

INTERNATIONAL COLLEGE FOR GIRLS

SFS, GURUKUL MARG, MANSAROVAR, JAIPUR

DEPARTMENT OF LIFE SCIENCES

CREDIT TEMPLATES

AND

OUTLINE OF THE SYLLABI

FOR

M.Phil.

LIFE SCIENCES EXAMINATION

Department of Life Science
M.Phil in Life Sciences
(With Specialization in Biotech /Botany/ Environmental Science/Zoology/

Papers	Name of the paper	Max. Marks	Coordinating Department	Paper Code
Paper I	Compulsory Research Methodology	100		LSC 141
Paper II & Paper III	Candidate may select any two papers from any one the following groups			
Group A				
Paper II	Physiology	100	Zoology	LSC 142 A
Paper III	Biochemistry	100		LSC 143 A
Group B				
Paper II	Cell and Molecular Biology I	100	Zoology	LSC 142 B
Paper III	Cell and Molecular Biology II	100		LSC 143 B
Group C				
Paper II	Animal Taxonomy and Biodiversity I	100	Zoology	LSC 142 C
Paper III	Animal Taxonomy and Biodiversity II	100		LSC 143 C
Group D				
Paper II	Reproductive Physiology I	100	Zoology	LSC 142 D
Paper III	Reproductive Physiology II	100		LSC 143 D
Group E				
Paper II	Environmental Science I	100	Environmental Science	LSC 142 E
Paper III	Environmental Science II	100		LSC 143 E
Group F				
Paper II	Microbiology	100	Biotechnology	LSC 142 F
Paper III	Biotechnology	100		LSC 143 F
Group G				
Paper II	Plant Pathology	100	Botany	LSC 142 G
Paper III	Plant Physiology	100		LSC 143 G

**Department of Life Sciences
Curriculum Credit Templates
M.Phil Life Sciences**

Semester I							
Paper Code	Title	Contact Hrs				Credit	Max. Marks
		Per Sem	Per week				
			*L	*T	*P		
LSC 141	Research Methodology	90	4	2	-	6	100
LSC 142 A	Physiology	90	4	2	-	6	100
LSC 142 B	Cell & Molecular Biology-I						
LSC 142 C	Animal Taxonomy & Bio Div-I						
LSC 142 D	Reproduction Physiology-I						
LSC 142 E	Environmental Science-I						
LSC 142 F	Microbiology						
LSC 142 G	Plant Pathology						

LSC 143 A	Biochemistry	90	4	2	-	6	100
LSC 143 B	Cell and Molecular Biology-II						
LSC 143 C	Animal Taxonomy & Bio Div-II						
LSC 143 D	Reproductive Physiology-II						
LSC 143 E	Environmental Science-II						
LSC 143 F	Biotechnology						
LSC 143 G	Plant Physiology						
LSC 144	Laboratory Techniques	180	-	-	12	6	100
CHY/LSC 146	Communication skills	45	-	3	-	3	100
LSC 145	Dissertation: Literature Survey and Synopsis presentation	45	-	3	-	3	100
Total		540	12	12	12	30	600

Semester II							
LSC 241 to LSC 247	Elective Papers I-VIII – Student may select any one	90	3	3	-	6	100
LSC 248	Thesis, Presentation and Viva-voce	360	-	-	-	24	200
Total		450			-	30	900

Elective Courses - Eligible for

LSC	241	Agricultural Bio-technology (Group A,B,C,D & E)
LSC	242	Animal Cell Culture (All groups)
LSC	243	Environmental Biotechnology (Group A,B,C,D & G)
LSC	244	Environmental Microbiology (Group A,B,C,D & G)
LSC	245	Plant Tissue Culture (All groups)
LSC	246	Toxicology (All groups)
LSC	247	Wild Life Management (All Group)

* L – lectures *T- Teaching Exposure *P- Practical

INTERNATIONAL COLLEGE FOR GIRLS

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DEPARTMENT OF LIFE SCIENCES

SCHEME OF EXAMINATION

FOR

M.Phil. LIFE SCIENCES EXAMINATION

I Semester Examination November 2008

II Semester Examination April 2009

INTERNATIONAL COLLEGE FOR GIRLS
M.Phil. Life Sciences
Scheme of Examination

Semester I	Paper code	Credits	Time duration per week	Maximum Marks	Minimum Marks	Continuous Assessment (30 %)	Semester End Exam (70 %)
	LSC 141	6	6	100	50	30	70
	LSC 142 A	6	6	100	50	30	70
	LSC 142 B						
	LSC 142 C						
	LSC 142 D						
	LSC 142 E						
	LSC 142 F						
	LSC 142 G						
	LSC 143 A	6	6	100	50	30	70
	LSC 143 B						
	LSC 143 C						
	LSC 143 D						
	LSC 143 E						
	LSC 143 F						
	LSC 143 G						
	LSC 144	6	12	100	50	30	70
	CHY/LSC 146	3	3	100	50	30	70
	LSC 145	3	3	100	50	30	70

Semester-II	LSC 241 to LSC 247 (any one)	6	6	100	50	30	70
	LSC 248	24		200	100	60	140

Scheme of Evaluation for Continuous Assessment (Theory)				
Semester I & II				
Test	Seminar/Teacher Interaction	Attendance	Total	Reduced To
30 mks	50 mks	10 mks	90 mks	30 mks

Scheme of Evaluation for Continuous Assessment (Practical)			
Semester I			
File	Student performance	Attendance	Total
10 mks	10 mks	10 mks	30 mks

Scheme of Evaluation for Continuous Assessment (Dissertation)	
Semester I	
Total 30 Marks	

Paper I – LSC – 141

Research Methodology & Instrumentation (compulsory)

60 hrs. (L) + 30 hrs. (T)
4 hrs./week(L) + 2 hrs./week (T)

UNITS	TOPICS	TEACHING HOURS
Unit I	<ul style="list-style-type: none"> ▪ Overview of the research process, criteria of research, common problems encountered during research. Qualities of a good research. ▪ Types of research: Historical, descriptive, experimental, case study, participatory and with social implications. ▪ Data, population, sample, statistic variables, types independent/ dependent, qualitative/ quantitative, discrete/ continuous, Error producing variables – intervening extraneous and attribute variables methods of controlling variables. Statistical manipulation of variables. Physical and selective manipulation of variables. ▪ Basic assumptions in qualitative and quantitative, parametric and non parametric studies. 	12
Unit II	<ul style="list-style-type: none"> ▪ Theory of probability: Probability sampling. Simple, random, systematic random sampling. Two stage and multistage sampling. Cluster sampling, Non probability sampling: purposive, quota and volunteer sampling, snow ball sampling. ▪ Scale of measurement and appropriate statistical techniques. Selecting a problem and writing a research proposal. ▪ Selection of problem area, topic and defining problem. Literature search: Reviewing related literature, referencing, abstracting, computer searches, bibliography. ▪ Developing research proposal: Title, statement of problem and its scope, defining concepts, objectives, basic assumption, delimitation and limitations of the problems. Statement of hypothesis. 	12
Unit III	<ul style="list-style-type: none"> ▪ Microscopy: Light, dark field, phase contrast, interference, polarization, fluorescence, transmission and scanning electron microscope, Confocal, Deconvolution. ▪ Centrifugation: Differential and density gradient centrifugation, zonal and isopycnic separation. Preparative and analytical centrifugation. ▪ Separation Techniques: Chromatography, paper and thin 	12

	layer chromatography, absorption column chromatography, Ion exchange chromatography, High performance liquid chromatography, affinity electrophoresis and Iso electric focusing P.C.R.	
Unit IV	<ul style="list-style-type: none"> ▪ Spectrophotometry: Colorimetry, spectrophotometry, atomic absorption spectroscopy, Flame emission spectroscopy. ▪ Nuclear Magnetic Resonance spectroscopy: The phenomenon of resonance, Magnetization, instrumentation, spectral parameter in NMR, applications. ▪ Radiochemical Methods: Radioactivity, Measurement of radio-activity photographic emulsion, ionization chamber, Geiger chamber, Autoradiography, RIA. 	12
Unit V	<ul style="list-style-type: none"> ▪ Histological, histochemical and cytological techniques. ▪ Plant tissue culture techniques. ▪ Herbarium techniques and characteristic survey. ▪ Microbial culture techniques. 	12

Books Recommended:

- Plant Biotechnology, Hammond, P. McGarvey and V. Yusibov (Editors.) Springer Verlag, 2000.
- Plant Cell and Tissue Culture for the Production of Food ingredients. J. Fu, G. Singh, and W.R. Curtis (Editors), Kluwer Academic/Plenum Press.1999.
- Advanced Methods in Plant Biotechnology, David. R. Murray: Panima Publishing Corporation. 1996
- Plant Tissue Culture – Techniques & Experiments, (2nd edition) Roberta. H. Smith. Elsevier. 2000
- Plant Molecular Biology – A Practical Approach. C. H. Shaw, IRL Press Ltd.
- Molecular plant Biology- volume 1 & 2. Philip M. Gilmartin and Chris Bowler, Oxford University Press. 2005
- Plant Tissue Culture. S.S. Bhojwani and M.K Razdan, Elsevier. 2004
- Biotechnology in Crop improvement, H.S. Chawla, International Book Distributing Company, 1998.
- Practical Application of plant Molecular Biology, R.J. Henry, Chapman and hall.1997.
- Laboratory Manual for Plant Biotechnology, H.S Chawla Oxford & IBH publishing Co. Pvt Ltd. 2003
- Plant Biotechnology – The genetic manipulation of plants. Adrian Slater, Nigel Scott & Mark Fowler, Oxford University Press. 2003
- Plant Tissue Culture – Techniques & Experiments, (2nd edition) Roberta. H. Smith. Elsevier. 2000
- Plant Molecular Biology – A Practical Approach. C. H. Shaw, IRL Press Ltd. 1988.

- Molecular Cloning: a Laboratory Manual, J. Sambrook. E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000.
- DNA Cloning: a practical Approach, D. M. Glover and B.D. Hames, IRL Press Oxford, 1955.
- Molecular and Cellular Methods in Biology and Medicine, P. B. Kaufman, W. Wu., D. Kim and L.J: Cseke, CRC Press.Florida,1995.
- An Introduction to Genetic Engineering. Edited by Desmond S.T. Nicholl, Cambridge University Press, February 2002.
- Manipulation and Expression of Recombinant DNA. Sue Carson and Dominique Robertson, Second edition, Academic Press, December 2005.
- Principles of Gene Manipulation and Genomics. Primrose and Twyman, (7th edition). Blackwell Publishers, 2006.
- Cell and Molecular Biology: Concepts and Experiments, (4th edition), G Karp, John Wiley & sons, Inc., 2005.
- Introduction to Instrumental analysis; Robert Braun:, Mc –Graw hill,
- Essentials of Biophysics, P Narayanan, New Age Int. Pub. New Delhi. 2000
- Fundamental Laboratory Approaches for Biochemistry and Biotechnology, A J Ninfa., D P Ballou, Fitzgerald science press, Inc., 1998
- Principles and Practice of Bioanalysis, R F Venn, Taylor and Francis, 2003
- Principles and Techniques of Biochemistry and Molecular Biology ,(6th edition), K Wilson and J Walker (editor), Cambridge University Press, 2007
- Bioinstrumentation, J G Webster, John Wiley & Sons Inc. 2004
- Methods in Modern Biophysics, B Notting, Springer Verlag Berlin Heidelberg New York, 2003
- Protein Purification Principles and Practice, (3rd edition), R K Scopes, Spring International, 2004
- Spectroscopy for the Biological Sciences, G G Hames, John Wiley & Sons Inc. 2005
- Biostatistics: A Foundation for Analysis in Health Sciences, (6th edition), W W Daniel, John Wiley and Sons Inc., 1995.
- Essential Bioinformatics, Jin Xiong, John Wiley and Sons. 2006.
- Introduction to Bioinformatics, A Teresa and D P Smith, Prentice Hall, 1999.
- Statistical Methods in Biology, N T J Bailey, Cambridge University Press, 1995.
- Statistics for Biologist, R C Campbell, Cambridge University Press, 1989.
- Bioinformatics, A practical Guide to the Analysis of Genes and Proteins, (2nd edition), A D Baxevanis, and B F Ouellette, John Wiley and Sons, 2002.
- Fundamentals of Biostatistics, Khan, Publishing Corporation, 1999
- Instant notes, Bioinformatics, Westhead, Parish, and Twyman, (1st edition), Bios Scientific Publishers Ltd., 2003.
- Introduction to Bioinformatics, A M Lesk, Oxford University Press, 2002.
- Practical statistics for Experimental Biologists, A C Swardlaw, John Wiley and sons Inc., 1985
- Hall. E. J. Radiobiology for the radiobiologists. Lippincott. Philadelphia.

