FACULTY OF LIFE SCIENCES

Syllabus

For

B.Sc. (Hons. School) in Botany

(Semester I-VI)
(Under Credit Based Continuous Evaluation Grading System)

Examinations: 2012-13

GURU NANAK DEV UNIVERSITY AMRITSAR

B.Sc. (HS) BOTANY (SEMESTER SYSTEM)
(Under Credit Based Continuous Evaluation Grading System)

Programme Code: BSA
Bachelor of Science (Honours School) in Botany

Scheme of Courses for B.Sc. (H.S.) I Semester in Botany

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
Core Courses						
BSL101	C	Cryptogams	3	-	-	3
ZOL121	C	Diversity of Animals - I (Non Chordates)	3	-	-	3
CYL192	C	Inorganic Chemistry	3	1	-	4
PHL191	C	Optics	3	1	-	3
MTL161	C	Differential Calculus	3	-	-	3
	C	English - I	2	-	-	2
BSP121	C	Cryptogams Lab	-	-	1.5	1.5
ZOP122	C	Diversity of Animals - I Lab	-	-	1.5	1.5
CYP194	C	Inorganic chemistry Lab	-	-	3	3
PHP192	C	Optics Lab	-	-	2	2
		Total Credits:	17	2	8	**27**

B.Sc. (HS) BOTANY (SEMESTER SYSTEM)
(Under Credit Based Continuous Evaluation Grading System)

Scheme of Courses for B.Sc. (H.S.) II Semester in Botany

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
Core Courses						
BSL151	C	Phanerogams	3	-	-	3
ZOL195	C	Diversity of Animals - II (chordates)	3	-	-	3
CYL191	C	Organic Chemistry	3	1	-	4
PHL196	C	Modern Physics-I	3	1	-	3
MTL162	C	Integral Calculus	3	-	-	3
	C	English - II	2	-	-	2
BSP171	C	Phanerogams Lab	-	-	1.5	1.5
ZOP196	C	Diversity of Animals - II Lab	-	-	1.5	1.5
CYP193	C	Organic Chemistry Lab (Classical Qualitative Organic Analysis)	-	-	3	3
PHP197	C	Electricity and Magnetism Lab	-	-	2	2
Total Credits			17	2	8	**27**

Scheme of Courses for B.Sc. (H.S.) III Semester in Botany

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
Core Courses						
BSL201	C	Cell biology	3	-	-	3
BSL202	C	Plant Organization	3	-	-	3
BSL203	C	Pharmacognosy	3	-	-	3
CYL291	C	Physical Chemistry	3	-	-	3
PBL-103/ HSL-101	C	Punjabi- I / History and Culture of the Punjab	2	-	-	2
ESL220	C	Environmental Studies	3	-	-	3
BSP221	C	Cell Biology and Anatomy Lab	-	-	3	3
BSP222	C	Pharmacognosy Lab	-	-	2	2
CYP292	C	Physical Chemistry Lab	-	-	2	2
Elective Courses (3 Credits)						
	E	Elective Course	3	-	-	3
Total Credits			20	-	7	**27**

B.Sc. (HS) BOTANY (SEMESTER SYSTEM)
(Under Credit Based Continuous Evaluation Grading System)

Scheme of Courses for B.Sc. (H.S.) IV Semester in Botany

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
Core Courses						
BSL251	C	Plant Physiology	3	-	-	3
BSL252	C	Biochemistry	3	-	-	3
BSL253	C	Inheritance Biology	3	-	-	3
BSL254	C	Ecology	3	-	-	3
BSL255	C	Modern Trends in Taxonomy	3	1	-	4
PBL-104/ HSL-102	C	Punjabi- II / History and Culture of the Punjab	2	-	-	2
BSP271	C	Physiology and Biochemistry Lab	-	-	3	3
BSP272	C	Inheritance Biology, Ecology and Taxonomy Lab	-	-	3	3
Elective Courses (3 Credits)						
	E	Elective Course	3	-	-	3
Total Credits			20	1	6	**27**

Programme Code: BSA
Bachelor of Science (Honours School) in Botany
Department of Botanical & Environmental Sciences

List of Elective Courses

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
Elective Courses						
BSL281	E	Seed Testing	3	-	-	3
BSL282	E	Seed Quality Control	3	-	-	3
BSL283	E	Seed Pathology and Entomology	3	-	-	3
BSL284	E	Entrepreneurship Development - I	3	-	-	3
BSL285	E	Seed Production	3	-	-	3
BSL286	E	Biophysics	3	-	-	3
BSL287	E	Microbial Technology	3	-	-	3

B.Sc. (HS) BOTANY (SEMESTER SYSTEM)
(Under Credit Based Continuous Evaluation Grading System)

Semester – V:

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
Core Courses						
BSL401	C	Mathematical Biology	3	-	-	3
BSL402	C	Computer Applications and Bioinformatics	3	-	-	3
BSL403	C	Phycology	3	-	-	3
BSL404	C	Fungi and Plant Pathology	3	-	-	3
BSL405	C	Plant Morphogenesis	3	-	-	3
BSL406	C	Metabolic Integration	3	-	-	3
BSP421		Botany Lab I (based on BSL401, BSL402)	-	-	2.5	2.5
BSP422		Botany Lab II (based on BSL403, BSL404 and BSL405)	-	-	4.5	4.5
Elective Courses (3 Credits)						
	E	Elective Course	3	-	-	3
Total Credits			21	-	7	**28**

Semester – VI:

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
Core Courses						
BSL451	C	Statistical Techniques	3	-	-	3
BSL452	C	Computer Programming in Botany and Ecology	3	-	-	3
BSL453	C	Instrumental Methods of Analysis	3	-	-	3
BSL454	C	Genetics and Cytogenetics	3	-	-	3
BSL455	C	Bryophytes and Pteridophytes	3	-	-	3
BSL456	C	Advanced Cell Biology	3	-	-	3
BSP471	C	Botany Lab III (based on BSL451, BSL452 and BSL453)	-	-	3	3
BSP472	C	Botany Lab IV (based on BSL454, BSL455 and BSL456)	-	-	4	4
Interdisciplinary/ Optional Courses (3 Credits)						
	I	To be offered from outside the department	3	-	-	3
Total Credits			21	-	7	**28**

B.Sc. (HS) BOTANY (SEMESTER SYSTEM)
(Under Credit Based Continuous Evaluation Grading System)

List of Elective Courses for Semester V and VI:

Course No.	C/E/I	Course Title	Credits			Total Credits
			L	T	P	
Elective Courses						
BSL581	E	Agroforestry Systems	3	-	-	3
BSL582	E	Seed Biotechnology	3	-	-	3
BSL583	E	Human Values and Professional Ethics	3	-	-	3
BSL584	E	Genomics, Transcriptomics and Proteomics	3	-	-	3
BSL585	E	Dynamics of Biogeography	3	-	-	3
BSL586	E	History of Science in India	3	-	-	3
BSL587	E	Immunology	3	-	-	3
ESL581	E	Urban Planning and Development	3	-	-	3
ESL582	E	Preventive and Social Medicine	3	-	-	3
ESL583	E	Geoinformatics in Environmental Management	3	-	-	3
ESL584	E	Ecological Biochemistry	3	-	-	3
ESL585	E	Design and Analysis of Experiments	3	-	-	3
ESL586	E	Chemical and Biochemical Engineering	3	-	-	3

B.Sc. (HS) BOTANY (SEMESTER-I)
(Under Credit Based Continuous Evaluation Grading System)

BSL101 - Cryptogams

Credits 3-0-0

Algae:

1. History of algal studies in India, Habit and Habitat, General characters, classification and economic importance
2. Important features and life histories of members of Cyanophyceae (*Oscillatoria*, *Nostoc*), Chlorophyceae (*Chlamydomonas, Volvox , Oedogonium, Coleochaete*).
3. Important features and life histories of members of Xanthophyceae (*Vaucheria*) Phaeophyceae (*Ectocarpus*, *Sargassum*), Rhodophyceae (*Batrachospermum*, *Polysiphonia*).

Fungi:

4. General characteristics, classification and economic importance.
5. Important features and life histories of members of Mastigomycotina (*Pythium, Phytophthora);* Zygomycotina (*Mucor*); Ascomycotina (*Saccharomyces, Eurotium, Chaetomium, Peziza*); Basidiomycotina (*Puccinia, Agaricus*); Deuteromycotina (*Cercospora, Colletotrichum*).
6. General account of Lichens.

Bryophytes:

7. General characters, classification and economic importance.
8. Bryophytes as amphibians of plant kingdom, adaptive characters for land habitat displaying heterologous alternation of generations.
9. Classification and comparative study of classes as seen in the life histories of some members of Hepaticopsida (*Marchantia Pellia, Porella*), Anthocerotopsida (*Anthoceros*), Bryopsida (*Funaria Sphagnum,* and *Polytrichum*). A study of plants and products of economic importance.

Pteridophytes:

10. The first vascular plants, salient feature of structures and life cycle of representative members of the classes (*Psilotum, Lycopodium, Equisetum, Nephrodium, Pteris* and *Marsilea)*. A comparative study of stelar system in pteridophytes. An elementary study of fossils, protocols of age determination of fossils.

Suggested Readings:

1. Alexopolous, J. and W. M. Charles. 1988. Introduction to Mycology. Wiley Eastern, New Delhi.

2. Dube, H.C.1990. An Introduction to Fungi, Vikas Publishing House, Pvt. Ltd. Delhi.

3. Pandey, B. P. 2001. College Botany, Vol. I: Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S. Chand & Company Ltd, New Delhi.

4. Puri, P. 1980. Bryophyta. Atma Ram and Sons. Delhi

5. Sharma, P.D. 1991. The Fungi, Rastogi and Co, Meerut.

6. Sharma, O.P. 1992. Text Book of Thallophytes, McGraw Hill Publishing Co., New Delhi.

7. Smith, G.M. 1971.Cryptogamic Botany, Vol I, Algae and Fungi, Tata McGraw Hill Publishing Co., New Delhi.

8. Smith, G.M. 1971. Cryptogamic Botany, Vol II, Bryophytes and Pteridophytes. Tata McGraw Hill Publishing Co., New Delhi.

9. Thakur, A. K. and S. K. Bassi**.** 2008. A Textbook of Botany: Diversity of Microbes and Cryptogams. S. Chand & Company Ltd, New Delhi.

10. Vashishta, B. R. 1990. Botany for Degree Students: Fungi, S. Chand & Company Ltd, New Delhi.

11. Vashishta, B. R., A. K. Sinha and Adarsha Kumar. 2008. Botany for Degree Students: Bryophyta. S. Chand & Company Ltd, New Delhi.

12. Vashishta, B. R., A. K. Sinha and V. P. Singh. 2008. Botany for Degree Students: Algae. S. Chand & Company Ltd, New Delhi.

B.Sc. (HS) BOTANY (SEMESTER-I)
(Under Credit Based Continuous Evaluation Grading System)

ZOL121 - Diversity of Animals -I (Non Chordates)

Credits 3-0-0

Unit-I

General Characters and Economic Importance of Phylum:
Protozoa
Coelenterata .
Platyhelminthes

Unit-II

General Characters and Economic Importance of Phylum:
Ascbelminthes
Arthropoda

Unit-Ill

General Characters and Economic Importance of Phylum:
Mollusca
Echinodermata

References:

1. Barrington, E. U. W. (1967), Invertebrates Structure and Functions. Houghton Mifflin Co. Boston.
2. Barth, R. H. and Broshears, R. E (1982), The Invertebrate World. Holt Saunder, Japan.
3. Bekleimishev, W. M. (1969), Principles of Comparative Anatomy of Invertebrates, Vol. I Morphology Vol II - Organology. Chicago University Press, Chicago.
4. Brusca, R.C. and Brusca, G. J. (2003), Invertebrates second edition. Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts.
5. Engemann, J.G. and Hegner, R; W. (19~1), Invertebrate Zoology (3rded.) Macinillan, New York.
6. Hyman,L. H. The Invertebrates.Vol. I, ProtozoathroughCtenophora (940), Vol. II - Platyhelminthes and Rhynchocoela (1951), Vol. III-Acanthocephala, Aschelminthes and Entoprocta (1951), Mc Graw Hill, New York.
7. Meglitsch, P.A. and Schran, F. R. (1991), Invertebrate Zoology 3f Ed. Oxford University Press, New York.
8. Pechenik, A. Jan. (2000), Biology' of the Invertebrates, Fourth Edition, McGraw Hill Book Co. Singapore.
9. Prosser, C.L. (1984), Comparative Animal Physiology. Satish Book Enterprise Books Seller & Publishers, Agra.
10. Purves, W.K., Oriane, G.H., Space, H.C. and Salava, D. (2001), Life – The Science of Biology 6 Ed., Sinatier Assoc. Inc., USA.
11. Ruppert, E.E. and Barnes, R. D. (2004), Invertebrate Zoology 7thed. Saunders Publ., Philadelphia.
12. Saxena, A. (2005). Text book of Mollusca. Discovery Publishing House, New Delhi. Withers, P.C. (1992), Comparative Animal Physiology Saunder College Publishing, NewYork.

B.Sc. (HS) BOTANY (SEMESTER-I)
(Under Credit Based Continuous Evaluation Grading System)

CYL192 - Inorganic Chemistry

Credit: 3-1-0

1. Co-ordination Chemistry (8 Hrs.)

Introduction, Werner's coordination theory, naming of co-ordinate complexes.
Co-ordination numbers 1-12 and their stereo-chemistries.
Factors affecting co-ordination numbers and stereo-chemistry (a) Configurational Isomers (b) Conformational isomerism, VSPER theory, molecular orbital theory applied to homoneuclear diatomic molecules and heteronuclear Diatomic molecules.

2. Bonding in metal complexes (5 Hrs.)

Valence bond theory for co-ordinate complexcs, inner and outer orbital complexes, Electro-neutrality and back bonding, limitations ofV.B. theory.

3. Stability of coordination compounds (5 Hrs.)
Introduction, Stability constant, stepwise stability constant, overall stability constant.
Factors affecting the stability of metal ion complexes with general ligands, HSAB principle.

4. Crystal field theory- Splitting of d-orbitals in octahedral, tetrahedral, cubic and square planer fields of ligands. Calculation of C.F.S.E. in high spin and low spin octahedral and High spin tetrahedral complexes, factors affecting the 10 Dq Value.
Structural effects of crystal field splitting (Jahn-Teller distortion, variation of Ionic radii with increase in atomic number). Thermodynamics effects of C.F. splitting, variation in lattice energies, Hydration energies, Dissociation energies, Formation constants of hexammines. Site selection in spinels, Paramagnetism, diamagnetism, ferro and anti ferromagnetism. Microstates and spectroscopic terms, a calculation of spectroscopic terms for dl - diD electronic configurations, L S coupling, Hund's rule for finding the ground state terms, Electronic spectral properties of 1st transition series, Orgel Diagrams for dl - diD systems, for weak field octahedral and tetrahedral complexes, limitations of C.F.T

5. Molecular Orbital Thcory: Evidence for covalent character in Bonding, MOEL diagram for octahedral and tetrahedral complexes involving bonding, charge transfer transitions. (15 Hrs.)

6. π Acid Ligands:

Definition Carbon monoxide complexes, bonding in linear MCa groups, polynuclear metal carbonyls, vibrational spectra, Reactions, carbonyl hydrides and halides. Metalmetal bonding metal-metal multiple bonding, isolable analogies, Structure of high nuclearity carbonyl clusters, counting of electrons in carbonyl clusters.

7. Alkali Metal and Alkaline Earth Metal Chclators (7 Hrs.)

Macrocyclic ligands, macrocyclic effect, crown ethers and podands, coronands, cryptands, structure of 18 crown-6 complex with KNCS, ion cavity complex, effect of anion and cation type on complex structure, simultaneous complexation of metal ion and water or of two metal ions, sandwich formation, cryptands and their cation complexes, podands with aromatic donors and groups.

References:

1. J.E. Huheey, Inorganic Chemistry, 3rd Ed.
2. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry.
3. RE. Douglas and D.H. McDaniel, Concepts and Models of Inorganic Chemistry.
4. R. Hilgenfeld and W. Saengar, Topics in current chemistry Vol-II.

PHL191 - Optics

Credits: 3-1-0

Interference: Young's experiment, Coherent Source, Phase and Path differences, Theory of interference fringes, Fresnel's biprism, thickness of thin transparent sheet, interference in thin film due to reflected and transmitted light colour of thin film, Newtons rings and their application, Michelson & Febry-Perot Interferometer, Anti reflection coatings, Holography.

Diffraction: Introduction, Franunhoffer diffraction at a single slit and its discussion, Fraunhoffer diffraction at double slit, missing orders in a double slit, Diffraction of N slits and its discussion, Diffraction grating, Missing orders, dispersive power, Rayleigh Criterion for resolving power, resolving power of a diffraction grating.

Polarization: Transverse nature of light, Polarization by reflection and refraction, Brewster's Law, Malus Law, Double refraction, Nicol Prism, Elliptically and circularly polarized light, Quarter-wave and half-wave plates, production and detection of polarized light, Optical activity, specific rotation. Half shade polarimeter.

References:

1. Text book of Optics: N. Subramanayam, B. Lal and M. N. Avadhamulu

2. Fundamentals of Optics: Jenkins and White

MTL161 - Differential Calculus

Credits: 3-0-0

Functions, Domain and Range of a function, Graph of a function, Inverse functions, Exponential and logarithmic functions, Limit of functions, Algebraic computation of limits, Continuity of function at a point.

Differentiation: Derivability and Derivative, Derivatives of standard functions, Formulae on derivative of sum, difference, product and quotient of functions~ Chain rule.

Derivative of trigonometric functions, inverse trigonometric functions, hyperbolic functions, exponential and logarithmic ,function, Derivative of implicit functions. Derivative of functions expressed in parametric form. Logarithmic differentiation.

Derivatives of higher order (upto 2nd order). Maxima and minima of a function of single variable. Introduction to partial differentiation.

Reference:

Shanti Narayan: Differential Calculus.

B.Sc. (HS) BOTANY (SEMESTER-I)
(Under Credit Based Continuous Evaluation Grading System)

COMMUNICATIVE ENGLISH-I

Credits: 2-0-0

Objectives: To introduce students in a graded manner to the communication skills of Reading and Writing in English. At the end of semester-I, the students should be able to demonstrate adequate competence in comprehending the prescribed text and performing the given writing tasks.

Reading:

a) **Developing habits of independent and fast reading:**
Students will be required to read a prescribed prose anthology titled selections from Modern English Prose (Ed. Haladhar Panda published by University Press, Hyderabad). The essays in the anthology will be read by students at home with the help of glossary given in the book. Progressing from one lesson to another, they should learn to read fast. Students are supposed to keep a record of their reading in the form of notes, difficulties, summaries, outlines and reading time for each essay. Class teacher may use this record for award of internal assessment (if any).

b) **Developing Comprehension Skills :**
Teacher will provide guided comprehension of the prescribe texts in the class and help students in answering the questions given at the end of each lesson. Teacher can construct more questions of factual and inferential nature to enhance the comprehension skills of the students. The teacher shall also guide students to do the vocabulary and grammar exercises given at the end of each lesson.

