

- M. Sc. In BOTANY
- THIRD SEMESTER (ODD SEMESTER)

FACULTY OF SCIENCE

Eligibility Criteria (Qualifying Exams)	Course Code	Course Type	Course (Paper/Subjects)	Credits	Contact Hours Per Week			EoSE Duration (Hrs.)	
					L	T	P	Thy	P
After appearing in the Second semester examination irrespective of any number of back/ arrear papers	MBT 301	CCC	ALGAE, ENVIRONMENT AND HUMAN WELFARE	5	4	2	00	3	00
	MBT 311	CCC	ALGAE, ENVIRONMENT AND HUMAN WELFARE (PRACTICAL)	2	00	00	3	00	3
	MBT 302	CCC	PRINCIPLES OF ECOLOGY	5	4	2	00	3	00
	MBT 312	CCC	PRINCIPLES OF ECOLOGY (PRACTICAL)	2	00	00	3	00	3
	MBT 303	CCC	ADVANCES IN ARCHEGONIATAE	5	4	2	00	3	00
	MBT 313	CCC	ADVANCES IN ARCHEGONIATAE (PRACTICAL)	2	00	00	3	00	3
	MBT S02	OSC	INTELLECTUAL PROPERTY, HUMAN RIGHTS & ENVIRONMENT: BASICS	6	4	3	00	3	00
	MBT C01	ECC/CB	TRIBAL STUDIES	6	4	3	00	3	00
	MBT C02	ECC/CB	MICROBES AND MICROBIAL TECHNOLOGY						
	MBT C03	ECC/CB	EVOLUTIONARY BIOLOGY						
	MBT C04	ECC/CB	BIOINFORMATICS, COMPUTATIONAL BIOLOGY AND BIOSTATISTICS						
	MBT C05	ECC/CB	GENOMICS AND PROTEOMICS						
	MBT C06	ECC/CB	IMMUNOLOGY						
					TOTAL=				
				33					

M.Sc (BOTANY)		IIIRD SEMESTER	
COURSE CODE: MBT301		COURSE TYPE: CCC	
COURSE TITLE: ALGAE, ENVIRONMENT AND HUMAN WELFARE			
CREDIT:7		HOURS:135	
THEORY: 5	PRACTICAL:2	THEORY:90	PRACTICAL: 45
MARKS			
THEORY: 100 (30+70)		PRACTICAL:33	
OBJECTIVE: This course is aimed towards generating fundamental knowledge, concepts and dimensions of Botany/ Plant Science.			
UNIT-1- 18 Hours	Unit-1-Diversity and distribution of the algae: Thallus organization, cell structure and reproduction in various groups. <i>Chlamydomonas</i> and <i>Porphyra</i> as modern experimental systems.		
UNIT-2- 18Hours	Unit-2- Classification: Molecular taxonomy – recent developments in algal classification, special emphasis on emerging trends in molecular phylogeny and inter relationship of principal groups of algae. The following groups will be covered: Cyanophyta, Chlorophyta, Phaeophyta and Rhodophyta.		
UNIT-3- 18 Hours	Unit-3- Algal Biotechnology: Historical perspectives, algal culturing techniques in the laboratory, tissue and cell culture studies in seaweeds,		
UNIT-4- 18Hours	Unit-4-cryopreservation, aquaculture (micro and macro algae cultivation), bioremediation, recent developments and future of algal biotechnology; Algal biofuels – algal biodiesel, bio-ethanol and biological hydrogen production; Algae in global warming – carbon capture by algae.		
UNIT-5- 18Hours	Unit-5- Industrial Phycology: Products, processes and applications, seaweeds polysaccharides like Agar, Carrageenan and Alginates. Bioactive compounds from algae: Bio-fertilizers; Algae in bioengineering, photo-bioreactors and raceway ponds.		

LABORATORY WORK**(MBT311)**

1. Study of diversity of freshwater and marine algae.
2. Raising of pure culture.
3. Phytoremediation experiments
4. Microtechniques

SUGGESTED**READINGS**

1. Andersen RA (2005). Algal Culturing Techniques. Physiological Society of America. Elsevier Academic Press, USA.
2. Cole KM and Sheath RG (1990). Biology of the Red Algae. Cambridge Univ. Press, Cambridge.
3. Fritsch FE (1945). The Structure and Reproduction of Algae. Vol. II. Cambridge Univ. Press. Cambridge, London.
4. Isabella A. Abbott, George J and Hollenberg (1993). Marine Algae of California. Stanford University Press. USA.
5. Lee RE (1989). Phycology. Vol. II. Cambridge Univ. Press. Cambridge, USA.
6. Sahoo D & Qasim SZ (Eds), (2002). "Sustainable Aquaculture". APH Publishing Corporation, New Delhi, India.
7. South GR and Whittick A. (1987). Introduction to Phycology. Blackwell Scientific Publications. London.