PAPER I – LSC – 142 A
Physiology

60 hrs. (L) + 30 hrs. (T)
4 hrs./week(L) + 2 hrs./week (T)

UNITS	TOPICS	TEACHING HOURS
Unit I	<p>Digestive system</p> <ul style="list-style-type: none"> Mechanism of secretion (including hormonal and nervous regulation); composition and action of all types of digestive juices at the molecular level in the mammalian digestive pathway; morphofunctional specialization of absorptive epithelium and physiological mechanisms involved in the absorption of various types of end products of digestion. <p>Metabolism</p> <ul style="list-style-type: none"> Energy metabolism; nutritional role of minerals; metabolism of iodine, iron, calcium and zinc. 	8
Unit II	<p>Respiratory System</p> <ul style="list-style-type: none"> Respiratory and metabolic adaptations; diving and altitudinal adaptations; effect of exercise on respiratory and cardiovascular physiology. <p>Blood and Circulation</p> <ul style="list-style-type: none"> Cytophysiology of hematopoiesis and leukocyto-genesis; physiological functions associated with all types of blood cells and plasma constituents; hemostasis and homeostasis. 	10
Unit III	<p>Excretory system</p> <ul style="list-style-type: none"> Sites and the chemistry of formation of various nitrogenous excretory products: biophysics and physiology of various functions performed by the nephrons; significance of Henle's loop; urine and its formation; control and regulation of renal physiology. <p>Bone</p> <ul style="list-style-type: none"> Chemical constitution and functional architecture of the bone tissue (including cartilage); neural innervation and metabolism in bone tissue. <p>Muscle System</p> <ul style="list-style-type: none"> Chemical and electrophysiology of the neuromuscular junction; biophysics, biochemistry and physiology of muscle contractions and relaxation process; physiological and biochemical properties of cardiac, skeleton and visceral muscles. 	16
Unit IV	<p>Nervous System:</p> <ul style="list-style-type: none"> Physiological, biophysical, molecular and biological bases of various concepts of nerve impulse; genesis; conduction and synaptic transmission of nerve impulse in central and 	16

	<p>peripheral nervous system, physiology and integration and computation of nervous signal in the nerve tissue; functional architecture of the nerve tissue.</p> <ul style="list-style-type: none"> • Physiology of the reflex arc and its action as the functional unit of neural organization and function. • Chemical architecture of nerve cell, energy sources; biogenic amines and neurotransmitter pathways involving GAI; glutamic acid in relation of inhibitory and excitatory function. • Physiological topography of the mammalian brain; visceral functions associated with the major parts in nuclei (centers) of brain. <p>Endocrine System</p> <ul style="list-style-type: none"> • Functional organization of neurosecretory centres in the hypothalamus; physiology and neurochemistry of the hypothalamic control of pituitary function. • Cellular mechanism of hormone action in target tissues. • Genesis, functions and kinds of hormones secreted by various endocrine glands (pituitary, thyroid, parathyroid, adrenal, islets of Langerhans, testis and ovaries) 	
Unit V	<p>Reproductive System</p> <ul style="list-style-type: none"> • Functional organization in sperm and ovum (including Graafian follicles); survival of sperm in the female tract; capacitation; physiology of implantation, hormonal control of uterine activity; physiology of placenta and parturition. • Mechanism of hormonal control of testis and ovary functions; oestrous and menstrual cycles; mechanisms of ovulation including neural control of ovulation. 	10

Books recommended :

- Animal Physiology Mechanisms and Adaptation. Eckert, R.W.H. Freeman and Company, New York
- Biochemical Adaptation. I-fochachka, P.W. and Somero, G.N. Princeton, New Jersey.
- General and Comparative Animal Physiology, Hoar, W.S. Prentice Hall of Indian.
- Animal Physiology: adaptation and Environment, Schiemdt Neilsen. Cambridge
- A regulatory Systems Approach. Strand, F.L. Physiology: Macmillan Publishing Co., New York.
- Environmental and Metabolic Animal Physiology, Prosser, C.L. Wiley-Liss Inc., New York.
- Environmental Physiology, Willmer, P.G. Stone, and I. Johnson. Blackwell Sci. Oxford, UK.
- Adaptation to Environment. Essays on the Physiology of Marine Animals. Newell, R.C. (ed.) 1976. Butterworths, London, UK.
- Physiological Ecology: An evolutionally approach to resource use. Townsend, C.R. and P. Cawlow. Blackwell Sci. Publ., Oxford, UK
- Optima for Animals. Alexander, R.M.N. Princeton Univ. Press. Princeton, NJ
- Comparative Physiology: Life in water or land. Dejours, P., L. Bolis, C.R. Taylor and ER. Weibel (eds.). Liviana Press, Padova, Italy
- Animals and Temperature: Phenotypic and Evolutionary Adaptation. Johnson, I.A., & A.F. Bennett (eds.) Cambridge Univ. Press, Cambridge, UK.
- Physiological Animal Ecology. Louw, G.N. Longman Harloss, UK.
- General and Comparative Endocrinology, E.J.W. Barrington. Oxford. Clarendon Press.
- Comparative Vertebrate Endocrinology. P.J. Bentley. Cambridge University Press.
- Text Book of Endocrinology, R.H. Williams. W.B. Saunders.
- Endocrine Physiology. C.R. Martin. Oxford Univ. Press.
- Comparative Endocrinology, A. Gorbman et al. John Wiley & Sons.
- The Structure functions of nervous tissue. Bourne, G.H. Academic Press New York.

PAPER I – LSC – 142 B
Cell and Molecular Biology - I

60 hrs. (L) + 30 hrs. (T)
4 hrs./week(L) + 2 hrs./week (T)

UNITS	TOPICS	TEACHING HOURS
Unit I	<ul style="list-style-type: none"> • Concept of cell surface <ul style="list-style-type: none"> ○ Properties of cell surface ○ Their role in intercellular interaction in cell fusion and cell aggregation. • Cell-cell signaling, cell-cell adhesion and communication, cell matrix adhesion. 	12
Unit II	<ul style="list-style-type: none"> • Biology of cancer • Biology of Aging • Apoptosis – Definition, mechanism and significance 	12
Unit III	<ul style="list-style-type: none"> • Stem cell – concept and application. • Genome organization <ul style="list-style-type: none"> ○ Hierarchy in organization ○ Chromosomal organization of genes and non-coding DNA. ○ Mobile DNA. ○ Morphological and functional elements of eukaryotic chromosomes 	12
Unit IV	<ul style="list-style-type: none"> • Cell and Tissue culture • Primary and established cell lines • Kinetics of cell growth • Natural and artificial media for culture 	12
Unit V	<ul style="list-style-type: none"> • Plant and animal cells : variation in structure and function • Viruses : Structure and classification • Life cycle – lytic and lysogenic cycle • Types of tissue – epithelium types • Epithelial apices – glycocalyx microvilli 	12

Books recommended:

- Animals Cell Culture - A practical approach, John R.W.Masters, IRL Press.
- Introduction to Instrumental analysis. Robert Braun. McGraw Hill International Edition
- A Biology Guide to Principles and Techniques of Practical Bio-chemistry, K. Wilson & K.H.Goulding
- *Genetics* : Altenberg, E.Oxford and IBH, New Delhi. *Cell Biology* : De Robertis, E.D.P. : Nowinski, W.W. and Saez, F.A.W.B. Saunders, Philadelphia (Saunders International Student Edition Toppan Co. Ltd. Tokyo).
- *Cytology and Genetics*. Dyansagar, C.R. Tata McGraw Hill Publ. Co. New Delhi.
- *Cell Biology* : Dyson, R.D. Allen and Bacon, New York.
- *Principles of Genetics* : Gardner, E.J. : Wiley Eastern New Delhi.
- *The Science of Genetics*. Helder. W.M. and Yost. M.T. Prentice Hall, India, New Delhi.
- Animals Cell Culture - A practical approach, John R.W.Masters, IRL Press.
- Introduction to Instrumental analysis. Robert Braun. McGraw Hill International Edition
- A Biology Guide to Principles and Techniques of Practical Bio-chemistry, K. Wilson & K.H.Goulding
- Gene IV, Benjamin Lewin. Oxford University Press, UK.
- Molecular Biology and Biotechnology. A comprehensive desk reference, R.A.Meyers (Ed.), VCH Publishers, Inc., New York.
- Molecular Cloning: A Laboratory Manual, J.Sambrook, E.F.Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York.
- Introduction to Practical Molecular Biology, P.D.Dabre, John Wiley & Sons Ltd. New York.
- Molecular Biology Lab Fax, T.A.Brown (Ed.), Bios Scientific Publishers Ltd., Oxford.
- Molecular Cell Biology, J. Darnell H.Lodish and D. Baltimore Scientific American Books, Inc., USA.
- Molecular Biology of the cell. B.Alberts, D.D.Bray, J.Lewis, M.Rafif, K. Roberts and J.D.Watson. Garland Publishing inc., New York.