Writing:

a) **Developing skills in personal writing:**
Students will be required to learn short personal write oups involving skills of description and narration. The types of composition task may include personal letter writing, telegram writing, notice writing, diary writing etc. Teacher shall instruct the students about the appropriate format and usual conventions followed in such writing. The teacher may also prescribe any composition / writing book if so required.

b) **Developing writing skills based on guided composition:**
The students will be required to write a longish composition on a question from the essays of Selections from Modern English Prose. The composition will require presentation of ideas beyond the prescribed essays. Sample composition topics are given at the end of each lesson.

Question Paper: The following format is suggested for a 3-hour test
(Appropriate choices may be given where possible)

1. Short answer comprehension question (at least 5) based on the lesson included in Selection from Modern English Prose) **App. Weighting : 30%**
2. Questions on grammar and vocabulary (words, phrases, proverbs) **App. Weighting : 20%**
3. Two short writing tasks of app. 150 words. One a personal letter involving narration of a personal experience or description of objects, persons, places or events. The second may be a telegram or public notice or a diary entry about a personal or family achievement loss or celebration **App. Weighting : 30%**
4. One long composition of about 300 words on one of the topics discussed in Selections from Modern English Prose. Due consideration be given to the organization of details and coherence in writing. **App. Weighting : 20%**

Internal Assessment. The teacher may consider the following for award of internal assessment, if any.

1. Evidence of independent reading as given above. Teacher may suggest some special tasks to suit the needs of their students.
2. Students may be asked to keep diary of their daily or specific routines.
3. Students may be asked to write a certain number of compositions on selected topics during the semester.

B.Sc. (HS) BOTANY (SEMESTER-II)
(Under Credit Based Continuous Evaluation Grading System)

BSL151 - Phanerogams

Credits: 3-0-0

Gymnosperms:

1. Classification of plants into major groups as cryptogams, phanerogams, embryophytes and tracheophytes. A study of major evolutionary events in the geological past. Geological time scale, Biostratigraphic categories.

2. Origin and classification of gymnosperms upto order level and distribution in time and space with special reference to India. Structure and life cycle of some representative types namely *Pentoxylon, Ginkgo, Cycas, Taxus, Pinus* and *Ephedra.* Pollen and pollination in gymnosperms. Physical and anatomical characters of common gymnosperms woods.

Angiosperms:

3. Angiosperms, origin and evolution, Classification system of Bentham and Hooker and phylogenetic systems of Engler and Prantl and Cronquist . Hutchinson's principles. Principles of plant classification, parallelism, convergence and divergence.

4. Brief history and approaches to taxonomy, alpha and omega taxonomy, role of phytochemistry , Cytology and Embryology. Identification keys, manual and electronic. Salient features of the International Code of Botanical Nomenclature, the type concept and the principle of priority.

5. Diversity of angiosperms as illustrated by members of the families Ranunculaceae, Brassicaceae, Rutaceae, Fabaceae, Apiaceae, Acanthaceae, Apocynaceae, Euphorbiaceae, Liliaceae and Poaceae

6. Role of taxonomic literature, herbaria, biometrics, figurative representation of taxonomic affinities, cladistics.

References:

1. Arnold, C.A. (1947) An Introduction to Palaeobotany. McGraw Hill Book Company, New York.
2. Bhatnagar, S.P., and Moitra, A. (1996). Gymnosperms. New age International, Private Limited.
3. Biswas, C., and Johri, B.M. (1997). Gymnosperms. Narosa Publishing House, New Delhi.
4. Brown, H.P. (1989). An Elementary Manual of Indian Tree Technology, Dehradun.
5. Chamberlin C.J. (1935) Gymnosperms: Structure and Evolution CBS Publishers and Distributors, N. Delhi.
6. Coulter, J.M., and Chamberlain, C.J. (1917) Morphology of Gymnosperms (Reprinted) Central Book Dept. Allahabad.

7. Davis P.H. and Heywood, V.H. (1973). Principles of Angiosperms Taxonomy. Robert E. Kreiger Pub. Co., New York.
8. Esau, K. (1977). Anatomy of Seed Plants, 2nd edition. John Wiley and Sons, New York. Fahn, A. 1974. Plant Anatomy, 2nd edition. Pergamon Press, Oxford.
9. Harrison, H.J. (1971), New Concepts in Flowering Plant Taxonomy. Hieman Educational Books Ltd., London.
10. Heslop - Harrison, J. 1967. Plant Taxonomy. English Language Book Society & Edward Arnold Pub. Ltd., U.K.
11. Jeffery, C (1982). An Introduction to Plant Taxonomy, Cambridge University Press, Cambridge.
12. Jones, S.B. Jr. and Luchsinger A.E. (1986). Plant Systematics (2nd Edition). McGraw Hill Book Co., New York.
13. Krishnan, M.S. (1982). Geology of India and Burma. CBS Publishers and Distributors, New Delhi.
14. Lawrence, D.H. (1969). Taxonomy of Vascular Plants. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
15. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publishing Company Inc., Menlo Park, California.
16. Nair, M.N.B. 1998. Wood Anatomy and Major Uses of Wood. Faculty of Forestry, Universiti Putra, Malaysia, 43400 Serdang, Selangor D. E., Malaysia.
17. Nair, P.K.K. (1970). Pollen Morphology of Angiosperms, Vikas Publishing House, New Delhi.
18. Saklani, P.S. (1991). Elementary Geology. Today's & Tomorrow's Printers and Publishers, New Delhi.
19. Singh, H. (1978). Embryology of Gymnosperms. Encyclopaedia of Plant Anatomy X. Gebruder Bortraeger, Berlin.
20. Solbrig O.T., and Solbrig D.J. (1979). Population Biology and Evolution. Addison – Wesley Publishing Co. Inc., USA.
21. Solbrig, O.T. (1970). Principles and methods of plant Biosystematics. MacMillan Company, Collier MacMillan Limited, London.
22. Sporne, K.R. (1965). The Morphology of Gymnosperms, B.I. Publications, New Delhi.
23. Swain T. (1963). Chemical Plant Taxonomy. Academic Press, London.
24. Takhtajan, A.L. (1997). Diversity and Classification of Flowering Plants. Columbia University Press, New York.
25. Thomas, P. (2000). Trees: Their Natural History. Cambridge University Press, Cambridge.
26. Tippo, O., and Stern, W.L. (1977). Humanistic Botany. W.W. Norton, New York.
27. Trotter, H. (1982). The Common Commercial Timbers of India and their Uses (Reprint). Govt. of India Press, Nasik.
28. Woodland, D.W. (1991). Contemporary Plant Systematics. Prentice Hall, New Jersey.

B.Sc. (HS) BOTANY (SEMESTER-II)
(Under Credit Based Continuous Evaluation Grading System)

ZOL195 - Diversity of Animals -II (Chordates)

Credit: 3-0-0

Unit-I

General Characters and Economic Importance of:
Hemichordata
Urochordata
Cephalochordata

Unit-II

General Characters add Economic Importance of:
Pisces
Amphibia

Unit-III

General Characters and Economic Importance of:
Reptilia
Aves
Mammalia

References:

1. Goodrich, E. S. (1958), Structure and Development ht of Vertebrates, Vol. I and n. D. E. Publication,
2. Hildebrand, M. and Goslow. Jr. G.E. (2001), ~IUilysisof Vertebrates Structure John Wiley, N. Y.
3. Hill, R.W., Wyse, G.K. and Anderson, N. (2004) Animal physiology, Sinauer Associate, INC. Pub. Saunderland, Massachusettes, USA
4. Hoar, W. S. (1984), General and Comparative Physiology. Prentice Hall of India Pvt. Limited, New Delhi, Indla.
5. Jollie, M. (1968), Chordate Morphology, Reinhold, New York.
6. Kardong, K. V. (1995), Vertebrates'-Comparative Anatomy, Function, Evolution. W.B.C. Pub. , Oxford
7. Kent, C. and Carr, R.K. ('2001), Comparative Ana~omyoftheVertebrates 9th edition, McGrawHill Higher Education, New York.
8. Linzey, D. GW01), Vertebrate Biology. McGraw Hill Publishing Company, New York.
9. McGowan,e. (1999), A Practical Guide to Vertebrates Mechanics, Cambridge University Press, UK.
10. Pechenik,A.Jan.(2000),Biology of the invertebrates, Fourth Edition, McGrawHill Book Co. Singapore
11. Prosser, C.L.,, (1974), Comparative Animal Physiology." Satlsh Book Enterprise Books ,
12. seller & Publishers, Agra
13. Pough, F.H. Heiser, J.B. and McFarland, W.N.)1990), Verterbrate Life 3rd ed, Macmillan Pub. Co., New York
14. Purves, W.K. Oriane, G.H. Space, H.C. and Salava, D.(2001), Life The Science of Biology 6th ed. Sinaurer Assoc Inc USA
15. Randall, D. Burggren K.L. and French, K.(2002), Eckert Animal Physiology: Mechanisms and Adaptations, W.H. Freeman and Company, New York
16. Withers, P.C. (1992), Comparative Animal Physiology Saunder College Publishing, NewYork
17. Young, J.Z. (1982), The Life of Vertetrates, New York

B.Sc. (HS) BOTANY (SEMESTER-II)
(Under Credit Based Continuous Evaluation Grading System)

CYL191 - Organic Chemistry

Credit: 3-1-0

1. Stereochemistry: (12Hrs.)

Molecular chirality, enantiomers/symmetry in achiaral structures, chiral centres in chiral molecules, properties of chiral molecules-optical activity, absolute and relative configuration, the Cahn-Ingold Perlog R-S notional system physical properties of enantiomers. Stereochemistry of chemical reactions that produce chiral centres, chemical reactions that produce stereo isomers, Resolution of enantiomers, chiral centres other than carbon.

2. Chemistry Alkanes and Alkencs: (9 Hrs.)

Conformations of alkanes and cycloalkanes: conformational analysis of ethane, butane, cyclohexane, monosubstituted and disubstituted cyclohexane, conformation of small, medium and large ring cycloalkanes and of polycyclic ring systems. Stereochemistry of alkenes, naming stereo isometric alkenes by the E-Z system, mechanism of hydrogenation of alkenes, stereochemistry of hydrogemition of cycloalkenes, Dehydration of alcohols and regioselectivity of these reactions. Acid cata!ysed dehydration of alcohols with complete mechanistic discussion, Mechanism of dehydrohalogenation of alkyl halides (E mechanism). stereoselective and anticlimination in E reactions, the E Mechanism, electrophilic addition of hydrogen halides to alkenes its regioselectivity explained on the basis of mechanism, free radical addition of hydrogen bromide to alkenes, acid catalysed hydration of alkene with mechanism stereochemistry of halogen addition to alkenes and its mechanistic explanation.
Hypohalous acid addition to alkenes, epoxidation of alkenes.

3. Alkynes: (4Hrs.)

Acidity of acetylene and terminal alkenes, metal ammonia reduction of alkyne, addition of hydrogen halides and water to alkynes, with detailed discussion of mechanism of these reactions, the diels Alder reaction, orbital symmetry and the diels Adler reaction.

4. Nucleophilic Substitution and Addition Reaction: (8Hrs.)

(a) Functional group transformation by nucleophilic substituion, the biomolecular(SN), mechanism of nucleophilic substitution, stereochemistry of SN reactions. how SN reactions occur, steric effect in SN reactions, nucleophiles and nucleophilicity, the unimolecular (SN) mechanism of nucleophilic substitution, carbocation stability and the rate of substitution, by the SN mechanism stereochemistry of SN reactions, carbocation real alTangements in SN reactions, solvent eflects, substitution and elimination as competing reactions.

(b) Principles of nucleophillic addition to carbonyl groups: Hydration acetal formation, cyanohydrin formation; reactions with primary and secondary amines, Wittig reaction, steroselective addition to carbonyl groups mechanism of halogenation, acid and base catalysed cholization, haloform reaction, aldol condensation, conjugate nucleophillic addition to unsaturated carbonyl compounds

5. Spectroscopy (12 Hrs.) Principles of molecular spectroscopy, electromagnetic radiation, quantized energy states, NMR(H) Spectroscopy, nuclear shielding and Chemical shift measurements chemical shift and molecular structure, interpreting proton NMR spectra, spin-spin splitting in NMR spectroscopy, patterns of spin-spin splitting, proton NMR spectra of alcohols, NMR and conformations carbons- 13 nuclear magnetic resonance, the sensitivity problem, interpretation of spectra. Infrared spectroscopy, ultraviolet--visible (UV -VIS) spectroscopy and mass spectrometry.

References:

1. R.T. Morison and R.N. Boyd, Organic Chemistry.
2. LL. Finar, Organic Chemistry, Vol. I IV ed.
3. Advanced Organic Chemistry, Reactions Mechanisms and Structure by J. March.
4. Schaum's Outlines Series Theory and Problems of Organic Chemistry.
5. Problems and their solution in Organic chemistry by LL. Finar, Modern Organic Chemistry by J.D. Robbert and M.C. Caserio.
6. Organic Chemistry by D.J. Cram and O.S. Hammond.
7. J.E. Banks, Naming Organic Compounds- Programmed Introduction to Organic Chemistry.
8. E.L. Eliel, Stereochemistry of carbon compounds.
9. W. Camp, Organic Spectroscopy.
10. F.A. Carey, Organic Chemistry.

PHL196 - Modern Physics - I

Credits: 3-1-0

Dual Nature of Matter and Radiation: De Brogile's hypothesis, electron diffraction experiments of Davission and Germer, Wave group and particle velocities, Heisenberg's uncertainty principle, principle of the electron microscope, Diffraction of X-rays from crystals, Planck's quantum hypothesis, Bragg's law of determination of structure of simple crystals.

Radioisotopes and Their Application: Radioactive decay laws, Uranium and Carbon dating, introduction to a, p and y decays, Radioisotopes, their production and separation, mass spectrograph, uses of radioisotopes in medicine, agriculture and geology Radiation doses and their units, Biological effects of radiation.

Elementary Particles: Uses of ionization chamber, cloud chamber, Scintillation counter and photographic emulsions as detectors, Classification of elementary particles and their properties, conservation laws. Antiparticles, Origin and general characterization of cosmic rays (Primary and Secondary)

References:

1. Concepts of Modem Physics: A. Beiser.
2. Essentials of Modem Physics: V. Acota and C. L. Grown.
3. Fundamentals of Modem Physics: B. D. Duggal and C. L. Chhabra.

MTL162 - Integral Calculus

Credits: 3-0-0

Integration as inverse of differentiation. Indefinite integral of standard fonns. Integration by parts. Integration by substitution.

Integration using method of partial fractions (of algebraic rational functions).

Definite integral and geometric interpretation of definite integral as an area.

Differential Equations: Definition. Solution of differential equations of first order and first degree (Variables separable, homogeneous equations, linear equations and equations reducible to the linear form). Applications of first order differential equations to biology.

Reference:

Shanti Narayan: Integral Calculus.

B.Sc. (HS) BOTANY (SEMESTER-II)
(Under Credit Based Continuous Evaluation Grading System)

COMMUNICATIVE ENGLISH-II

Credits: 2-0-0

Objectives: To introduce students in a graded manner to the communication skills of Reading and Writing in English. At the end of semester-II, the students should be able to demonstrate adequate competence in comprehending an unseen passage and performing the prescribed communication/ writing tasks.

Prescribed Reading: Vandana R. Singh. *The Written Word*, Oxford University Press, New Delhi (Selected chapters)

"Orient Longman: Wisdom and Experience"

a) **Developing Comprehension Skills:**
Students will be required to read sample comprehension passage as given in chapter *critical reading and comprehension* of the prescribed book, teacher will help students in handling text and answering questions given at the end of each passage. Teacher can bring in more texts and construct questions of factual and inferential nature to enhance the comprehension skill of the students.

b) **Developing Habits of Additional Reading:**
The students will be required to show evidence of additional independent reading. They will maintain a scrapbook consisting of such readings as clippings from newspapers and magazines, short articles, stories etc. The minimum quantum of such additional reading will be decided by the class teacher, who will also test students individually on their additional reading (and appropriately award internal assessment, if required).

Writing:

a) **Developing Vocabulary and Using it in the Right Context**
Students will be required to pay special attention to build up their vocabulary; They should master the contents of the chapter on vocabulary in the prescribed book. Teacher will help the students learn the correct and appropriate use of the given set of words/phrases/expressions.

b) **Developing skills in formal**
Students will be required to do write-ups involving skills of making formal complaints, requests, orders etc., reporting, note taking, summarizing and transcoding. The types of composition task may include business and public interest letters, new/feature writing, speeches, minutes, instructions, summary reports etc. Teacher shall instruct the students about the appropriate format and usual conventions followed in such writings, the following chapters in the prescribed book may be consulted for exercise materials on these tasks:

- ❖ Paragraph and Essay Writing
- ❖ Report Writing
- ❖ Letter Writing
- ❖ Note Making and Summerising
- ❖ Transcoding

Question Paper: The following format is suggested for a 3-hour test.
(Appropriate choices may be given where possible)

1. One unseen passage of app. 300 words with at least five questions for testing comprehension (at least three of them may be multiple choice) **App. Weighting 20%**
2. Vocabulary and other expressions **App. Weighting 20%**
3. Two writing tasks pertaining to formal letter writing, reporting, note taking, summary writing etc. **App. Weighting 40%**
4. One task involving transcoding from dialogue to prose or prose to dialogue **App. Weighting 20%**

Internal Assessment: The teacher may consider the following for award of internal assessment, if any.

1) Evidence of independent and additional reading as given above teacher may suggest some special reading list to suit the needs of their student.
2) Classroom tests on vocabulary and suggested writing tasks.
3) Project writing involving the communication skills referred in writing tasks.

B.Sc. (HS) BOTANY (SEMESTER-III)
(Under Credit Based Continuous Evaluation Grading System)

BSL201 - Cell Biology

Credits: 3-0-0

1. Introduction: Discovery of cells, basic properties of cells, Two fundamentally different classes of cells: prokaryotic and eukaryotic cells, viruses, viroids, Biological molecules: carbohydrates, lipids, proteins, nucleic acids.
2. Structure and Function of Plasma membrane: An overview of membrane functions, membrane lipids, membrane proteins, membrane carbohydrates, importance of membrane fluidity
3. Cell walls and cell-cell interactions: Bacterial cell walls, plant cell walls, tight junctions, gap junctions, plant cell adhesion and plasmodesmata.
4. Mitochondrial structure and function: Mitochondrial membranes matrix, an overview of its functions
5. Plastids structure and functions with special reference to chloroplast.
6. Peroxisomes and their functions
7. Structure and functions of Endoplasmic reticulum, Golgi apparatus and lysosomes.
8. Nucleus: Internal organisation, Nucleolus, Nucleus during mitosis.
9. Phases of cell cycle: G1, S, G2 phases, Mitosis and Meiosis.