M.Sc (BOTANY)		IIIRD SEMESTER	
COURSE CODE: MBT302		COURSE TYPE:CCC	
COURSE TITLE: PRINCIPLES OF ECOLOGY			
CREDIT:7		HOURS:135	
THEORY: 5	PRACTICAL:2	THEORY:90	PRACTICAL: 45
MARKS			
THEORY: 100 (30+70)		PRACTICAL:33	
OBJECTIVE: This course is aimed towards generating fundamental knowledge, concepts and dimensions of Botany/ Plant Science .			
UNIT-1- <i>18 Hours</i>	Unit-1- Introduction to ecology, evolutionary ecology, environmental concepts – laws and limiting factors, ecological models. Characteristics of population, population size and exponential growth, limits of population growth, population dynamics, life history pattern, fertility rate and age structure, population growth. Competition and coexistence, intra-specific interactions, inter-specific interactions, scramble and contest competition model, mutualism and commensalism, prey-predator interactions		
UNIT-2- <i>18Hours</i>	Unit-2- Nature of ecosystem, production, food webs, energy flow through ecosystem, biogeochemical cycles, resilience of ecosystem, ecosystem management. The biosphere, biomes and impact of climate on biomes		
UNIT-3- <i>18 Hours</i>	Unit-3- Environmental Stresses and their management, global climatic pattern and variations over time, global climatic changes and global warming, atmospheric ozone, acid and nitrogen deposition, coping with environmental variations. Environmental pollutants- air, water and soil pollution, chemical fate and transport in air, water and soil. Use of fertilizer, pesticides and other chemicals in agriculture and hygiene and their disposal. Chemical usage and disposal from industry and pollution. Impact of chemicals on biodiversity of microbes, animals and plants. Bioindicator and biomarkers of environmental health. Biodegradation and bioremediation of chemicals, environmental issues, policies and regulations		
UNIT-4- <i>18Hours</i>	Unit-4- Biodiversity – assessment, conservation and management, biodiversity act of India and related international conventions. Sustainable development, natural resource management in changing environment. Molecular ecology, genetic analysis of single and multiple population, phylogeography, molecular approach to behavioural ecology, conservation genetics.		
UNIT-5- <i>18Hours</i>	Unit-5- .Acclimatization and adaptive responses of conifers to environmental stresses. Drought tolerance and cold hardiness, stimulation of reproductive growth seed and seedling ecology, litter decomposition rate, Conifer plantation as seed trap, impact of coniferous forest on human life.		

<p style="text-align: center;">LABORATORY WORK (MBT312)</p>	<p>Habitat studies:</p> <ol style="list-style-type: none"> 1. Physical and chemical characters of soil 2. Assessing influence of light, temperature and moisture on plant germination and growth/animal behavior and growth 3. Assessing influence of soil nutrient status on plant germination and growth <p>Community/ecosystem studies:</p> <ol style="list-style-type: none"> 1. Assessment of density, frequency and abundance of plants/animal in a community using various techniques i.e. transect, quadrat etc. 2. Comparison of stands/communities and ordination 3. Profile diagrams 4. Biomass and reproductive allocation under various environments 5. Nutrient uptake and budget for various communities/ Food chain assessment 6. Decomposition of various organic matters and nutrient release mechanisms/role of arthropods and other micro-, and macrofauna in decomposition 7. Understanding ecosystem succession by studying various stages of vegetation/community assemblages development 8. Molecular techniques in laboratory. 9. Insect diversity in soil <p>Landscape studies:</p> <ol style="list-style-type: none"> 4. Principles of GIS and RS technology 5. Interpretation (visual and automated) of remote sensing information for landscape differentiation
<p style="text-align: center;">SUGGESTED READINGS</p>	<ol style="list-style-type: none"> 1. Conklin, A.R. Jr. 2004. Field Sampling: Principles and Practices in Environmental Analysis. CRC Press. 2. Fahey, T.J. and Knapp, A.K. 2007. Principles and Standards for Measuring Primary Production. Oxford. 3. Grant, W.E. and Swannack, T.M. 2008. Ecological Modeling. Blackwell. 4. Wilkinson, D.M. 2007. Fundamental Processes in Ecology: An Earth system Approach. Oxford.