PAPER-I LSC 142 C

Animal Taxonomy & Biodiversity I

60 hrs. (L) + 30 hrs. (T)
4 hrs./week(L) + 2 hrs./week (T)

UNITS	TOPICS	TEACHING HOURS
Unit I	Definition and basic concepts of biosystematics and taxonomy <ul style="list-style-type: none"> • Importance and applications of biosystematics in biology • Historical resume • Material basis of biosystematics-different attributes • Trends in biosystematics- Chemotaxonomy Cytotaxonomy Molecular taxonomy 	10
Unit II	Dimensions of speciation and taxonomic characters: <ul style="list-style-type: none"> • Dimensions of speciation – types of lineage changes, production of additional lineage • Mechanisms of speciation in panmictic and apomictic species • Species concept- Species category, different species concept, subspecies and other infra specific categories • Theories of Biological classification , Hierarchy of categories • Taxonomic characters – different kinds, origin of reproductive isolation 	15
Unit III	Introduction to Biodiversity <ul style="list-style-type: none"> • Definition and concept of Biodiversity • Types of Biodiversity; • Importance of Biodiversity-Ethical and aesthetic values, Economic values • Hotspots of Biodiversity; • Common flora and fauna of India and Rajasthan • Endemic species, Endangered and threatened species of India and Rajasthan. 	15
Unit IV	Biodiversity Conservation <ul style="list-style-type: none"> • Causes of loss of Biodiversity • Extinction, Conservation methods and strategies-<i>in situ</i> (National parks, Sanctuaries, Biosphere reserves, sacred groves, etc) and <i>ex situ</i> (Botanical gardens, Zoos, Gene banks, live museums) methods • Role of biotechnology in biodiversity conservation; Agenda 21 	10
Unit V	Introduction to Wildlife <ul style="list-style-type: none"> • Wildlife resources, Wildlife habitat, Home range, territory • Types of animal movements • Mortality factors • Wildlife depletion 	10

	<ul style="list-style-type: none"> • Methods of population estimations of animals-Census, sampling, indices, transect estimates, aerial survey and mark recapture estimate; Bird counting methods. 	
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Books Recommended:

- Invertebrate Diversity of Life : Rounds H.D. : Reinhold, New York (Indian reprinting : Affiliated East West Press, New Delhi.)
- Principles of Taxonomy : Simpson, G.G. Oxford and IBH Publ. Co., New Delhi.
- General Zoology :Storer, T.I. and Using, K.L. : Tata McGraw Hill Publishing Co., New Delhi.
- Saharia, V.B. : Wildlife in India, Natraj Publishers, Dehradun
- The Biology of Biodiversity, M.Kato, Springer.
- Molecular Markers, Natural History and Evolution, J.C.Avisé. Chapman & hall. New York
- Biodiversity, E.O. Wilson, Academic Press; Washington.
- Elements of Taxonomy.E. Mayer.
- The diversity of life (The College Edition), E.O.Wilson. W.W.Northern & Co.
- Threatened Animals of India, B.K.Tikadar. ZSI Publication, Calcutta

Paper I – LSC – 142 D
Reproductive Physiology I

60 hrs. (L) + 30 hrs. (T)
4 hrs./week(L) + 2 hrs./week (T)

UNITS	TOPICS	TEACHING HOURS
Unit I	<ul style="list-style-type: none"> ▪ Endocrine glands An overview ▪ Biochemical nature of Hormones ▪ Mechanism of Hormone actions. ▪ Structure and nomenclature of steroid hormones steroidogenesis. 	12
Unit II	<ul style="list-style-type: none"> ▪ Biology of spermatozoa and ovum: structure, development and function a) The female reproductive system: Comparative anatomy and physiology of the mammalian and sub mammalian ovary and ductal system. Follicular growth, kinetics and atresia, ovarian hormones, two cell theory of estrogen biosynthesis. Autocrine, Paracrine and endocrine regulation of ovarian functions. b) The male reproductive system: Comparative anatomy and physiology of the mammalian and sub mammalian testis and the sex accessory glands; Functional Organization of testis, spermatogenic cycle. Testicula androgens, autocrine, paracrine, and endocrine regulation of testicula functions. Semen and its, biochemical nature 	12
Unit III	<ul style="list-style-type: none"> • Regulation of reproduction 6 • The pituitary gland : Functional cytology, adenohipophyseal hormones, their chemistry and physiology • The Hypothalamus and its neurosecretory centres: Structure of neurosecretory cells, the hypothalamic principles: synthesis storage, release and chemistry. • The phenomenon of neuroendocrine integration and the hypothalamo-hipophyseal gonadal axis. • Role of thyroid, pineal and adrenal glands in reproduction 	12
Unit IV	<ul style="list-style-type: none"> • Breeding seasons and reproductive cycles • Hormonal regulation of reproductive behaviour • Biology of Sex-determination and Sex-differentiation • Fertilization, Pre fertilization events, biochemistry of fertilization and post-fertilization events. 	12
Unit V	<ul style="list-style-type: none"> • Implantation and its hormonal regulation, delayed implantation • Placenta as an endocrine tissue: foeto-placental unit. • Gestation and its hormonal regulation' • Parturition and its hormonal regulation. • The mammary gland: Endocrinology of lactation. 	12

	<ul style="list-style-type: none"> • Prostaglandins: Chemistry, mechanism of action and their role in reproduction. • Miscellaneous factors affecting reproduction: nutrition, light, temperature, pheromones, environmental disruptors. 	
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Books Recommended:

- Ball, G.H. Davidson, J.N. & Scarborough, H.,:Text book of physiology & Biochemistry E. & S. Livingstone Ltd. London (1956). .
- Bast, C.H. & Tayler, N.B. :Physiological basis of medical practices, Dilkins Co. Baltimore. (1957).
- Guyton A.G.:Text book of Medical Physiology, 7th ed. Saunders Publishers (1986).
- Hoar, W.S. :General and comparative Animal physiology 3rd ed. Prentice Hall, Pvt. Ltd. New Delhi (1983).
- Scheer: General Physiology
- Schmidt Nielsen, K. Animal Physiology, Adaptations & Environment, Cambridge Univ. Press (1975).
- Tumer CII. General Endocrinology. W.B. Daunders, Tippet Co. Ltd. Tokyo, Japan (1966).
- Schmidt Nielsen, K.: Animal Physiology, Adaptations & Environment Cambridge Press (1975).
- Tumer CII: General Endocrinology, W.B. Saunders, Tippet Co. Ltd. Tokyo, Japan (1966).
- General and Comparative Endocrinology, E.J.W. Barrington. Oxford. Clarendon Press.
- Text Book of Endocrinology, R.H. Williams. W.B. Saunders.
- Endocrine Physiology. C.R. Martin. Oxford Univ. Press.
- Assali,N.S.: Biology of Gestation.VolI and II. Academic press, New York.
- Birkhead T.K. and Moller A.P. :Sperm competition and sexual selection. Academic press,London,1998.
- Cole, H.h. ,Cupps P.T.: Reproduction in domestic animals.
- Dorfman, R.I.: Methods in hormone research (Vol I and Vol II) . Academic press, New York.1962.
- Edwards R.G. and Brody S,A.: Principles and practice of assisted human reproduction. W.b. Saunders Co., Philadelphia,1995.

Paper I- LSC 142 E
ENVIRONMENTAL SCIENCE-I

60 hrs. (L) + 30 hrs. (T)
4 hrs./week(L) + 2 hrs./week (T)

ENVIRONMENTAL PROCESSES

UNITS	TOPICS	TEACHING HOURS
Unit I	Ecosystem processes : Trophic webs, Autotrophic vs. heterotrophic systems; Energy Flows and Efficiencies; Disruption of Biogeochemical Cycles and its consequences; Perturbation, Disturbance and Stress; Responses of Ecosystems (Land, Water, Marine) to deforestation, fire, pollution, ecological invasions; Rural vs. Urban systems; Restoration of Degraded Ecosystems. Biodiversity-Threats and methods of conservation.	12
Unit II	Atmospheric Processes: Structure and composition of the atmosphere – weather elements; Potential temperature, dry and moist adiabatic lapse rates; Stability in the atmosphere, mixing heights. Meteorological Fundamentals; Adiabatic Diagram; Effects of Meteorological parameters on Transport and Diffusion, Pollutant Concentration variation; Influence of Topography on Transport and Diffusion; Equation of state and conversion of concentrations; Meteorological roses	12
Unit III	Earth Processes : Plate tectonics and the formation of oceans, continents and mountains, geological processes Physico-chemical, mineralogical and biological properties of soil; Micro-organisms of soil; Decomposition of organic matter in soil; Pollution and residual toxicity from the application of insecticides, fungicides, weedicides and synthetic fertilizers; Interactions between industrial effluents and soils; soil contamination with radionuclide; Natural resources-conventional and non conventional	12
Unit IV	Water resources: Introduction: The hydrologic cycle. Inventory of Earth's water, properties of water, Surface Water Resources: Rainfall, infiltration, evapotranspiration and runoff, springs, lakes. Groundwater Resources: Rock properties affecting groundwater, vertical distribution of groundwater, Zone of Saturation, Geologic formations as aquifers, type of aquifers and groundwater basin. Environmental Influences on Water Resources: Surface and groundwater resources of Arid and Semi-arid regions, fluctuations due to evapotranspiration, fluctuations due to tides and urbanization.	12
Unit V	Geochemical Cycles: Chemistry of natural waters, physical chemistry of dissolved materials in water, pH and stability diagrams, basic concept of cycling through time, concept of reservoirs, fluxes and transfer of materials, steady and non-steady state models, global cycling of elements, rates of erosion, disturbance in the cycling due to anthropogenic impact, hydrological systems and distribution of materials through various sub-systems, Nutrient, Toxic metals and Biogeochemical Cycles.	12

Books Recommended:

- Essential Environmental Science – Methods and Techniques 1996. Simon Watts and Lyndsay Halliwell .Routledge, London
- Chemistry of the environment, second edition Author : spiro thomas g.,Stigliani william m. Prentice-hall of India Private Limited,New Delhi
- Ecology: theories and applications, 4th ed. Author : stiling peter d. Prenticehall of India Private Limited,New Delhi
- Environmental science: toward a sustainable future, 8th ed. Author: wright richard t., Nebel bernard j. Prentice-hall of India Private Limited, New Delhi
- Environmental chemistry, Author: banerji samir k., Prentice-hall of India Private Limited,New Delhi

Paper I – LSC – 142 F

Microbiology

60 hrs. (L) + 30 hrs. (T)
4 hrs./week(L) + 2 hrs./week (T)

UNITS	TOPICS	TEACHING HOURS
Unit I	EARLY MICROBIAL LIFE The prebiotic Earth: the Hadean environment, origin of life The first cellular life forms ; chemolithoautotrophs, deepest branching bacteria, fermentors and initial respirees Evolution of photosynthesis; early phototrophs, photosynthetic expansion, Cyanobacteria Metabolic diversification:obligately anaerobic and aerobic respirees Earth oxygenation: changing proterzoic environment, Eukaryotic evolution	12
Unit II	MICROBIAL DIVERSITY Extremophiles: Hyperthermophiles, halophiles halophilic thermophiles. Heat, cold and deep sea adaptations. Exploitation of extremophiles in medicine, agriculture and industries VNBC and Metagenomics: Culture independent methods to study microbial diversity construction of metagenomic libraries in culturable host. Screening of metagenomic libraries for novel bioactive compounds	12
Unit III	ENVIRONMENTAL MICROBIOLOGY Aero microbiology : bioaerosols, sampling of bioaerosols aquatic microbiology: Microbial habitats in aquatic environments Microbial Biofilms Soil Microbiology: micro flora of various soil types, Culture methods for enumeration of soil microorganisms	12
Unit IV	BIODEGRADATION BIODETERIORATION and BIOLEACHING Biodegradation of natural compounds (lignocellulose compounds) and xenobiotics Biodeterioration of paper, wood, textiles, metals (corrosion). Biobleaching of metals, Microbial enhanced oil recovery	12
Unit V	MICROBIAL DISEASES Disease reservoirs; Epidemiological terminologies; Infectious disease transmission. Host-Parasite Relationships. Normal micro flora of skin: oral cavity. Gastrointestinal tract. Entry of pathogens into the host; Colonization and factors predisposing to infections; Types of toxic (Exo-Endo-Entero-) and their structure, Mode of actions, Virulence and Pathogenesis Respiratory infections caused by bacteria and viruses; Tuberculosis; Sexually transmitted diseases including AIDS; Disease transmitted by animals (rabbits plague). Insects and ticks	12

	(rickettsias, Lyme diseases, malaria), Food and water borne diseases, Public health and water quality; Pathogenic fungi; Emerging and resurgent infectious diseases	
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Books Recommended:

- Molecular Genetics of Bacteria, Larry Shyder and Wendy Champness, ASM Press, 1997.
- Introduction to Geomicrobiology, Kurt Konhauser, Blackwell Publishing, 2007.
- Environmental Biotechnology: Basic Concepts and Applications, Indu Shekhar Thakur, IK International, 2006.
- Medical Microbiology and Immunology: Examination and Board Review, Warren Levinson and Ernst Jawetz, (7th edition), Mc Graw Hill, 2002.
- Microbial Diversity: Current Prospective and Potential Applications, T. Satyanarayana, B.N. Johri, IK International, 2005.

