

BHARTI UNIVERSITY

DURG (C.G.)

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SCHEME OF EXAMINATION

&

SYLLABUS

Of

Bachelor of Science (Honors)

UNDER

FACULTY OF BOTANY

(Approved by Board of Studies)

Effective from Nov. 2021

B. Sc. (Hon's) examination will be conducted in six semesters.

	Course Code	Course Title	THEORY	TEACHER ASSESMENT	Total marks
Semester-I					
CORE-1	LBC 101	LBC 101: Plant Diversity I (Virus, Bacteria, Algae & Fungi)	70	30	100
	LBC 102	LBC 102: Plant Diversity II	70	30	100
	LBCL 103	Lab. exercises based on course LBC-101 & LZC-102	70	30	100
GE-1	GE-I	1. Physics-I 2. Mathematics-I 3. Zoology-I 4. Chemistry-I	70	30	100
AECC	AECC	English Communication / MIL	70	30	100
ECA	ECA	ECA-Extracurricular activity/ Tour, Industrial training/ Field visit, NSS/ Swachhta/ vocational Training/ Sports/ others			100
Semester –II					
CORE 2	LBC 201	LBC 201: Taxonomy And Embryology Of Angiosperms	70	30	100
	LBC 202	LBC 202: Cell & Molecular Biology	70	30	100
	LBCL 203	Lab. exercises based on course LBC 201and LZC 202	70	30	100
GE-2	GE-II	A. Physics-II B. Mathematics-II C. Zoology-II D. Chemistry-II	70	30	100
AECC	AECC	Environmental Science	70	30	100
ECA	ECA	ECA-Extracurricular activity/ Tour, Industrial training/ Field visit, NSS/ Swachhta/ vocational Training/ Sports/ others			100
Semester –III					
CORE-3	LBC 301	LBC 301: Plant Physiology	70	30	100
	LBC 302	LBC 302: Genetics And Biostatistics	70	30	100
	LBCL 303	Lab. Exercises based on course LBC 301and LBC 302	70	30	100

GE-3	GE-III	A. Physics-III B. Mathematics-III C. Zoology-III D. Chemistry-III	70	30	100
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Semester –IV

	LBC 401	LBC 401: General Microbiology	70	30	100
	LBC 402	LBC 402: Plant Pathology	70	30	100
	LBC 404	Lab. Exercises based on LBC 401 and LBC 402	70	30	100
GE-4	GE-IV	A. Physics-IV B. Mathematics-IV C. Zoology-IV D. Chemistry-IV			100

Semester –V

CORE-4	LBC 501	LBC 501: Plant Anatomy	70	30	100
	LBC 502	LBC 502: Plant Developmental Biology	70	30	100
	LBC 503 (IDLS)	LBC 503: Analytical Techniques in Plant Sciences	70	30	100
DSE-1	LBC 504	LBC 504 : Elective I	70	30	100
	LBCL 505	LBCL 505 based on LBC 501 and 502	70	30	100
	LBCL 506	Lab. exercises based on courses LBC 503 and 504	70	30	100
	LBC 507	Seminar & Skill enhancement course (1&2)	50	50	100

Semester –VI

CORE-5	LBC 601	LBC 601: Plant Ecology	70	30	100
	LBC 602	LBC 602: Plant Biochemistry	70	30	100
	LBC 603	LBC 603: Biodiversity And Its Conservation	70	30	100
DSE-2	LBC 604	Elective courses II (LBC 604)	70	30	100
	LBC 605	Lab. exercises based on courses LBC 601, 602 & 603	70	30	100
	LBC 606	Lab. exercises based on courses LBC 604	70	30	100
	LBC 607	Dissertation work & Skill enhancement course (3&4)	50	50	100

BOTANY (ELECTIVES I&II)

Elective courses I (LBC 504) DSE-1

LBC 504 (a) PLANT TISSUE CULTURE TECHNOLOGY

LBC 504 (b) MICROBIAL TECHNOLOGY

LBC 504 (c) ETHNOBOTANY AND MEDICINAL PLANT

LBC 504 (d) BIOINFORMATICS

Elective courses II (LBC 604) DSE-2

LBC 604 (b) MICROBIAL GENETICS

LBC 604 (c) GENETIC ENGINEERING AND CROP IMPROVEMENT

LBC 604 (d) ENVIRONMENTAL CLEANUP TECHNOLOGY

LBC 604 (e) COMPUTATIONAL BIOLOGY

LBC 604 (f) BIOSTATICS

LBC (507): SKILL ENHANCEMENT COURSE (ANY TWO)

SEC-1: GREEN METHODS IN BOTANY
SEC-2: INTELLECTUAL PROPERTY RIGHTS (IPR)
SEC.3: BASIC ANALYTICAL BOTANY
SEC-4: PHARMACEUTICAL BOTANY

EXPERIMENT	MARKS
Experiment	70
Viva-voce	10
Teacher Assessment	20
TOTAL MARKS	100

CORE COURSE (HONOURS IN BOTANY)

SEMESTER- I

LBC 101: PLANT DIVERSITY I (VIRUS, BACTERIA, ALGAE & FUNGI)

Unit 1

Viruses: General characteristics, general account of Retrovirus, TMV; Bacteria: General characteristics, cell structure of Gram Positive and Gram negative bacteria, mycoplasma.

Unit 2

Cyanobacteria: General characteristics; heterocyst and akinetes; General account of *Nostoc*, *Oscillatoria* and *Scytonema*; Economic importance of cyanobacteria. General account of actinomycetes.

Unit 3

Algae: General characteristics; Chlorophyceae: *Volvox*, Xanthophyceae: *Vaucheria*; Phaeophyceae: *Sargassum*; Rhodophyceae: *Polysiphonia*; Single cell protein, Economic importance of algae.