References:

1. Becker, W.M., Kleinsmith, L.J. and Hardin, J. (2000). The World of the Cell. The Benjamin/Cummings Publishing Company.
2. Cooper, G.M. (2000). The Cell – A Molecular Approach. ASM Press, Washington, D.C.
3. Karp, G. (1999). Cell and Molecular Biology: Concepts and Experiments. John Wiley & Sons Inc., New York.
4. Purves, W.K., Oriam, G.H., Hellen, H.C., Sadana, D. (1998). Life. The Science of Biology. W.H. Freeman and company, Utah.
5. Sadava, D.E. (1993). Cell Biology: Organelle Structure and Function. Jones and Barlett Publishers, Boston, London.
6. Smith, C.A. and Wood, E.J. (1993). Cell Biology: Molecular and Cell Biochemistry. Chapman & Hall, London

B.Sc. (HS) BOTANY (SEMESTER-III)
(Under Credit Based Continuous Evaluation Grading System)

BSL202 - Plant Organization

Credit: 3-0-0

1. Plant organization, external and internal, different groups of plants, organographic development, the basic body plan of flowering plants.
2. Cells and tissues: The shoot, root and leaf meristems and their histological organization and function, types of cell, tissues and tissue systems, chemical and ultrastructure of cell and cell wall.
3. The shoot system: The internal organization of primary shoot in monocots and dicots, formation of internodes, branching patterns, monopodial and sympodial growth, vascularization of the primary shoots, the vascular cambium, histology and function, the secondary xylem and anomalous secondary growth.
4. A general account of wood structure is relation to types of wood, ascent of sap, sapwood and heartwood, dendrochronology, parenchyma, phloem structure and function, periderm, origin and function, structure, development and function of laticifers.
5. Leaf, origin , development , types and diversity in size and shape , internal structure in relation to photosynthesis and transpiration, adaptation to water and carbon dioxide stress, krantz anatomy, role in carbon assimilation , anatomy of senescence and abscission.
6. The root system, differences from the shoot system, differentiation from primary and secondary tissue and their roles, structural modification for storage and reproduction.

References:

1. Cutter, E.G., 1969, Part 1 Cells and Tissues, Edward Arnold, London.
2. Cutter, E.G., 1971, Plant anatomy: Experiment and interpretation, Part II, Organs Edward Arnold, London.
3. Esdu, K., 1977, Anatomy of Seed Plants, 3rd Edition. John Wiley and Sons, New York.
4. Hartman, H.T. and Kestler, D.E., 1976. Propagation: Principles and Practices, 3rd Edition, Prentice Hall of India Pvt. Ltd., New Delhi.
5. Mauseth , J.D., 1998, Plant Anatomy. The Benjamin Cumming Publishing Company Inc. Menlo Park, California, USA.
6. Brown, H.P. 1989. An Elementary Manual on Indian Wood Technology. R. P.S Publishers.
7. Trotter, H. 1982. The Common Commercial Timbers of India and their Uses. Controller of Publications Delhi.

B.Sc. (HS) BOTANY (SEMESTER-III)
(Under Credit Based Continuous Evaluation Grading System)

BSL203 - Pharmacognosy

Credit: 3-0-0

1) Introduction, development, present status and future scope of pharmacognosy.

2) Classification of crude drugs: morphological, taxonomical, pharmacological and chemical.

3) Study of carbohydrate containing drugs, biological source, geographical distribution, collection, commercial production, chemical constituents, chemical tests for identity, adulterants and uses of the following:

   Acacia gum, Guar gum and Plantago

4) Study of lipids and lipid containing drugs, biological source, general methods of extraction, chemical constituents, tests for identity, and uses of the following:
   Arachis oil, Castor oil, Sesame oil, Almond oil, Olive oil and Linseed Oil.

5) Study of drugs containing resins and resin combinations:
   Cannabis, Podophyllum, Colophony, Myrrh, Asafoetida, Balsam of Peru, Tolu Balsam and Benzoin.

6) Study of Tannins and tannin containing drugs:
   Gambier, Black catechu and nutgall

7) Study of Biological sources, cultivation, collection, chemical constituents, adulterants, uses and chemical tests for identity of the following groups of drugs:
   a) Glycosidic drugs:
      (i) Saponin containing drugs: glycyrrhiza, Safed musali, Brahmi
      (ii) Cardioactive drugs: digitalis, Oleander
      (iii) Anthraquinone glycosides: aloe, rhubarb and hypericum
   b) Alkaloid containing drugs:
      (i) Pyridine-piperidine group: areca,lobelia
      (ii) Tropane group: belladonna, hyoscyamus,datura
      (iii) Quinoline group: cinchona,
      (iv) Isoquinoline group: ipecac, opium
      (v) Indole group: ergot, rauwolfia, catharanthus
      (vi) Steroidal group: Ashwagandha, kurchi bark
      (vii) Alkaloidal amino group: Ephedra, colchicum

8) Study of drugs from animal sources:
   Beeswax, Shark liver oil, cod liver oil, honey, Gelatin.

References:

1. Kokate, C.K., Purohit, A.P. and Gokhale, S.B.2004. Pharmacognosy, Nirali Prakashan,Pune.
2. Ali, M.1998. Text book of Pharmacognosy, CBS Publisheres & Distributors, New Delhi.
3. Wallis, T. E.1985. Text book of Pharmacognosy, CBS Publisheres & Distributors, New Delhi.
4. Handa, S.S and Kapoor, V.K.1998. Pharmaconosy, Vallabh Prakashan,Delhi.
5. Shah, C.S and Qadry, J.S.1996. B.S.Shah Prakashan,Ahmedabad.

CYL291 - Physical Chemistry

Credit: 3-1-0

1. Chemical Thermodynamics: (14 Hrs.) System and surroundings properties and variables of a system, laws of thermodynamics, Enthalpy of a system, heat capacity, Isothermal & adiabatic processes in ideal gases, Joule- Thomos effect, Carnot cycle, themlodynamic efficiency. Thermo-Chemistry:heat of reaction at constant volume and pressure thermochemical equations, calculations of E from H & vice versa, I-Iess's law of heat summation, heat of formation, heats of combustion, heat of solution, heat of neutralization of acids & bases, heat of formations of ions, heat of reaction from bond enthalpies, dependence ofH & E for a reaction (Kirchoff's equation).

II & III law ofthermodynamics: Entropy, dependence of entropy on variables of a system, Entropy change in ideal gases, entropy of mixing for ideal gases, entropy change in physical transfonnations, Entropy change in chemical reactions, absolute Entropies, residual entropy, thermodynamics of III Law.

2. Spontaneity and Equilibrium: (4 Hrs.) General conditions for Equilibrium and Spontaneity under constraints. Helmholtz free energy (A) for reactions, Gibbs free energy.

3. Chemical Equilibrium: (4 Hrs.) Chemical potential, Gibbs free energy and entropy of mixing of ideal gases. The Equilibrium constants Kp and Kc of real gases Temperature dependence of Equilibrium constant. The Lechatelier principle.

4. Phase Rule: (6 Hrs.) Gibbs Phase rule, derivation of phase rule, one component system. the water system, the sulphur system, two components system-simple eutectic diagram, formation of compound with congruent M. pt.

5. Chemical Kinetics: (5 Hrs.) Measurement of reaction rate, order, molecularity of reaction, first order reactions, second order reactions, third order reactions. Methods of determination of order, effect of temperature, activation energy, catalysis, Homogeneous catalysis in gases, homogenous catalysis in solutions.

6. Electro Chemistry: (12Hrs.) Conductance & Ionic Equilibrium: Faraday's law of electrolysis. transference numbers determination of transference numbers, electrolytic conductance, variation of conductance with concentration, equivalent conductance at infinite dilution, intrinsic attraction theory of conductance, Absoute velocities of ions, degree of ionization & conductance activity & activity coefficients of strong electrolytes, determination of activity coefficients, Debye-Huckel Theory of activity coefficients, Ionization constants of weak acids, & weak bases. Ionic product of water, pH & pOH Buffer solution, hydrolysis, calculation of hydrolytic constants, solubility product, salt effect & solubility.

7. Electrochemical Cells:
Reversible & In-eversible cells, standard cells. Cell reaction & EMP. single electrode potential & its calculation, thermodynamic & EMF, standard potential & equilibrium constants, Classification of electrodes, chemical & concentration cells, Junction potential, solubility product & EMF.

References:

1. Physical Chemistry by Samuel H, Carl P. Prutton Americ Inc. Co.

2. Physical chemistry by Glassstone, The Macmillian Press Ltd.

3. Kinectic and Mechanism by frost A and Pearson R.G, Wiley Eastern Pvt. Ltd.

4. Chemical Kinectic by KJ. Laidler, Harper and Row,

5. Physical chemistry by Glberg W. Castelli an Addison- Wesley Publishing Co.

B.Sc. (HS) BOTANY (SEMESTER-III)
(Under Credit Based Continuous Evaluation Grading System)

PBL103: ਪੰਜਾਬੀ ਲਾਜ਼ਮੀ – I

ਪਾਠ–ਕ੍ਰਮ ਅਤੇ ਪਾਠ–ਪੁਸਤਕਾਂ

Credit: 2–0–0

(I) 1. **ਆਤਮ ਅਨਾਤਮ** (ਸੰਪ. ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ ਅਤੇ ਡਾ. ਸੁਹਿੰਦਰਬੀਰ ਸਿੰਘ, ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ) ਵਿੱਚੋਂ ਹੇਠ ਲਿਖੇ ਕਹਾਣੀਕਾਰ

(ੳ) ਗੁਰਮੁਖ ਸਿੰਘ ਮੁਸਾਫਿਰ : **ਗਟਾਰ**
(ਅ) ਸੁਜਾਨ ਸਿੰਘ : **ਪਠਾਣ ਦੀ ਧੀ**
(ੲ) ਕਰਤਾਰ ਸਿੰਘ ਦੁਗਲ : **ਉੱਚੀ ਅੱਡੀ ਵਾਲੀ ਗੁਰਗਾਬੀ**
(ਕਹਾਣੀ–ਸਾਰ, ਵਿਸ਼ਾ–ਵਸਤੂ, ਕਹਾਣੀ–ਕਲਾ, ਕਹਾਣੀਕਾਰ)

2. ਗੁਰਮੁਖੀ ਔਰਥੋਗਰਾਫੀ ਦੀ ਜੁਗਤ, (ਪੈਂਤੀ; ਮੁਹਾਰਨੀ; ਬਿੰਦੀ, ਟਿੱਪੀ ਤੇ ਅੱਧਕ); ਵਿਰਾਮ ਚਿੰਨ੍ਹ, ਸ਼ਬਦ ਜੋੜ (ਸ਼ੁਧ–ਅਸ਼ੁਧ)

(II) 1. **ਆਤਮ ਅਨਾਤਮ** (ਸੰਪ. ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ ਅਤੇ ਡਾ. ਸੁਹਿੰਦਰਬੀਰ ਸਿੰਘ, ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ) ਵਿੱਚੋਂ ਹੇਠ ਲਿਖੇ ਕਹਾਣੀਕਾਰ

(ੳ) ਸੰਤੋਖ ਸਿੰਘ ਧੀਰ : **ਸਾਂਝੀ ਕੰਧ**
(ਅ) ਕੁਲਵੰਤ ਸਿੰਘ ਵਿਰਕ : **ਉਜਾੜ**
(ੲ) ਮਹਿੰਦਰ ਸਿੰਘ ਸਰਨਾ : **ਜਥੇਦਾਰ ਮੁਕੰਦ ਸਿੰਘ**
(ਕਹਾਣੀ–ਸਾਰ, ਵਿਸ਼ਾ–ਵਸਤੂ, ਕਹਾਣੀ–ਕਲਾ, ਕਹਾਣੀਕਾਰ)

2. ਲੇਖ ਰਚਨਾ (ਜੀਵਨੀ–ਪਰਕ, ਸਮਾਜਕ ਅਤੇ ਚਲੰਤ ਵਿਸ਼ਿਆਂ ਉਤੇ):
10 ਲੇਖ ਲਿਖਵਾਉਣੇ (ਕਲਾਸ ਵਿਚ ਅਤੇ ਘਰ ਲਈ ਅਭਿਆਸ)

(III) 1. **ਆਤਮ ਅਨਾਤਮ** (ਸੰਪ. ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ ਅਤੇ ਡਾ. ਸੁਹਿੰਦਰਬੀਰ ਸਿੰਘ, ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ) ਵਿੱਚੋਂ ਹੇਠ ਲਿਖੇ ਕਹਾਣੀਕਾਰ

(ੳ) ਪ੍ਰੇਮ ਪ੍ਰਕਾਸ਼ : **ਮਾੜਾ ਬੰਦਾ**
(ਅ) ਗੁਲਜ਼ਾਰ ਸਿੰਘ ਸੰਧੂ : **ਕੁਲੱਛਣੇ**
(ੲ) ਮੋਹਨ ਭੰਡਾਰੀ : **ਘੋਟਣਾ**
(ਸ) ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ : **ਦਲਦਲ**
(ਕਹਾਣੀ–ਸਾਰ, ਵਿਸ਼ਾ–ਵਸਤੂ, ਕਹਾਣੀ–ਕਲਾ, ਕਹਾਣੀਕਾਰ)

2. ਪੈਰਾ ਪੜ੍ਹ ਕੇ ਪ੍ਰਸ਼ਨਾਂ ਦੇ ਉੱਤਰ ਦੇਣਾ
(**ਆਤਮ ਅਨਾਤਮ** ਪੁਸਤਕ ਦੇ ਕਹਾਣੀ ਭਾਗ ਵਿੱਚੋਂ 15 ਪੈਰ੍ਹਿਆਂ ਦੇ ਅਭਿਆਸ ਕਰਵਾਉਣੇ)

B.Sc. (HS) BOTANY (SEMESTER-III)
(Under Credit Based Continuous Evaluation Grading System)

HISTORY & CULTURE OF THE PUNJAB (1450-1716)
(Special paper in lieu of Punjabi Compulsory)
HSL: 101

Credits: 2-0-0

Instructions for the Paper Setters/Examiners:
Examination Minor–I shall cover Theme No. 1-3, Minor–II shall cover Theme No. 4-6. The Major shall cover the entire syllabus.

1. Land and the People
2. Bhakti Movement
3. Life and Teachings of Guru Nanak Dev.
4. Contribution of Guru Angad Dev, Guru Amar Das and Guru Ram Das.
5. Guru Arjun Dev.
6. Guru Hargobind
7. Martyrdom of Guru Tegh Bahadur
8. Guru Gobind Singh and the Khalsa
9. Banda Singh Bahadur: Conquests and Execution.

Suggested Readings:

1. Kirpal Singh (ed.): *History and Culture of the Punjab*, Part-II, Punjabi University, Patiala, 1990.

2. Fauja Singh (ed.): *History of Punjab*, Vol. III, Punjabi University, Patiala, 1987.

3. J.S. Grewal: *The Sikhs of the Punjab*, CUP, Cambridge, 1991.

4. Sukhwant Singh. *Agriculture Growth under Colonial Constraints: The Punjab 1849-1947,* Manpreet Publication, Delhi, 2000.

5. Khushwant Singh, *A History of the Sikhs,* Vol. I, OUP, New Delhi, 1990.

B.Sc. (HS) BOTANY (SEMESTER-III)
(Under Credit Based Continuous Evaluation Grading System)

ESL 220 Environmental Studies (Compulsory Paper)
(Under Credit Based Continuous Evaluation Grading System)

Credit 3-0-0

1. **The Multidisciplinary Nature of Environmental Studies:** Definition, scope & its importance, Need for public awareness.
2. **Natural Resources**: Natural resources and associated problems.
   - **a)** **Forest Resources**: Use of over exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
   - **b)** **Water Resources**: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
   - **c)** **Mineral Resources**: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
   - **d)** **Food Resources**: World food problems, change caused by agriculture and overgrazing, effects or modern agriculture, fertilizer-pesticide problem, salinity, case studies.
   - **e)** **Energy Resources**: Growing of energy needs, renewable and non-renewable energy resources, use of alternate energy sources, case studies.
   - **f)** **Land Recourses**: Land as a resource, land degradation, soil erosion and desertification.
   - **g)** Role of an individual in conservation of natural resources, Equitable use of resources for sustainable lifestyles.
3. **Ecosystem:**
   Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids.
   Introduction, types, characteristic features, structure and function of the following ecosystems:
   a. Forest ecosystem
   b. Grassland ecosystem
   c. Desert ecosystem
   d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).
4. **Biodiversity and its Conservation:**
   Definition: Genetic, species and ecosystem diversity, Biogeographical classification of India.
   Value of Biodiversity: Consumptive use; productive use, social, ethical, aesthetic and option values.
   Biodiversity of global, National and local levels, India as mega-diversity nation "Hot-spots of biodiversity.
   Threats to Biodiversity: Habitat loss, poaching of wild life, man wildlife conflicts
   Endangered and endemic species of India.
   Conservation of Biodiversity: In situ and Ex-situ conservation of biodiversity.

5. Environmental Pollution:

Definition, Causes, effects and control measures of:

a) Air Pollution
b) Water Pollution
c) Soil Pollution
d) Marine Pollution
e) Noise Pollution
f) Thermal Pollution
g) Nuclear Hazards

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes.

Role of an individual in prevention of pollution.