Paper I – LSC – 142 G

Plant Pathology

60 hrs. (L) + 30 hrs. (T)
4 hrs./week(L) + 2 hrs./week (T)

UNITS	TOPICS	TEACHING HOURS
Unit I	History and scope of plant pathology. Pathogens and parasitism. Factors affecting disease development (pathogen as well as host factors). Physiological specialisation of microbes, environmental factors in disease development.	12
Unit II	Plant – microbe interaction (Molecular level) : Molecular mechanisms of microbial pathogenesis and plant disease resistance. Involvement of toxins, hydrolytic enzymes and other virulence factors used by microbes to compromise the plant cell and incite disease. Plant defense, production of host defense compounds and mechanisms of defense, phytoalexins, hypersensitive reactions (gene-for gene theory), induced systemic resistance, and pathogenesis related proteins.	12
Unit III	Management of plant diseases- Physical, chemical and biological control, IPM, plant disease clinics, role of biotechnology and IT in management of diseases. Mechanism of Plant protection and disease resistance mechanisms at molecular level, review of developments and future prospects of plant pathology, use of softwares for disease forecasting. Use of tissue culture for production of disease free plants.	12
Unit IV	Advances in Mycology New trends and recent developments in systematic mycology.. Molecular mycology: current advances in fungal research. Use of biotechnology in different fields of Mycology. Role of modern techniques like PCR, Chromatography and Spectroscopy in identification and characterization of species. Ecology, epidemiology and control of rust and smut of wheat, smut of jowar and barley, paddy blast, early and late blight of potato, downy and powdery mildews.	12
Unit V	Systematics of bacterial plant pathogens. Identification on the basis of morphology, serology and pathogenicity. Ecology, epidemiology and control of soft rot of vegetables, leaf spot of cotton, tundu disease of wheat, blight of rice. Symptomatology, transmission of viral diseases. Ecology, epidemiology and control of TMV, potato virus X and Y, bhindi yellow mosaic and tomato ring mosaic. Ecology, epidemiology and control of diseases caused by phytoplasma, sesame phyllody, spike of sandal, little leaf of brinjal.	12

Books Recommended:

- Agrios, G.N., 1997. Plant Pathology. Academic press, London.
- Bridge, P.D., 1998. Application of PCR in Mycology. CAB Intern. Ferry Lane, Kew, U.K.
- Cook, R. C. and M. J. Whipps. 1993. Ecophysiology of Fungi. Blackwell Scientific, London, UK.
- Daniels, M.J., Downie, J.A. and Osbourn, A.E., 2000. Advances in molecular Genetics of Plants Microbe interactions. Software R Mathias Zehe.
- Hawksworth, D.I., Kile, P.M., Sutton, B.C. and Pegler, D.M., 1995. Ainsworth and Bisby's Dictionary of the Fungi. 8th edition, International Mycological Institute, Egham, UK.
- Horsfall, J.G. and Diamond, A.L., 1960. Plant Pathology, Advanced treatise vol. I, II, III. Academic Press, Sant Paul. USA.

Paper II – LSC – 143 A

Biochemistry

60 hrs. (L) + 30 hrs. (T)
4 hrs./week(L) + 2 hrs./week (T)

UNITS	TOPICS	TEACHING HOURS
Unit I	<ul style="list-style-type: none">• Thermodynamics in Biochemistry, Bioenergetics, Biosynthesis of monosaccharides and Polysaccharides and their regulation.• Anaerobic production of ATP, mechanism of Fermentation Regulation of glycolysis.• Aerobic production of ATP, TCA cycle, its regulation, Gluconeogenesis, Hormonal regulation of carbohydrate metabolism, Molecular aspects of diseases caused by abnormal metabolic pathways.	12
Unit II	<ul style="list-style-type: none">• Regulation of fatty acid and triacylglycerol metabolism.• Glycolipids, sphingolipids and prostaglandins, their metabolic regulation in normal and diseased conditions.• Molecular mechanism of steroid and lipoprotein metabolism, Diseases caused by abnormal metabolic pathways.	12
Unit III	<ul style="list-style-type: none">• Role of essential and non-essential amino acids in normal growth and development.• Regulation of amino acid metabolism and Diseases involved in abnormal metabolic processes.	12
Unit IV	<ul style="list-style-type: none">• Mechanism of Nitrogen fixation, amino acid transport in plant and animal cells.• Biosynthesis of Urea and its regulation• Role of various vitamins in the overall metabolic process.• Precursor functions of amino acids and its importance.	12
Unit V	<ul style="list-style-type: none">• Regulation of purine and pyrimidine nucleotides, metabolism and diseases involved in the abnormal functioning .• Role of Myoglobin and Hemoglobin in oxygen transport with special emphasis on allostery. Molecular mechanism of Sickle –Cell anemia.	12

Books recommended

- Berry, A.K. Biochemistry, Emkey Pub. New Delhi.
- Conn, E.E. and Stuff, P.K. Outlines of Biochemistry, John Wiley New York.
- Donald Voet and Judith G. Voet Biochemistry, John Wiley and Sons., New York.
- Lubert Stryer, Biochemistry International Student edition W.H. Freeman and Company, New York.
- H.S. Srivastava, Element of Biochemistry, Rastogi Publications Meerut.
- Lehninger, A.D. Principles of Biochemistry, CBS Publishers and Distributors, Shahdra, Delhi. Alberts R.H. Frey P.A. and Jencks W.P. Biochemistry Jones, & Bartlett Publisher, Boston/London. 1992
- Deb A.C. Fundamentals of Biochemistry, New Book Agency Pvt. Ltd. Calcutta.
- Nelson D.L. and Cox M.M. Lehninger Principles of biochemistry, MacMillan/Worth Publishers. 2000
- Stryer L. Biochemistry. W.H. Freeman and Co. New York, 2001
- Voet D. Voet J.G. and Pratt C.W. Fundamentals of Biochemistry. John Wiley and sons Inc. New York, 1999
- Wilson K. and Walker J. Principles and Techniques of Practical Biochemistry Cambridge University Press, Cambridge, 1994
- Zubay G.L. Parson W.W and Vence D.E. Principles of Biochemistry. Wm.C.Brown Publishers, Oxford, England, 1995
- Harper's biochemistry by Murray, Granner, Mays Rodwell, McGraw Hill Publication, 2000

PAPER II – LSC – 143 B

Cell and Molecular Biology - II

60 hrs. (L) + 30 hrs. (T)

4 hrs./week(L) + 2 hrs./week (T)

UNITS	TOPICS	TEACHING HOURS
Unit I	<ul style="list-style-type: none"> • Energy and chemical reaction –chemical bonds, pH and concentration of hydrogen ion, chemical reaction • The molecules in cells – Proteins, Enzymes, Antibodies, Nucleic acids, lipids and bio-membrane carbohydrates. • Gene isolation, sequencing, synthesis, amplification, cloning, molecular probes, cDNA and genomic library, RFLP, RAPD, chromosome jumping and walking, gene transfer technology 	12
Unit II	<ul style="list-style-type: none"> • Immunity – Immunity to Microbes, Immune responses to tissue transplants, immunity to tumors, self-tolerance and acquired immuno deficiencies • Rearrangment in chromosomal DNA • Comparative genomics and the evolution of animal diversity. <ul style="list-style-type: none"> a) Most animals have essentially same genes b) Three ways gene expression is changed during evolution. c) Experimental manipulations that alter animal morphology. d) Morphological changes in Crustaceans and insects, genome evolution and human origin. 	12
Unit III	<ul style="list-style-type: none"> • Antisense and Ribozyme technology <ul style="list-style-type: none"> ○ Molecular mechanisms of antisense molecules. ○ Inhibition of splicing, polyadenylation and translation. ○ Disruption of RNA structure and capping ○ Biochemistry of ribozyme: hammerhead, hairpin and other ribozymes. ○ Application of antisense and ribozyme technology. 	12
Unit IV	<ul style="list-style-type: none"> • Fermentation Technology <ul style="list-style-type: none"> ○ Primary and secondary metabolites in Biotechnology continuous and batch type culture technique principle types of fermenters ○ Production of single cell proteins. ○ Production strategies for other antibiotics and other organic compound. 	12
Unit V	<ul style="list-style-type: none"> • Proteins Technology <ul style="list-style-type: none"> ○ Classical proteomics (CD & 3D electrophoresis) separation and isolation of protein, acquisition of protein structure database utilization (PDB) ○ Functional characterization of proteins through mass 	12

	spectroscopy. <ul style="list-style-type: none"> ○ Types of proteomics ○ Proteomics application ○ DNA and protein microarrays. 	
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Books Recommended:

- Molecular Cloning: a Laboratory Manual, J. Sambrook. E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000.
- DNA Cloning: a practical Approach, D. M. Glover and B.D. Hames, IRL Press Oxford, 1955.
- Molecular and Cellular Methods in Biology and Medicine, P. B. Kaufman, W. Wu., D. Kim and L.J: Cseke, CRC Press.Florida,1995.
- An Introduction to Genetic Engineering. Edited by Desmond S.T. Nicholl, Cambridge University Press, February 2002.
- Manipulation and Expression of Recombinant DNA. Sue Carson and Dominique Robertson, Second edition, Academic Press, December 2005.
- Principles of Gene Manipulation and Genomics. Primrose and Twyman, (7th edition). Blackwell Publishers, 2006.
- RNA interference Technology- From basic science to drug development. Edited by Krishnarao Appasani. Forewords by Andrew Fire and Marshall Nirenberg, Cambridge Press, 2005.
- Methods in Enzymology Vol.152,Guide to Molecular Cloning Techniques, S. L. Berger and A. R. Kimmel, Academic press. Inc. San Dlogo, 1998.
- Methods in Enzymology Vol.185,Gene Expression Technology, D. V. Gooddol, Academic Press, Inc., San Diego,1990.
- DNA Science. A First Course in Recombinant Technology, D.A. Mickloss and G.A. Greyer, Cold Spring Harbor Laboratory Press, New York,1990
- Molecular Biotechnology (2nd Edition), S.B. Primorse, Blackwell Scientific Publishers, Oxford, 1994.
- Milestones in Biotechnology. Classic papers on genetic Engineering, J.A. Davies and W.S.Roznikolf, Butterworth-Helnemann, Boston, 1992.
- Route Maps in Gene Technology, M. R. Walker and R.Repley, Blackwell Science Ltd. Oxford, 1997.
- Genetic Engineering. An Introduction to gene analysis and exploitation in eukaryotes. S. M. Kingsman and A.J. Kingsman, Blackwell Scientific Publications. Oxford, 1998.
- Molecular Biology of the Gene. I.D Watson, N.H. Hopkins, J.W. Roberts, J.A. Steiz and AM Weiner The Benjamin/Cummings Pub. Co., Inc., California.
- Molecular Cell Biology, J. Darnell H.Lodish and D. Baltimore Scientific American Books, Inc., USA.
- Molecular Biology of the cell. B.Alberts, D.D.Bray, J.Lewis, M.Rafif, K. Roberts and J.D.Watson. Garland Publishing inc., New York.
- Gene IV, Benjamin Lewin. Oxford University Press, UK.
- Molecular Biology and Biotechnology. A comprehensive desk reference, R.A.Meyers (Ed.), VCH Publishers, Inc., New York.
- Molecular Cloning: A Laboratory Manual, J.Sambrook, E.F.Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York.