Unit 4

Fungi: General characteristics; Mastigomycotina: *Phytophthora*; Zygomycotina: *Rhizopus*; Ascomycotina: *Peziza*; Basidiomycotina: *Puccinia*; Deuteromycotina: *Alternaria*.

Suggested Readings:

1. Alexopoulos and Mims, 1996. An introduction to fungi. Wiley, New York
2. Ananthanarayan and Paniker: 7th Edition. A text book of Microbiology, Orient Blackswan Publisher, Delhi
3. Kumar H D, 1990. Introductory Phycology. East-west Press, India
4. Lee R E. 2008. Introduction to Algae. Cambridge University Press, U K.
5. Pelczar Mi J., Chan, E.C.S., Krieg, NR, 1972. Microbiology, McGraw-Hill publisher, Columbus, OH
6. Prescott ML, 2000: Microbiology. McGraw-Hill Publisher, Columbus, OH

LBC 102: PLANT DIVERSITY II
(BRYOPHYTES, PTERIDOPHYTES GYMNOSPERMS)

Unit 1

Bryophyta: General characteristics, Hepaticopsida (*Marchantia*), Anthocerotopsida (*Anthoceros*) and Bryopsida (*Funaria*). Alternation of generations in bryophytes

Unit 2

Pteridophyta: General characteristics; Lycopsida: *Selaginella*, Sphenopsida: *Equisetum* and Pteropsida: *Marsilea*. stelar system in pterodophytes, heterospory and origin of seed habit.

Unit 3

Gymnosperm: General characteristics, General account of *Cycas*, *Pinus* and *Ephedra*; Economic importance of gymnosperms.

Unit 4

Paleobotany: Fossil and its type; fossilisation, carbon dating. Type study: *Rhynia*, *Lepidodendron*

Suggested readings

1. Biswas C. And Johri B M, 1997. The Gymnosperms:, Springer-Verlag, Germany.
2. K R Sporne, 1962. The Morphology of Pteridophytes: Hutchinson University Library, UK, London.
3. Parihar N.S. 1977. An introduction to embryophyta Voll II. Pteridophytes. Central Book Depot, Allahabad.
4. Parihar, N.S. 2010 (digitized), An introduction to Bryophyta Vol I: Bryophytes: Central Book Depot, Allahabad.
5. Bhatnagar S P & Moitra A. 1996 Gymnosperms:, New Age International, Italy.

LBCL 103: based on LBC 101 and 102

LBC 101: Practical

1. Micro preparation observations of bacteria and viruses.
2. Gram staining of bacteria
3. Identification of cyanobacterial specimens
4. Identification of algal specimens
5. Identification of fungal specimens

Field trips: for habitat study & collection of samples

LBC 102: Practical

1. Study of *Marchantia*, *Anthoceros*, *Funaria*,
2. Study of *Selaginella*, *Equisetum*
3. Study of *Cycas*, *Pinus*, *Ephedra*
4. Cones of *Cycas*, *Pinus*, *Ephedra*
5. Study of fossil slides

Field trips: for habitat study & collection of samples.

SEMESTER - II

LBC 201: TAXONOMY AND EMBRYOLOGY OF ANGIOSPERMS

Unit 1

Characteristic features, origin and evolution of Angiosperms, Nomenclature of plant, Main points of ICB (ICN).

Unit 2

General feature and classification of Angiosperms, merits and demerits (Bentham and Hooker, Takhtajan); Modern trends in plants taxonomy.

Unit 3

General features of the following families: Ranunculaceae, Malvaceae, Brassicaceae, Asclepiadaceae, Solanaceae, Asteraceae, Euphorbiaceae, Poaceae.

Unit 4

Embryology: structure of angiosperms flower, Androecium (stamens), pollen morphology only, Gynoecium (Ovary, style and Stigma). Types of ovary, ovules and placentation, Mature embryo sac, structure and main types. Pollination types, Double fertilization and triple fusion, Monocot and dicot embryo.

Suggested readings:

1. Bhojwani S and Bhatnagar S P, 2009. Embryology of Angiosperm, Vikas Publication House, New Delhi.
2. Eames, A.J, 1961: Morphology of Angiosperms, McGraw Hill Publication, New Delhi.
3. Pandey B P, 2001: Plant Anatomy, S Chand and Company, New Delhi.
4. Sharma O P, 2005. Plant Taxonomy, Tata Mc Graw Hill, New Delhi.

LBC 202: CELL & MOLECULAR BIOLOGY

Unit 1

Cell: Cell theory, plant cell. Plasma membrane: structure and function, Cell organelles: Mitochondria, Chloroplast, Endoplasmic Reticulum, Golgi body, Ribosome, Peroxisome, Nucleus & Nucleolus

Unit 2

Chromosome: chemical components; nucleosome, centromere, telomere, euchromatin and heterochromatin,

Unit 3

Cell cycle: Interphase nucleus: mitosis, meiosis, endomitosis; crossing over and its significance

Unit 4

DNA structure and its type; DNA replication: types of DNA replication, DNA replication in prokaryotes and eukaryotes, DNA damage and repair

Suggested Readings:

1. Alberts B, Johnson A, Lewis J, Raff M, Roberts K, Walter P. 2007. The Molecular cell
2. Biology of the Cell. Garland Science, UK.
3. Karp G. 2009. Cell and Molecular Biology: Concepts and Experiments, Wiley, USA
4. Nelson D L and Cox MM, 2012. Lehninger: Principle of Biochemistry, W H Freeman, SA
5. Pragya K, 2008. Cell and Molecular Biology, I K International Pvt Ltd, New Delhi
6. Rastogi S C, 2006. Cell and Molecular Biology, New Age International New Delhi

LBCL 203: based on LBC 201 and 202

LBC 201Practicals

1. Study of Floral characters and Floral diagram of representative member of some families: Malvaceae, Brassicaceae, Asclepiadaceae, Solanaceae, Euphorbiaceae, Poaceae
2. Study of type of ovary, ovules, placentation types, types of pollen grains and stages of dicotembryo.

