental Biochemistry (1993, Benjamin-Cummings,)
2. Pearse: Histochemistry - Theoretical and applied, Volume I-III (1980-1993, Churchill-Livingstones)
3. Plummer: An Introduction to Practical Biochemistry (1989, McGraw Hill)
4. Wilson & Walker: Experimental Biochemistry (2006, Cambridge)

ZOB505: Environmental Biology and Systematics **(Credit- 3)**

Section A: Environmental Biology **(Credit-2)**

Hours of teaching

1. General concepts **8**

1. 1 Introduction to environmental biology

1. 2 Major ecosystems of the world

1. 3 Energy flow in ecosystems

1. 4 Productivity, food chains and food web

2. Populations and communities **6**

2. 1 Population characteristics: density, natality, mortality and growth curves

2. 2 Nature, structure and attributes of biological communities

2.3 Types of interactions

3. Environment and Society **12**

3.1 Environmental ethics

3.2. Pollution

3.2.1 Sources and impact of environmental pollution: air, noise, water and soil

3.2.2 Global environmental changes: greenhouse gases and their effects

3.3. Natural resources and conservation

3.3.1 Soil, water, mineral resources and their conservation

3.2.2 Biodiversity: benefits, hotspots, threats and conservation

3.4 Land-use planning

3.5 Solid waste management

Section B: Systematics **(Credit 1)**

Hours of teaching

1.	**Introduction to taxonomy and its relationship with systematics**	**1**
2.	**Zoological nomenclature**	**2**
	2.1 Binominal	
	2.2 Trinominal	
3.	**Kinds of taxonomic characters**	**5**
	3.1 Morphological	
	3.2 Embryological	
	3.3 Behavioural	
	3.4 Ecological	
	3.5 Numerical	
4.	**Kinds of zoological classification**	**2**
	4.1 Components of classification	
	4.2 Linnaean hierarchy	
5.	**Concept of species**	**2**
	5.1 Typological	
	5.2 Nominalistic	
	5.3 Biological	
	5.4 Evolutionary	
6.	**Molecular taxonomy**	**1**

Suggested readings:

Environmental Biology

1. Reece et al. (2011) Campbell Biology (9th edition), Pearson, New York
2. Cunningham and Cunningham (2003): Principles of Environmental Science (2nd edition), Tata McGraw Hill Publishing Company Limited, New Delhi.
3. Enger and Smith (2000): Environmental Science (7th edition), McGraw-Hill Higher education, London.
4. Odum and Barrett (2005): Fundamentals of Ecology, Thomson Brooks/Cole, USA
5. Primack (2004): A primer of conservation biology (3rd edition), Sinauer Associates, Massachusetts.
6. Raven and Berg (2001): Environment (3rd edition), Harcourt College Publishers, New York.
7. Turk and Turk (1998): Environmental Science, Saunders.

Systematics

1. Boolotian and Stiles: College Zoology (1981, Macmillan)
2. Dalela and Sharma: Animal Taxonomy and Museology (1976, Jai Prakash Nath).
3. Kapoor: Theory and Practicals of Animal Taxonomy (1988, Oxford & IBH).
4. Mayr and Ashlock: Principles of Systematic Zoology (1991, McGraw Hill).
5. Roymahoney: Laboratory Techniques in Zoology (1966, Butterworths).
6. Simpson: Principles of Animal Taxonomy (1962, Oxford).

LABORATORY EXERCISES

ZOB 506: Based on Course ZOB501 & 502 (Credit 2)

Part A: Functional Anatomy of Non chordates (Credit 1)

1. **Protozoa:** Culturing of *Paramecium* and *Euglena* and observation of their locomotion
2. **Porifera**
   - 2.1 Study of canal systems (asconoid, syconoid, leuconoid) from prepared slides and models
   - 2.2 Study of the following museum specimens: *Euplectella, Hyalonema, Cliona, Euspongia*
3. **Cnidaria**
   - 3.1 Study of the following through prepared slides: T.S. of Hydra through ovary and testis, Scyphistoma and Ephyra.
   - 3.2 Study of the following museum specimens: *Physalia, Porpita, Tubipora, Corallium, Gorgonia, Fungia, Millepora.*
4. **Ctenophora:** Study of the following museum specimens: *Hormiphora, Beroe*
5. **Platyhelminthes:** Study of the following from slides/specimen: *Dugesia, Polystomum, Schistosoma, Echinococcus, Fasciola, Taenia,* Miracidium, sporocyst, redia, cercaria, metacercaria, Hexacanth bladder worm
6. **Nemathelminthes:** Study of the following from slide/specimen: *Ascaris* (male and female)
7. **Annelida**
   - 7.1 Leech
     - 7.1.1 External features
     - 7.1.2 Dissections: Digestive
     - 7.1.3 Mounting of jaws and salivary glands
   - 7.2. *Nereis*: Permanent stained preparation of parapodium
   - 7.3 Study of the following museum specimens/slides*: Nereis, Aphrodite, Arenicola, Sabella, Acanthobdella, Branchellion, Bonellia*
   - 7.4 Trochophore Larva, T.S. of Leech through crop sac
8. **Arthropoda**
   - 8.1. Cockroach
     - 8.1.1 External features
     - 8.1.2 Dissections: Tracheal system and salivary gland
     - 8.1.3 Mounting of trachea and heart
   - 8.2 Study of the following museum specimens/slides: *Daphnia, Cypris, Cyclops (male and female), Lepas, Balanus, Cancer, Julus, Scolopendra,* Lepisma, Cricket, grasshopper, termite, *Apis*, wasp, butterfly, moth.
   - 8.3 Study of the following larval forms from slides: Nauplius, Zoea and Megalopa.
9. **Mollusca**
   - 9.1 *Unio*: Dissection of nervous system
   - 9.2 Study of the following museum specimens: *Chiton, Cyprea, Patella, Aplysia, Doris, Dentalium, Mytilus, Pecten, Teredo, Sepia, Loligo, Octopus.*
10. **Echinodermata**