- Introduction to Practical Molecular Biology, P.D.Dabre, John Wiley& Sons Ltd. New York.
- Molecular Biology Lab Fax, T.A.Brown (Ed.), Bios Scientific Publishers Ltd., Oxford. Molecular Biology of the Gene. I.D Watson, N.H. Hopkins, J.W. Roberts, J.A. Steiz and AM Weiner The Benjamin/Cummings Pub. Co., Inc., California.
- Molecular Cell Biology, J. Darnell H.Lodish and D. Baltimore Scientific American Books, Inc., USA.
- Molecular Biology of the cell. B.Alberts, D.D.Bray, J.Lewis, M.Rafif, K. Roberts and J.D.Watson. Garland Publishing inc., New York.
- Gene IV, Benjamin Lewin. Oxford University Press, UK.
- Molecular Biology and Biotechnology. A comprehensive desk reference, R.A.Meyers (Ed.), VCH Publishers, Inc., New York.
- Molecular Cloning: A Laboratory Manual, J.Sambrook, E.F.Fristsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York.
- Introduction to Practical Molecular Biology, P.D.Dabre, John Wiley& Sons Ltd. New York.
- Molecular Biology Lab Fax, T.A.Brown (Ed.), Bios Scientific Publishers Ltd., Oxford.
- Kuby's Immunology, (4th Edition)-R.A. Goldsby, Thomas J. Kindr. Barbara, A. Osbarne, (Freeman) & Co. New York.
- Roitt's Essential Immunology,(10th edition), Ivan M .Roitt and Peter J. Delves, Blackwell Science, 2001
- Instant Notes on Immunology, (2nd edition), Lydyard, Wheran and Fanger, Viva Books Pvt. Ltd., 2003
- Cellular and Molecular Immunology, (3rd edition), Abbas, Litchman and Pober, Harcourt Brace and Company, 1998
- Immunology: A Comprehensive Review. Darla J. Wise and Gordon R. Carter, Iowa State University Press, 2001
- Medical Microbiology and Immunology: Examination and Board Review, (7th edition), Warren Levinson and Ernst Jawetz, Mc Graw Hill, 2002
- Molecular databases for Protein sequence and Structure studies, J A Sillince and M Sillince, Springer Verlag, 1991

PAPER-II - LSC 143 C

Animal Taxonomy & Biodiversity II

60 hrs. (L) + 30 hrs. (T)
4 hrs./week(L) + 2 hrs./week (T)

UNITS	TOPICS	TEACHING HOURS
Unit I	<p>Procedure keys in taxonomy</p> <ul style="list-style-type: none"> • Taxonomy procedures-Taxonomic collections, preservations, curation process of identification • Taxonomic keys-Different kinds of Taxonomic keys, their merits and demerits • Systematic publication-Different kinds of publications • Process of typification and different zoological types • International code of Zoological nomenclature(ICZN) – its operative principles, interpretation and application of important rules, Zoological nomenclature, formation of scientific names of various taxa. • Evaluation of biodiversity indices: Shannon-Weiner index, dominance index 	10
UNIT II	<p>Concept of evolution and theories of organic evolution with an emphasis on Darwinism.</p> <ul style="list-style-type: none"> • Micro and Macro-evolution • Neo-Darwinism • Hardy –Weinberg law of genetic equilibrium <p>A detailed account of Destabilizing forces:</p> <ol style="list-style-type: none"> (i) Natural selection (ii) Mutation (iii) Genetic drift (iv) Migration (v) Meiotic drive 	15
UNIT III	<p>Genetics of quantitative traits in populations</p> <ul style="list-style-type: none"> • Analysis of quantitative traits • Quantitative traits and natural selection • Genotype-environment interactions • Inbreeding depression and heterosis • Molecular analysis of quantitative traits • Phenotypic plasticity • Molecular phylogenetics • How to construct phylogenetic trees • Phylogenetic inference-Distance methods, parsimony methods, maximum likelihood method • Immunological techniques 	15
UNIT IV	<p>Wildlife Management in India</p> <ul style="list-style-type: none"> • Conservation and management strategy of wildlife, Action plan for conservation and management of wildlife 	

	<ul style="list-style-type: none"> • Restoration of wildlife population-Captive breeding, soft and hard release • Important projects for the conservation of wildlife in India-Project Tiger, Operation Rhino, Gir Lion Project • National and International organizations involved in Wildlife protection (WWF, IUCN, BNHS,IBWL); Red Data Book 	10
UNIT V	<p>Legal implementation towards Wildlife and Biodiversity</p> <ul style="list-style-type: none"> • Wildlife (Protection) Act,1972 • Wildlife (Protection) Amendment Act ,1991 • Man and Biosphere programme, Convention on Biological Diversity (CBD), Biodiversity and Patent Law; Biosafety Protocol • Intellectual Property Right (IPR) • The TRIP Agreement • Bioprospecting 	10

Books Recommended:

- Invertebrate Diversity of Life : Rounds H.D. : Reinhold, New York (Indian reprinting : Affiliated East West Press, New Delhi.)
- Principles of Taxonomy : Simpson, G.G. Oxford and IBH Publ. Co., New Delhi.
- General Zoology :Storer, T.I. and Using, K.L. : Tata McGraw Hill Publishing Co., New Delhi.
- Barnes, R.D. : Invertebrate Zoology, W.G. Saunders, Philadelphia.
- Saharia, V.B. : Wildlife in India, Natraj Publishers, Dehradun
- The Biology of Biodiversity, M.Kato, Springer.
- Molecular Markers, Natural History and Evolution, J.C.Avisé. Chapman & hall. New York
- Biodiversity, E.O. Wilson, Academic Press; Washington.
- Principle of Animal Taxonomy; G.G Simpson. Oxford IBH Publishing Company.
- Elements of Taxonomy.E. Mayer.
- The diversity of life (The College Edition), E.O.Wilson. W.W.Northern & Co.
- Threatened Animals of India, B.K.Tikadar. ZSI Publication, Calcutta

Paper I – LSC – 143 D
Reproductive Physiology II

60 hrs. (L) + 30 hrs. (T)
4 hrs./week(L) + 2 hrs./week (T)

UNITS	TOPICS	TEACHING HOURS
Unit I	<ul style="list-style-type: none"> • Fundamental aspects of control of fertility in males: a) Mechanical. b) Surgical. c) Chemical. d) Immunological methods 	12
Unit II	<ul style="list-style-type: none"> • Fundamental aspects of control of fertility in females a. Natural. b. Mechanical. c. Surgical. d. Chemical. e. Immunological. f. Emergency contraception 	12
Unit III	<ul style="list-style-type: none"> • Reproductive dysfunctions in males and females. • Diagnosis of male infertility: a) Semen analysis: Physical examinations, microscopic examinations, biochemical analysis, Immunological tests. b) Sperm function tests: Sperm mitochondrial Hypo-osmotic swelling test, acrosome, reaction. Zona binding assays. Acrosome intactness test. hamster- oocyte penetration test. c) Endocrinological diagnosis. 	12
Unit IV	<ul style="list-style-type: none"> • Diagnosis of female infertility a. Monitoring of ovarian and reproductive cycles. b. Endometrial biopsy. c. Ductal blockage. d. Endocrine diagnosis 	12
Unit V	<ul style="list-style-type: none"> • Assisted reproductive technology (ART) a). Super ovulation, oocyte collection. b). Collection and preparation of sperm for assisted fertilization. c). Insemination. d). In vitro fertilization and related techniques (IVF, GIFT, ZIFT, TET, ICSI). • Cryopreservation of semen, oocytes and embryos. • Cloning, transgenic animals. • Teratological effects of Xenobiotics • Pre-natal diagnosis • Impact of aging, hormone replacement therapy • Hormonal bioassay: a). ELISA. b). Radio immunoassay (RIA). c). Radioreceptor binding assay 	12

Books Recommended:

- Ball, G.H. Davidson, J.N. & Scarborough, H.,:Text book of physiology & Biochemistry E. & S. Livingstone Ltd. London (1956). .
- Bast, C.H. & Tayler, N.B. :Physiological basis of medical practices, Dilkins Co. Baltimore. (1957).
- Guyton A.G.:Text book of Medical Physiology, 7th ed. Saunders Publishers (1986).
- Hoar, W.S. :General and comparative Animal physiology 3rd ed. Prentice Hall, Pvt. Ltd. New Delhi (1983).
- Scheer: General Physiology
- Schmidt Nielsen, K. Animal Physiology, Adaptations & Environment, Cambridge Univ. Press (1975).
- Tumer CII. General Endocrinology. W.B. Daunders, Tippan Co. Ltd. Tokyo, Japan (1966).
- Schmidt Nielsen, K.: Animal Physiology, Adaptations & Environment Cambridge Press (1975).
- Tumer CII: General Endocrinology, W.B. Saunders, Tippan Co. Ltd. Tokyo, Japan (1966).
- General and Comparative Endocrinology, E.J.W. Barrington. Oxford. Clarendon Press.
- Text Book of Endocrinology, R.H. Williams. W.B. Saunders.
- Endocrine Physiology. C.R. Martin. Oxford Univ. Press.
- Assali,N.S.: Biology of Gestation.VolI and II. Academic press, New York.
- Birkhead T.K. and Moller A.P. :Sperm competition and sexual selection. Academic press,London,1998.
- Cole, H.h. ,Cupps P.T.: Reproduction in domestic animals.
- Dorfman, R.I.: Methods in hormone research (Vol I and Vol II) . Academic press, New York.1962.
- Edwards R.G. and Brody S,A.: Principles and practice of assisted human reproduction. W.b. Saunders Co., Philadelphia,1995.

Paper II- LSC 143 E

ENVIRONMENTAL SCIENCE-II

60 hrs. (L) + 30 hrs. (T)
4 hrs./week(L) + 2 hrs./week (T)

ENVIRONMENTAL MANAGEMENT AND SUSTAINABLE DEVELOPMENT

UNITS	TOPICS	TEACHING HOURS
Unit I	Pollution Management : Air Quality Models: Diffusion model, Gaussian dispersion model, evaluation of stability parameters, model for line sources, area sources, plum rise equations, dry deposition models, evaluation and experimental verification of plume models. Air monitoring survey networks, siting criteria; Principles and techniques for ambient and stack sampling; Principles & Methods of monitoring particulate and gaseous air pollutants; Stack emission standards, ambient air quality standards. Water quality criteria; objectives and steps in water quality management; analysis of water quality system; Modeling approaches to water quality system. Waste water treatment	12
Unit II	Waste minimization and life-cycle assessment: Waste problem: Definition of waste, Benefits of waste management, Objectives of waste management, Criteria for the assessment of raw materials, Process design and management, Principles of waste minimization, assessing the total waste impact. Life Cycle Assessment (LCA): The process of LCA & methodology; Green marketing, packaging and eco- labeling	12
Unit III	Environmental Impact Assessment (EIA) and Environmental Auditing: Definition of EIA and its purpose; Sustainable Development with reference to EIA; Indian directive on EIA: EIA guidelines 2006 i.e. Notification of Government of India. EIA process and methods used, Environmental Management Plan. Environmental Auditing : objectives and process; Environmental management system; Auditing of EMS; Concept of CDM.	12
Unit IV	Environmental biotechnology: Biotechnological approaches in environment, role of microbes in environmental abatement, genetic manipulation and biodegradation of pesticides and organic compounds genetically modified organisms, release of GMO in environment; Bioremediation.	12
Unit V	Unit V- Legislative approach to environmental management: Overview of Environmental laws in India; The Water (Prevention and Control of Pollution) Act, 1974; The Water (Prevention and Control Of Pollution) CESS Act, 1977; The Air (Prevention and Control of Pollution) Act, 1981; The Environment (Protection) Act; 1986, Convention on biodiversity. Wildlife protection act 1982 Hazardous Wastes (Management and Handling) Rules, 1989; Bio-	12