Field trips: for habitat study & collection of samples.

LBC 202 Practical

1. Isolation of chloroplast using density gradient centrifugation method.
2. Laboratory study of mitosis and meiosis taking suitable example.
3. Isolation of DNA from plant.

SEMESTER - III

LBC 301: PLANT PHYSIOLOGY

Unit 1

Water relation of plants: Transport of solutes, Osmosis, Transpiration, Guttation: Mineral nutrition of plants: Role of micro-and macronutrients. Essential minerals.

Unit 2

Photosynthesis: photophosphorylation, C3, C4 and CAM pathways of carbon fixation, photorespiration.

Unit 3

Respiration: Glycolysis, TCA cycle, electron transport, oxidative phosphorylation, alpha and beta oxidation of fatty acid.

Unit 4

Plant growth hormones: Physiological role of auxins, gibberellins, cytokinins, abscisic acid and ethylene, Phytochrome: Structure and function; Photoperiodism; Vernalization; Seed dormancy

Suggested readings:

1. Devlin Robert M. 1983. Plant Physiology, Prindle Weber and Schmidt Publisher; 4th edition. UK
2. Hopkins, W.G. 1995. Introduction to Plant Physiology, John Wiley & Sons. Inc., New York, USA.
3. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones. Springer Verlag, New York, USA.
4. Pandey S N and Sinha B K. 2009. Plant physiology: Vikas Publishing, New Delhi
5. Singh G S. Renger G, Sopory, S K, Irrganag K D, Govindjee; 1999. Concepts in Photobiology, Photosynthesis and Phytomorphogenesis, Narosa Pub. House, New Delhi.
6. Taiz L and Zeiger E. 2010. Plant physiology. Sinauer Associates, UK.

LBC 302: GENETICS AND BIOSTATISTICS

Unit 1

Mendel's law of inheritance, back cross, test cross, incomplete dominance, codominance, epistasis. Non-Mendelian inheritance: cytoplasmic inheritance; organellar genetics: mitochondria; chloroplasts,

Unit 2

Chromosomal aberrations: Structural changes- deletion, duplication, inversion, translocation; Numerical changes-Aneuploidy- monosomy, trisomy; Euploidy nullisomy tetrasomy; monoploidy, haploidy and polyploidy.

Unit 3

Mutation and mutagens: Types of mutation, physical and chemical mutagens, significance of mutation

Unit 4

Collection, tabulation, frequency distribution, Central tendencies-Mean, Median, Mode, Standard deviation, chi-square tests.

Suggested Readings:

1. Bailey T.J. 200 Statistical methods in Biology Cambridge University Press. U K
2. Gupta, P.K. 2009. Text Book of Genetics. Rastogi Publications, Meerut.
3. John Ringo, 2004- Fundamental Genetics Cambridge University Press UK.
4. Lewin B, 2000. Genes VII, Oxford University Press UK
5. Rosner, B. 2010. Fundamentals of Biostatistics. Duxbury Press. CA, USA
6. Snustad Peter, D. Michael J. Simmons. 2010 Principles of Genetics, John Wiley Sons, New York

LBCL 303: based on LBC 301 and 302

LBC 301 Practical

1. Determination of diffusion pressure deficit (DPD)
2. Study of transpiration rate
3. Transpiration rate by Ganong's potometer
4. Study of effect of different light on photosynthetic rate
5. Separation of plant pigments by paper chromatography
6. Demonstration of osmosis phenomenon
7. Role of plant growth hormones

LBC 302 Practical

1. Study of different type of chromosomes
2. Study of different stages of mitotic cell division in suitable material.
3. Study of meiotic cell division in Pollen mother cells.
4. Genetics Problem:- Incomplete/Di-hybrid/Modified Ratio
5. Biostatistics problem

SEMESTER – IV

LBC 401: GENERAL MICROBIOLOGY

Unit 1

History and scope of microbiology, Koch postulate, A brief idea of microbial nutrition; Culture media; Growth factors, Isolation of pure cultures

Unit 2

Gene transfer in bacteria: Mechanisms of transformation, conjugation and transduction in bacteria

Unit 3

Role of microorganism in industry: Fermentation technology for production of lactic acid, acetic acid

Unit 4

Role of microorganism in agriculture: Nitrogen fixation and phosphate solubilizing microorganisms; ammonification; nitrification and denitrification.

Suggested Readings:

1. Dubey R.C. and Maheswari D.K., 2000. A Textbook of Microbiology, Chand & Co, New Delhi.
2. Prescott, Harley and Kleins, 2007. Microbiology, McGraw-Hill International, UK
3. Rangaswami, R and Paniker C.K.J.. 1998. Textbook of Microbiology, Orient Longman, Kolkata
4. Ross, F.C. 1983. Introductory Microbiology. Charles E. Merrill Publishing Company, Columbus OH
5. Sharma P.D., 2004. Microbiology and Plant Pathology Rastogi Publication. New Delhi

LBC 402: PLANT PATHOLOGY

Unit 1

History of plant pathology, classification of plant diseases, general symptoms of plant diseases.

Unit 2

Mode of infection and role of enzymes and toxins in plant disease, defense mechanisms of plants against infection: Pre-existing structural and chemical defense, Host pathogen interactions, PR proteins.

Unit3

Control of plant diseases: biological, chemical, physical; bio-pesticides, plant quarantine, integrated pest management.

Unit 4

General account of some plant diseases: Late blight of Potato, Tikka disease of groundnut, Black rust of wheat, Red rot of sugarcane, leaf spot of rice, Citrus canker; Yellow vein mosaic of bhindi.