    Study of the following larval form from slides: Bipinnaria, Brachiolaria, Auricularia, Ophiopluteus and Echinopluteus.

Part B ***Functional Anatomy of Chordates*** ***(Credit 1)***

1. Lower chordates

1.1. Amphioxus

1.1.1 External features

1.1.2 Mounting of oral hood, velum and pharyngeal wall

1.1.3 Study of the following slides: *T.S. through oral hood, midgut diverticulum, pharyngeal region, gonads and post oral region of intestine*

1.2 Study of the following permanent slides specimens: *Pyrosoma, Salpa, Doliolum*

2. Vertebrates

2.1 Integument and its derivatives

2.1.1 Mounting of cycloid and ctenoid scales

2.1.2 Mounting of chromatophores of fish

2.1.3 Study of different types of feather: Contour, filoplume and down feathers

2.2 General anatomy

2.2.1 Vascular system

2.2.1.1 Heart and afferent and efferent branchial vessels of *Cirrhinus sp.*

2.2.1.2 Arterial and venous systems of rat

2.2.2 Respiratory system: Accessory respiratory organs of *Heteropneustes*

3. Histology: Study of permanent slides of the following tissues and organs of mammals-

Tooth, tongue, oesophagus, stomach, intestine, pancreas, liver, spleen, kidney, cartilage, bone

4. Classification and distinctive features of the following

1. Cyclostomata: *Petromyzon*, *Myxine*
2. Chondrichthyes: *Scoliodon*, *Sphyrna*, *Torpedo*, *Pristis*
3. Osteichthyes: *Protopterus, Exocetus, Hippocampus, Syngnathus, Tetradon, Diodon, Amia, Anabas, Ophiocephalus, Clarias, Heteropneustes, Catla, Labeo,Wallago*
4. Amphibia: *Ichthyophis*, *Axolotl larva, Amphiuma*, *Pipa*, *Xenopus*,
5. Reptilia: *Chameleon, Draco, Uromastix, Varanus, Calotes, Iguana, Mabuya, Alligator, Natrix, Naja, Vipera, Crotalus*
6. Aves: *Apterys, Struthio, Aptenodytes, Francolinus, Tytoalba, Dinopium, Milvus, Corvus, Pavo, Eudynamys, Passer, Psittacula, Anas, Grus*
7. Mammalia: *Ornithorhynchus, Tachyglossus, Macropus, Manis, Erinaceus, Pteropus, Lemur, Loris, Bradypus, Phoca, Lutra, Equus cabalus, Camelus, Capra, Bos*

ZOB 507: Based on courses ZOB503 & 504 **(Credit 2)**

Part A: Biochemistry and Molecular Biology ***(Credit 1)***

1. Determination of pK and pI values of glycine
2. Identification of amino acids in the mixture using paper chromatography
3. Estimation of protein by Biuret method
4. Determination of the activity of enzyme (Urease):
   4.1. Effect of [S] and determination of Km and Vmax
   4.2. Effect of temperature
   4.3. Effect of time

5. Qualitative tests for identification of sugars
6. Qualitative test for DNA & RNA

Part B: Biotechniques ***(1 credit)***

1. Protein estimation using spectrophotometer
2. Separation of protein using SDS-PAGE
3. Demonstration of DNA gel electrophoresis
4. Demonstration of bright field, phase contrast, fluorescence, confocal and electron microscopes
5. Tissue fixation, paraffin block preparation, sectioning and stained slide preparation
6. Visit to any tissue culture lab

ZOB 508: Based on course ZOB505 **(credit 1)**

Environmental Biology (Credit 0.5)