Books Recommended:

- Environmental Management & Business Strategy, Richard Welford and Andrew Gouldson, 1993 , Pitman Publishing, London.
- Environmental Management- New Directions for the Twenty-first Century. Geoff A.Wilson & Raymond L.Bryant 1997, UCL Press Ltd., London.
- Corporate Environmental Management- Systems and Strategies. Richard Welford 1996. Universities Press (India) Limited.
- Integrated Environmental Management Handbook . 1996, Paul W O’Callaghan. John Wiley and Sons
- Resource and Environmental Management 2nd ed. 2002 Bruce Mitchell. Printice Hall
- Best Practices Environment, 1999. Universities Press (India) Limited.
- Principles of International Environmental Law, Philippe Sands, 1995, Manchester University Press, Manchester.
- Environmental Law, J.D.leeson 1995 Pitman Publishing London
- Handbook of Environmental Impact Assessment, Volume 1 Environmental Impact Assessment: Process, Methods and Potential, Blackwell Science, Oxford, : Petts, J (ed) 1999.
- Handbook of Environmental Impact Assessment, Volume 2 Environmental Impact Assessment in practice: Impact and Limitations, Blackwell Science, Oxford,: Petts, J (ed) 1999.
- Environmental Methods Review: Retooling Impact Assessment for the New Century. Edited by Alan L. Porter and John J. Fittipaldi. Fargo, North Dakota,USA: The Press Club. March 1998.
- Environmental Impact assessment ,Canter, Larry W.- 2nd ed. McGraw Hill.
- Conducting Environmental Impact Assessment for Developing Countries, Oxford :Modak, P & Biswas, A.K.
- Ecological Impact Assessment, J.Traweek, Blackwell Science, Oxford
- Environmental Impact Assessment : A Practical Guide Betty Marriott
- Methods of Environmental Impact Assessment UCL Press, London. Morris, Pand Therivel, R (1995)
- Environmental Science for Environmental Management Longman, Harlow.Riordan, T (ed) (1995)
- Environmental Regulation and Impact Assessment John Wiley & Sons, New York, NY. Ortolano, L (1997)
- Disaster mitigation: experiences and reflections, Author: Sahni Pardeep, et al., Prentice-hall of India Private Limited, New Delhi
- Environmental risks and hazards, Cutter Susan. Prentice-hall of India Private Limited, New Delhi
- Department of the Environment (1989) Environmental Assessment - a Guideto the Procedures HMSO, London.

Paper-II- LSC-143 F

BIOTECHNOLOGY

60 hrs. (L) + 30 hrs. (T)
4 hrs./week(L) + 2 hrs./week (T)

UNIT	TOPICS	TEACHING HOURS
Unit I	RECOMBINANT DNA TECHNOLOGY: Principles and methods of recombinant DNA technology-hybridization, cloning, sequencing, polymerase chain reaction, genome projects; gene manipulations; cloning in <i>E.coli</i> , plasmids, bacteriophages and cosmid vectors, cloning strategies, genomic and cDNA library; cloning in yeast: transformation in yeast, yeast vector development: Yep, YRp, YCp and YIp, 2m plasmid, yeast artificial chromosome (YAC), retrovirus like vector (Ty) in yeast/shuttle vector; features of yeast promoter and expression of cloned genes; yeast 2-hybrid system; plasmid shuffling to explore interactive domains of multimeric proteins; the cassette model for mating type switches and silencing of genes.	10
Unit II	PLANT BIOTECHNOLOGY: Transformation of plants, manipulating gene expression in plants, selectable markers and reporter genes, <i>Agrobacterium tumefaciens</i> ; Genetic elements present on the Ti plasmid, genetic engineering of the Ti plasmid, vectors used to introduce foreign DNA into plant cells- binary cloning vector, disarmed Ti plasmid, cointegrate cloning vector; comparison of methods for transfer of DNA to plants, manipulation of gene expression in plants; production of transgenic plants without reporter or marker genes. Plant cell tissue and organ cultures: Introduction to cell and tissue culture techniques; totipotency ; Morphogenesis <i>in vitro</i> ; Organogenesis and somatic embryogenesis; Micropropagation and clonal propagation. Synthetic seeds; Germplasm preservation <i>in vitro</i> ; Production of haploids and triploids (anther, microspore and endosperm culture); Protoplast culture and somatic hybridization; nuclear and cytoplasmic hybrids. Somaclonal variation in plant cell culture and regenerated plants; Cryopreservation and germplasm conservation	15
Unit III	ANIMAL BIOTECHNOLOGY Equipments and materials for animal cell culture technology Primary and established cell line cultures Introduction to the balanced salt solution and simple growth medium Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium Role of carbon dioxide Role of serum and supplements. Serum & protein free defined media and their application. Measurement of viability and cytotoxicity Biology and characterization of the cultured cells, measuring	10

	parameters of growth Basic techniques of mammalian cell culture <i>in vitro</i> , disaggregation of tissue and primary culture, maintenance of cell culture; cell separation Scaling-up of animal cell culture cell synchronization cell cloning and micromanipulation cell transformation.	
Unit IV	FERMENTATION TECHNOLOGY : Different fermentative system; Batch and Continuous Process, Fermentor Design, Surface and submerged liquid substrate fermentation; Solid Substrate Fermentations, Fermentation raw materials, Down stream processing, Bio-mass production (alcohol, lactic acid, cheese making, bread making, soya based foods, meat fermentation, vinegar, industrial chemical, bio-polymer, bioinsecticides, food additive [amino acids, nucleosides, vitamins, fats and oils], health care products {antibiotics, steroids, vaccines}, Production of Industrial solvents[alcohol, acetone, butanol etc.]); Industrial Enzymes (amylase, proteases, lipases), concepts of immobilized enzymes	15
Unit V	ENVIRONMENTAL BIOTECHNOLOGY: Types of environment pollution, Methods for the measurement of pollution, Methodology of environment management-the problem solving approach and its limitations. Global Environmental problems Ozone depletion, UV-B, greenhouse effect and acid rain, their impact and biotechnological approaches for management Energy. Patenting and IPR. Global Environmental problems Ozone depletion, UV-B, greenhouse effect and acid rain, their impact and biotechnological approaches for management	10

Books Recommended:

- Plant, Gene and crop Biotechnology, M.J. Chrispeel and D.E. Sadava ASPB 2003.
- Textbook of Environmental Biotechnology, P.K Mohapatra, I K International Publications, Mumbai 2006.
- Environmental Chemistry, A.K.De, Willey Eastern Ltd., New Delhi.
- Microbial Ecology- Fundamentals and applications. Ronald. M. Atlas, Richard Bartha. Pearson Education. 2005.
- Advances in Industrial Waste water treatment. P.K. Goel. (First Edition). Technosound Publications. 1999.
- Wastewater Engineering- Treatment, Disposal and Resuse, Metcalf and Eddy, Inc., Tata McGraw Hill, Delhi.1999
- Comprehensive Biotechnology, vol.4, M. Moo- Young (Ed-in-chief), Pergamon Press, Oxford.
- Introduction to Biodeterioration. D. Allsopp and K.J. Seal, ELBS/Edward Arnold.
- Bioremediation Engineering: design and Application. Cookson, J.T. McGraw- Hill, Inc.1995
- Environmental Biotechnology – Basic concepts and applications, Indu Shekhar Thakur, I K International publications. 2006 Molecular Cloning: a Laboratory Manual, J. Sambrook. E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000

- DNA Cloning: a practical Approach, D. M. Glover and B.D. Hames, IRL Press Oxford, 1955.
- Molecular and Cellular Methods in Biology and Medicine, P. B. Kaufman, W. Wu., D. Kim and L.J: Cseke, CRC Press.Florida,1995.
- An Introduction to Genetic Engineering. Edited by Desmond S.T. Nicholl, Cambridge University Press, February 2002.
- Manipulation and Expression of Recombinant DNA. Sue Carson and Dominique Robertson, Second edition, Academic Press, December 2005.
- Principles of Gene Manipulation and Genomics. Primrose and Twyman, (7th edition). Blackwell Publishers, 2006.
- RNA interference Technology- From basic science to drug development. Edited by Krishnarao Appasani. Forewords by Andrew Fire and Marshall Nirenberg, Cambridge Press, 2005.
- Methods in Enzymology Vol.152,Guide to Molecular Cloning Techniques, S. L. Berger and A. R. Kimmel, Academic press. Inc. San Dlogo, 1998.
- Methods in Enzymology Vol.185,Gene Expression Technology, D. V. Gooddol, Academic Press, Inc., San Diego,1990.
- DNA Science. A First Course in Recombinant Technology, D.A. Mickloss and G.A. Greyer, Cold Spring Harbor Laboratory Press, New York,1990
- Molecular Biotechnology (2nd Edition), S.B. Primorse, Blackwell Scientific Publishers, Oxford, 1994.
- Milestones in Biotechnology. Classic papers on genetic Engineering, J.A. Davies and W.S.Roznikolf, Butterworth-Helnemann, Boston, 1992.
- Route Maps in Gene Technology, M. R. Walker and R.Repley, Blackwell Science Ltd. Oxford, 1997.
- Genetic Engineering. An Introduction to gene analysis and exploitation in eukaryotes. S. M. Kingsman and A.J. Kingsman, Blackwell Scientific Publications. Oxford, 1998.

Paper-II – LSC 143 G

Plant Physiology

60 hrs. (L) + 30 hrs. (T)
4 hrs./week(L) + 2 hrs./week (T)

UNITS	TOPICS	TEACHING HOURS
Unit I	Plant Growth Regulators: Biochemistry and physiological effects of anti- auxins (TIBA), defoliants (endothal, TDZ), plant toxins (brucine, abrin, ricin and thionin), growth inhibitors (jasmonic acid and morphactins: flurenol and chloroflurenol).	12
Unit II	Antioxidants: The oxidative challenge in biology, significance of metabolites: vitamin E, ascorbic acid, melatonin and glutathione, Pro-oxidant activities, enzyme systems: Super Oxide Dismutase (SOD), antioxidants and oxidative stress in disease prevention and disease treatment, adverse effects of anti-oxidants.	12
Unit III	Mineral Nutrition: Introduction to plant nutrients: essential and non-essential nutrients, role of nutrients in plant metabolism, deficiency symptoms of nutrients in plants, hydroponics, various nutrients in tissue culture media, replacement of PGR by mineral nutrients with special reference to medicinal plants, spices and cereals.	12
Unit IV	Pharmacognosy: History, definition and scope of pharmacognosy, ethnopharmacology, Natural drugs and their classification, chemical groups of natural drugs: introduction, structure and mode of action of alkaloids, terpenoids, tannins, volatile oils and glycosides, herb and drug interaction.	12
Unit V	Stress Physiology: Plant responses to biotic and abiotic stress (metal toxicity, salinity, temperature, water and nutrient), mechanism of defense and phytotoxicity	12

Books Recommended:

- Dennis, DT; Turpin, DH; Lefebvre, DD and Layzell (eds.). 1997. Plant.
- Devlin. 1997. Plant Physiology. East-West Press Pvy. Ltd.
- Metabolism (2nd edition). Longman, Essex, England.
- Galston, AW. 1989. Life Processes in Plants. Scientific American Library.
- Gosh, AK. 2005. Plant Physiology. New Central Book Agency (P) Ltd., Calcutta.
- Handa SF and Kapoor VK. Text Book of Pharmacognosy.CBS Publishers New Delhi.
- Hopkins, WG. 1995. Introduction to Plant Physiology. John Wiley & Sons Inc., New York, USA.
- Lawlor and David, W. 2001. Photosynthesis. Viva Books Pvt. Ltd.
- Lea, PJ and Leegood, RC. 1999. Plant Biochemistry and Molecular Biology. John Wiley & Sons, New York.
- Mohr, H and Schopfer, P. 1995. Plant Physiology. Springer- Verlag, Berlin, Germany.