Suggested Readings:

1. Agrios G N, 200. Plant Pathology, Academic press, London
2. Alexopoulos J and Mims C W 2003. An introduction to fungi, Wiley New York
3. Bilgrami K.H. & Dube H.C..1976. A textbook of Modern Plant Pathology. International Book Distributing Co. Lucknow.
4. Dubey H.C. 2009. An introduction to Fungi, Vikas Publisher New Delhi
5. R.S. Mehrotra and A. Agrawal, 2005. Plant Pathology, Tata McGraw New Delhi
6. Sharma P.D. 2004. Plant Pathology, Rastogi Publishers, Meerut

LBCL 403 based on LBC 401 and 402

LBC 401 Practical:

1. Demonstration of the different instruments related to the microbial study
2. Study of different culture techniques
3. Preparation of different culture media
4. Isolation of pure culture from soil sample
5. To study Nitrogen fixation
6. Identification and characterization of different types of microorganisms

LBC 402 Practical:

1. To demonstrate control of plant diseases.
4. Symptomology of some viral disease specimens: Yellow vein mosaic of bhindi
5. Symptomology of some bacterial disease specimens: Bacterial blight of rice, Citrus canker
6. Symptomology of some fungal disease specimens: Late blight of Potato, Tikka disease of groundnut, Black rust of wheat, Red rot of sugarcane.

SEMESTER - V

LBC 501: Plant Anatomy

Unit 1

Plant tissues and its types, permanent tissue xylem and phloem, Types of vascular bundles, Tissue system in dicot and monocot stem, root and leaves.

Unit 2

Secondary growth –Vascular cambium, periderm, anomalous secondary growth in dicot and monocot.

Unit 3

Epidermis and secretory structures - stomata, trichomes and glands, secretory canals including laticifers

Unit 4

Nodal anatomy, Softwoods and hardwoods, Anatomy of pneumatophores and aerial roots of epiphytes.

Suggested reading:

1. Eames, A. J. &Mac Daniels L H, 1987.An Introduction to Plant Anatomy. Tata Mac Graw HillPublishing company Ltd. New Delhi.
2. Esau K. 1985. Plant Anatomy (2nd ed.) Wiley Eastern Ltd. New Delhi.
3. Fahn A 2000. Plant Anatomy.Permagon Press England
4. Pandey B.P. 2005. Plant Anatomy, S. Chand & Co. New Delhi.
5. Tayal M.S, 2000.Plant Anatomy.Rastogi Publishers, Meerut.
6. Vasishta P.C. 1974. Plant Anatomy, Pradeep Publication, Jalandhar.

LBC 502: Plant Developmental Biology

Unit 1:

Seed germination and seedling growth, Theories related to Organization of shoot and root apical meristem (RAM & SAM).

Unit 2:

Formation of floral organs. Megasporogenesis, Organization of embryo sac, Microsporogenesis. Double Fertilization. Polyembryony, Endosperm, development of dicot and monocot embryo.

Unit 3:

Pollen –Pistil interaction, Sexual Incompatibility, Barriers to fertilization.

Unit 4:

Fruit growth and development and fruit ripening, Dormancy, Parthenocarpy-types and importance.

Suggested readings

1. Bhojwani S Sand Bhatnagar S P, 2009. Embryology of Angiosperm, Vikas Publication House, New Delhi
2. Eames, A.J, 1961: Morphology of Angiosperms, McGraw Hill Publication, New Delhi
3. Pandey B P, 1999. Economic Botany, S Chand and Company, New Delhi
4. Pandey B P, 2001: Plant Anatomy, S Chand and Company, New Delhi
5. Sharma O P, 2005. Plant Taxonomy, Tata Mc Graw Hill, New Delhi.

LBCL 505 based on LBC 501 and 502

LBC 503 Practical

1. T.S. of dicot stem / root
2. TS of monocot stem/root
3. Study of Trichomes
4. Study of stomata
5. Study of abnormal secondary growth in dicot and monocot stem

LBC 504 Practical

1. Study of aerial root of *Ficus*
2. Study of anther
3. Study of permanent slides: ovules, embryo, pollen grains
4. Study of dicot embryo.
5. Study of types of fruits

IDLS (Interdisciplinary Life Science)

LBC 503: Analytical Techniques in Plant Sciences

Unit 1:

Microscopy and spectroscopy: Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy and Scanning electron microscopy – sample preparation for electron microscopy. Spectrophotometry: principle and its application in biological research.

Unit 2:

Cell fractionation: Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CsCl₂ gradient, analytical centrifugation, ultracentrifugation, marker enzymes.

Unit 3:

Chromatography: Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ionexchange chromatography; Molecular sieve chromatography; Affinity chromatography.

Unit 4:

Characterization of proteins and nucleic acids: Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE. Use of radioisotopes in biological research, autoradiography, Chromosome banding, FISH, Chromosome painting.

Practicals

1. To separate nitrogenous bases by paper chromatography.
2. To separate sugars by thin layer chromatography.
3. Isolation of chloroplasts by differential centrifugation.
4. To separate chloroplast pigments by column chromatography.
5. To estimate protein concentration through Lowry's methods.

Suggested Readings

1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co.Ltd. New Delhi. 3rd edition.
2. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A.
3. Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A.,
4. Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rd edition.
5. Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition.

Elective courses I (LBC 504)

LBC 504 (a) PLANT TISSUE CULTURE TECHNOLOGY

Unit 1:

Definition and scope of biotechnology, Introduction and history of Plant Tissue cultures.

Unit II

Media preparation and their composition. Growth regulator and their use in tissue culture. Sterilization process for tissue culture technology. Sterilization of explants. Instruments used in tissue culture technology.

Unit III

Callus culture, Single cell culture, suspension culture, Factors affecting cell culture; Importance of tissue culture. Micropropagation and their application.

Unit IV

Protoplast isolation, culture. Somatic hybridization, Somaclonal variation and their selection.