1. Estimation of grasshopper population density by capture-recapture method
2. Estimation of percent frequency, abundance and dominance of producers in grassland by quadrat sampling method
3. Estimation of percent frequency, abundance and dominance of consumers in grassland by quadrat sampling method
4. Determination of carbonate and nitrate in soil samples
5. Determination of free CO_2 in different samples of pond *water*
6. Determination of total hardness of water sample

Systematics ***(Credit 0.5)***

1. Identification of five locally available fishes on the basis of their morphological characters
2. Identification of the following species of *Drosophila* on the basis of pattern of their sex-combs: *D. melanogaster*, *D. ananassae*, *D. bipectinata* and *D. malerkotliana*
3. Zoological names of some common animals
4. Cold anesthesia in fish
5. Preservation of insects
6. Fixation of fresh water protozoans

ZOB 509: Field Study **(Credit 2)**

Field study will be conducted under the supervision of teachers followed by submission of report.

SEMESTER VI

ZOB 601: Mammalian Physiology **(Credit 3)**

Hours of teaching

1. Respiration **4**

1.1 Mechanism and regulation of breathing

1.2 Transport of oxygen and carbon dioxide

1.3 Respiratory quotient

2. Circulation **6**

2.1 Blood buffers

2.2 Blood groups

2.3 Cardiac cycle and its regulation

2.4 Haemostasis

3. Nutrition and Digestion **5**

3.1 Balanced diet

3.2 Digestion and absorption of carbohydrates, proteins and fats

3.3 Hormonal regulation of gastrointestinal function

4. Excretion **3**

4.1 Nephron

4.2 Urine formation

4.3 Hormonal control of renal function

5. Nervous System **6**

5.1 Organization

5.2 Myelinated and non-myelinated nerve fibres

5.3 Resting and action potential

5.4 Initiation and conduction of nerve impulse

5.5 Types of synapses and chemical transmission

6. Vision **5**

6.1 Structure of eye

6.2 Retinal components

6.3 Photoreceptors: ionic basis of potential generation

7. Hearing **4**

7.1 Structure of ear

7.2 Mechanoreceptor: ionic basis of potential generation

8. Muscles **6**

8.1 Types and functional diversity

8.2 Ultra structure of skeletal muscle

8.3 Muscle proteins

8.4 Neuromuscular junction

8.5 Chemistry of muscle contraction

8.6 Elementary knowledge of muscle twitch, tetanus and fatigue, isotonic and isometric contractions

Suggested readings:

1. Ganong: Review of Medical Physiology (22nd ed. 2005, Lange Medical)
2. Guyton and Hall: A text book of Medical Physiology (11th ed. 2006, Saunders).
3. Keele & Neil: Samson Wright's Applied Physiology (13th ed. 1989, Oxford)

ZOB 602: Mammalian Endocrinology **(Credit 3)**

Hours of teaching

1. General mechanism of hormone action **3**

1.1 Peptide hormone

1.2 Steroid hormone

2. Hypothalamo-hypophysial system **8**

2.1 Structure of the hypothalamo-hypophysial system

2.2 Neurohypophysial hormones – oxytocin and vasopressin

2.3 Hormones of the adenohypophysis

2.4 Hypothalamic control of adenohypophysis

3. Biosynthesis, biological actions and regulation of secretion of: **18**

3.1 Thyroid and parathyroid hormones

3.2 Adrenal cortical and medullary hormones

3.3 Insulin and glucagon

3.4 Androgens, Inhibin

3.5 Estrogens, progesterone, relaxin

3.6 Melatonin

3.7 Gastrointestinal hormones : gastrin, CCK, secretin

4. Hormonal dysfunction **10**

4.1 Diabetes insipidus

4.2 Dwarfism, gigantism and acromegaly

4.3 Goitre

4.4 Tetany

4.5 Addison's disease

4.6 Cushing's syndrome

4.7 Diabetes mellitus (Type I and II)

4.8 Polycystic ovary syndrome

4.9 Male infertility: oligospermia and azoospermia

Suggested readings:

1. Hadley: Endocrinology (5th ed. 2000, Prentice Hall)
2. Turner and Bagnara: General Endocrinology (6th ed. 1984, Saunders)
3. Norris: Vertebrate Endocrinology, Fourth Edition, 2007, Academic Press