M.Sc (BOTANY)		IIIRD SEMESTER	
COURSE CODE: MBT303		COURSE TYPE: CCC	
COURSE TITLE: ADVANCES IN ARCHEGONIATAE			
CREDIT:7		HOURS:135	
THEORY: 5	PRACTICAL:2	THEORY:90	PRACTICAL: 45
MARKS			
THEORY: 100 (30+70)		PRACTICAL:34	
OBJECTIVE: This course is aimed towards generating fundamental knowledge, concepts and dimensions of Botany/ Plant Science .			
UNIT-1- 18 Hours	Unit-1-Bryophytes: Vegetative and reproductive innovations of early land plants, Role of bryophytes in ecosystem dynamics and in the global carbon budget, bryophyte association with microorganism and animals, Symbiotic fungal associations in early land plants		
UNIT-2- 18Hours	Unit-2- Poikelohydry, Desiccation tolerance. Bryogeography and conservation. Hormonal regulation of gametophyte development in bryophytes. Breeding system, population ecology and population genetics, Anisospory and sexual dimorphism. Biologically active compounds in Bryophytes. Cytogenetics of bryophytes, Molecular genetic studies of moss species with special reference to <i>Physcomitrella patens</i> , Expression of genes under stress conditions.		
UNIT-3- 18 Hours	Unit-3- Pteridophytes: Morphological diversity and evolution of vegetative organs in Pteridophytes, Diversity of Ferns - an ecological perspective, Genetics and reproductive biology of ferns, Culture of fern gametophyte for experimental investigation, photomorphogenesis, Model system in <i>Ceratopteris</i> , <i>Trichomanes</i> , <i>Osmunda</i> , <i>Marsilea</i>		
UNIT-4- 18Hours	Unit-4-Gymnosperms: Evolution of pollination mechanisms and embryogeny of gymnosperms: propagation of conifers using plant tissue culture approaches, advances in synthetic seeds technology of conifers, somatic embryogenesis and plantlet regeneration;		
UNIT-5- 18Hours	Unit-5- Acclimatization and adaptive responses of conifers to environmental stresses. Drought tolerance and cold hardiness, stimulation of reproductive growth seed and seedling ecology, litter decomposition rate, Conifer plantation as seed trap, impact of coniferous forest on human life.		

LABORATORY WORK (MBT313)	<ol style="list-style-type: none"> 1. Study of structural modification in Marchantiales, Jungermanniales, Isobryales and Hypnobryales. 2. Regeneration experiments, Effect of light, sugars and pH on regeneration. 3. Growth forms, water-holding capacity. 4. Effect of bryophyte extract on the growth of microbes. 5. Pollution Monitoring 6. Systematics in bryophytes and Pteridophytes. 7. Cytological studies on bryophytes and ferns 8. Evolution of reproductive pathways in Gymnosperms 9. Spore viability test. Male and female cone and pollen study in gymnosperms.
SUGGESTED READINGS	<ol style="list-style-type: none"> 1. Shaw AJ and B Goffinet (2000) Bryophyte Biology. Cambridge University Press. 2. Geissler and Greene SW (1982) Bryophyte Taxonomy, methods, practices and floristic exploration. J Cramer, Germany. 3. Dyer AF (Ed) (1979) The experimental Biology of Ferns. Academic London. 4. Richardson DHS (1981) The Biology of mosses. John Wiley & Sons, Inc New York. 5. Bhatnagar SP and Moitra A (1996) Gymnosperms. New Age International (P) Limited, Publishers, New Delhi 6. Singh Hardev (1978) Embryology of Gymnosperms. Encyclopedia of Plant Anatomy. Vol X Gebruder Borntraeegr1, Berlin, Stuttgart.