- Pandey, BP. 1998. Plant Physiology. Vikas Publishing House.
- Salisbury, FB and Ross, CW. 1992. Plant Physiology (4th edition). Wadsworth Publishing Co., California, USA.
- Sands. 1995. Problems in Plant Physiology. John Murray, London.
- Srivastava, HN. 2006. Pradeep's Botany Vol. V. Pradeep Publications, Jalandhar.
- Taiz and Lincoln. 2003. Plant Physiology. Panima Publishing Co., New Delhi.
- Taiz, L and Zieger, E. 1998. Plant Physiology (2nd edition). Sinauer Associates, Inc. Publishers Massachusetts, USA.
- Verma, SK. Plant Physiology and Biochemistry. S. Chand & Sons, New Delhi.
- Wallis TE. Text Book of Pharmacognosy. CBS Publishers, New Delhi.

Paper-II – LSC 144
Laboratory Techniques

UNITS	TOPICS	TEACHING HOURS
	Practical related to paper LSC-141	

**Paper : LSC-146
Communication Skills**

45 Hrs (3 hrs/week)

Needs of the Learners:

1. Presentations (Writing and Speaking)
2. Participation in Seminars/Conferences
3. Participation in Group Discussion
4. Writing Reports (for Academic Purposes, on Projects / Experiments, etc.)
5. Teaching.

Language-skills required:

1. Reading
2. Writing
3. Speaking

I Grammar

9 hrs

Conditionals
Relative Clauses
Subject – Verb Agreement
Passive Voice

II Written Communication – I

9 hrs

Discuss a topic of general interest, but related to science in about 300 words.
(Analyse, Comment, Argue, Reflect, Persuade, etc.)
(can also be used for an oral presentation, followed by discussion)

III Written Communication – II

9 hrs

Writing a Report on a project undertaken or an experiment conducted (Theory + Practice)

IV Oral Communication I

9 hrs

- (a) Consulting a dictionary for correct pronunciation (familiarity with Phonemic Symbols and Stress-marks only) **(6 hrs)**
(b) Making a Presentation (Powerpoint) **(3 hrs)**

V Oral Communication – II

9 hrs

- (a) Group Discussion **(6 hrs)**
(b) Interviews **(3 hrs)**

Text/References:

1. Advanced English Usage; Quirk & Greenbaum; Pearson Education.
2. Developing Communication Skills; Banerjee Meera & Mohan Krishna; Macmillan Publications, 1990.
3. Business Communication; Chaturvedi, P.D.; Pearson Publications.
4. Business Communication; Mathew, M.J.; RBSA Publications, 2005.
5. Communication of Business; Taylor, Shirley; Pearson Publications.

Assessment – Pattern

- **30 Marks**
 - 10 – Written Test (On Grammar)
 - 10 – Teacher Interaction
 - 10 – Attendance

- **70 Marks**
 - 30 –Powerpoint Presentation
 - 20 – Group Discussion
 - 20 – Viva-Voce

Elective Course – LSC – 241

Agricultural Bio-technology

UNITS	TOPICS	TEACHING HOURS
Unit I	Agricultural Microbiology : Classification of Bacteria, Gene transfer methods in microorganisms ,Role of microbes in carbon and nitrogen cycles-Variou types of nitrogen fixing microorgranism, genetic transformation of microorganisms for enhancing the agricultural productivity,Production of bacterial biofertilizers: Rhizobium, Azospirillum, Fungal biofertilizers; Ecto- and Endomychorizae-Azolla and BGA.	12
Unit II	Soil as a medium of plant growth and its composition; mineral and organic constituents of soil and their role in crop production; chemical physical and microbiological properties of soil; principles of soil fertility and its evaluation for judicious use of fertilizers; organic manure and biofertilizers; soil conservation planning on water shed basis .role of biotechnology in prevention of soil erosion.	12
Unit III	Diseases of field, vegetable, orchard and plantation crops of India and their control; biological control of diseases; Seed health testing, Integrated pest management - concepts and components; host plant resistance-biological control of insect pests; genetic manipulation of insects for their control; pesticides, their formulation, classification and safe use; behavioural methods; use of computer modeling in pest and disease out break; use of semiochemicals in IPM; insect growth regulators; biotechnological approaches in IPM.	12
Unit IV	Application of Genetic Engineering in agricultural and food industry, genetic transformation of microorganisms for enhancing the agricultural productivity, Application of Plant Biotechnology for the production of quality oil, industrial enzymes, edible vaccines and plantibodies.	12
Unit V	Secondary metabolites, isolation & purification, importance of metabolites in agriculture; important metabolic pathways, chemistry and molecular genetics of flavanoid, terpenoid, and polykeloid pathways. Characterization of compounds of agriculture importance from microbes and plants. Prospecting genes of these compounds from germplasm. Strategies for large scale production of important bimolecules.	12

Books Recommended:

- Roberta Smith, Plant Tissue Culture: Techniques and Experiments. 2nd ed., Academic Press, 2000.
- Bhojwani, S.S. and Rajdan, Plant Tissue Culture: Theory and Practice. 2004
- Roberta Smith, Plant Tissue Culture: Techniques and Experiments, Academic Press; 2nd ed, 2000.
- Crispeels, M.J. and Sadava, D.E., Plants, Genes and Crop Biotechnology, Jones and Bartlett Publishers (2nd Edition), 2003.
- Bhowjwani, S.S., Plant Tissue Culture: Application and Limitations. Amsterdam, Elsevier, 1990.
- Charles Cunningham and Andrew J.R. Porter, Recombinant Proteins from Plants: Production and Isolation of Clinically Useful Compounds (Methods in Biotechnology), Humana Press, 1997.
- Bernard R. Glick and John E. Thompson, Methods in Plant Molecular Biology and Biotechnology, CRC Press, 1993.
- I. Potrykus and G. Spangenberg, , Gene Transfer to Plants (Springer Lab Manual), Springer Verlag, 1997.
- Peter M. Gresshoff, Plant Genome Analysis: Current Topics in Plant Molecular Biology. CRC Press, 1994.
- John Hammond, Peter McGarvey, Vidadi Yusibov, Plant Biotechnology.

Elective Course – LSC – 242

ANIMAL CELL CULTURE

UNITS	TOPICS	TEACHING HOURS
Unit I	Structure, organization and biology of animal cell, Principles of animal cell culture, Equipments and materials for animal cell culture technique	10
Unit II	Simple growth media, Introduction to Balanced Salt Solution, chemical, physical and metabolic functions of different constituents of culture medium, Role of CO ₂ , Role of serum supplements, Serum and protein free defined media, Measuring parameters of growth.	11
Unit III	Primary and established cell line cultures, Cell lines- Introduction, diversity and selection, nomenclature, routine maintenance and cryopreservation, Disaggregation of tissue and primary culture, Cell separation, General concept of differentiation and dedifferentiation, Organ and histotypic cultures.	15
Unit IV	Measurement of viability and cytotoxicity, Cell synchronization, Cell cloning and micromanipulation, Cell transformation, Measurement of cell death, Scaling-up of animal cells	12
Unit V	Application of animal cell culture, Stem cell culture, Embryonic stem cells and their applications, Cell culture based vaccines, Somatic cell genetics, Cell hybridization, Hybridomas and their selection and its application	12

Books Recommended:

- Culture of Animal Cells, 4th edition, R. Ian Freshney, Wiley-Liss. 2000
- Animal Cell Culture-Practical Approach, John R.W. Masters, Oxford.2000
- Methods in Cell Biology, Vol.57, Animal Cell Culture Methods. Jenni P Mather and David Barnes. Academic Press. 1998
- Basic Cell Culture edited by J.M. Davis 2nd edition, Oxford,2000
- Protein Expression: A Practical Approach, S.J. Higgins and B.D. Hames, Oxford University Press, 2004

Elective Course- LSC - 243

Environmental Biotechnology

UNITS	TOPICS	TEACHING HOURS
Unit I	<p>Environmental Resources: Air, water and soil</p> <ul style="list-style-type: none"> • Atmosphere, characteristics of atmosphere gases, atmospheric circulation. • Hydrosphere-water resources • Lithosphere-soil as resource <p>Environmental Pollution & its control</p> <ul style="list-style-type: none"> • Air pollution: sources, air pollution monitoring • Water pollution: Eutrophication, water quality, monitoring • Soil and solid waste pollution: soil erosion, salivation • Biotechnology for liquid/solid waste management 	20
Unit II	<p>Microbial properties and diversity</p> <ul style="list-style-type: none"> • Classification of Microorganisms • Physical properties of microorganisms; prokaryotes, eukaryotes, requirements for microbial growth. • Microbial diversity: Life in extreme environment, microbial community profiling, genetic fingerprint (application in the study of microbial diversity and its limitations) Biosensor, bioreporter, microchips. 	12
Unit III	<ul style="list-style-type: none"> • Degradation of xenobiotic compounds • Bioabsorption of metals • Bioremediation • Bioleaching 	10
Unit IV	<p>Biotechnology in Biodiversity conservation</p> <ul style="list-style-type: none"> • Bio-resource assessment • Ex-situ conservation of biodiversity • Role of biotechnology in the utilization of biodiversity. <p>Bio-polymers and Bio-plastics</p> <ul style="list-style-type: none"> • Types of bio-polymers and bio-plastics • Properties and applications of PHA 	10
Unit V	<ul style="list-style-type: none"> • Biofertilizers and biopesticides • Bio methanation • Composting • Degradation of lignocellulose compounds 	8

Books Recommended:

- Plant, Gene and crop Biotechnology, M.J. Chrispeel and D.E. Sadava ASPB 2003.
- Economic Botany, S.L.Kochar.
- Wastewater Engineering- Treatment, Disposal and Resuse, Metcall and Eddy, Inc., Tata McGraw Hill, Delhi.
- Comprehensive Biotechnology, vol.4, M. Moo- Yound (Ed-in-chief), Pergamon Press, Oxford.
- Environmental Chemistry, A.K.De, Willey Eastern Ltd., New Delhi.
- Introduction to Biodeterioration. D. Allsopp and K.J. Seal, ELBS/Edward Arnold.
- Cookson, J.T. 1995. Bioremediation Engineering: design and Application. McGraw- Hill, Inc.