ZOB 603: Cell Biology & Genetics **(Credit 3)**

Section A: Cell Biology **(Credit 1.5)**

Hours of teaching

1. Membrane transport **2**

1.1 Principles of membrane transport, channel proteins, carrier proteins

1.2 Passive and active transport

2. Intracellular transport and protein sorting **4**

2.1 Signal peptides and protein targeting

2.2 Entry and passage of proteins through endoplasmic reticulum

2.3 Processing and sorting of proteins in Golgi apparatus

2.4 Endosomes and lysosomes

2.5 Nuclear pore complex and nuclear transport

3. Mitochondria and energy transfer **2**

3.1 Structure, origin and genome

3.2 Electron transport and oxidative phosphorylation

4. Cytoskeleton **2**

4.1 Organization and functions

4.2 Microtubular organelles

5. Cell-cell communication **3**

5.1 Cell junctions

5.2 Cell adhesion and extracellular matrix

5.3 General principles of cell signaling

6. Cell proliferation **3**

6.1 Events in different phases of cell cycle

6.2 Genetic regulation of cell proliferation

6.3 Cell transformation and malignancy

7. Interphase nucleus and chromosome organization **4**

7.1 Organization of interphase nucleus

7.2 Higher order organization of chromatin into chromosome

7.3 Centromere and telomere

7.4 Lampbrush and polytene chromosomes: structure and application in study of gene expression

Section B: Genetics **(Credit 1.5)**

1. Gene mapping **3**

1.1 3-point test cross in *Drosophila*

1.2 Tetrad analysis in *Neurospora*

1.3 Elementary knowledge of modes of recombination in bacteria

2. Mutation and mutagenesis **4**

2.1. Molecular basis of mutation

2.2. Spontaneous and induced mutations

2.3. DNA damage and repair

2.4. Detection of mutations (Ames' test, nutritional mutations in *Neurospora*, *ClB* technique in *Drosophila*)

3. Genetic determination of sex **2**

3.1 *Drosophila*

3.2 Human

4 . Introduction to quantitative inheritance **1**

5. Gene expression and gene regulation **3**

5.1 Inducible (*lac*) and repressible (*trp*) operones in *E. coli*

5.2. Regulation of gene activity in eukaryotes

5.2.1 Transcription unit

5.2.2 Transcription factors, enhancers and silencers

5.2.3 Transcriptional regulation

6. Organization of human genome **1**

7. Human genetic disorders **1**

7.1 Metabolic (Phenylketonuria)

7.2 Triplet repeat expansion (Huntington)

7.3 Multifactorial (Diabetes mellitus)

8. Transgenic animals: strategies and applications **1**

9. Elementary idea of genome, transcriptome and proteome **2**

10. Basic concept of mobile elements **1**

Suggested readings:

Cell Biology

1. Alberts et al: Molecular Biology of the Cell (2008, Garland)
2. Cassimeris et al: Lewin's Cells (2011, Jones Bartlet)
3. Karp: Cell and Molecular Biology (2010, John Wiley)
4. Lodish et al: Molecular Cell Biology (2008, Freeman)

Genetics

1. Gardner et al: Principles of Genetics (2006, John Wiley)
2. Griffith et al: An Introduction to Genetic Analysis (Freeman, 2008)
3. Pierce: Genetics – A Conceptual Approach (2011, Freeman)
4. Russell: Genetics (2010, Benjamin Cummings)
5. Snustad & Simmons: Principles of Genetics (2012, John Wiley)

ZOB 604: Evolution & Animal Behaviour **(Credit 3)**

Section A: Evolution **(Credit 1.5)**

Hours of teaching

1. Evolution through ages **4**

1.1 Fossils and dating fossils

1.2 Geological column

1.3 Evolution of horse

2. Population as unit of Evolution **5**

2.1 Gene frequency in Mendelian population

2.2 Hardy-Weinber equilibrium

2.3 Major evolutionary forces

3. Genetic variations in natural populations with special reference to chromosomal, allozyme and DNA polymorphism **3**

4. Molecular Phylogenies **2**

5. Isolating mechanisms **2**

6. Modes of speciation: Allopatric and Sympatric **2**

7. Adaptive coloration and mimicry **2**

Section B: Animal Behaviour **(Credit 1.5)**

Hours of teaching

1. Concepts and patterns of behaviour **1**

2. Instinct and learning **5**

2.1 Innate behaviour

2.2 Learned behaviour and types of learning

3.	**Genetic basis of behaviour**	**1**
4.	**Control of behaviour**	**2**
	4.1 Neural control	
	4.2 Hormonal control	
5.	**Social organization**	**4**
	5.1 Communication	
	5.2 Living in groups	
	5.3 Eusocial organization	
6.	**Biological rhythms**	**2**
7.	**Migration, orientation and navigation**	**4**

Suggested readings:

Evolution

1. Futuyma: Evolutionary Biology (2005, Sinauer)
2. Hall and Hallgrimsson: Strickberger's Evolution (2008, Jones and Bartlet)
3. Hartl and Clark: Principles of Population Genetics (1989 & 1997, Sinauer)
4. Moody: Introduction to Evolution (1978, Kalyani).
5. Rastogi: Organic Evolution (2007, Kedarnath & Ramnath).