Suggested reading:

1. Bhojwani S S and Rajdan, 2002. Plant Tissue Culture, Science Publisher New Delhi
2. Gamborg, O.L. and Philips G.C. (Eds.) 1995. Plant Cell, Tissue and Organ Culture, Fundamental Methods. Narosa Publishing House, New Delhi.
3. Gupta, P.K. 1996. Elementary Biotechnology. Rastogi & Company, Meerut.
4. Hammond, J., Megary, P. 2000. Plant Biotechnology. Springer-Verlag, Germany
5. Mantel, S. H, Mathew, J.A. 1985 An introduction to Genetic Engineering in plants. Springer, Germany

Practicals

1. Preparation of MS medium and organ culture with suitable explants
2. Experimental demonstration of Liquid culture
3. Experimental demonstration of callus induction
4. Experimental demonstration of artificial seeds synthesis.

LBC 504 (b) MICROBIAL TECHNOLOGY

Unit I: Sources and characters of industrial microbes, their isolation, purification & maintenance. Screening of useful strains: primary screening & secondary screening. Strain improvement. through random mutation (random & rational selection), Role of genetic recombination & genetic engineering in strain improvement.

Unit II: Fermentation technology: microbial growth kinetics in batch, continuous & fed-batch fermentation process. Stirred aerobic bioreactor: principles & designing. Other types of bioreactors. Raw materials used in fermentation media and upstream processes. Solid state fermentation & submerged fermentation: Downstream Processing (product recovery).

Unit III: Bioremediation: Applicability of bioremediation: Intrinsic bioremediation, Biostimulation, Bioaugmentation. Applications of bioremediation to various contaminants.

Unit IV: Biofuels: From organic residue (ethanol), biogas production, fuel from algae. Production of bioethanol from molasses, starchy and cellulosic materials.

Suggested Reading:

1. Reed G (1997). Industrial Microbiology. CBS Publishers (AVI Publishing Co.)
2. Stanbury PF, Whitekar A. and Hall (1995). Principles of Fermentation Technology. Pergaman.McNeul and Harvey.
3. Rehm and Reed (1983). Biotechnology. Verlag Chemie.
4. Bhosh, Fiechter and Blakebrough (1999). Advances in Biochemical Engineering. Springer VerlagPublications.

LBC 504 (c) ETHNO BOTANY AND MEDICINAL PLANT TECHNOLOGY

Unit I:

Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses.

Unit II: Methodology of Ethnobotanical studies: a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places.

Unit III: Role of ethnobotany in modern Medicine: Medico-ethnobotanical sources in India; Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) *Azadiractha indica* b) *Ocimum sanctum* c) *Vitex negundo*. d) *Gloriosa superba* e) *Tribulus terrestris* f) *Pongamia pinnata* g) *Cassia auriculata* h) *Indigofera tinctoria*. Role of ethnobotany in modern medicine with special example *Rauwolfia serpentina*, *Trichopus zeylanicus*, *Artemisia*, *Withania*. Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management).

Unit IV: Conservation of endangered and endemic medicinal plants. Definition: endemic and endangered medicinal plants, Red list criteria; In situ & ex situ conservation, Application of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases.

Suggested Readings

- 1) S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
- 2) S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi – 1981
- 3) Lone et al., Palaeoethnobotany
- 4) S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
- 5) S.K. Jain, 1990. Contributions of Indian ethnobotny. Scientific publishers, Jodhpur

LBC 504 (d) BIOINFORMATICS

Unit I

Introduction to Bioinformatics Introduction, Branches of Bioinformatics, Aim, Scope and Research areas of Bioinformatics. Databases in Bioinformatics: Introduction, Biological Databases, Classification format of Biological Databases, Biological, Database Retrieval System.

Unit II:

Biological Sequence Databases: National Center for Biotechnology Information (NCBI): Tools and Databases of NCBI, Database, Basic local alignment search tool (BLAST), Nucleotide Database, Protein Database, Gene Expression Database. EMBL Nucleotide Sequence Database (EMBL-Bank)

Unit III

Sequence Alignments: Introduction, Concept of Alignment, Multiple Sequence Alignment (MSA), MSA by CLUSTALW, Scoring Matrices, Percent Accepted Mutation (PAM), Blocks of Amino Acid Substitution Matrix (BLOSUM).

Unit IV

Molecular Phylogeny: Methods of Phylogeny, Software for Phylogenetic Analyses, Consistency of Molecular Phylogenetic Prediction. Applications of Bioinformatics

Suggested Readings

1. Ghosh Z. and Bibeknand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
2. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.
3. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.

Practicals 504 (d)

1. Nucleic acid and protein databases.
2. Sequence retrieval from databases.
3. Sequence alignment.
4. Sequence homology and Gene annotation.
5. Construction of phylogenetic tree.

Unit I

Elective courses (LBC 504)

LBC 504 (e) Reproductive Plant Biology

Reproductive development: Induction of flowering; flower as a modified determinate shoot.

Flower development: genetic and molecular aspects.

Unit II

Anther and pollen biology: Anther wall: Structure and functions, microsporogenesis, callose deposition and its significance. NPC system; Palynology and scope (a brief account); Abnormal features: Pseudomonads, polyads, massulae, pollinia. Ovule: Structure; Types; Special structures—endothelium, obturator, aril, caruncle and hypostase

Unit III

Pollination and fertilization: Pollination types and significance; adaptations; structure of stigma and style; path of pollen tube in pistil; double fertilization. Self incompatibility Basic concepts (interspecific, intraspecific, homomorphic, heteromorphic, GSI and SSI); Methods to overcome self- incompatibility: mixed pollination, bud pollination, stub pollination; Intra-ovarian and in vitro pollination; Modification of stigma surface, parasexual hybridization; Cybrids, in vitro fertilization.

Unit IV

Embryo, Endosperm and Seed: Structure and types; General pattern of development of dicot and monocot embryo and endosperm; Suspensor: structure and functions; Embryo-endosperm relationship; Nutrition of embryo; Unusual features; Embryo development in Paeonia . Seed structure, importance and dispersal mechanisms

Suggested Readings

1. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms, Vikas Publishing House. Delhi. 5th edition.
2. Shivanna, K.R. (2003). Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.
3. Raghavan, V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands.
- Johri, B.M. I (1984). Embryology of Angiosperms, Springer-Verlag, Netherlands.