Pollution case studies Disaster Management: Floods, Earthquake, Cyclone and Landslides

6. Social Issues and Environment:

* From unsustainable to sustainable development
* Urban problems related to energy
* Water conservation, rain water harvesting, watershed management
* Resettlement and rehabilitation of people; its problems and concerns. Case studies
* Environmental ethics: Issues and possible solutions.
* Climate change, global warning, acid rain, ozone layer depletion, nuclear accidents and holocause. Case studies.
* Wasteland reclamation
* Consumerism and waste products
* Environmental Protection Act
* Air (prevention and Control of Pollution) Act
* Water (prevention and Control of Pollution) Act
* Wildlife Protection Act
* Forest Conservation Act
* Issues involved in enforcement o£. environmental legislation
* Public awareness

7. Human Population and the Environment

* Population growth, variation among nations
* Population explosion-Family welfare programme
* Environment and human health
* Human rights
* Value education
* HIV / AIDS
* Women and child welfare
* Role of information technology in environment :and human health
* Case studies
* **Road Safety Rules & Regulations:** Use of Safety Devices while Driving, Do's and Don'ts while Driving, Role of Citizens or Public Participation, Responsibilities of Public under Motor Vehicle Act, 1988, General Traffic Signs
* **Accident & First Aid:** First Aid to Road Accident Victims, Calling Patrolling Police & Ambulance

8. Field Work: Visit to a local area to document environmental assets–river / forest / grassland/ hill / mountain. Visit to a local polluted site–Urban / Rural / Industrial / Agricultural. Study of common plants, insects, birds. Study of simple ecosystems–pond, river, hill slopes, etc. (Field work equal to 5 lecture hours)

References:

1. Agarwal, K. C. 2001. Environmental Biology, Nidhi Publications Ltd. Bikaner.
2. Bharucha, E. 2005. Textbook of Environmental Studies, Universities Press, Hyderabad.
3. Bharucha, E. 2004. The Biodiversity of India, Mapin Publishing Pvt. Ltd. Ahmedabad.
4. Brunner, R. C. 1989. Hazardous Waste Incineration, McGraw Hill Inc. New York.
5. Clark, R. S. 2000. Marine Pollution, Clanderson Press Oxford.
6. Cunningham, W. P., Cooper, T. H., Gorhani, E. & Hepworth, M. T. 2001. Environmental Encyclopedia, Jaico Publications House, Mumbai.
7. De, A. K. 1989. Environmental Chemistry, Wiley Eastern Ltd.
8. Down to Earth, Centre for Science and Environment, New Delhi.
9. Hawkins, R. E. 2000. Encyclopedia of Indian Natural History, Bombay Natural History Society.
10. Heywood, V. H & Waston, R. T. 1995. Global Biodiversity Assessment, Cambridge House, Delhi.
11. Jadhav, H. & Bhosale, V. M. 1995. Environmental Protection and Laws. Himalaya Pub.
12. Joseph, K. and Nagendran, R. 2004. Essentials of Environmental Studies, Pearson Education (Singapore) Pte. Ltd., Delhi.
13. Kaushik, A. & Kaushik, C. P. 2004. Perspective in Environmental Studies, New Age International (P) Ltd, New Delhi.
14. Miller, T. G. Jr. 2000. Environmental Science, Wadsworth Publishing Co.
15. Odum, E. P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA.
16. Rajagopalan, R. 2005. Environmental Studies from Crisis to Cure. Oxford University Press, New Delhi.
17. Sharma, B. K. 2001. Environmental Chemistry. Geol Publishing House, Meerut.
18. Sharma, J. P. 2004. Comprehensive Environmental Studies, Laxmi Publications (P) Ltd, New Delhi.
19. Sharma, P. D. 2005. Ecology and Environment, Rastogi Publications, Meerut.
20. Subramanian, V. 2002. A Text Book in Environmental Sciences, Narosa Publishing House, New Delhi.
21. Survey of the Environment. 2005. The Hindu.
22. Tiwari, S. C. 2003. Concepts of Modern Ecology, Bishen Singh Mahendra Pal Singh, Dehra Dun.
23. Townsend, C., Harper, J. and Michael, B. 2001. Essentials of Ecology, Blackwell Science.
24. Booklet on Safe Driving. Sukhmani Society (Suvidha Centre), District Court Complex, Amritsar

B.Sc. (HS) BOTANY (SEMESTER-IV)
(Under Credit Based Continuous Evaluation Grading System)

BSL251 – Plant Physiology

Credit: 3-0-0

1. **Membrane Transport and Translocation of Water and Solutes:** Plant water relations, mechanism of water transport through xylem, root-microbe interactions in facilitating nutrient uptake, comparison of xylem and phloem transport, phloem loading and unloading, passive and active solute transport, membrane transport proteins.

2. **Photosynthesis:** Introduction, overview of photosynthesis, light absorption and energy conversion, the reaction centre complex, the photosystem, organization of the thylakoid membrane, Electron transport pathways in chloroplast membranes, ATP synthesis in chloroplasts, Carbon reactions in C_3 plants , variations of mechanisms of CO_2 fixation.

3. **Senescence and Programmed Cell Death:** Types of cell deaths observed in animals and plants, PCD in the life cycle of plants, Overview of senescence, Pigment metabolism during senescence, Protein metabolism in senescence, Impact of senescence of photosynthesis, Impact of senescence on oxidative metabolism, Degradation of nucleic acids during senescence, Regulation of metabolic activity in senescing cells, Endogenous plant growth regulators and senescence, Environmental influences on senescence, Examples of developmental PCD in plants, Examples of PCD as a plant response to stress

4. **Stress Physiology:** Plant responses to biotic and abiotic stress, mechanisms of biotic and abiotic stress tolerance, HR and SAR, water deficit and drought resistance, salinity stress, metal toxicity, freezing and heat stress, oxidative stress.

References:

1. Buchanan, B.B., Gruissem, W., and Jones, R.L. (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland.

2. Dennis, D.T., Turpin, D.H., Lefebvre, D.D., and Layzell, D.B. (eds) (1997). Plant Metabolism. Longman, Essex.

3. Galston, A.W. (1989). Life Processes in Plants. Scientific American Library, Springer-Verlag, New York.

4. Hooykaas, P.J.J., Hall, M.A., and Libbenga, K.R. (eds) (1999). Biochemistry and Molecular Biology of Plant Hormones. Elsevier, Amsterdam.

5. Hopkins, W.G. (1995). Introduction to Plant Physiology. John Wiley & Sons, Inc., New York.

6. Lodish, H., Berk, A., Zipursky, S.l., Matsudaira, P., Baltimore, D., and Darnell, J. (2000). Molecular Cell Biology. W.H. Freeman and Company, New York.

7. Moore, T.C. (1989). Biochemistry and Physiology of Plant Hormones. Springer-Verlag, New York.

8. Nobel, P.S. (1999). Physiochemical and Environmental Plant Physiology. Academic Press, San Diego.

9. Salisbury, F.B., and Ross, C.W. (1992). Plant Physiology, Wadsworth Publishing Co., California.

10. Singhal, G.S., Renger, G., Sopory, S.K., Irrgang, K.-D. and Govindjee (1999). Concepts in Photobiology: Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.

11. Taiz, L., and Zeiger, E. (1998). Plant Physiology. Sinauer Associates, Inc., Publishers, Massachusetts.

12. Thomas, B., and Vince-Prue, D. (1997). Photoperiodism in Plants. Academic Press, San Diego.

13. Westhoff, P. (1998). Molecular Plant Development: From Gene to Plant. Oxford University Press, Oxford.

BSL252 - Biochemistry

Credit: 3-0-0

1. **Biomolecules:** Chemical compositon and bonding, Three dimensional structure-configuration & conformation, chemical reactivity, macromolecules and their monomeric subunits.
2. **Water**: Weak interactions in aqueous systems, ionization of water, weak acids and weak bases, buffering against pH changes in biological systems, water as a reactant.
3. **Amino acids peptides and proteins**: Structural features and functions.
4. **Carboydrates and glycobiology**: Monosaccharides, disaccharides, polysaccharides, proteoglycons, glycoproteins and glycolipids.
5. **Nucleotides and nucleic acids**: Nucleic acid structure and its chemistry, Functions.
6. **Lipids**: Storage lipids, structural lipids in membrances, lipids as signals, Cofactors and pigments.
7. **Bioenergetics:** Bioenergetics and thermodynamics, Phosphoryl group transfers and ATP, Biological oxidation-reduction reactions.
8. **Glycolysis and the catabolism of Hexoses**: Glycolysis, fates of pyruvate under aerobic and anaerobic conditions, feeder pathways for glycolysis, Regulation of carbohydrate metabolism, Pentose phosphate pathway of Glucose oxidation.
9. **Citric acid cycle and its regulations**: The Glyoxylate cycle.
10. **Oxidation of fatty acids**: Digestion, Mobilization and Transport of fatty acids, β-oxidation, ketone bodies.
11. **Amino acid oxidation and production of urea**: Metabolic fates of amino groups. Nitrogen excretion and the urea cycle, Pathways of amino acid degradation.

References:

1. Dryer, R.L. and Lata, G.F. (1989). Experimental Biochemistry, Oxford University Press, New York.
2. Murray, R.K., Grammer, D.K., Mayes, P.A. and Rodwell V.W. (1990). Harper's Biochemistry. Prentice Hall International Inc., London.
3. Nelson, D.L. and Cox, M.M. (2000). Lehninger's Principles of Biochemistry. Worth Publishers, New York.
4. Stryer, L. (1995). Biochemistry W.H. Freeman & Co., New York.
5. Wilson, K. and Goulding, K.H. (Eds.) 1986. A Biologists Guide to Principles and Techniques of Practical Biochemistry, Edward Arnold, London.
6. Zubay G. (1993). Biochemistry. WCB Publishers, IOWA.

B.Sc. (HS) BOTANY (SEMESTER-IV)
(Under Credit Based Continuous Evaluation Grading System)

BSL253 - Inheritance Biology

Credit: 3-0-0

1. **Mendelian principles:** Dominance, segregation, independent assortment, deviation from Mendelian inheritance.
2. **Concept of gene:** Allele, multiple alleles, pseudoallele, complementation tests.
3. **DNA-The genetic material,** Hershey-Chase experiment, RNA as genetic material of viruses, DNA structure, replication.
4. **Structure of chromosomes:** Chemical composition of eukaryotic chromosomes, packaging giant DNA molecules into chromosomes (nucleosome), euchromatin and heterochromatin specialized chromosomes, polytene chromosomes, Lampbrush chromosomes.
5. **The Cell Cycle**: Mitosis, Meiosis.
6. **Chromosomal theory of heredity**: Experimental evidence linking the inheritance of genes to chromosomes.
7. **Variation in chromosome structure**: Deletions, duplications, translocations and inversions.
8. **Variation in Chromosome number**: Aneuploidy, euploidy, polyploidy
9. **Mutation:** Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis.
10. **Gene Expression**: Transcription, translation and genetic code.

References:

1. Brown, T.A. (1999). Genomes. BIOS Scientific Publishers Limited, UK.
2. Gardener, E.J., Simsons, M.J., and Sinustad, D.P. (1991). Principles of Genetics. John Wiley Sons Inc., New York.
3. Griffiths, A.J.F., Miller, J.H., Suzuki, D.T., Lewontin, R.C., and Gelbart, W.M. (1993). An Introduction to Genetic Analysis. Freeman and Company, USA.
4. Klug W. S. and Cummings, M. R. (1997). Concepts of Genetics. Printice Hall International, Inc.
5. Lewin, B. (2000). Gene VII. Oxford University Press, New York.
6. Schulz-Schaeffer, J. (1980). Cytogenetics of Plants, Animals and Human. Spinger-Verlag, New York.
7. Strickberger, M.W. (2001). Genetics. Prentice-Hall, Inc., Englewood Cliffs, N. Jersey.
8. Snustab, D. P., Simmons, M. J. and Jenkins, J. B. (1997). Principles of Genetics, John Wiley and Sons, Inc., New York.

BSL254 - Ecology

Credit: 3-0-0

Principles and concepts pertaining to ecosystems: Concept of ecosystem, Biological control of chemical environment, Production and decomposition of nature, Homeostasis of ecosystem

Energy in ecosystems: Fundamental concepts related to energy, Energy environment, Concepts of productivity, Relationship between solar energy input and primary productivity, metabolism and size of individuals, Ecosystem energies

Biogeochemical cycles: Patterns and basic types of biogeochemical cycles, Quantitative study of biogeochemical cycles, sedimentary cycles, cycling of non essential elements, cycling of organic nutrients, nutrient cycling in tropics, recycle pathways

Limiting factors: Liebig's law of minimum, Shelford's Law of Tolerance, Combined concept of limiting factors, conditions of existence as regulatory factors, Ecological indicators

Organization at the community level: biotic community concept, intracommunity classification and concept of ecological dominance, Community analysis, species diversity in community, Patterns in community, Ecotones and concept of edge effect, Paleoecology

Organization at the population level: Population group properties, Population density and indices of relative abundance, Natality, Mortality, Population age distribution, Population growth form and concept of carrying capacity, Cyclic oscillations/Population fluctuations, dispersals, aggregation and Allee's Principle, Interactions between two species.

Species and the individuals in ecosystem: Concepts of Habitat and Ecological Niche, Ecological equivalents, Character displacement: Allopatry and sympatry, Artificial selection, Biological clocks, Regulatory and compensatory behavior, Social behavior.

Development and evolution of ecosystem: Concept of climax, Evoluation of ecosystems, coevolution, group selection

Systems ecology: Nature of mathematical models, goals of model building, anatomy of mathematical models, analysis of model properties

Ecosystems: Freshwater, Marine, estuarine, Terrestrial, Radiation ecology, Microbial ecology and ecology of space travel (exobiology).

References:

1. Agarwal, K. C. 2001. Environmental Biology, Nidhi Publications Ltd. Bikaner.
2. Bharucha, E. 2005. Textbook of Environmental Studies, Universities Press, Hyderabad.
3. Kaushik, A. & Kaushik, C. P. 2004. Perspective in Environmental Studies, New Age International (P) Ltd, New Delhi.
4. Odum, E. P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA.
5. Sharma, P. D. 2005. Ecology and Environment, Rastogi Publications, Meerut

BSL255 - Modern Trends in Taxonomy

Credit: 3-0-0

1. Taxonomy, the science of identification and classification into ranks of taxonomic hierarchy, species concept, biological and taxonomic, Plant taxonomy from Carolus Linnaeus to the contemporary.
2. The biosystematic approach to taxonomy, biosystematic categories, experimental studies.
3. The phenetic approach and numerical methods in taxonomy, the concept of operational taxonomic units, numerical data, statistical analysis of taxonomic affinities and representation. Cluster and discriminant function analysis, cladistics, taxonomic dendrograms.
4. Digitalization of field and herbarium data, manual and computer aided keys of identification, softwares for development of computer aided keys, polyclaves
5. Role of phytochemistry and serology in taxonomy, the role of geographical distribution systems and remote sensing.
6. Phylogenetic reconstruction and reclassification of major plant groups by palaeobotanical and biogeographical evidences Role of biogeography in taxonomy.
7. Recent developments in the International Code of Botanical Nomenclature, etymology and grammar of names of genera, subdivision of genera, species and infraspecific taxa.

References:

1. Singh, Gursharan, 1999. Plant Systematics Theory and Practices. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi 110001
2. Jones , S.B; Luchsinger , A.E. 1986. Plant systematic. McGraw Hills , Inc
3. Naik V. N. 1984. Taxonomy of Angiosperms. Tata McGraw Hills.
4. Subrahmanyam, N. S. 2004. Modern Plant Taxonomy. Vikas Publishing House Pvt. Ltd.

B.Sc. (HS) BOTANY (SEMESTER-IV)
(Under Credit Based Continuous Evaluation Grading System)

PBL-104 **ਪੰਜਾਬੀ ਲਾਜ਼ਮੀ–II**

ਪਾਠ–ਕ੍ਰਮ ਅਤੇ ਪਾਠ ਪੁਸਤਕਾਂ

Credits: 2-0-0

(I) 1. **ਆਤਮ ਅਨਾਤਮ** (ਸੰਪ. ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ ਅਤੇ ਡਾ. ਸੁਹਿੰਦਰਬੀਰ ਸਿੰਘ, ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ) ਵਿੱਚੋਂ ਹੇਠਾਂ ਲਿਖੇ ਕਵੀ

(ੳ) ਭਾਈ ਵੀਰ ਸਿੰਘ
(ਅ) ਪ੍ਰੋ: ਪੂਰਨ ਸਿੰਘ
(ੲ) ਪ੍ਰੋ: ਮੋਹਨ ਸਿੰਘ
(ਕਵਿਤਾ–ਸਾਰ, ਵਿਸ਼ਾ–ਵਸਤੂ, ਕਾਵਿ–ਕਲਾ, ਕਵੀ)

2. ਪੰਜਾਬੀ ਸ਼ਬਦ ਬਣਤਰ : ਧਾਤੂ/ਮੂਲ, ਵਧੇਤਰ (ਅਗੇਤਰ, ਪਿਛੇਤਰ, ਵਿਉਂਤਪਤ ਅਤੇ ਰੁਪਾਂਤਰੀ), ਸਮਾਸ ।

(II) 1. **ਆਤਮ ਅਨਾਤਮ** (ਸੰਪ. ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ ਅਤੇ ਡਾ. ਸੁਹਿੰਦਰਬੀਰ ਸਿੰਘ, ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ) ਵਿੱਚੋਂ ਹੇਠ ਲਿਖੇ ਕਵੀ

(ੳ) ਅੰਮ੍ਰਿਤਾ ਪ੍ਰੀਤਮ
(ਅ) ਡਾ. ਹਰਭਜਨ ਸਿੰਘ
(ੲ) ਸ਼ਿਵ ਕੁਮਾਰ ਬਟਾਲਵੀ
(ਕਵਿਤਾ–ਸਾਰ, ਵਿਸ਼ਾ–ਵਸਤੂ, ਕਾਵਿ–ਕਲਾ, ਕਵੀ)

2. **ਪੈਰ੍ਹਾ ਰਚਨਾ :** ਕਲੱਸ ਵਿੱਚ 10 ਵਿਸ਼ਿਆਂ (ਸਭਿਆਚਾਰਕ, ਧਾਰਮਿਕ ਅਤੇ ਰਾਜਨੀਤਕ) ਤੇ ਪੈਰ੍ਹਾ ਰਚਨਾ ਦੇ ਅਭਿਆਸ ਕਰਵਾਉਣੇ ।

(III) 1. **ਆਤਮ ਅਨਾਤਮ** (ਸੰਪ. ਵਰਿਆਮ ਸਿੰਘ ਸੰਧੂ ਅਤੇ ਡਾ. ਸੁਹਿੰਦਰਬੀਰ ਸਿੰਘ, ਗੁਰੂ ਨਾਨਕ ਦੇਵ ਯੂਨੀਵਰਸਿਟੀ, ਅੰਮ੍ਰਿਤਸਰ) ਵਿੱਚੋਂ ਹੇਠ ਲਿਖੇ ਕਵੀ

(ੳ) ਡਾ. ਜਸਵੰਤ ਸਿੰਘ ਨੇਕੀ
(ਅ) ਡਾ. ਜਗਤਾਰ
(ੲ) ਡਾ. ਸੁਰਜੀਤ ਪਾਤਰ
(ਸ) ਪਾਸ਼
(ਕਵਿਤਾ–ਸਾਰ, ਵਿਸ਼ਾ–ਵਸਤੂ, ਕਾਵਿ–ਕਲਾ, ਕਵੀ)

2. ਮੁਹਾਵਰੇ ਤੇ ਅਖਾਣ (ਅਖਾਣ ਤੇ ਮੁਹਾਵਰਾ ਕੋਸ਼ ਵਿੱਚ) 200 ਮੁਹਾਵਰਿਆਂ ਅਤੇ 100 ਅਖਾਣਾਂ ਨੂੰ ਵਾਕਾਂ ਵਿੱਚ ਵਰਤਣ ਦੇ ਅਭਿਆਸ ਕਰਵਾਉਣੇ (ਕਲਾਸ ਵਿਚ ਤੇ ਘਰ ਲਈ) ।

B.Sc. (HS) BOTANY (SEMESTER-IV)
(Under Credit Based Continuous Evaluation Grading System)

HISTORY & CULTURE OF THE PUNJAB (1717-1947)
(Special Paper in lieu of Punjabi Compulsory)
HSL: 102

Credits: 2-0-0

Instructions for the Paper Setters/Examiners:
Examination Minor–I shall cover Theme no. 1-3, Minor–II shall cover Theme no. 4-6. The Major shall cover the entire syllabus.