Animal behaviour

1. Alcock: Animal Behaviour: An evolutionary approach (9 ed. 2009, Sinauer)
2. Drickamer, Vessey and Jacob: Animal Behaviour (5th ed. 2002, McGraw Hill)
3. Goodenough et al.: Perspectives on Animal Behaviour (1993, Wiley)
4. Grier: Biology of Animal Behaviour (1984, Mosby)
5. Lorenz: The foundation of ethology (1981, Springer)
6. Manning & Dawkins: An Introduction to Animal Behaviour (5th ed. 1998, Cambridge).
7. Mcfarland: Animal Behaviour, Psychology, Ethology and Evolution (1985, Pitman).
8. Scott: Essential Animal Behaviour (2005, Blackwell)
9. Slater: An introduction to ethology (1985, Cambridge)

ZOB 605: Immunology & Parasitology (Credit 3)

Section A: Immunology (Credit 1.5)

		Hours of teaching
1.	**Introduction to immunology**	**1**
2.	**Cells and organs of immune system**	**4**
	2.1. Types of immune cells: lymphoid and myeloid	
	2.2. Primary and secondary lymphoid organs and lymphatic system	
3.	**Humoral Immunity**	**5**
	3.1. Antigen	
	3.2. Immunoglobulins : types, structure and function	
	3.3. Complement system	
4.	**Cell mediated immunity**	**5**
	4.1. Structure and organization of Major Histocompatibility Complex and T cell interaction	
	4.2. Antigen processing and presentation	

5. Immunological disorders **3**

5.1 Autoimmunity

5.2 Immunodeficiency

5.3 Hypersensitivity

6. Concept of vaccination **2**

Section B: Parasitology **(Credit 1.5)**

Hours of teaching

1. General concept of parasites and parasitism **7**

1.1. Introduction to parasitology: basic principles and concepts

1.2. Signs and symptoms of parasitic diseases

1.3. Systematics, ecology and evolution.

1.4. Concepts of immunodiagnostics and pathology

1.5. Vector

1.6. Zoonosis

2. Parasitic protozoans: life cycle, pathogenesis and disease caused by - **5**

2.1 Parasitic Amoebae

2.2 *Plasmodium*

2.3 *Toxoplasma gondii*

3. Helminths: life cycle, pathogenesis and disease caused by - **5**

3.1 *Paragonimus westermani*

3.2 *Diphyllobothrium latum*

3.3 *Trichinella spiralis*

4. Dynamics of Host-Parasite interaction **2**

Suggested readings:

Immunology

1. Abbas *et al.*: Cellular and Molecular Immunology, 6th ed. 2007, Saunders Publication.
2. Acharya *et al.*: Immunology, 2nd ed. 2011, Kalyani Publishers, Ludhiyana, Punjab.
3. Janeway's Immunobiology, 7th ed. 2008, Garland Science Publication.
4. Klaus D. Elgert: Understanding the Immune System, A John Wiley & Sons Inc. Publication.
5. Kubey *et al.*: Immunology, 6th ed. 2007, W.H. Freeman and Company Publication, New York.
6. Roitt and Delvis: Roitt's Essential Immunology, 6th ed. 2006, Blackwell Publication.

Parasitology

1. Burton J Bogitsh Human Parasitology 3rd edition Elsevier.
2. Roberts, L. S. and J. Janovy, Jr. 2004. *Foundations of Parasitology.* 7th Edition. McGraw Hill, Boston.
3. Smith. Animal Parasitology 1996. Cambridge University Press.
4. Chandler and Reid. Introduction to Parasitology 1970, Wiley.
5. Marr et al. Molecular Medical Parasitology 2003, Elsevier.
6. Lawrence R. Ash and Thomas C. Orihel. Atlas of Human Parasitology. American Society for clinical pathology press 5th edition, 2007.
7. Alan Gunn. Parasitology: An Integrated Approach Wiley-Blackwell. 2012.
8. Janet Amundson Romich. Understanding Zoonotic Diseases. 2007
9. Paul Schmid-Hempel. The Integrated Study of Infections, Immunology, Ecology, and Genetics (Oxford Biology), 2011
10. Alan Gunn. Parasitology: An Integrated Approach Wiley-Blackwell. 2012.
11. Janet Amundson Romich. Understanding Zoonotic Diseases. 2007
12. Paul Schmid-Hempel. The Integrated Study of Infections, Immunology, Ecology, and Genetics (Oxford Biology), 2011

LABORATORY EXERCISES

ZOB 606: Based on Courses ZOB601 & 602 (Credit 2)

Part A: Mammalian Physiology ***(Credit 1)***

1. Counting of red blood corpuscles
2. Counting of white blood corpuscles
3. Determination of haemoglobin content
4. Determination of blood groups
5. Measurement of blood pressure using sphygmomanometer
6. Determination of oxygen consumption (cockroach)
7. Preparation of casein from milk

PartB: Mammalian Endocrinology ***(Credit 1)***

(Animal Model – albino rat)

1. Survey of endocrine glands and sex accessory organs
2. Study of estrous cycle by vaginal smear preparation
3. Surgical Techniques

3.1 Ovariectomy

3.2 Orchidectomy

4. Study of effects of orchidectomy/ovariectomy on seminal vesicle/uterus
5. Study of histological slides of the following-