Practical 504 (e)

1. Study of Anther: Wall and its ontogeny
2. Study of Pollen grains:
3. Pollen viability test: Tetrazolium test.germination: Calculation of percentage germination in differentmedia using hanging drop method.
4. Study of Ovules:
5. Study of Female gametophyte through permanent slides/ photographs: Types, ultrastructure ofmature egg apparatus.

Elective courses I (LBC 504)

LBC 504 (f) INTELLECTUAL PROPERTY RIGHTS (IPR)

Unit I

Introduction to Intellectual Property: Historical Perspective, Different Types of IP, Importance of protecting IP.

Unit II

Patents: Historical Perspective, Basic and associated right, WIPO, PCT system, Traditional Knowledge, Patents and Healthcare – balancing promoting innovation with public health, Software patents and their importance for India.

Unit III

Copyrights. Trade Marks. Geographical Indications. Industrial Designs, Layout design of integrated circuits, Trade Secrets

Unit IV

Different International agreements: (a) World Trade Organization (WTO): (i) General Agreement on Tariffs & Trade (GATT), Trade Related Intellectual Property Rights (TRIPS) agreement (ii) General Agreement on Trade related Services (GATS) (iii) Madrid Protocol (iv) Berne Convention (v) Budapest Treaty

Suggested Reading

1. N.K. Acharya: *Textbook on intellectual property rights*, Asia Law House (2001).
2. Manjula Guru & M.B. Rao, *Understanding Trips: Managing Knowledge in Developing Countries*, Sage Publications (2003).
3. P. Ganguli, *Intellectual Property Rights: Unleashing the Knowledge Economy*, Tata McGraw-Hill(2001).
4. Arthur Raphael Miller, Micheal H.Davis; *Intellectual Property: Patents, Trademarks and Copyright in a Nutshell*, West Group Publishers (2000). 118
5. Jayashree Watal, *Intellectual property rights in the WTO and developing countries*, Oxford University Press, Oxford.

Elective courses I (LBC 504)

LBC 504 (g) MUSHROOM CULTIVATION TECHNOLOGY

Unit I:

Introduction, history. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms available in India - *Volvariella volvacea*, *Pleurotus sajourcaju*, *Agaricus bisporus*.

Unit II:

Pure culture: Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation. Low cost technology, Composting technology in mushroom production.

Unit III:

Cultivation Technology of *Volvariella volvacea*, *Pleurotus sajourcaju*, *Agaricus bisporus*.

Unit IV:

Food Preparation_: Types of foods prepared from mushroom. Research Centres - National level and Regional level. Cost benefit ratio - Marketing in India and abroad, Export Value.

Suggested Readings

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
2. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co.Ltd., No. 88, Mysore Road, Bangalore - 560018.
3. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
4. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.

SEMESTER - VI

LBC 601: PLANT ECOLOGY

Unit I

General concepts of ecology; Ecological factors – climatic, edaphic, biotic and topographic.

Unit II

Tolerance ranges and adaptations, ecological amplitude, Autecology and Synecology; Genecology – ecads, ecotypes, ecospecies, concept of ecological niche.

Unit III

Population characteristics, age-structure of population; Population interactions – Symbiosis, mutualism, commensalism, predation, parasitism, Community: Analytic and synthetic characters of plant community, Ecological succession and climax

Unit IV

Ecosystem: Structure and function, food chain and food web, ecological pyramids, flow of energy.

Suggested readings

1. Ambasht R.S. and Ambasht N.K. 2006. A Text Book of Plant Ecology., CBS Publ., New Delhi
2. Kormondy E. J, 2000. Concept of Ecology, Prentice Hall of India, New Delhi.
3. Odum E.P., 1996. Fundamentals of Ecology, , Natraj Publishers, Dehradun.
4. Sharma P.D., 2007. Ecology and Environment, , Rastogi Publication, Meerut.
5. Singh J.S., Singh S.P., Gupta S.R., 2006. Ecology, Environment and Resource Conservation, Anamya Publication, New Delhi, 2006.

LBC 602: PLANT BIOCHEMISTRY

Unit 1

Classification and structure of carbohydrates: Glucose Sucrose, Starch, Cellulose; Lipids, Amino acids, Vitamins, Sulphur and phosphorus metabolism: energy-rich phosphorus compounds.

Unit 2

Protein structure and synthesis: transcription, translation (activation of amino acids, initiation, elongation, termination & release of peptides).

Unit 3

Enzymes: Mechanism of enzyme action, coenzymes, allosteric enzyme, isozymes, Secondary metabolites: Phenolic compounds, alkaloids, flavonoids.

Unit 4

Biochemical tools and techniques: chromatography techniques, centrifugation, protein isolation and separation, nucleic acid isolation and separation.

Suggested Readings:

1. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones. Springer Verlag, Germany
2. Nelson D L and Cox MM, 2012. Lehninger: Principle of Biochemistry, W H Freeman, USA
3. Taiz L and Zeiger E. 2010. Plant physiology. Sinauer Associates, UK
4. Pandey B P, 2005: Biochemistry, S Chand and Company, New Delhi

LBC 603: BIODIVERSITY AND ITS CONSERVATION

Unit 1

Introduction to biodiversity and its importance; Levels of biodiversity: Genetic, species, community and ecosystem

Unit 2

Diversity gradients and related hypotheses, methods for biodiversity monitoring, megadiversity zones and hot spots. Botanical regions of India.

Unit 3

Biodiversity and ecosystem functions: Concepts and models, Threats to biodiversity: Causes of biodiversity loss, species extinction, vulnerability of species to extinction, IUCN threat categories, Reddata book

Unit 4

Biodiversity conservation: Principles and Strategies of biodiversity conservation, in-situ and ex-situ conservation strategies.