1. Sikh Struggle for Sovereignty
2. Ranjit Singh: Conquests, Administration and the Anglo-Sikh Relations
3. Anglo-Sikh Wars and the Annexation
4. The Punjab under the British: New Administration, Education and Social Change
5. Economic Changes: Agricultural
6. Socio-Religious Reform Movements
7. Role of Punjab in the Freedom Struggle
8. Fairs and Festivals
9. Folk Dances and Legends

Suggested Readings:

1. Kirpal Singh (ed.): *History and Culture of the Punjab*, Part-II, Punjabi University, Patiala, 1990.
2. Fauja Singh (ed.): *History of Punjab*, Vol. III, Punjabi University, Patiala, 1987.
3. J.S. Grewal: *The Sikhs of the Punjab*, CUP, Cambridge, 1991.
4. Sukhwant Singh. *Agricultural Growth under Colonial Constraints: The Punjab 1849-1947,* Manpreet Publication, Delhi, 2000.
5. Khushwant Singh, *A History of the Sikhs,* Vol. I, OUP, New Delhi, 1990.

B.Sc. (HS) BOTANY (SEMESTER-IV)
(Under Credit Based Continuous Evaluation Grading System)

List of Elective Courses (Session 2011-12)
BSL281 - Seed Testing

Credits: 3-0-0

1. Introduction, history and development.
2. National and international organizations and seed testing linkages.
3. Seed testing laboratory-layout and furnishing.
4. Seed testing equipments and their maintenance.
5. Seed testing laboratory-management and functioning.
6. Seed sampling, dividing.
7. Heterogenity test.
8. Handling and testing of the sample.
9. Physical purity analysis.
10. Determination of other distinguishable varieties (ODV).
11. Cultivar purity testing
12. Moisture testing.
13. Germination testing – requirements, seedling evaluation.
14. Seed vigour testing.
15. Testing of pelleted seeds.
16. Uniformity in seed testing results and use of tolerances.
17. Record keeping and reporting of results.
18. Storage of guard samples.

Books Recommended:

1. Agarwal. P.K. and Dadlani, M. (1990). Techniques in Seed Science and Technology. South Asian Publishers, New Delhi.
2. Agarwal, R.L. (1987). Seed Technology. Oxford & IBH Publishing Co., New Delhi.
3. Kozlowski, T.T. (1972). Seed Biology, Vol. III, Academic Press, New York.
4. Tunwar N.S. and Singh S.V. (1988). Indian Minimum Seed Certification Standards. The Central Seed Certification Board, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, New Delhi.

B.Sc. (HS) BOTANY (SEMESTER-IV)
(Under Credit Based Continuous Evaluation Grading System)

BSL282 - Seed Quality Control

Credits: 3-0-0

1. **Seed Certification** – Introduction, history and objectives

2. **The general scheme of certification**

3. **Organisation of certification :** Seed certification agency

4. **General Seed certification standards**

5. **Specific crop standards for seed certification**: Field standards, Seed standards.

6. **Field inspection:** Objectives and general principles.

7. **Seed inspection**

8. **Seed legislation:** Types: statutory bodies and agencies established under the seed Act, Regulatory legislations: regulation of sale of seed penalties, seed law enforcement: power of seed inspector, procedure. Seed (Control) Order 1983. Plant Variety Production Act, New Seed Policy (1988).

Books Recommended:

1. Agarwal. P.K. and Dadlani, M. (1990). Techniques in Seed Science and Technology. South Asian Publishers, New Delhi.

2. Agarwal, R.L. (1987). Seed Technology. Oxford & IBH Publishing Co., New Delhi.

3. Kozlowski, T.T. (1972). Seed Biology, Vol. III, Academic Press, New York.

4. Tunwar N.S. and Singh S.V. (1988). Indian Minimum Seed Certification Standards. The Central Seed Certification Board, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, New Delhi.

5. Agrawal P.K. (1993). Hand Book of Seed Testing. Department of Ag. And Co., MOA, GOI, New Delhi.

6. Nema, N.P. ( ). Principles of Seed Certification and Testing. Allied Publishers Ltd.

7. Legislation on Seeds (1992). National Seeds Corporation Ltd for Ministry of Ag. & Co., GOI, New Delhi.

B.Sc. (HS) BOTANY (SEMESTER-IV)
(Under Credit Based Continuous Evaluation Grading System)

BSL283 – Seed Pathology and Entomology

Credits: 3-0-0

1. History of seed pathology, Economic significance of seed borne diseases, seed borne fungi, bacteria, viruses and nematodes, Storage fungi and its impact on animal and human health

2. Mechanisms of seed transmission, Entry point of seed infection, Influence of environmental factors, seed borne diseases, Seed crop management, Management of seed storage, Seed treatment procedures and equipments, Quarantine for seed.

3. Objectives of seed health testing, Procedures of sampling for seed health testing, Methods of seed health testing. Inspection of plants beyond the seedling stage, Inoculum density of seed borne pathogens and its relationship with disease security, yield losses.

4. Seed certification and tolerance limits of seed borne pathogens, Seed act in relation to seed borne diseases, Ecological relationship of seed borne microorganisms. National & International Cooperation in seed pathology.

5. Role of insects in seed production, General organization of insect. Methods of insect classification, Orders of insects of economic importance. Insect body & appendages. External morphology, Type of appendages.

6. Life Cycle of insect. Stages of insect development, Complete and incomplete metamorphosis. Insect ecology, Definition and its importance, Ecological factors governing insect development and population build up.

7. Seed Entomology: Important insect – pests of seed crops, their nature of damage and management: Cereals – paddy, maize and sorghum, Pulses – Kharif pulses, pigeon pea, mung, cowpea, urd; Rabi pulses – chickpea, field pea, linseed, oilseeds-mustard, castor, linseed, groundnut, sesame, vegetables and dry fruits.

8. Beneficial Insects: Type of beneficial insects and their role in seed production, Type of insect pollinators, their usage in crop pollination, Honeybees, their social structure and management (Bee Keeping).

9. Insect Control: Definition and methods of insect control viz. Monitoring insect infestation by different troups, Cultural, mechanical, physical, quarantine chemical control / pre harvest senitation spray, Use of plant products invert waterick, Insecticides formulations and preparation of spray solution, safe application of pesticides.

10. Storage Entomology: Types of insect pests and mites in storage, Nature of damage and losses caused and factors influencing them, Sources and development of infestation, Detection of infestation, Fumigants and methods of fumigation, Seed protestants and their impact on seed viability etc. IPM strategies for important pests.

Books Recommended:

1. P. Neergaard, Seed Pathology Vol. I & II, MacMillan Press Ltd.
2. V.K. Agarwal & J.B. Sinclair, Principles of Seed Pathology, Vol. I & II.
3. K.A. Jeffs, Seed Treatment.
4. C.J. Alexopoulos, Introductory Mycology.
5. J.P. Srivastava, An Introduction to Fungi.
6. R.W. Marsh, Systemic Fungicides.
7. Y.L. Nene and P.N. Thapliyal, Fungicides in Plants diseases Control.
8. Mary Noble and M.J. Richardson. An annotated list of seed borne disease.
9. S.C. Vyas, Systemic Fungicides.
10. Metcalf and Flint, Destructive and useful insects.
11. J.B. Free, Insect pollination of field crops.
12. A.S. Atwal, Agricultural Entomology.
13. O.S. Bindra, Plant Protection Equipments.

BSL284 – Entrepreneurship Development

Credits: 3-0-0

1. Need, scope and characteristics of entrepreneurship, special scheme for Technical Entrepreneurs, STED.
2. Identification of opportunities.
3. Exposure to demand based, resource based, service based, import substitute and export promotion industries.
4. Market survey techniques.
5. Need scope & approaches for project formulation.
6. Criteria for principles : of product selection and developments.
7. Structure of project report.
8. Choice of technology, plant and equipment.
9. Institution/financing procedures and financial incentives.
10. Financial ratios and their significance.
11. Books of accounts, financial statements and funds flow analysis.
12. Energy requirement and utilisation.
13. Resource Management Men, Machine and materials.
14. Critical Path Method (CPM) & Project Evaluation Review Techniques (PERT) as Planning tools for establishing SST.

Books Recommended:

1. Deshpande, M. V. (1984) Entrepreneurship of Small-scale Industries: Concept Growth & Management. Deep & Deep Publication, New Delhi.

2. McCleand, D.C. (1961) The Achieving Society, Princeton. N.J.D. Van Nostrand Co. New York.

3. Meredith, G.G. (1982) Practice of Entrepreneurship ILO., Nelson Rcetal, Geneva.

4. Pareek, U. and Rao, T.V. (1978) Personal Efficacy in Developing Entrepreneurship. Learning Systems, New Delhi.

5. Rao, T.V. and Pareek, U. (1980) Developing Entrepreneurship- A Handbook. Learning Systems, New Delhi.

6. Vyas, J.N. Planning an Industrial Unit. I. Neelkung Neelkanth part. Opp. Navrangpura, Ahmedabad.

7. Welsh, J.A. and Jerry. (1983) Entrepreneurs Master Planning Guide -How to Launch a Successful Business, Prentice Hall, Englewood Cliffs.

8. Department of Industrial Development. Incentives and Concessions for Setting up Industries in Backward Areas, Department of Industrial Development Govt. of India, New Delhi.

9. India investment industrial Centre. Guide for Enterpreneurs, India investment Centre. Jeevan Vihar Building, Sansad Marg, New Delhi.

10. Entrepreneurship Development Institute of India. A Handbook for New Entrepreneurs (with special reference to S & T group) Entrepreneurship Development Institute of India.

B.Sc. (HS) BOTANY (SEMESTER-IV)
(Under Credit Based Continuous Evaluation Grading System)

BSL285 - Seed Production

Credits: 3-0-0

1. **Modes of reproduction and pollination control:** Structure of flower and its parts, Anthesis, Asexual and sexual reproduction, Apomixis, Modes of pollination in crop plants, conditions or mechanisms facilitating self and cross pollination, Determination of modes of pollination, Sterility and incompatibility mechanisms – Definitions, Types of male sterility (Genetic, cytoplasmic and cytoplasmicgenetic) and their utilization in hybrid seed production, types of self incompatibility (SI), Morphological, genetic and biochemical basis of SI, Utility of SI, Use of chemical hybridizing agents (male gametocides).

2. **Concept of heterosis and inbreeding depression:** Calculation of heterosis, Genetic and Physiological basis of heterosis, Fixation of heterosis.

3. **Seed production:** Definition, differences between seed and grain, seed quality concept, role of quality seed.

4. **General principles of seed production:** Genetic and agronomic principles.

5. **Hybrid seed production:** Hybrdization**,** feasibility of hybrid seed production using emasculation and hand pollination, male sterility, self – incompatibility and gametocides.

6. **Ecology of seed production:** Climate (light, temperature, rainfall etc.), Soil, Area, Insect factors.

7. **Seed production systems and management:** Systems of seed production in India, planning and organization of a seed programme, classes of quality seed, seed production organization, Nucleus and breeder seed production in self and cross pollinated crops, Indian and international seed industry, production of synthetic / artificial seeds.

8. **Field Crops:** Detailed seed production procedures in following crops with reference to land and isolation requirements, brief cultural practices, Roguing, Harvesting and threshing – Wheat, Paddy, Sorghum, Bajra, Maize, Chickpea, Lentils, Cowpea, Urd and Mungbeans, Soybean, Groundnut, Rape and mustard, Sesame, Sunflower, Forages, Cotton, Sugarcane and potato (Seed plot technique).

9. **Vegetable Seed production:** Introduction, classification of vegetable crops, Methods of seed production of the under mentioned crops dealing with the aspects of land and isolation requirement, Seedling / root production, Nursery management, Planting, Cultural practices, Plant protection, Seed harvesting, vegetable cum seed production, Drying Grading, Seed extraction methods (wet – dry methods).

10. **Tropical Crops:** Solanaceous (Brinjal, Potato, Chillies, Tomato). Cruciferous (Early Cauliflower, Turnip), Root crops (Raddish, Carrot), Leafy vegetables (Palak,Methi), Bulb (Onion), Okra and Cucurbits.

11. **Temperate:** Cauliflower, Cabbage, Capsicum.

12. **Hybrid Seed Production:** Procedure of hybrid seed production in following crops with reference to floral biology, land and isolation requirements, special agronomic practices, Roguing, harvesting, threshing etc. – Maize, Pearlmillet, Sorghum, Sunflower, Pigeonpea, Cotton, Rice and Mustard.

13. **Commercial flower seed production:** Brief procedures in Agaratum, Alyssum, Aster, Dahlia, Pensy, Petuniam Carnation, phlox etc.

Books Recommended:

1. Agrawal, R.L. 1995. Seed Technology (2nd Ed.) Oxford and IBH Publ. Co. Pvt. Ltd., New Delhi.

2. Bhandari, M.M. 1974. Practicals in Plant Breeding.

3. Desai, B.B., Kotecha, P.M. and Salunkha, D.K. 1997. Seeds Handbook-Biology, Production, Process and Storage, Marcel Dekker Inc., New York.

4. McDonald, M.B. and Copeland I.O. 1997, Seed Production Chapman and Hall, New York.

5. Poehlman J.M. and Sleper D.A. 1995 Breeding Field crops (4th Edition) Panima Publishing Corporation, New Delhi.

6. Raghuvanshi, R.K., Chauhan, A.K.S. and Siddiqui, B.A. 1995, Practical Exercises in Cytology, Genetics, Plant Breeding and Biostatistics (Ist Editions). CBS Publishers and Distributors, New Delhi.

7. Singh, B.D. 1994. Plant Breeding – Principles and methods, (5th edition) Kalyani Publishers, Ludhiana.

8. Singh, H.B., Vishnu Savrup and B. Singh. Exploitation of Hybrid Vigour in Vegetables.

9. Sundara Raj, D.D. and Thulsidas G. 1993. Botany of Field Crops (2nd edition), MacMillan India Ltd., N. Delhi.

10. Agrawal, R.L. (1998). Fundamentals of plant Breeding and Hybrid seed production. Oxford and IBH Publ. Co. Pvt. Ltd., New Delhi.

BSL286 - Biophysics

Credits: 3-0-0

1. **Biomolecular Structures:** Basic principles of quantum mechanics, electronic structure of atoms, molecular orbitals and bonds, molecular interactions, stereochemistry and chirality and thermodynamics.
2. **Proteins:** Structural organization of proteins, globular and fibrous proteins, dynamics of protein folding, protein engineering.
3. **Nucleic Acids:** Base pairing/ base stacking, nucleic acid families (A,B and Z), protein ligand interactions.
4. **Chromatography:** Principles and applications of Column, Thin layer, Paper, Adsorption, Partition, Gas - liquid, Ion exchange, Molecular exclusion and Affinity chromatographies.
5. **Electrophoresis:** Principles and applications of Moving boundary, Zone, Low voltage, High voltage, Gel, SDS-PAGE and Continuous flow electrophoresis.
6. **Physico-chemical Techniques to Study Biomolecules**: Hydration of molecules, friction, diffusion, sedimentation, ultracentrifugation, viscosity, rotational diffusion, light scattering, small angle X-ray scattering.
7. **Spectroscopy:** Principles and applications of UV/ VIS, CD, ORD, Fluorescence, IR, Raman and Electron spin resonance spectroscopies.
8. **X-ray Crystallography:** Crystals and symmetries, crystal systems, growth of crystals and biomolecules, X-ray diffraction, structure solution.
9. **NMR Spectroscopy:** Description of NMR, parameters, nuclear overuser effect, applications.
10. **Molecular Modeling:** Generating a model.
11. **Macromolecular Structure:** Nucleic acid structure, protein structure.
12. **Biomechanics:** Striated muscles, mechanical properties of muscles, biomechanics of cardiovascular system.
13. **Neurobiophysics:** Nervous system, membrane potentials, eye, hearing, signal transduction.
14. **Lasers and Holography**: Principles and applications.

Books Recommended:

1. Pattabhi, V. and Gautham, N. (2003). Biophysics. Narosa, New Delhi.
2. Narayanan, P. (2000). Essentials of Biophysics. New Age International (P) Ltd., New Delhi.

BSL287 - Microbial Technology

Credits: 3-0-0

1. **Isolation, Nutrition and Cultivation of Microorganisms:** substrate constituents for growth, uptake of nutrients into cells, cultivation of microorganisms, isolation of selected microbes by enrichment culture.

2. **Microbial Growth and its Control:** Microbial growth: growth curve characteristics, measures of growth, effect of nutrient concentration on growth rate, effect of environmental conditions on growth. Control of microbial growth: Heat sterlization, pasteurization, radiation, filteration, chemical and chemotherapeutic agents.

3. **Microbes on Biodegradation and Biochemical Transformation:** Catabolism of poly saccharides, lipids, proteins and aromatic compounds, biodegradation of herbicides and pesticides, biochemical transformation of nitrogen and nitrogen compounds, carbon dioxide and sulphur and sulphur compounds.

4. **Microbial Technology and Industry:** Products of microbial dissimilation: Alcohol and alcoholic beverages , Vinegar, Lactic acid; Products of microbial synthesis: Penecillin, enzymes, amino acids, vitamins; microorganism in recovery of raw materials, mining , paper products, textiles and bioremediation ; Production of therapeutic compounds; microbial deterioration of material.

Books Recommended:

1. Pelczar, M.J.E.C.S. Chan and N.R. Kreig 1986. Microbiology. McGraw Hill Book Co. New York.

2. Perry, J.J., Staley, J.T., Lory, S. (2002). Microbial Life. Sinauer Associates, Publishers, USA.

B.Sc. (HS) BOTANY (SEMESTER-V)
(Under Credit Based Continuous Evaluation Grading System)

BSL401 – Mathematical Biology

Credits: 3-0-0

1. **Linear function:** $y=ax$ and $y=ax+b$, implicit and explicit functions, linear relation, linear programming
2. **Power function:** $y=ax^n$, polynomials, differences, quadratic equation.
3. **Periodic function:** Cycloid, polar coordinates, sine and cosine, conversion of polar coordinates into rectangular coordinates, trigonometric relations, polar graphs, trigonometric polynomials.
4. **Exponential and logarithmic functions:** Geometric sequence and mean, arithmatic sequence and mean, exponential function $y=aq^x$, logarithmic function, scaling, Weber's law, spirals- spiral of Archimedes and logarithmic spiral, helix.
5. **Graphical methods:** Linear and non-linear scales, semilogarithmic and double logarithmic plots, triangular charts, pictorial views.
6. **Probability:** Events, concept of probability, conditional probabilities, multiplication rule, permutations and combinations, random variable, binomial, Poisson, continuous, uniform, normal and chisquare distributions.
7. **Limits:** Limits of sequences, constant and continuous and discontinuous functions, Fibonacci sequence.
8. **Differentiation and Integration:** Growth rates, instantaneous rate of change, differentiation of some important functions, product rule and quotient rule of differentiation, chain rule of differentiation.
9. **Integration:** Integrals, definite integral, rules of integration, second derivative, extremes of a function, mean of a continuous function.
10. **Exponential and logarithmic functions:** $d/dx(e^x)$, $d/dx(\ln x)$, integral of $1/x$, properties of ln x**,** inverse functions of ln x, logarithms, $a^x = e^{x\ln a}$, introduction to hyperbolic functions.
11. **Ordinary differential equations:** $y'=ay$, $y'=ay+b$, $y'=ay^2 + by+c$, $dy/dx=k.y/x$, system of linear differential equations.
12. **Fractal dimension**: Measurement by divider method, applications in biology.