   Pituitary, Thyroid and parathyroid , Endocrine pancreas, Adrenal, Testis, Ovary, Uterus, Seminal vesicle

ZOB 607: Based on courses ZOB603 & 604 (Credit 2)

Part A: Cell Biology and Genetics ***(Credit 1)***

Cell Biology

1. Use of phase contrast optics by observing live sperm in physiological saline
2. Demonstration of use of fluorescence microscope (DNA and RNA fluorescence) and familiarity with confocal microscope
3. Familiarity with scanning and transmission electron microscopes (visit to SEM and TEM labs)
4. Familiarity with tissue culture (visit plant and animal tissue culture labs.)
5. Demonstration of gel electrophoresis
6. Preparation of polytene chromosomes from *Drosophila* larvae
7. Use of colchicine in arresting anaphase movement (onion root tips)
8. Metaphase chromosome preparations from bone marrow of mouse/rat
9. Meiosis in grasshopper testis
10. Study of permanent slides to understand the following:

    10.1 Constitutive heterochromatin (C-band)

    10.2 Semiconservative DNA replication (BrdU-labelling)

    10.3 Detection of S-phase cells in a random population (autoradiography)

    10.4 Transcription in polytene chromosome puffs (autoradiography)

    10.5 Chromosome organization (G-banding)

Genetics

1. Simulation of principles of segregation and independent assortment using coloured beads.
2. Application of laws of probability and chi-square test.
3. Mono and dihybrid crosses in *Drosophila*.
4. Study of sex-linkage: reciprocal crosses between red and white eyed *Drosophila* flies.
5. Study of pattern of inheritance of the traits in human populations: rolling of tongue and interlocking, and of the sex-influenced trait long versus short second finger in relation to the fourth finger (apply Hardy-Weinberg Law).
6. Study of mutants in *Drosophila* (Bar eye, white eye, yellow body, sepia eye, curled wing, dumpy wing, vestigial wing and sepia eye-curled wing and curled wing-ebony body-sepia eye).
7. Genotype analysis in the pedigree chart of the Victorian family affected with haemophilia
8. Preparation of flow charts to depict steps involved in the following:
   8.1 Production of transgenic mouse for a chosen gene
   8.2 Gene therapy for a chosen human disease

Part B: Evolution & Animal Behaviour ***(Credit 1)***

Evolution

1. Natural selection – experiment using red and white eyed *Drosophila* flies
2. Isolating mechanism – Demonstration of hybrid sterility in *Drosophila*: *D. bipectinata* and *D. malerkotliana*.
3. Genotypic analysis of blood groups in human population to estimate allele frequencies by Hardy -Weinberg equation
4. Fossils – One representative fossil each from Foraminifera, Brachiopoda, Trilobita, Ammonites, Echinodermata
5. Models of chordate fossils – *Brontosaurus, Dimetrodon, Archaeopteryx, Dinoceras*
6. Evolution of horse – through models

Animal behaviour

1. Study of habitat selection in the first and third instar larvae of *Drosophila melanogaster.*
2. Habituation in earthworms/mosquito larvae.
3. Locomotory behaviour of dipteran larvae (Housefly/blowfly/fruitfly):
   3.1 Locomotion on different types of substrata (writing paper, plastic sheet and sand paper
   3.2 Effects of light intensity and light quality on the rate of locomotion
4. Study of individual and social behavioural patterns of a troop of monkey
5. Study of interspecific association between cattle and egrets
6. Study of circadian rhythm by measuring locomotor activity patterns in mice (demonstration).

ZOB 608: Based on course ZOB 605 **(Credit 1)**

Immunology and Parasitology **(Credit 0.5)**

Immunology

1. An introduction and acquaintance with necessary precautions in immunological practicals and proper handling of the mice.
2. Study of different lymphoid organs, counting and fix the cell number for particular experiments.
3. To perform retro-orbital bleeding with the help of capillary tubes and preparation of blood film for differential cell count.

4. Separation of peritoneal macrophages and their identification on the basis of non specific esterase staining.
5. Enumeration of apoptotic cells by trypan blue exclusion test.
6. To study antigen-antibody interaction with the help of Mancini/Ouchterlony method (Immunodiffusion).

Parasitology

1. Introduction on collection and preservation of specimens, quality control and safety measure.
2. Staining procedure for parasites.
3. Preparation of thin blood smear
4. Identification protozoan parasites from permanent slides.

   Trypanosoma : epimastigote or trypomastigote form.

   Leishmania : promastigote and amastigote form.

   Plasmodium : sporozoites and signet ring.

   Toxoplasma : tachyzoites and bradyzoites.

   Giardia

   Entamoeba: trophozoites
5. Identification and characterization of helminth parasites from permanent slides

   Cercaria of *Fasciola.*

   Eggs of *Schistosoma.*

   Cyst of *Echinococcus granulosus.*

   Microfilarie of *Wuchereria*.
6. Parasite culture (demonstration only)

ZOB 609: Term Paper **(Credit 2)**

Submission of a write up on a specific topic/research proposal/review.