Suggested readings

1. Ambasht R.S. and Ambasht N.K. 2006. A Text Book of Plant Ecology., CBS Publ. New Delhi
2. Kormondy E. J, 2000. Concept of Ecology, Prentice Hall of India, New Delhi.
3. Odum E.P., 1996. Fundamentals of Ecology, Natraj Publishers, Dehradun.
4. Sharma P.D., 2007. Ecology and Environment, Rastogi Publication, Meerut.
5. Singh J.S., Singh S.P., Gupta S.R., 2006. Ecology, Environment and Resource Conservation, Ananya Publication, New Delhi, 2006

LBCL 605 based on LBC 601, 602 & 603

LBC 601 Practicals

Qualitative and Quantitative studies of Plant communities.

Construct a food web from the given set of data, (Representative of a natural ecosystem).

Construct ecological pyramids of number, biomass, and energy from the given set of data (Representative of a natural ecosystem).

Field Study of Local Environment: In and around 200 KM of Durg (one day)

Field Trip: Any biodiversity rich area of India (seven day Excursion trip)

LBC 602 Practical

Determination of the acid value of a fat Determination of iodine number of a fat Iodine test for polysaccharides Study of enzyme action.

Separation of amino acids by chromatography Separation of proteins by electrophoretic method Chemical Test for Alkaloids and flavonoids.

LBC 603 Practical

To calculate the relative frequency, density and abundance and IVI by quadrat method. To calculate the species area curve.

To calculate the alpha diversity, beta diversity & gamma diversity. To study the diversity in ecotone region.

To calculate the IVI of different plant species.

Elective courses II (LBC 604)

LBC 604 (a) ENVIRONMENTALBIOLOGY & POLLUTION

Unit I

Microbes and environment; Microbes in soil; Organic matter decomposition: Cellulose, hemicelluloses and lignin decomposers; Rhizosphere and rhizoplane microorganisms; Factors affecting microbial community in soil. Microbes in extreme environment.

Unit II

Sewage microbes; Sewage treatment: Biodeterioration: Biodeterioration of stored food commodities, cellulosic materials. Biomonitoring of environmental pollutants; bioremediation, biodegradation, superbugs, Phytoremediation..

Unit III

Air pollution: types & sources; ozone depletion, global warming, reducing smog, oxidizing smog, green belts.

Unit IV

Water pollution: Sources & types; Eutrophication, biomagnifications; acid rain; algal blooms; red tides; oil spills, xenobiotics.

Suggested readings:

1. Bell J N, 2009. Air Pollution and Plant Life, Academic Press London
2. Madigan M. 2010. Brocks biology of Microorganisms, Pearson Education, USA
3. Marcos von, 2007. Basic Principles of Wastewater Treatment: Sperling, IWA Publishing Germany
4. Sharma P.D. 2010. Microbiology, Rastogi Publication, Meerut
5. Wastewater Treatment: Biological & Chemical processes; M.Henze, Springer
6. WunJern Ng, 2008. Industrial Waterwater Treatment:, Imperial College Press U K

Practicals

1. To estimate Dust holding capacity of plants
2. To determine free CO₂ in water samples
3. To determine dissolved oxygen (DO) in water samples
- 4 To determine free Biological oxygen demand (BOD) in water samples
5. To calculate chemical oxygen demand (COD) in water samples
6. To study soil micro organisms.

Elective courses II

(LBC 604) LBC 604 (b) MICROBIAL GENETICS

LBC 604: MICROBIAL GENETICS

Unit I

Tools of microbial genetics: bacteriophages (T4, lambda), *Neurospora crassa*; Genetics of bacteria: Genetic recombination- an overview; mechanisms of transformation, conjugation and transduction in bacteria

Unit II

Gene expression and regulation: Lactose and Tryptophan operon, Regulation of virulence genes in pathogenic bacteria, SOS response.

Unit III

Cell signalling: Communication between cell and environment with special reference to nutrients (N and P) and temperature

Unit IV

Microbial toxins: Types of microbial toxins and their health hazards, Gene manipulation for production of commercial products: organic acids and antibiotics

Suggested Readings:

1. Dubey R.C. & D.K. Maheswari 2000. A Textbook of Microbiology, Chand & Co, New Delhi. Kanika, S. 2007.
2. Manual of Microbiology – Tools and Techniques. Ane's student edition. Madigan M, Stahl, Clarke M. 2010.
3. Brocks biology of Microorganisms, Benjamin Cummings, USA Prescott, Harley & Kleins, 2008. Microbiology, McGraw-Hill International U K.
4. Rangaswami, R & C.K.J. Paniker. 1998. Textbook of Microbiology, Orient Longman, USA

Practical

1. Study of the growth behaviour and determination of generation time
2. Isolation of antibiotic resistant colonies from bacterial culture
3. Isolation of DNA from microbial culture
4. Siderophore assay in microbial system
5. Electrophoresis of protein
6. To estimate the β -galactosidase activity in different E.coli cultures grown in different sugarsource
7. Preparation of a standard curve of RNA and DNA

Elective courses II (LBC 604)

LBC 604 (c) GENETIC ENGINEERING AND CROP IMPROVEMENT

Unit I

Basic concepts of DNA structure and properties, restriction enzymes, DNA ligase, , Radioactive and non-radioactive probes.

Unit II

Hybridization techniques, Northern, Southern and Colony Hybridization, Fluorescence in situ hybridization, Chromatin immunoprecipitation, footprinting,

Unit III

Cloning vectors and characteristics, gene cloning techniques, Restriction and modification system, DNA sequencing

Unit IV

Methods for the plant genetic transformation, particle bombardment method, electroporation, microinjection, mechanism of *Agrobacterium* mediated gene transformation. GMO crops.