M.Sc (BOTANY)		IIIRD SEMESTER
COURSE CODE: MBT421		COURSE TYPE : OSC
COURSE TITLE: INTELLECTUAL PROPERTY RIGHTS, HUMAN RIGHTS & ENVIRONMENT: BASICS		
CREDIT: 06	HOURS : 90	
THEORY: 06	THEORY: 90	
MARKS : 100		
THEORY: 70	CCA : 30	
OBJECTIVE:		
<ul style="list-style-type: none"> - Understands the concept and place of research in concerned subject - Gets acquainted with various resources for research - Becomes familiar with various tools of research - Gets conversant with sampling techniques, methods of research and techniques of analysis of data. 		
UNIT - 1 12 Hrs	<ul style="list-style-type: none"> • Patents :- Introduction & concepts, Historical Overview. • Subject matter of patent. • Kinds of Patents. • Development of Law of Patents through international treaties and conventions including TRIPS Agreement. • Procedure for grant of patents & term of Patent. • Surrender, revocation and restoration of patent. • Rights and obligations of Patentee • Grant of compulsory licenses • Infringement of Patent and legal remedies • Offences and penalties • Discussion on leading cases. 	
UNIT - 2 24 Hrs	<ul style="list-style-type: none"> • Meaning of Copyright, Historical Evolution, • Subject matter of copyright. • Literary works • Dramatic Works & Musical Works • Computer Programme • Cinematographic films • Registration of Copyrights • Term of Copyright and Ownership of Copyrights • Neighboring Rights • Rights of Performers & Broadcasters • Assignment of Copyright. • Author's Special Rights (Moral Rights) • Infringement of Copyrights and defenses • Remedies against infringement (Jurisdiction of Courts and penalties) • International Conventions including TRIPS Agreement WIPO, UCC, Paris Union, Berne Convention, UNESCO. • Discussion on leading cases. 	
UNIT - 3 10 H rs	<ul style="list-style-type: none"> • Rights: Meaning • Human Rights- Meaning & Essentials • Human Rights Kinds • Rights related to Life, Liberty, Equals & Disable 	
UNIT - 4 24 Hrs	<ul style="list-style-type: none"> • National Human Rights Commission • State Human Rights Commission • High Court • Regional Court • Procedure & Functions of High & Regional Court. 	

UNIT - 5 20 Hrs	<ul style="list-style-type: none"> • Right to Environment as Human Right • International Humanitarian Law and Environment • Environment and Conflict Management • Nature and Origin of International Environmental Organisations (IEOs) • Introduction to Sustainable Development and Environment • Sustainable Development and Environmental Governance
SUGGESTED READINGS	<ol style="list-style-type: none"> 1. G.B.Reddy, <i>Intellectual Property Rights and Law</i>, Gogia Law Agency, Hyderabad. 2. S.R.Myneni, <i>Intellectual Property Law</i>, Eastern Law House, Calcutta 3. P Narayanan <i>Intellectual Property Rights and Law (1999)</i>, Eastern Law House, Calcutta, India 4. Vikas Vashistha, <i>Law and Practice of Intellectual Property</i>,(1999) Bharat Law House, New Delhi. 5. Comish W.R <i>Intellectual Property</i>,3rd ed, (1996), Sweet and Maxwell 6. P.S. Sangal and Kishor Singh, <i>Indian Patent System and Paris Convention</i>, 7. Comish W.R <i>Intellectual Property, Patents, Copyrights and Allied Rights</i>, (2005) 8. Bibeck Debroy, <i>Intellectual Property Rights</i>, (1998), Rajiv Gandhi Foundation.

M.Sc (BOTANY)		IIIIRD SEMESTER
COURSE CODE: MBTC 01		COURSE TYPE : ECC
COURSE TITLE: TRIBAL STUDIES		
CREDIT: 06	HOURS : 90	
THEORY: 06	THEORY: 90	
MARKS : 100		
THEORY: 70	CCA : 30	
OBJECTIVE:		
<ul style="list-style-type: none"> - Understands the concept and place of research in concerned subject - Gets acquainted with various resources for research - Becomes familiar with various tools of research - Gets conversant with sampling techniques, methods of research and techniques of analysis of data - Achieves skills in various research writings - Gets acquainted with computer Fundamentals and Office Software Package . 		
UNIT - 1 12 Hrs	Tribal Studies : Meaning, Nature, Scope, Need & importance of tribal studies. Meaning, Definition & characteristics of Tribe, Caste & Race.	
UNIT - 2 24 Hrs	Scheduled Tribe in India : Population Composition of tribal, classification of Indian Tribe – Racial, Lingual, Geographical, Cultural. Some Major Tribes in India : Santhal, Khasi, Munda, Bhils. Some Major Tribes in Central India : Gond, Baiga, Bharia, Korkus.	
UNIT - 3 10 H rs	Illiteracy :Poverty, Indebt ness, Unemployment, migration & Exploitation Environmental & Degradation. Problem of Health and sanitation : Prostitution, Culture Decay due to assimilation. Replacement & Rehabilitation of Tribal population.	
UNIT - 4 24 Hrs	Welfare-Concept, Characteristics: Tribal Welfare in post independence period. Constitutional provision & safe guard after independence, Legislation & Reservation Policy.	
UNIT - 5 20 Hrs	Tribal Development Programs for Scheduled Tribes : Medical, Education, Economy, Employment & Agriculture Evaluation of Programs Tribal Welfare & Advisory Agencies in India : Role of NGO's in tribal development, Role of Christian missionaries in tribal welfare & development. Tribal Welfare Administration.	
SUGGESTED READINGS	<i>Tribal Development In India (Orissa)</i> by Dr. Taradutt <i>Books on Tribal studies</i> by PK Bhowmik <i>Books on 'Tribal Studies'</i> by W.G. Archer	