ANCILLARY COURSES

ZOB 203A: Animal Biology **(Credit 2)**

Hours of teaching

1. Properties and origin of life **1**

2. Diversity of evolution of animal systems **5**

2.1 Classification of major groups of living system

2.2 Concept and evidence of organic evolution

2.3 Theory of natural selection – industrial melanism

2.4 Human evolution

3. Cell – the unit of life **4**

3.1 Organization of cell

3.2 Cell multiplication

3.3 Cancer and cell death

4. Biomolecules **4**

4.1 Sugars, fats and proteins

4.2 Enzymes - biological catalysts

4.3 Production of energy in biological system

5. Inheritance of biological characters **4**

5.1 Laws of inheritance

5.2 Nature of hereditary material and flow of genetic information

5.3 Genes and diseases – sickle cell anemia, Down syndrome

6. Physiology of: **4**

6.1 Digestion

6.2 Breathing

6.3 Blood circulation

6.4 Urine formation

7. Elementary knowledge of endocrine glands and hormones **2**

8. Defense mechanisms of body **2**

Suggested readings:

1. Campbell & Reece: Biology (2005, Pearson)
2. Chaudhuri: Concise Medical Physiology (2002, Central)
3. Gardner et al: Principles of Genetics (2006, John Wiley)
4. Raven and Johnson: Biology (2002, McGraw)
5. Verma et al: Cell biology, Genetics, Molecular biology, Evolution and Ecology (2008, S Chand)
6. Biology for class XI & XII NCERT Text books

ZOB 403A: Applied Zoology **(Credit 2)**

Hours of teaching

1. Aquaculture **5**

1.1 Aquaculture resources in India

1.2 Fin fish culture

1.3 Prawn culture

1.4 Pearl culture

2. Sericulture **3**

2.1 Rearing of Silkworms

2.2 Harvesting and processing of cocoons

3. Apiculture **3**

3.1 Organization of bee colony

3.2 Bee products and their uses

4. Lac culture **3**

4.1 Lac insect and its host plants

4.2 Lac production and its uses

5. Pests and their management **4**

5.1 Chemical methods

5.2 Biological methods

6 Animal husbandry **4**

6.1. **Dairy**

6.1.1. Breeds of Bovine

6.1.2. Milk and milk products

6.2 **Poultry**

6.2.1. Types of Breeds

6.2.2. Reproductive system and egg formation (Hen model)

6.2.3. Nutritional value of egg and chicken

7 Transgenic animals **2**

8 Snake venom and antivenin production **2**

Suggested readings:

1. Shukla and Upadhyaya : Economic Zoology (Rastogi Publishers, 2009)
2. Shrivastava: Test book of Applied Entomology, Vol. I &II (Kalyani Publishers, 1991)
3. Insects. M. S. Mani, NBT, India, 2006.
4. Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture, Lac-Culture, Agricultural Pests and their Control by Pradip V. Jabde, 2005 Publisher Vedams eBooks (P) Ltd. New Delhi
5. Absan and Sinha: A hand book of Economic Zoology (S. Chand and Company, 2009)
6. Kotpal : Modern Text Book of Zoology Vertebrates (Rastogi Publication, 2011)

BANARAS HINDU UNIVERSITY

Department of Botany

Faculty of Science

SYLLABI

B.Sc. (Hons.) Programme
in
INDUSTRIAL MICROBIOLOGY

B.Sc. INDUSTRIAL MICROBIOLOGY
DEPARTMENT OF BOTANY

DISTRIBUTION OF DIFFERENT COURSES AND CREDITS IN VARIOUS SEMESTERS

SEMESTER-I		
Course Code	**Course Title**	**Credits**
IMB-101	Microbial Physiology, Biochemistry, Genetics and Molecular Biology	4
IMB-102	Lab work based on Course IMB-101	2
	Total	**6**
SEMESTER-II		
IMB-202	Environmental Microbiology and Biotechnology	4
IMB-202	Lab work based on Course IMB-202	2
	Total	**6**
SEMESTER-III		
IMB-301	Agricultural and Food Microbiology	4
IMB-302	Lab work based on Course IMB-301	2
	Total	**6**
SEMESTER-IV		
IMB-401	Fermentation Technology	4
IMB-402	Lab work based on Course IMB-401	2
	Total	**6**

The distribution of Credits will be as follows:

SEMESTERS	**No. of Papers**		
	Theory	**Practical**	**Total**
I	4	2	6
II	4	2	6
III	4	2	6
***IV**	4	2	6

***Dissertation (Viva-voce): Grade**

The candidates will have to take a dissertation and the same will be evaluated through Viva-Voce examination.

SEMESTER-I

Theory Course (IMB-101): Microbial Physiology, Biochemistry, Genetics and Molecular Biology

Section – A

Nutritional requirements and mode of nutrition.