Elective Course – LSC – 244

Environmental Microbiology

UNITS	TOPICS	TEACHING HOURS
Unit I	<p>Aero microbiology and aquatic microbiology: Nature of bioaerosols, sampling devices for collection of bioaerosols (impingement, impaction, centrifugation, filtrations and depositions), microbial survival in air, bioaerosol control.</p> <p>Microbial habitats in aquatic environments- planktonic environment, benthic habitat, microbial mats. Microbial Biofilms- Physiology, Morphology, Biochemistry of microbial biofilms formed in natural environment</p>	10
Unit II	<p>Unit-II Soil Microbiology: Classification of Soil- Physical and chemicals characteristics, micro flora of various soil types (bacteria and nematodes in relevance to soil types; rhizosphere- phyllosphere- brief account of microbial interactions symbiosis- mutualism- commensalism -competition - amensalism- synergisms - parasitisms- predation.</p> <p>Biopesticides (with special emphasis on B. Thuringensis.) Culture methods- for enumeration of bacteria, culture methods for fungi, algae, cyanobacteria.</p>	10
Unit III	<p>Biofertilizers & Mycorrhizal Relationship: Definition and types of biofertilizers, Mass cultivation and methods of inoculation of microbial inoculants – (<i>Rhizobium</i>, <i>Azotobacter</i>, & <i>Asospirillum</i>.)Cyanobacteria – <i>Azolla</i> – <i>Anabaena</i> association and its role in rice cultivation</p> <p>Quality control and ISI specifications for <i>Rhizobium</i> cultures. VAM mycorrhizal association, Types of mycorrhizal association, Isolation, stock plants and inoculum production of VAM . Physiology and function of mycorrhizas- Nutrient Uptake and other effects.</p>	15
Unit IV	<p>Waste management Treatment of industrial effluents and municipal waste through microorganisms. Aerobic Processes: Oxidation pools, Rotating Biological Discs, Rotating Drums, Anaerobic Processes: Anaerobic digestion, Anaerobic filter, upflow anaerobic sludge blanket reactors. Indicator microorganisms. Solid wastes: Sources and management (composting, vermiculture)</p>	10
Unit V	<p>Biodegradation. Biodeterioration and Bioleaching Biodegradation of natural compounds (cellulose, hemicelluloses, lignin, chitin) biodeterioration of paper, wood, paint, textiles, leather, metals (corrosion). Control of biodeterioration. Bioleaching of metals, Microbial enhanced oil recovery.</p>	15

Books recommended:***Essential readings:***

- Environmental Biotechnology – Basic concepts and applications, Indu Shekhar Thakur, I K International publications. 2006
- Environmental Microbiology R.M Maier, I.L. Pepper and C.P.Gerba, Academic Press. (2000)
- Introduction of Environmental Microbiology, Michel. R. 1999
- Microbial Ecology- Fundamentals & Applications, 4th Edition, Ronald M. Atlas, Richard Bartha, Pearsrson Publication. 2005.
- Microbial ecology. Alexander, M. John Wiley & Sons, Inc., New York. (1971)
- Microbial Ecology: A conceptual approach Lynch and Poole -Blackwell Scientific Publications (1984).
- Microbials in Integrated Pest Management, (special Indian edition) edited by Ignacimuthu S, SEN A, Oxford and IBH Publishing Co. Pv. Ltd. 2001
- Introduction to Biodeterioration (2nd edition) Allsopp D and Seal K J, Gaylarde C, Cambridge University Press, 2003
- Biofertilizers in Agriculture, Subba Rao.

References:

- Soil Organic matter and biological activity. Vanghan, D.and Malcolm, R.E Martinus Nighoff W.Junk Publishers. 1985.
- Advances in microbial ecology K.C. Marshall, Vol-8 Plenum Press. (1985)
- Aronson - Experimental Microbial Ecology -Academic Press
- Experimental Microbial Ecology Burns R.G., and Slater J.H. Blackwell Scientific Publications, Oxford, London. (1982)
- Introduction to soil microbiology. Alexander, M John, Wiley & Sons. Inc., New York. (1977)
- Microbial interactions and communities , A.T.Bull and J.H.Slater Academic Press (1982)
- S. P. Denier- Biofilms.
- Introduction to soil microbiology. Alexander, M John, Wiley & Sons. Inc., New York. (1977)
- Advances in Industrial Waste water treatment, First Edition, Technosound Publications. 1999
- Biofertilizers and Biopesticides Deshmukh AM, Technosciences Publications, 1998.

Elective Course – LSC – 245

Plant Tissue culture

UNITS	TOPICS	TEACHING HOURS
Unit I	Introduction to cell and tissue culture; Terms and definitions, Historical developments and milestones in plant tissue culture, special feature and internal organization of plant cells, totipotency, Tissue culture media (composition, preparation). Dedifferentiation & redifferentiation.	12
Unit II	Micro propagation– axillary bud, shoot tip, meristem culture. Protoplast isolation, testing viability of isolated protoplast. Steps in regeneration of protoplast, protoplasm fusion, chemical & electrical. Cell suspension culture.	12
Unit III	Agro-bacterium mediated plant transformation. Plant genetic engineering & productivity (Biotic stress) herbicide resistance, insect resistance and virus resistance. Application in agriculture & food industry. Plant genetic engineering & productivity- (Abiotic stress). Tolerance to drought, temperature & salt.	12
Unit IV	Production of secondary metabolites from plant cell cultures, processes for enhancing the production of secondary metabolites, bioreactor system and modules for mass multiplication. Germplasm conservation (Cryopreservation)	12
Unit V	Plant tissue culture and utility crops (i) Energy Crops- biodiesel crops, ethanol fuel crops, high lipid content microalgae (ii) Underutilized Crops- Gaur, Morinfa oleifera, Eleusine, Panicum, Sorghum, Green Manure and Organic Farming.	12

Books Recommended:

- Roberta Smith, Plant Tissue Culture: Techniques and Experiments. 2nd ed., Academic Press, 2000.
- Bhojwani, S.S. and Rajdan, Plant Tissue Culture: Theory and Practice. 2004
- Roberta Smith, Plant Tissue Culture: Techniques and Experiments, Academic Press; 2nd ed, 2000.
- Crispeels, M.J. and Sadava, D.E., Plants, Genes and Crop Biotechnology, Jones and Bartlett Publishers (2nd Edition), 2003.
- Bhowjwani, S.S., Plant Tissue Culture: Application and Limitations. Amsterdam, Elsevier, 1990.
- Charles Cunningham and Andrew J.R. Porter, Recombinant Proteins from Plants: Production and Isolation of Clinically Useful Compounds (Methods in Biotechnology), Humana Press, 1997.
- Bernard R. Glick and John E. Thompson, Methods in Plant Molecular Biology and Biotechnology, CRC Press, 1993.
- I. Potrykus and G. Spangenberg, , Gene Transfer to Plants (Springer Lab Manual), Springer Verlag, 1997.
- Peter M. Gresshoff, Plant Genome Analysis: Current Topics in Plant Molecular Biology. CRC Press, 1994.
- John Hammond, Peter McGarvey, Vidadi Yusibov, Plant Biotechnology.

Elective Course – LSC – 246

Toxicology

UNITS	TOPICS	TEACHING HOURS
Unit I	History and scope of Toxicology <ul style="list-style-type: none">• Environmental Toxicology• Economic Toxicology• Forensic Toxicology Different areas of Toxicology Classification of Toxic Agents	10
Unit II	Disposition of Toxicants <ul style="list-style-type: none">• Absorption, Distribution & Excretion of Toxicants• Toxicokinetics: Classic Toxicokinetics Physiologic Toxicokinetics	10
Unit III	Target Organ Toxicity <ul style="list-style-type: none">• Liver• Immune System• Respiratory System• Reproductive System	15
Unit IV	Non-Organ-Directed Toxicity <ul style="list-style-type: none">• Chemical Carcinogenesis• Genetic Toxicology• Development Toxicology	10
Unit V	Environmental Toxicology <ul style="list-style-type: none">• Air Pollution• Ecotoxicology : Chemodynamics, Biorkers : Terrestrial and Aquatic Ecotoxicology• Good Laboratory Practices• Ecologic Risk Assessment	15

Books Recommended:

- Casarett and Daull's Toxicology : The basic science of poisons. By : Curtis D. Klaassen 6th Edn., McGraw-Hill (Medical Publishing Div. NewYork
- Environmental Biotechnology – by. Indu Shekhar Thakur, I.K. International Pub.(2006)
- Toxicology, Principles and Applications: Raymond I.M.. CRC Publication.
- Microbial Ecology: Fundamentals and Applications by Atlas Bartha (An imprint of Addison Wesley Longman Inc)
- Environmental Microbiology: Maier R.M., Academic Press. 2000 Press, Cambridge. 1993.
- Environmental Science- A global concern; Cunningham W.P. and Saigo B.W Win. C. Brown Publishers, London, 1995.
- Advances in Industrial Waste Water Treatment; P.K. Goel; Technoscience Publications. Jaipur, 1999.

- An Introduction to Air Pollution; Trivedy R.K. and Goel P.K., Technoscience Publications, Jaipur, 1995.
- Problems of Environment Management in India; Goel M.M., Sharma M.C. and Purohit N.K; Anupriya Publishing House, Jaipur, 1999.
- Environmental Science (A study of interrelations); Enger E.D. and Smith B.F.; Win. C. Brown Pub. (Latest Edition).
- Botkin D. And Keller E. Environmental Science. Earth as a Living Planet; Botkin D. And Keller E

Elective Course – LSC – 247
Wild Life Management

UNITS	TOPICS	TEACHING HOURS
Unit I	Biological Basis of Wild Life : Breeding Potential, Density, Carrying capacity, Shelter, Sigmoid curve, Critical limit, Growth rates, Gregariousness, Flocking, Migration, Territoriality, Nesting Grounds, Ecological Factors.	12
Unit II	Field Investigations in connection with Wild Life Management Methods of Population estimation of animals-Census, Sampling, Indices, Transect estimates, Aerial survey and Mark recapture estimate.	12
Unit III	Wild Life Conservation in India Definition of Wildlife, Importance of Wild Life Conservation, Significance-Aesthetic and Recreational, Ecological and Ethical, Protected species of India, Concept of Endemic, Threatened and Endangered species, Causes for endangering the species.	12
Unit IV	Special Wildlife Conservation Schemes and Organizations Steps that may help conservation of wildlife, Conservation Methods and Strategies- in situ (National Parks, Sanctuaries, Biosphere Reserves, Sacred Grooves, etc.) and ex-situ (Botanical Gardens, Zoos, Gene Banks); Project Tiger, Global Tiger Forum (GTF), Gir Lion Sanctuary Project, Eco Development Project; Wildlife Conservation Organizations (B.N.H.S., I.U.C.N., I.B.W.L., W.P.S.I., WWF) and concept of Red Data Book.	12
Unit V	Legal Aspects of Wild Life Management Wild Life Protection Act. (Amendment 1991): Important features; Wild Life (Protection) Act 1972; Convention on International Trade in Endangered Species of wild flora and fauna (CITES); The Biological Diversity Act 2002.	12

Books Recommended:

- Resolving Human –Wildlife Conflicts: The Science of Wildlife Damage Management, Michael Conover, McGraw-Hill.
- Analysis and Management of Animal Populations; Modeling, Estimation and Decision Making, Byron K. Williams, James D. Nichols, Michael J. Conroy, Mc. Graw-Hill.
- Wildlife Management in India, B.B. Hosetti, Pointer Publishers
- A Text Book of Forestry and Wildlife Management/S.S. Negi, International Book Distributors, 2007, 2 vols;
- Text Book of Wildlife Management, S.K. Singh, : International Book Distributing Co.
- Introduction to Wildlife Management by James H. Shaw, Mc.Graw-Hill.

Semester II

LSC-248 Dissertation

450 hrs (30 hrs/week)

Dissertation: Literature Survey and Synopsis Presentation

This has been incorporated in semester I, with the aim that a candidate does extensive literature survey on a topic of choice and further take up dissertation on the same topic in the subsequent semester.

Dissertation

To give an exposure of research to candidates, dissertation has been introduced in semester II.

Candidate is required to carry out minor research project on any topic of choice (based on Semester I Literature Survey Article) under the supervision of an allotted guide or faculty.

The marking scheme of dissertation is as follows:

Total Marks : 100

Internal (30 %)

Synopsis	Attendance	Total
20 marks	10 marks	30 marks

External (70 %)

Objective	Methodology	Review and bibliography	Results	Presentation	Viva	Total
10 marks	10 marks	10 marks	15 marks	10 marks	15 marks	70 marks