References:

1. Batschelet, E. (1971). Introduction to Mathematics for Life Scientists. Springer-Verlag, Berlin.
2. Krebs, C.J. (1989). Ecological Methodology. Harper and Row, New York, USA.
3. Ludwig, J. and Reynolds, J.F. (1988). Statistical Ecology. John Wiley & Sons, New York.
4. Magurran, A.E. (1988). Ecological Diversity and its Measurement. Chapman & Hall, London.
5. Pielou, E.C. (1984). The Interpretation of Ecological Data. Wiley, New York.
6. Poole, R.W. (1974). An Introduction to Quantitative Ecology. McGraw Hill Book Co., New York.
7. Sokal, R.R. and Rohlf, F.J. (1995). Biometry. W.H. Freeman & Co. San Francisco.

BSL402 - Computer Applications and Bioinformatics

Credits: 3-0-0

1. **Number systems:** Binary, octal, hexadecimal and decimal numbers, conversion from one system to another, 1's and 2's complements, binary addition and subtraction, gates, half adder, full adder.
2. **Computer organization:** Components of digital computers, hardware and software, programming languages, compiler & interpreters.
3. **Overview of bioinformatics:** Introduction, bioinformatics and the internet, useful bioinformatics sites on the WWW.
4. **Introduction to PERL:** Scalar variables, strings and numbers, Assignment statements, Arrays, Hashes, Operators, Input from file, Standard Input, Conditional and logical operators, loops, I/O, Input from file named in command line, Regular expression, Pattern matching, Meta symbols, Pattern modifiers, Subroutines.
5. **Applications of PERL in bioinformatics:** Storing DNA sequence, DNA to RNA transcription, Finding motifs, Counting nucleotides, Generating random numbers, simulating DNA mutation, generating random DNA, Analyzing DNA.
6. **Biological databases:** Introduction, classification of databases on the basis of type of molecule, nucleic acid, protein sequence and structure databases, classification of databases on the basis of source and type of information.
7. **Data mining methods for sequence analysis:** Data retrieval with Entrez and DBGET/ Link DB and SRS (Sequence retrieval system).
8. **Analysis of data:** sequence similarity search, amino acid substitution matrices, web-based tools for sequence searches (FASTA and BLAST), motif analysis.
9. **Sequence alignment:** Multiple sequence alignment and family relationships, phylogenetics.
10. **Structural bioinformatics:** Obtaining, viewing and analyzing structural data, structural alignment, classification of known three dimensional structure : CATH and SCOP, structure prediction by comparative modeling.
11. **Applications of Bioinformatics.**

References:

1. Malvino, A.P., and Leach, Donald P. (1996). Digital Principles and Applications. Tata McGraw-Hill Publishing Company Limited, New Delhi.
2. Sinha, P.K. (1998). Computer Fundamentals. BPB Publications, New Delhi.
3. Tisdall, J. (2001). Beginning Perl for Bioinformatics. O' Rilley.
4. Foy, B.D. Phoenix, T and Schwartz, R. L. (2005). Learning Perl, 4th Edition. O' Rilley.
5. Westhead, D.R., Parish , J.H. (2003). Instant Notes : Bioinformatics. Viva Books Private Ltd., New Delhi.
6. Sensen, C.W. (Ed.) (2002). Essentials of Genomics and Bioinformatics Wiley-VCH, Verlag GmbH Winheim.
7. Mount, D.W. (2001). Bioinformatics: Sequence and genome analysis. Cold spring Leubn Laboratory press, NewYork.
8. Baxevains, A.D. and Ouellete, B.F.F. (2001). Bioinformatics: A practical guide to the analysis of genes and proteins. John Wiley and Sons, NewYork.
9. Misenere, S. and Krawetz, S.A. (2001). Bioinformatics: Methods and Protocols. Humana Press, Totowa, New Jersey.
10. Rastogi, S.C., Mendiratta, N. and Rastogi, P. (2004). Bioinformatics - Methods and Application. Genomics, Proteomics and Drug Discovery. Prentice - Hall of India Pvt Ltd. New Delhi.

B.Sc. (HS) BOTANY (SEMESTER-V)
(Under Credit Based Continuous Evaluation Grading System)

BSL403- Phycology

Credits: 3-0-0

1. Classification, the occurrence and distribution of algae, forms of algal plant body, fossil records of the algae.
2. Reproductive diversity, life cycle patterns, algae of uncertain affinity.
3. Origin and evolution of sex in algae, algae as indicators of water pollution, bacterial and fungal pathogens of algae.
4. Cultivation of algae in the laboratory, culture media, some media for fresh water algae, marine algae, conditions of cultivation, sources of algal culture.
5. Chlorophyta (Volvox, Chlorella, Ulothrix, Cladophora, Fritschiella, Oedogonium, Zygnema, Vaucheria Acetabularia)
6. Charophyta (Chara, Nitella).
7. Euglenophyta (Euglena, Astasia).
8. Phaeophyta (Ectocarpus, Cutleria, Laminaria, Macrocystis, Dictyota, Padina, Fucus, Sargassum).
9. Chrysophyta (Chromulina, Cyclotella, Navicula, Denticula).
10. Rhodophyta (Bangia, Porphyra, Batrochospermum, Nemilion, Gelidium, Gigartina, Gracilaria, Polysiphonia).
11. Cyanophyta (Chroococcus, Microcystis, Nostoc, Oscillitoria, Rivularia, Scytonema, Spirulina, Stigonema).
12. Pyrrhophyta (Dinophysis, Peridinium, Noctiluca, Pyrocystis).
13. Cryptophyta (Cryptomonas).

References:

1. Bold, H.C. and Wynne, M.J. (1985). Introduction to the Algae. Structure and Reproduction, Prentice Hall Inc. Englewood Cliffs, New York.
2. Smith, G.M. (1955). Cryptogamic Botany, McGraw Hill Publication.
3. Smith, G.M. (1955). Cryptogamic Botany. Vol. II, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
4. Ahluwalia, A.S. (Ed.) (2003). Phycology. Daya Publishing House, New Delhi-110035
5. Kumar. H.D. and Singh, H.H. (1971). A Textbook on Algae, East – West Press Pvt. Ltd. New Delhi.
6. Trivedi, P.C. (Ed.) (2001). Algal Biotechnology. Pointer Publishers, Jaipur.

BSL404 – Fungi and Plant Pathology

Credits: 3-0-0

Kingdom PROTOZOA

1. **Acrasiomycota**: Acrasiomycetes - A general account

2. **Dictyosteliomycota :** Dictyosteliomycetes - *Dictyostelium*

3. **Myxomycota:** Myxomycetes - *Stemonitis*

Kingdom CHROMISTA

4. **Oomycota:** Oomycetes - *Saprolegnia, Pythium* and *Achlya*

Kingdom FUNGI

5. **Ascomycota:** Ascomycetes , Discomycetes - *Morchella and Tuber,* Pyrenomycetes - *Erysiphe, Claviceps, Xylaria, Neurospora*, Hemiascomycetes - *Protomyces* and *Taphrina*

6. **Basidiomycota:** Basidiomycetes - *Agaricus,* Ustomycetes - *Ustilago* Teliomycetes : *Puccinia*

7. **Mitosporic Fungi:** Coelomycetes – *Colletotrichum, Hyphomycetidae: Alternaria, Fusarium, Rhizoctonia,* Agonomycetes: Sclerotium

8. **Fungi- General**: Evolutionary tendency in lower fungi, Sexuality in ascomycetes with special reference to degeneration & modification of sex organ, heterothallism in basidiomycetes, sex hormone in fungi, parasexual cycle.

Plant Pathology:

9. Pathogenesis, Principles and methods for the prevention and control for plant diseases, toxins and enzymes in plant diseases, defence mechanisms of plants against pathogens, Genetics of plant pathogen interaction.

   Symptomatology, identification, etiology and control measures of the following fungal plant diseases:

10. Potato wart, damping-off diseases, late blight of potato, white rust of crucifers, downy mildew of bajra, powdery mildew pea, apple scab, ergot of rye and bajra, anthracnose disease of chillies, red rot of sugarcane, tikka disease of groundnuts, blast of rice, false smut of rice, Karnal bunt of wheat, smut/smuts of wheat, barley, oats, bajra and sorghum, rust of wheat.

References:

1. Agrios, G.N. (1997). Plant Pathology. Academic Press, New York.
2. Ainsworth, G.C. Sparrow, F.K., and Sussman A.S. (1973). The Fungi- An Advanced Treatise. Vols. IV A. Academic Press, London.
3. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. (1996). Introductory Mycology. John Wiley and sons, INC, New York.
4. Hawksworth, D.L., Kirk, P.M. Sulton, B.C. and Pegelr, D.N. (1995). Ainsworth and Bisby's Dictionary of Fungi. International Mycological Institute. CAB International.
5. Mehrotra, R.S. (1980). Plant Pathology. Tata McGraw Hill Publishing Co. Ltd., New Delhi.
6. Mehrotra, R.S. and Aneja, K.R. (1990). An Introduction to Mycology. New Age International Publishers, New Delhi.
7. Webster, J. (1980). Introduction to Fungi. Cambridge University Press, Cambridge, London.
8. Vashista, B.R. and Sinha, A.K. (2008) Botany for degree students-Fungi. S. Chand and Company Ltd, New Delhi-pp 1-752.

B.Sc. (HS) BOTANY (SEMESTER-V)
(Under Credit Based Continuous Evaluation Grading System)

BSL405 - Plant Morphogenesis

Credits: 3-0-0

1. **Correlation:** Physiological and genetic correlations.
2. **Polarity:** Polarity as expressed in external and internal structures, polarity in isolated cells, polarity in plasmodia and coenocytes, physiological manifestations of polarity, developmental patterns.
3. **Symmetry:** Inorganic and organic symmetries, radial symmetry bilateral symmetry, dorsiventral symmetry, development of symmetry.
4. **Differentiation:** Growth and differentiation, differentiation as expressed in structure, external and internal differentiation, differentiation during ontogeny, differentiation in relation to environment, physiological differentiation, differentiation without growth.
5. **Regeneration:** Regeneration in lower plants, regeneration in higher plants, reconstitution, restoration, reproductive regeneration.
6. **Tissue Mixtures:** Stock – scion interrelations, chimeras, somatic mutations.
7. **Abnormal Growth:** Abnormal development of organs, production of new types of organized structures, amorphous structures.
8. **Morphogenetic Factors:** Introduction to factors, light, water temperature, physical factors like tension, compression, balancing and swaying, ultrasonics, gravity, bioelectical effects, genetic factors, chemical factors in general.

References:

1. Bhojwani, S.S. and Bhatnagar, S.P. (1975). The Embryology of Angiosperms. Vikas Publishing House, Delhi.
2. Eames, A.J. (1961). Morphology of the Angilosperms. Tata McGraw Hill Publishing Co., Bombay.
3. Maheshwari, P. (1950). An Introduction to the Embryology of Angiosperms. Tata McGraw Hill Publishing Co. Bombay – New Delhi.
4. Sinnet, E.W. (1960). Plant Morphogenesis, McGraw Hill Book Company, New York.

B.Sc. (HS) BOTANY (SEMESTER-V)
(Under Credit Based Continuous Evaluation Grading System)

BSL406 - Metabolic Integration

Credits: 3-0-0

1. **Long Distance Transport:** Introduction, Overview of diffusive and active transport in plants, Importance of channel dimensions in defining the transport properties of the apoplast and symplasm. Comparison of xylem and phloem transport. Transpirational water movement in the xylem, Symplasmic transport via plasmodesmata, Phloem transport, Intercellular transport of endogenous macromolecules.
2. **Nitrogen and Sulphur:** Introduction, Overview of nitrogen in the biosphere and in plants, Overview of nitrogen fixation, Enzymology of nitrogen fixation, Symbiotic nitrogen fixation, Ammonia uptake and transport, Overview of nitrate uptake and reduction, Nitrate reduction, Nitrate reduction, Interaction between nitrate assimilation and carbon metabolism, Overview of sulfate assimilation, Sulfur chemistry and function, Sulfur uptake and transport, The reductive sulfate assimilation pathway, Synthesis and function of glutathione and its derivatives.
3. **Signal Perception and Transduction:** Introduction, Overview of signal transduction, receptors, specific examples of plant receptors, G-proteins and phospholipid signaling, Cyclic nucleotides, Calcium, Protein kinases : primary elements in signal transduction, Particulars pathways of signal transduction associated with plant growth regulators, The future of plant cell signal transduction research.
4. **Senescence and Programmed Cell Death**: Types of cell deaths observed in animals and plants, PCD in the life cycle of plants, Overview of senescence, Pigment metabolism during senescence, Protein metabolism in senescence, Impact of senescence of photosynthesis, Impact of senescence on oxidative metabolism, Degradation of nucleic acids during senescence, Regulation of metabolic activity in senescing cells, Endogenous plant growth regulators and senescence, Environmental influences on senescence, Examples of developmental PCD in plants, Examples of PCD as a plant response to stress, Further questions and future directions for PCD research.

References:

1. Buchanan, B.B., Gruissem, W., and Jones, R.L. (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, Maryland.
2. Dennis, D.T., Turpin, D.H., Lefebvre, D.D., and Layzell, D.B. (eds) (1997). Plant Metabolism. Longman, Essex.
3. Galston, A.W. (1989). Life Processes in Plants. Scientific American Library, Springer-Verlag, New York.
4. Hooykaas, P.J.J., Hall, M.A., and Libbenga, K.R. (eds) (1999). Biochemistry and Molecular Biology of Plant Hormones. Elsevier, Amsterdam.
5. Hopkins, W.G. (1995). Introduction to Plant Physiology. John Wiley & Sons, Inc., New York.
6. Lodish, H., Berk, A., Zipursky, S.l., Matsudaira, P., Baltimore, D., and Darnell, J. (2000). Molecular Cell Biology. W.H. Freeman and Company, New York.
7. Moore, T.C. (1989). Biochemistry and Physiology of Plant Hormones. Springer-Verlag, New York.
8. Nobel, P.S. (1999). Physiochemical and Environmental Plant Physiology. Academic Press, San Diego.
9. Salisbury, F.B., and Ross, C.W. (1992). Plant Physiology, Wadsworth Publishing Co., California.
10. Singhal, G.S., Renger, G., Sopory, S.K., Irrgang, K.-D. and Govindjee (1999). Concepts in Photobiology: Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.
11. Taiz, L., and Zeiger, E. (1998). Plant Physiology. Sinauer Associates, Inc., Publishers, Massachusetts.
12. Thomas, B., and Vince-Prue, D. (1997). Photoperiodism in Plants. Academic Press, San Diego.
13. Westhoff, P. (1998). Molecular Plant Development: From Gene to Plant. Oxford University Press, Oxford.

BSL451 - Statistical Techniques

Credits: 3-0-0

Basic principles of statistical techniques with numericals for analysis of ecological data.

1. **Statistical methods:** Measures of central tendency and dispersal; sampling distribution; difference between parametric and non-parametric statistics; confidence interval; errors; levels of significance; basic introduction to Multivariate statistics, etc.

2. **Central tendency:** Arithmatic mean, geometric mean, harmonic mean, median, mode.

3. **Dispersion:** Range, quartile deviation, mean deviation, variance, standard deviation, standard error, coefficient of variation, Lorenz curve.

4. **Skewness, moments and kurtosis:** Measures of skewness, moments about mean, measures of kurtosis.

5. **Probability:** Events, concept of probability, conditional probabilities, multiplication rule, permutations and combinations.

6. **Probability distributions:** Binomial, Poisson and Normal distributions

7. **Normal distribution:** Mathematical equation for normal curve, confidence limits, hypothesis testing, null hypothesis, comparing the mean of a sample with a known standard, comparing the means of two samples, Student's *t*-test.

8. **Binomial distribution:** Comparison of percentage with a known standard, comparison of two percentages.

9. **Poisson distribution:** Comparing two Poisson distributions.

10. **Chi square distribution:** Goodness of fit.

11. **Regression and correlation:** Computation of correlation coefficient and regression equation.

12. **Partial correlation and multiple regression:** Partial correlation, multiple regression with two independent variables, multiple regression with three independent variables**.**

13. **Elements of path and principal component analysis**.

14. **Analysis of variance:** F-test, one way and two way analysis of variance, multivariate statistics

15. **Non-parametric and distribution –free tests:** Wilcoxon's signed rank sum test for single sample Wilcoxon's signed rank sum test for two samples, Kendall's rank correlation coefficient.

16. **Time series analysis:** Seasonal, cyclic and irregular variations, trend analysis, Index numbers and their classification.

References:

1. Bailey, N.T.J. (1995). Statistical Methods in Biology. Cambridge University Press, Cambridge.
2. Ludwig, J. and Reynolds, J.F. (1988). Statistical Ecology. John Wiley & Sons, New York.
3. Sokal, R.R. and Rohlf, F.J. (1995). Biometry. W.H. Freeman & Co. San Francisco.

B.Sc. (HS) BOTANY (SEMESTER-VI)
(Under Credit Based Continuous Evaluation Grading System)

BSL452 – Computer Programming in Botany and Ecology

Credits: 3-0-0

1. **Network:** Introduction, Objectives, Applications, Types of Network, Components of Network, Elementary Idea of OSI Model, Network Topologies; Star, Ring, Bus, Hybrid, Tree.

2. **Internet:** Development, Management, Services Available, Various Applications of Internet

Programming in C

3. **Introduction to C Language**: About C language, evolution of C, Structure of a C Program, Compiling a C Program, Character Set, Keywords, **Operators:** Arithmetic Operators, Unary Operators, Relational and Logical Operators, Hierarchy of Operators, Expressions. **Data types**: Basic Data types, Constants and Variables in C, Type Declaration, Local and Global Variables, Constraints in C.

4. **Input/Output Functions:** Input Function, Output Functions, Formatted I/O, Character I/O and String I/O Functions.

5. **Control Statements:** Why control statements, if statement, if-else statement, for statement, while statement, do-while statement, break and continue statements, switch statement, goto statement, ternary operators.

6. **Arrays & String:** Introduction to Arrays, advantages of Arrays, types of Arrays, one, two and three dimensional arrays, array declaration, array initialization, accessing data from array, character arrays, string variables, reading & writing strings, string handling functions, array of strings.

7. **Functions:** Introduction to functions, library functions vs user-defined functions, advantages of functions, declaring a function, calling a function, passing arguments to a function, passing array to functions, recursion in functions, call by value and call by reference.

8. **Pointers:** Introduction to pointers, pointer variables, declaring pointer variables, assessing values via pointers, pointer to string, passing arguments using pointers.