Suggested reading

1. Brown T.A. 2007. Genomes 3. Garland Science Publication. USA.
2. Brown.T.A.2011. Gene Cloning and DNA Analysis. Taylor and Francis. UK Karp, G. 2009.
3. Cell and Molecular Biology Concepts and Experiments. Willey Publication. UK. Primrose and Twyman, 2009.
4. Principles of Gene manipulation and Genomics, Wiley-Blackwell. UK.Sambrook and Russell. 2001. Molecular Cloning. 3rd Edn. CSHL Press. USA.
5. Senger, Gupta and Sharma. 2010. Laboratory manual on Biotechnology. WH Publishers. USA.Singh, B.D. 2008. Biotechnology. Narosa Publishing House. New Delhi.

Elective courses II (LBC 604)

LBC 604 (d) ENVIRONMENTAL CLEANUP TECHNOLOGY

Unit I

History of Environmental technology; Microorganism in the Environment; Microbial habitats in the aquatic and extreme environment.

Unit II

Techniques in environmental cleanup technology: Methods for determination of numbers, biomass and activities of microbes in soil, water, air and on plant surfaces and dead organic materials. Environment sample collection and processing.

Unit II:

Biodegradation and Biodeterioration: Biodeterioration of cultural heritage; Principal methods for their protection.

Unit III:

Bioremediation: Microbial degradation of xenobiotics; hydrocarbons; clean up of sites polluted with oil spills, heavy metals and chlorinated solvents; biological treatment of effluents of textile, sugar, leather and paper and pulp industry; Recovery of minerals and metals from ores.

Unit IV:

Microbiology of waste disposal: Microbes in solid waste and solid waste management; Sewage treatment systems (primary, secondary, tertiary and disinfection); Disinfection of potable water supplies; Indicators organism for water safety; Microbial assessment of water quality; Standards for tolerable levels of faecal contamination.

Suggested Reading:

1. Maier RM, Pepper IL and Gerba CP (2000). Environmental Microbiology. Academic Press. USA
2. Pepper IL, Gerba CP and Brusseau ML (2006). Environmental and Pollution Science. Academic Press. USA
3. Baker KH and Herson DS (2000). Bioremediation. MacGraw Hill Inc. N.Y.
4. Ralph MA (2001). Environmental Microbiology. John Wiley and Sons. Inc.
5. Forster CF and John DA (2000). Environmental Biotechnology. Ellis Horwood Ltd. Publication.
6. Christon JH (2001). A Manual of Environmental Microbiology. ASM Publications.

Practical based on theory

1. To estimate Dust holding capacity of plants
2. To determine free CO₂ in water samples
3. To determine dissolved oxygen (DO) in water samples
- 4 To determine free Biological oxygen demand (BOD) in water samples
5. To calculate chemical oxygen demand (COD) in water samples

Elective courses II (LBC 604)
LBC 604 (e) COMPUTATIONAL BIOLOGY

Unit I

Basic concepts about data and information, Representation of data in computers in binary, bits and bytes. Computer words coding (ASCII and EBCDIC), Number conversion system, Introduction to Internet, WWW, NICNET, ERNET, On-line publishing ventures eg. Biomed Central, BTIS Network in India.

Unit II

Biological Databases: Primary Sequence databases (Protein and DNA databases), Secondary databases, Composite databases. Online international database access

Unit III

Sequence Alignment and Databases searching: Evolutionary basis of sequence alignment, Optimal alignment methods; Dot Plot, Dynamic Programming Databases similarity searching: Algorithms of FASTA, BLAST

Unit IV

Testing Evolutionary Hypotheses, In silico analysis of phylogeny, construction of phylogenetic tree, dendrogram, Computational phylogenetics, Construction of QTL mapping, Microarray data analysis.

Suggested reading

1. Brown T.A. 2011. Gene Cloning and DNA Analysis. Tailor and Francis. UK. Campbel. 2006.
2. Discovering Genomics, Proteomics and Bioinformatics. Pearson Education. USA. Jonathan, P. 2009.
3. Bioinformatics and Functional Genomics. Wiley Blackwell. UK. Rastogi S.C. 2012.
4. Bioinformatics: Methods and Applications. Prentice Hall of India Private Limited. NewDelhi Rastogi S.C. 2012.
5. Bioinformatics: Methods and Applications. Prentice Hall of India Private Limited. NewDelhi Sharma, Munjal and Shanker. 2009. Text Book of Bioinformatics. Rastogi Publication. Meerut.

Practical based on theory

Elective Courses II
(LBC 604) LBC 604 (f) BIOSTATICS

Unit I

Scope of Biostatistics, variables in biology, collection, classification, tabulation of data. Frequency distribution, Diagrammatic and graphical presentation of statistical data,

Unit II

Sampling techniques. Measures of central location and dispersion, Simple measure of skewness and Kurtosi,

Unit III

Probability theory: Classical and Statistical definitions, conditional probability, Bayes' Theorem. Introduction to Random variable and Mathematical expectation. Probability Distributions: Binomial, Multinomial, Poisson and Normal Distribution. Correlation and regression

Unit IV:

Analysis of variance for one way and two way classification. Principles of Design of experiment: Replication, Randomization and Local control. Statistical analysis of completely randomized Design, Randomized block design and Latin square design; Analysis of Covariance.

Suggested reading.

1. Arthur, M. 2002. Introduction to Bioinformatics. Oxford University Press. New Delhi
2. Bernard, A. Rosner, 2006. Fundamentals of Biostatistics. Thompson Publication. Canada
3. Khan and Khanam. 2003. Fundamental of Biostatistics. Ukaaz Publications. Hyderabad
4. Krawetz. 2003. Introduction to Bioinformatics: A theoretical and Practical Approach. Humana Press. USA
5. Miguel and Rade. 2003. Bioinformatics and Genome. Horizon Scientific Press. Utah. USA.

Practical based on theory