Growth-Batch, synchronous and continuous culture.

Biological Nitrogen Fixation – Mechanism and O_2-regulation

Respiration: Aerobic and anaerobic pathway for energy production.

Photosynthesis: pigments, photophosphorylation, carbon fixation.

A brief account in sulphur and phosphorous metabolism

Section – B

Biomolecules: Structure and function of carbohydrates, lipids, amino acids and proteins.

Enzymes: Major classes, basic mechanism of action, kinetics and factors affecting enzyme activities, ribozymes.

Section – C

Organization of prokaryotic genome

Mutation: Type, mutagens and their mode of action.

Nucleic acids: Structure and types, DNA replication.

Genetic information flow: Mechanism of transcription, genetic code translation.

Basic concept of gene regulation: *Lac* operon

Organization of genetic material: Transposons, split genes and overlapping gene.

Suggested readings:

1. Madigan M.T., Martinko J.M., Dunlop P.V. and Clark D.P. (2011). Brock Biology of Microorganisms. 13th Edition, Pearson Education Inc.
2. Stanier R.Y., Ingraham J.L., Wheelis M.L. and Painter P.R. (1987). General Microbiology. Fifth Edition, MacMillan.
3. Willey J.M., Sherwool L. and Woolverton C.J. (2010). Prescott's Microbiology. 8th Edition, McGrow-Hill.

SEMESTER-II

Theory Course (IMB-202): Environmental Microbiology and Biotechnology

Section – A

Microbes in diverse environments.

Extremophilic microorganisms (thermophilic, alkalophilic, acidophilic, halophilic and desiccation-tolerant microbes) and mechanisms of their survival.

Aeromicroflora: Sources, diversity, methods of sampling and enumeration.

Microbial indicators of water quality, biosensors.

Section – B

Role of microorganisms in secondary treatment of waste water: Activated sludge, trickling filter and oxidation pond.

Methane and energy production from agricultural and domestic wastes.

Microbial degradation of synthetic pesticides and petroleum hydrocarbons, bioremediation of oil spills.

Section – C

Principles of recombinant DNA technology – Vectors and restriction endonucleases.

Prospects of microbial biotechnology in the context of agriculture, environment, medicine and energy.

Regulation of the safety of biotechnology procedures and products.

Suggested readings:

1. Raina M. Maier – Environmental Microbiology 2nd Edition, Academic Press 2009.
2. Altas and Bartha : Microbial Ecology: Fundamentals and Applications IVth Edition, Pearson Education India, 1998.
3. T.A. Brown **:** Genomes, 2nd Editions, Oxford Willey-Liss, 2002.

SEMESTER-III

Theory Course (IMB-303) : Agricultural and Food Microbiology

Section – A : Agricultural Microbiology

Biocontrol of plant pathogens, pests and weeds.

Symbiotic and free-living bacteria and cyanobacteria

Mycorrhiza, PGPM and PSM.

Restoration of waste and degraded lands

Biofertilizers: Types, technology for their production and application, green manuring and vermi-compost.

Section – B : Food Microbiology

Intrinsic and extrinsic factors, influencing growth of microorganisms in food.

Microbes as source of food: mushrooms, single cell protein.

Microbial spoilage of food and food products: cereals, vegetables, prickles, fish and poultry and dairy product.

Food poisoning and food intoxication.

Food preservation process.

Microbes and fermented foods, butter, cheese and bakery products.

Suggested readings:

1. W.C. Frazier: Food Microbiology, 4th Edition, Tata McGraw Hill Education, 1958.
2. M.R. Adams: Food Microbiology, 3rd Edition, Royal Society of Chemistry, 2008.
3. David M. Sylvia: Principles and Applications of Soil Microbiology, Prentice Hall, 1998.

SEMESTER-IV

Theory Course (IMB-404): Fermentation Technology

Scope and opportunities of fermentation technology.

Isolation, selection and improvement of industrially important microorganisms.

Maintenance and preservation.

Metabolic regulations and overproduction of metabolites.

Microbial growth kinetics.

Principles of fermentations: submerged, solid state, batch, fed batch and continuous.

Preparation and sterilization of fermentation media.

Fermentative production of vinegar, alcohol (ethanol, wine, beer) acids (citric acid and gluconic acid) amino acids (lysine and glutamic acid) antibiotics (Penicillin and Streptomycin).

Microbial production of Enzymes: Amylase and Protease.

Bioproduct recovery.

Suggested reading:

1. Michael J. Waites; Industrial Microbiology: An Introduction, 7th Edition, Blackwell Science, 2008
2. L.E Casida, JR; Industrial Microbiology, New age international (P) Limited Publishers.
3. Samuel Cate Prescott, Cecil Gordon Dunn, Gerald Reed; Prescott & Dunn's industrial microbiology 4th Edition AVI Pub. Co., 1982.