References:

1. Crumlish, C. (1996). The ABC's of the Internet. BPB Publications, New Delhi.
2. Tanen, Baun A.S. (1977). Computer Networks. Prentice Hall of India, Delhi.
3. Salaria, R.S. (1998). Application Programming in C. Khanna Publications, Delhi.
4. Kanetkar, Y. (2004). Let Us C - Fifth Edition. BPB Publications, New Delhi.
5. Balagurusamy, E. (1992). Programming in ANSI C. Tata McGraw Hill Publishing Company Limited, New Delhi

BSL453 - Instrumental Methods of Analysis

Credits: 3-0-0

1. **Principles of Analytical Methods:** Titrometry, Gravimetry, Colorimetry, Spectrophotometry, Atomic Absorption Spectrophotometry and Flame Photometry

2. **Histochemical and Immunotechniques:** Antibody generation, detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flow cytometry and immunofluorescence microscopy, detection of molecules in living cells, *in situ* localization by techniques such as FISH and GISH.

3. **Biophysical Methods:** Analysis of biomolecules using UV/visible, fluorescence, UV, ORD/CD, Visible, circular dichroism, NMR and ESR spectroscopy, structure determination using X-ray fluorescence and X-ray diffraction and NMR; analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods, GC - MS/LC - MS Hydrodynamic methods; Atomic absorption and plasma emission spectroscopy.

4. **Principles and Techniques of Nucleic Acid:** Hybridisation and Cot curves; Sequencing of proteins and nucleic acids; Southern, Northern and South Western blotting techniques; Polymerase chain reaction.

5. **Principles and Applications of Gel-filtration**: Ion exchange and Affinity chromatography; Thin layer gas chromatography; GLC, HPLC; Electrophoresis and electrofocussing; Ultracentrifugation.

6. **Radiolabeling Techniques:** Properties of different types of radioisotopes normally used in biology, their detection and measurement; incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines.

7. **Electrophysiological Methods:** Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT.

References:

1. Wilson K. and Walker J. (Eds.) (1995). Practical Biochemistry : Principles and Techniques, Cambridge University Press, U.K.
2. Riley, T. and Tomilson, C. (1987). Principles of Electroanalytical Methods. John Wiley and Sons Ltd. , Chichester, England.
3. Sheehan, D. (2000). Physical Biochemistry : Principles and Applications, John Wiley and Sons Ltd. , Chichester, England.
4. Pungor, E. (1995). A Practical Guide to Instrumental Analysis. CRC press LCC, U.S.A

BSL 454: Genetics and Cytogenetics

Credits: 3-0-0

1. **Introduction:** Growth of Science from Mendel to Genetic Engineering.
2. **Extensions of Mendelian Principles:** Codominiance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy.
3. **Sex determination and sex linkage:** Mechanisms of sex determination, environmental factors and sex-determination, sex-influenced dominance, sex-limited gene expression, sex-linked inheritance, Morgan's discovery of sex-linkage in *Drosophila.*
4. **Linkage and Crossing over:** Cytological basis of crossing over, Molecular mechanism of crossing over.
5. **Gene mapping methods:** Linkage maps, two factor crosses, three factor crosses, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants.
6. **Extra chromosomal inheritance:** Maternal effect, Organelle heredity- chloroplast: variegation in 4'O clock plants, Iojap in Maize, *Chlamydomonas* mutaions, Mitochondria: poky in *Neurospora*, Mitochondrial DNA and human diseases, kappa in *Paramecium*, infective particles in *Drosophila*.
7. **Microbial genetics:** Methods of genetic transfer in bacteria – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes.
8. **Human genetics:** Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.
9. **Quantitative genetics:** Polygenic inheritance, heritability and its measurements, QTL mapping.
10. **The mutability and repair of DNA:** Nature of mutations, DNA damage from hydrolysis, deamination, alkylation, oxidation and radiation, Repair of DNA damage: base excision repair, recombination repair.
11. **Homologous Recombination:** Molecular level, site-specific recombination and transposition of DNA.

12. Regularly RNAs: Regulation by RNAs in bacteria and eukaryotes, synthesis and function of mi RNA molecules, evolution and exploitation of RNA.

References:

1. Brown, T.A. (1999). Genomes. BIOS Scientific Publishers limited, UK.
2. Gardener, E.J., Simsons, M.J., and Sinustad, D.P. (1991). Principles of Genetics. John Wiley Sons Inc., New York.
3. Griffiths, A.J.F., Miller, J.H., Suzuki, D.T., Lewontin, R.C., and Gelbart, W.M. (1993). An Introduction to Genetic Analysis. Freeman and Comapany, USA.
4. Hawley R.S. and Walker, M. Y. (2003) Advanced Genetics analysis-Finding meaning in Genome. Blackwell Publishing, USA.
5. Klug W. S. and Cummings, M. R. (1997). Concepts of Genetics. Printice Hall International, Inc.
6. Lewin, B. (2000). Gene VII. Oxford University Press, New York.
7. Schulz-Schaeffer, J. (1980). Cytogenetics of Plants, Animals and Human. Spinger-Verlag, New York.
8. Strickberger, M.W. (2001). Genetics. Prentice-Hall, Inc., Englewood Cliffs, N. Jersey.
9. Smith, J. M. (1998). Evolutionary Genetics. Oxford University Press, New York.
10. Snustab, D. P., Simmons, M. J. and Jenkins, J. B. (1997). Principles of Genetics, John Wiley and Sons, Inc., New York.

BSL455 - Bryophytes and Pteridophytes

Credits: 3-0-0

1. Origin of land habit, Bryophytes- the first land plants, the fossil evidence, adaptive characters for land habit.
2. Classificatiuon of Bryophytes, comparative account of morphology, life cycle and affinities of Marchantiales, Jungermanniales, Anthocerotales, Sphagnales, Andreales, Bryales and Polytrichales, experimental studies and economic importance.
3. Organographic development in vascular plants – telome theory, significance and shortcomings, homologous and antithetic theories of origin of sporophyte, Pteridophytes- the first vascular plants, monophyletic vs polyphyletic origin.
4. Salient features of pteridophytic life cycle with reference to phylogenetic status of major plant groups, classical and modern classification of pteridophytes, occurrence, comparative organography, systematics, reproduction and life cycle in various divisions, classes and orders evolutionary relations.
5. Evolutionary trends in pteridophytes, prothallial evolution, organization and evolution of sorus in ferns, role of polyploidy and hybridization in speciation in ferns, apomictic life cycle, apogamy, apospory, heterospory and development of seed habit.

References:

1. Bierhorst, D.W. (1971). Morphology of Vascular Plants. The MacMillan Press, London.
2. Bower F.O. (1928). The Ferns, Vols. I – III. Cambridge University Press, Cambridge.
3. Bower, F.O. (1908). The Origin of Land Flora. The MacMillan Press, London.
4. Campbell, D.R. (1985). The Evolution of Land Plants (Embryophyta) Reprinted Central Book Depot, Allahabad.
5. Forster, A.S. & Gifford, E.M. (1959). Comparative Morphology of Vascular Plants. W.H. Freeman & Company.
6. Goebel, K. (1969). Organography of Plants. Hafner Publishing Company, New York.
7. Kumar, B.K. Kazami, F.O. Kaur, S. and Chandra, S. (1962). Ferns of India, Today's and Tomorrow's Printers and Publishers, New Delhi.

8. Parihar, N.S. (1987). The Biology and Morphology of Pteridophytes, Central Book Distributors, Allahabad.
9. Rashid, A. (1991). An Introduction to Pteridophytes. Vikas Publishing House Pvt. Ltd. New Delhi.
10. Schofield, W.B. (1985). Introduction to Bryology, MacMillan Publishing Company, New York.
11. Sinnott, E.W. (1960). Plant Morphogenesis. McGraw Hill Book Company Inc. New york, Toronto london.
12. Smith, G.M. (1955). Cryptogamic Botany. Vol. II, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
13. Sporne, K.R. (1962). Morphology of Pteridophytes, BI Publications, New Delhi.
14. Stewart, W.N. (1983). Palaeobotany and Evolution of Plants. Cambridge University Press, London.
15. Taylor, T.N. (1981). Palaeobotany. An Introduction to Fossil Plant Biology, McGraw Hill Book Company, New York.

B.Sc. (HS) BOTANY (SEMESTER-VI)
(Under Credit Based Continuous Evaluation Grading System)

BSL456 - Advance Cell Biology

Credits: 3-0-0

1. **Origin and Evolution of Cells:** First cell, evolution of metabolism, Present day Prokaryotes, Eukaryotic Cells, Development of multicellular organisms.
2. **Cells as experimental models**: *Escherichia coli Yeasts, Dictyosteliun discoideum, Caenorhabditis elegans, Drosophila melanogaster, Arabidopsis thaliana*
5. **Techniques in Molecular cell biology:** Microscopy-light, phase-contrast, fluorescence, confocal, scanning electron microscopy. Use of radioisotopes, cell culture, fractionation of cells contents.
6. **Transport across membranes**: Simple Diffusion, Facilitated diffusion, Active transport, Energetics of transport.
7. **Oxidative metabolism in Mitochondira**: Electron transport chain, Chemiosmotic coupling, role of mitochondria in the formation of ATP.
8. **Phototrophic Energy Metabolism**: Light Harvesting, NADPH Synthesis, ATP Synthesis.
9. **Cell signalling:** Modes of cell-cell signaling, hormones and their receptors, functions of cell surface receptors, pathways of intracellular signal transduction.
10. **Regulators of cell cycle progression**: MPF, families of cyclins and cyclin dependent kinases, Growth factors, cell cycle inhibitors.
11. **Cancer:** Properties of cancer cells, types of cancer, virus-induced cancer, oncogenes tumor-suppressor genes, Apoptosis.

References:

1. Pollard, T.D. and Ernshaw, W.C. (2002). Cell Biology. Elsevier Science (USA)
2. Becker, W.M., Kleinsmith, L.J. and Hardin, J. (2000). The World of the Cell. The Benjamin/Cummings Publishing Company.
3. Cooper, G.M. (2000). The Cell – A Molecular Approach. ASM Press, Washington, D.C.
4. Karp, G. (1999). Cell and Molecular Biology: Concepts and Experiments. John Wiley & Sons Inc., New York.
5. Smith, C.A. and Wood, E.J. (1993). Cell Biology: Molecular and Cell Biochemistry. Chapman & Hall, London
6. Purves, W.K., Oriam, G.H., Hellen, H.C., Sadana, D. (1998). Life. The Science of Biology. W.H. Freeman and company, Utah.
7. Sadava, D.E. (1993). Cell Biology : Organelle Structure and Function. Jones and Barlett Publishers, Boston, London.

BSL581 - Agroforestry Systems

Credits: 3-0-0

1. **Introduction**: The history of agroforestry, Definition and concepts of agroforestry, community forestry, farm forestry, and social forestry.
2. **Classification of Agroforestry Systems**: Structural classification of systems Classification based on function of systems. Ecological classification. Classification based on socioeconomic criteria. A framework for classification. Agroforestry systems and practices.
3. **Distribution of Agroforestry Systems in the Tropics**: The tropical environment. Distribution of tropical agroforestry systems. Agroecological spread of tropical agroforestry systems.
4. **Shifting Cultivation and Improved Fallows**: System overview, soil management and shifting cultivation, the evolution of planted fallows. Improved tree fallows.
5. **Plantation Crop Combinations**: Integrated land-use systems with plantation crops. Small holder systems with coconuts: a notable example of integrated land-use. Crop combinations with other plantation crops. Multistory tree gardens.
6. **Alley Cropping**: Nutrient yield. Effect on soil properties and soil conservation. Effect on crop yields. Future directions.
7. **Other Agroforestry Systems and Practices**: Tree fodder and silvopastoral systems. Agroforestry for firewood production. Intercropping under scattered or regularly planted trees. Agroforestry for reclamation of problem soils. Underexploited trees in indigenous agroforestry systems. Buffer-zone agroforestry.
8. **Agroforestry Species**: Multipurpose trees (MPTs). Herbaceous species.
9. **Component Interactions**: Positive (production-enhancing) interactions. Negative (production- decreasing) interactions. Component management.
10. **Effects of Trees on Soils**: Beneficial effects. Adverse effects.
11. **Field experiments in Agroforestry**: Agroforestry research, different perspectives. Principles of field experimentation. Special considerations in agroforestry experiments. The current state of agroforestry field experimentation. Prognosis of the directions in agroforestry research.

12. **Sociocultural considerations**: Agroforestry as a social science. Important sociocultural factors in agrogorestry. Farmer's perception of tree planting. Government policies and agroforestry implementation. Social acceptability of agroforestry.
13. **Evaluation of agroforestry systems**: Productivity evaluation. Sustainability evaluation. Adoptability evaluation. Towards development of a methodology for evaluating agroforestry systems.

References:

1. Nair, P.K.R.(1993). An introduction to Agroforestry. Kluwer Academic Publishers, London
2. Indian Council of Agricultural Research (1979) Proceedings of National Seminar on Agroforestry, May, 1979, ICAR, New Delhi India
3. Raintree, J.B. (1987) The state of the art of agroforestry diagnosis and design. Agroforestry Systems 5:219-250
4. Evans, J.(1992) Plantation Forestry in the Tropics, 2nd edition Clarendon Press, Oxford, U.K.
5. MacDicken, K.G and Vergara, N.T. (eds.) 1990. Agroforestry: Classification and Management. JohnWiley, New York, USA
6. Nair, P.K.R(eds.) (1989) Agroforestry Systems in the Tropics, Kluwer, Dordrecht, The Netherlands
7. Grigg, D.B.(1974) The agricultural systems of the world. Cambridge University Press, London, U.K.
8. Bavappa, K.V.A. and Jacob, V.J. (1982) High intensity multispecies cropping: A new approach to small scale forming in tropics. World Crops, 47-50.

BSL582 - Seed Biotechnology

Credits: 3-0-0

1. **Seed Enhancements:-** Seed hydration – prehydration priming and solid matrix priming , preplant germination, factors affecting priming.
2. **Synthetic seed Biotechnology:** Introduction, culture procedure, drying, storage, encapsulation, germination etc. Advantages and Disadvantages of artificial seeds, future prospects.
3. **Loss reduction biotechnology of seeds:** Introduction, Causes and magnitude of seed crop losses, loss reduction measures.
4. **Modern techniques in variety identification:** Various biochemical methods like electrophoresis, DNA profiling techniques. Use of machine vision. Applications of variety identifications and future trends.
5. **Commercial seed treatment technology:** Introduction, Biological seed treatments against diseases or pests, Pelleting, coating or other techniques to alter physical characteristics, future directions.
6. **Molecular farming using seeds as hosts:** Seed storage proteins, strategies for protein targeting, examples of recombinant proteins produced in seeds. Advantages and prospects of seed based molecular farming.
7. **The seed production industry:-** Functions of the seed industry. Growth and Development of the seed industry- Indian as well as international. Indian seed exports and imports. Genetically Modified Organisms (GMOs) in seed industry.

References:

1. Desai, B.B., Kotecha, P.M. Salunkhe, D. K. (1997). Seeds Handbook. Biology, Production, Processing, and Storage. Marcel Dekker, Inc; New York. pp. 1-627.
2. Black, M and Beewley, J.D. (2000). Seed Technology and its Biological Basis. Sheffield Academic Press, CRC Press, Boca Raton, U.S.A., pp. 1-419.
3. Black M, Bradford K J and Vazquez- Romos J. (2000) (Editors) Seed Biology - Advances and Applications Proceedings of the sixth International Workshop on seeds, Merida, Mexico, 1999. CABI Publishing, Oxon pp. 1-508.

4. Basra A S (1995) (Ed.) Seed Quality Basic Mechanisms and Agricultural Implications. Variety identification: Modern Technologies and Applications (Robert J. Cook). Food Product Press, New York.pp. 279-318.
5. Copeland L O, McDonald M B (1995). Principles of Seed Science and Technology. (3rd Edition) Chapman and Hall, New York
6. Kelly A F and George RAT (1998) (Editors). Encyclopedia of Seed Production of World Crops. Cultivars identification: Review of new methods (R J Cooke and J C Reeves). John Wiley and Sons, New York, pp. 88-111.

BSL583 - Human Values and Professional Ethics

Credits: 3-0-0

INTRODUCTION TO VALUE EDUCATION

1. Understanding Value Education
2. Self-exploration as the Process for Value Education
3. The Program to Fulfil Basic Human Aspirations
4. The Basic Human Aspirations - Continuous Happiness and Prosperity

UNDERSTANDING THE HARMONY AT VARIOUS LEVELS

5. Understanding the Human Being as Co-existence of Self ('I') and Body
6. Harmony in the Self ('I') - Understanding Myself
7. Harmony with the Body - Understanding Sanyama (Self regulation) and Svasthya (Health)
8. Harmony in the Family - Understanding Values in Human Relationships
9. Harmony in the Society - From Family Order to World Family Order
10. Harmony in Nature - Understanding the Interconnectedness and Mutual Fulfilment
11. Harmony in Existence - Understanding Existence as Co-existence

IMPLICATIONS OF THE RIGHT UNDERSTANDING

12. Providing the Basis for Universal Human Values and Ethical Human Conduct
13. Basis for the Holistic Alternative towards Universal Human Order
14. Professional Ethics in the Light of Right Understanding
15. Vision for Holistic Technologies, Production Systems and Management Models
16. Journey towards the Holistic Alternative - The Road Ahead

References:

1. Gaur, R.R., Sanghal, R. and Bagaria, G.P. (2010), A foundation Course in Human Values and Professional Ethics. Excel Books, New Delhi

2. Seebauer, E.G. and Berry, R.L. (2000). Fundamentals of Ethics for Scientists and Engineers. Oxford University Press.

3. Tripathy, A.N.(2003), Human Values, New Age International Publishers.

4. www.universalhumanvalues.info

BSL584 - Genomics, Transcriptomics and Proteomics

Credits: 3-0-0

1. **Defining genome and genomics,** sequencing complete genomes, genomic databases.
2. **Physical mapping of DNA**, Restriction site mapping, hybridization mapping.
3. Finding genes in genomes of (bacterial genome and higher eukaryotic genomes), detecting non-coding RNA genes
4. **Genomic variation:** Can genome diversity affect global warming, human SNPs and their relation to diseases and therapies, ethical consequences of genomic variations.
5. **Defining transcriptome and transcriptomics**, methods for large scale analysis of gene expression.
6. **Microarrays:** Introduction; properties and processing of array data, Microarray standards and databases.
7. **Defining proteome and proteomics:** amino acid residue conservation, substitution matrices.
8. **Protein analysis:** major proteomic approaches, data processing, major protein identification programs.
9. **Conceptional models of proteins structure**, obtaining viewing and analyzing structural data, structural alignment.
10. **Classification of proteins** of known 3-D structure. CATH and SCOP. Protein structure prediction.

References:

1. Zimmermann, K. (2003). An Introduction to protein Informatics. Kluwer Academic Publishers. The Netherland.
2. Christine, O., David, J. and Thornton, J. (2003). Bioinformatics: genes, proteins and computers. 1st Edition. Bios Scientific Publishers. Oxford, United Kingdom.
3. Setubal and Meidanis. (2008). Introduction to computional Molecular Biology. 1st Edition. Krishna offset.New Delhi.
4. Baxevanis, A.D. and Onellette, B.F.F. (2005). Bioinforamtics: A Practical guide to the analysis of genes and proteins.3rd edition. John Willey. Hoboken, New Jersey.
5. Cambell, A.M. (2003). Discovering Genomics, Proteomics and Bioinformatics. Banjamin Cummings Publishers. San Franciso.

BSL585 - Dynamics of Biogeography

Credits: 3-0-0

1. **Biogeography and its History:** Basic principles, its relationship to physiography and other modern sciences, biology, geography, biodiversity, and landscape ecology, age of exploration, biogeography of 18th , 19th and 20th centuries, biogeographic distribution of globe., vegetation types and classification of floristic regions.

2. **Geological History of the Earth:** The geological time scale, Wegner's theory of continental drift, tectonic history of the planet, patterns of continents, Gondwanaland, Laurasia, assembly and breakup of Pangaea, early life on moving continents, the Cretaceous extinctions, development of marine basins and island chains, Epeiric, Mediterranean and Red seas, dynamics of Pacific ocean, glaciations and biogeographic dynamics of the Pleistocene.

3. **Climate and Environment:** Physical setting of the planet, climatic zones of the world, ombrothermic and climate diagrams, solar energy and temperature regimes, winds and rainfall, soils and successions, formation of major soil types, aquatic environments, stratification and oceanic circulation.

4. **Island Biogeography**: Types of islands, islands as model systems, MacArthur-Wilson theory of island biogeography, Effects of size and distance, equilibrium equation, modifications caused by selective nature of immigration and extinction and interspecific interactions.

5. **Distributions of Single Species:** The geographic range projections and geographic coordinate systems, mapping and measuring range, distribution of individuals, populations and ecosystems, Hutchinson's multidimensional niche concept, relationship between distribution and abundance.

6. **Dispersal and Immigration:** Mechanisms of active and passive dispersal, Physiological, ecological and psychological barriers, biotics, exchange and dispersal routes: corridors, filters, sweepstakes routes, dispersal curves within and among species, establishment of colony and habitat selection, ecosystem theories (Wedge effect, Bergmann's rule, Allen's rule, Gloger's rule, Jordon's rule and Merriam's classification).

7. **Species Introductions:** Intentional and accidental, effects of non-native (invasive) species on the local flora, magnitude of the problem, concept of invasibility.

References:

1. Brown, J.H. and Lomolino, M.V (1998). Biogeography. Sinauer Associates Inc., Sunderland, Massachusetts.

2. Cox, C. B. and Moore, P.D. (2000). Biogeography – An Ecological and Evolutionary Approach. Blackwell Scientific Ltd. pp. 298. London.

3. Fahrig, L., and K. Freemark. (1994). Landscape-scale effects of toxic events for ecological risk assessment. In J. Cairns and B.R. Niederlehner (eds.), Ecological Toxicity Testing, Scale, Complexity, and Relevance. Lewis Publishers, Boca Raton, FL.

4. Weinstein, D.A., and H.H. Shugart. (1983). Ecological modeling of landscape dynamics. In H.A. Mooney and M. Godron (eds.), Disturbance and Ecosystems. Springer-Verlag, New York.

BSL586 - History of Science in India

Credits: 3-0-0

1. Science and Education in Ancient India: Indian scholars. The Gurukula System science in ancient Indian scriptures-Vedas, Samhitas.
2. Western and Inidna Concepts of Science, views of the West and India towards logic and experiments.
3. Biology, medical science, astronomy, mathematics, garment industry, architecture, agriculture etc. in India. Science in Indus Valley Civilization. The great centres of learning-Takschila and Nalanda University, Nadiyad, Amaravati, Ujjayini, Kashi etc.
4. Scientific methods and scietists of India: C. V. Raman, Charka, Homi Jehangir Bhabha, J.C. Bose, Shanti Swarup Bhatnagar, Susruta, Vkram Sarabhai, Aryabhata, Bhaskara, Varahamihira etc.
5. Impact of science on modron life: Summery of scientific and technological developments in India, important recent scientific discoveries.

References:

1. Swadeshi Science Movement, Indian Contribution to Science(Junior). Swadeshi Science Movement, Cochin, pp 1-111.
2. Awakening Indians to India (2003). All India Chinmaya Yuva Vendra. Central Chinmaya Mission Trust, Mumbai
3. Jain, N.K. (2001). Science and scientists in India. Kalyani India, Delhi pp 1-162.
4. Jain, N.K. (1990), History of Science and Scientific Methods. Oxford and IBMPublishing Co. Pvt. Ltd., New Delhi. pp 1-274.
5. Soni, S. (2006), India's Glorious Scientific Tradition, Ocean Books Pvt. Ltd., New Delhi pp 1-248
6. Samskrita Bharati (2007), Science in Samskrit. Samskrita Bharati, New Delhi 1-147
7. Samskrita Bharati. (2006). Pride of India- A glimpse into India's scientific heritage. Samskrita Bharati, New Delhi pp 1-208

BSL587- Immunology

Credits: 3-0-0

An Overview of the Immune System : Historical perspective, an introduction to the immune system – innate and adaptive immunity. Immunodeficiencies : secondary immunodeficiency disorders.

Antigens and Antigen Recognition : Antigens: prerequisites for immunogenicity, relative immunogenicity of different types of molecules, Molecules that enhance immunogenicity. Activators of hympocytes: antigens, superantigens, mitogens. Antigen recognition by cells of innate immunity & adaptive immunity.

Antibodies: Gamma globulins; structure, bifunctional property of antibodies, determining bifunctionality, cross reactivity, Antigen antibody interactions: primary interactions, secondary interactions. Classification of antibodies: Isotypes, Allotypes, properties & biological functions of antibody isotypes, IgG,IgE,IgM, IgD, IgA, Monoclonal antibodies

Cells and Tissues of Immunity: Lymphoid tissues: primary & secondary lymphoid tissues, cells of innate immunity : phagocytes, antigen presenting cells, natural killer cells, Eosinophils, mast cells and basophills, B- cells, secondary immune responses.The major histocompatibility complex, antigen process and antigen presentation, complement.

The immune system in Health & Disease, specially AIDS.

Books Recommended:

1. Goldsby, R.A. Kindt, T.J., Oxborne B.A., Kuby, J. (2003). Immunology.W.H. Freemen & Company, NewYork.
2. Stanley, J. (2002). Essentials of Immunology and Serology. Delmar Thomson Learning, USA

ESL581 - Urban Planning and Development

Credits: 3-0-0

1. **Historical Perspectives:** The roots of planning, Classic planning, planning theories: Haussman's Boulevards, Sitte's artistic planning, Howard's garden city.

2. **Economy in Urban Systems Models:** Causes and effects in urban development, components of growth model, economic base-multiplier model, Input-out model, Economy and Quality of urban life, Land-use forecasting, modeling framework, trend model, gravity model, intervening opportunity mode, land market model.

3. **City Planning:** Evolution of cities, principles of city planning, types of cities & new towns, planning regulations and building byelaws, eco-city concept, sustainable development.

4. **Housing**: Concept of housing, neighbourhood concept, site planning principles, housing typology, housing standards, housing infrastructure, housing policies, finance and management, housing programs in India, self help housing.

5. **Environmental Studies in Building Science**: Components of Ecosystem, ecological principles concerning environment, climate responsive design, energy efficient building design, thermal comfort, solar architecture, principles of lighting and styles for illumination, basic principles of architectural acoustics, environment pollution, their control & abatement.

6. **Development of Contemporary Architecture**: Architectural developments and impacts on society since industrial revolution, influence of modern art on architecture, works of national and international architects, art novuea, eclecticism.

7. **Building Services**: Water supply, sewerage and drainage systems, sanitary fittings and fixtures, plumbing systems, principles of internal & external drainage systems, principles of electrification of buildings, intelligent buildings, elevators & escalators, their standards and uses, air-conditioning systems, fire fighting systems, building safety and security systems.

8. **Materials and Structural Systems**: Behavioural characteristics of all types of building materials e.g. mud, timber, bamboo, brick, concrete, steel, glass, FRP, different polymers, composites, principles of strength of materials, design of structural elements in wood, steel and RCC, elastic and limit state design, complex structural systems, principles of pre-stressing, tall buildings, principles of disaster resistant structures.

9. **Techniques of Planning**: Planning survey techniques, preparation of urban and regional structure plans, development plans, action plans, site planning principles and design, statistical methods of data analysis, application of G.I.S and remote sensing techniques in urban and regional planning, decision making models.

10. **Traffic and Transportation Planning**: Principles of traffic engineering and transportation planning, traffic survey methods, design of roads, intersections, grade separators and parking areas, hierarchy of roads and levels of services, traffic and transport management in urban areas, intelligent transportation system, mass transportation planning, para-transits and other modes of transportation, pedestrian & slow moving traffic planning.

References:

1. Broadbent, G. (1990). Emerging concepts in urban space design. Van Nostrnd Reinhold (International) London.

2. Helly, W. (1975). Urban system models. Academic Press. New York.

3. Hambleton, R. (!978). Policy Planning and Local Government. Hutchinson of London. London.

4. Sain, M. (1982). Urban planning in third world. Mansell P Publishing Limited. London.

ESL582 - Preventive and Social Medicine

Credits: 3-0-0

1. **Concepts in Community Health**, Genetics and Health, Sociology and Health, Nutrition and Health

2. **Environment and Health:** ` Water, Air, Ventilation, Lighting, Noise, Radiation, Meteorological Environment, Housing, Solid Wastes Disposal, Excreta Disposal, Medical Entomology, Insecticides, Rodents.

3. **Epidemiology :** Epidemiologic methods, Uses of epidemiology, Screening for disease, Epidemic Investigation, Infectious disease epidemiology, Disease transmission, immunity, immunizing agents, disease control and prevent, health advice to travelers, hospital acquired, infection, disinfection.

4. **Diseases : A) Communicable** I) Respiratory Tract Infections – smallpox, chickenpox, measles, rubella, mumps, influenza, diphtheria, whooping cough, tuberculosis. II) Intestinal Infections – poliomyelitis, viral hepatitis, cholera, typhoid fever, food poisoning, amoebiasis, ancylostomiasis, III) Arthropod borne infections –yellow fever, dengue, KFD, rickettsial diseases, plague., malaria, sleeping sickness, kala azar, filariasis. IV) Suface Infections – Rabies, trachoma, tetanus, AIDS, leprosy, STD, yaws.
B) Non-Communicable Diseases and Conditions Cancer, cardiovascular diseases, Diabetes.

Reference:

Park, J.E. & Park, K. (1991). Preventive and Social Medicine. M/S Banarsidas Bhanot, Jabalpur.

ESL583 - Geoinformatics in Environmental Management

Credits: 3-0-0

1. **Introduction:** Geoinformatics and geographic information sciences, components of geoinformatics, applications of geoinformatics, approach to the study of geoinformatics, legal implications, geoinformatics and environmental modelling, GIS data collection, concept and techniques of geoinformatics.
2. **Surveying Technology:** Introduction, surveyors, datum and reference systems, survey operations classification of surveys, principles of surveying, methods of surveying, stages in surveying, modern trends in surveying and mapping.
3. **Cartography:** Introduction, task of cartographer, model of cartographic communication, cartographic symbolization, cartographic generalization, cartographic design, thematic cartography, digital cartography, conventional mapping Vs. Digital mapping, layout and numbering of topographical maps, classification of maps and map projections.
4. **Photogrammetry:** Introduction, brief history of photogrammetry, stereo photogrammetry, stereoscopic parallax, aerial photography: classification, geometry and scale of vertical aerial photographs, aerial triangulation, digital or soft copy photogrammetry.
5. **Global Positioning Systems (GPS) and Satellites:** Introduction, GPS elements, GPS satellite constellation and signals, GPS measurements, GPS instrumentation, earth resources satellites, meteorological satellites, satellite carrying microwave sensors, OCEANSAT-1(IRS-P4) and Ikonos satellite series.
6. **Geodesy:** Definition, problems of geodesy, the ellipsoid of revolution, coordinate system of rotational ellipsoid, spatial ellipsoid coordinate system, computations on the ellipsoid and satellite geodesy.
7. **Geographic Information Systems:** Introduction, roots of GIS, overview of information system, the four Ms, GIS architecture, theoretical models of GIS, theoretical frame work for GIS, GIS softwares, GIS applications and GIS operations.
8. **Forest Resources Management:** Geomatics in forestry, forest cover mapping and change detection, forest inventory (stock mapping), parameters of forest inventory, development of working plan, Forest Management Information system(FMIS), forest fire forecasting and risk area mapping, biodiversity characterization, wildlife habitat mapping.
9. **Watershed Management:** Introduction, concept of watershed, GIS database for watershed management, model watershed, landuse and landcover, slope analysis, soil mapping, hydrogeomorphological mapping, groundwater prospects map and drainage mapping

10. **Water Quality Mapping and Modelling:** Introduction, role of GIS and remote sensing in water quality mapping and modeling, case study of Hyderabad city, correlation between water quality and groundwater level, correlation between water quality index and landuse, groundwater quality studies using SPANS and evaluation of impact of landuse / land cover changes on groundwater quality.
11. **Management of Natural Disaster (Landslides):** Introduction, types and features and causes of landslides, landslide analysis, remote sensing for landslide mapping, landslide analysis in GIS, hazard mapping of landslides, case study of Kohima area.
12. **Urban Planning and Management:** Introduction, role of GIS and remote sensing in urban planning and management, issues in urban planning, urban land use and infrastructure identification and delineation, urban transport network identification and mapping, urban city guide map change detection and updation.

References:

1. Curran, P.J. (1988). Principles of Remote Sensing. E.L.B.S., Longman Scientific and Technical, Harlow.

2. Reddy, M.A. (2004).Geoinformatics for Environmental Management. BS Publications, Hyderabad.

3. Smith, K. (1996). Environmental Hazards. Routledge Publishers, London.

4. Ustin, S.L. (Ed.) (2004). Remote Sensing for Natural Resource Management and Environmental Monitoring. John Wiley & Sons, U.S.A.

ESL584 - Ecological Biochemistry

Credits: 3-0-0

1. **Biochemical Adaptation of Plants to Environment:** Adaptation to climate, soil, detxification mechanisms.

2. **Biochemistry of Plant Pollination:** Role of flower colour, flower scent, nectar and pollen

3. **Plant Toxins and their Effects on Animals:** Different classes of plant toxins, cyanogenic glycosides, cardiac glycosides, pyrrolizidine alkaloids, utilization of plant toxins by animals.

4. **Hormonal Interactions Between Plants and Animals:** Plant estrogens, insect moulting hormones in plants, insect juvenile hormones in plants, pheromones.

5. **Insect Feeding Preferences:** Biochemical basis of plant selection by insects, secondary compounds as feeding attractants, secondary compounds as feeding deterrents.

6. **Feeding Preferences of Vertebrates:** Domestic animals, wild animals, birds, man.

7. **Coevolution:** Static plant defence, induced plant defence, animal response.

8. **Animal Pheromones and Defence Substances:** Insect pheromones, mammalian pheromones, defence substances.

9. **Biochemical Interactions Between Higher Plants:** Allelopathy, biochemistry of host-parasite interactions.
10. **Higher Plant-lower Plant Interactions**: Biochemical basis of disease resistance, phytotoxins.

Reference:

1. Harborne, J.B. (1992). Ecological Biochemistry. Academic Press Ltd., London.

ESL585 - Design and Analysis of Experiments

Credits: 3-0-0

Strategy of experimentation, Basic principle, Guidelines for designing experiments. Experiments with single factor: ANOVA, Model adequacy checking, Interpretation of results, Use of computers in analysis.

Randomized complete block design, Latin square design, factorial design, two factor factorial design with design example, Fitting response curve and surfaces, Blocking in factorial design.

Two level fractional factorial design: One half fractional 2^k design, One-quarter fraction of 2^k design, Resolution III, IV, and V designs.

Fitting regression models: Linear regression models, Estimates of parameters in linear regression models, Hypothesis testing, Confidence intervals, regression model diagnostic, Scaled residuals and PRESS, Testing of lack of fit.

Response surface methods and process optimization: Method of steepest ascent, Analysis of second order response surface, Mixture experiments, Robust design.

References:

1. Box, G.E.P. and Draper, N.R. (1987) Empirical model building and response surfaces, 2nd ed., Wiley, New York.
2. Cochran and Cox. Experimental design, 2nd ed., Wiley, Singapore.
3. Draper N.R., Smith H. (2004) Applied regression analysis, 3rd ed., Wiley, New York.
4. Montgomery D.C., Peck E.A. (1992) Introduction to Linear regression analysis, 2^{nd} ed., Wiley, New York.
5. Montgomery, D.C. (2004) Design and analysis of experiments, 5th ed., Wiley, Singapore.
6. Myers R.H., Montgomery D.C. (1995) Response Surface Methodology: Process and Product Optimization Using Designed Experiments, Wiley, New York.
7. Ravindran A., Ragsdell K.M., Reklaitis G.V. (2006) Engineering optimization: Methods and applications, 2nd ed., Wiley, Singapore.

ESL586 Chemical and Biochemical Engineering

Credits: 3-0-0

Overview of Chemical and Biochemical engineering, Introduction to Reactor design, Enzymes, Cofactors, Effect of temperature, pH and trace elements on biochemical processes.

Kinetics of substrate utilization: Ideal reactor for kinetic measurements, Batch, CFSTR, Monod kinetics, Product limiting microbial fermentation, Mathematical modeling of batch growth, Specific growth rate.

Structured kinetic models: Compartment models, Metabolic models, Modeling of cell growth as an optimum process,

Transport phenomenon in bioprocess systems, Gas-Liquid mass transfer in cellular system, Determination of oxygen transfer rate, Measurement of KLa, Factors affecting. KLa, Non Newtonian fluids, Heat transfer, Sterilization of gases and liquids by filtration.

References:

1. Bailey, J.E, Ollis, D.F. Biochemical Engineering Fundamentals, 2nd ed., McGraw Hill, 1986.
2. Bungay, H.R., Belfort, G. Advanced Biochemical Engineering (Ed.), John Wiley & Sons, 1987.
3. Cappuccino, J.G., Sherman, N. Microbiology A Laboratory Manual, Pearson Education, 2005.
4. Casida, L.E. Jr. Industrial Microbiology, New Age International, 1968.
5. Levenspiel, O. Chemical Reaction Engineering, 3rd ed., John Wiley & Sons, 2004.
6. Nazaraff, W.W., Alvarez-Cohen, L. Environmental Engineering Science, John Wiley & Sons, 2004.
7. Sawyer, C.N., McCarty, P.L., Parkin, G.F. Chemistry for Environmental Engineering and Science, Tata McGraw Hill, 2003.
8. Segel, Biochemical Calculations: How to solve Mathematical Problems in General Biochemistry, 2nd Ed., John Wiley & Sons.