M.Sc (BOTANY)		IIIRD SEMESTER	
COURSE CODE: MBTC02		COURSE TYPE: ECC/CB	
COURSE TITLE: MICROBES AND MICROBIAL TECHNOLOGY			
CREDIT:6		HOURS:90	
THEORY: 6	PRACTICAL:0	THEORY:90	PRACTICAL: 00
MARKS			
THEORY: 100 (30+70)		PRACTICAL:00	
OBJECTIVE: This course is aimed towards generating fundamental knowledge, concepts and dimensions of Botany/ Plant Science .			
UNIT-1- <i>18 Hours</i>	Unit-1-General Microbiology: Diversity of the microbial world – Microbial taxonomy and phylogeny; Microbial nutrition, growth and metabolism; Genetics of bacteria and their viruses.		
UNIT-2- <i>18Hours</i>	Unit-2- Agricultural Microbiology: Agriculturally important microorganisms; Biological nitrogen fixation; Mycorrhizae, microbial mineralization, Biocontrol of plant diseases, Plant growth promoting rhizobacteria (PGPR).		
UNIT-3- <i>18 Hours</i>	Unit-3- Environmental Microbiology: Microbes and quality of environment; Distribution and implications of microbes in air – bio-aerosols, microbial flora of water, water pollution, drinking water and domestic waste treatment systems;		
UNIT-4- <i>18Hours</i>	Unit-4-Microbial pesticides, Biotransformations: microbial degradation of pesticides and toxic chemicals, biodegradation of the agricultural residues, bioremediation of contaminated soils and water. Microbes in nanotechnology, biosensors; Microbes in extreme environments		
UNIT-5- <i>18Hours</i>	Unit-5- Food and Industrial Microbiology: Recent developments in food and industrial microbiology – Fermentation, fermented foods, fermenter design and growth processes, food spoilage, methods of food preservation; Microbes in recovery of metal (bioleaching) and oil, Recombinant-DNA technology; Cell and enzyme immobilization, microbial enzymes of industrial interest; Novel medicines from microbes.		

**SUGGESTED
READINGS**

1. Prescott L, Harley J, Klein D (2005) Microbiology, 6th edition, Mc Graw-Hill.
2. Singh VP and Stapleton RD (Eds.) (2002) Biotransformations: Bioremediation Technology for Health and Environmental Protection. "Progress in Industrial Microbiology Vol. 36", Elsevier Science.
3. Subba Rao NS (1982) Advances in Agriculture Microbiology, Butterworth-Heinemann.
4. Subba Rao NS and Dommergues YR (Eds.) (2001) Microbial Interactions in Agriculture and Forestry Vol. 2, Science Pub. Inc.
5. Waites MJ, Morgan NL, Rockey JS, Higton G (2001) Industrial Microbiology: An Introduction, Wiley-Blackwell.

M.Sc (BOTANY)		IIIRD SEMESTER	
COURSE CODE: MBTC03		COURSE TYPE: ECC	
COURSE TITLE: EVOLUTIONARY BIOLOGY			
CREDIT:6		HOURS:90	
THEORY: 6	PRACTICAL:0	THEORY:90	PRACTICAL: 00
MARKS			
THEORY: 100 (30+70)		PRACTICAL:00	
OBJECTIVE: This course is aimed towards generating fundamental knowledge, concepts and dimensions of Botany/ Plant Science .			
UNIT-1- <i>18 Hours</i>	Unit-1-Introduction: Evolutionary Biology before Darwin, Darwin, after Darwin. Evolutionary synthesis. Fact and theory.		
UNIT-2- <i>18Hours</i>	Unit-2- Biological diversity: Species and classification. Phylogenetic trees, reading and using trees. Tree of Life. The fossil record. Geological fundamentals. Phylogeny and the fossil record. Evolutionary trends. Rates of evolution. The geography of life. Major patterns of distribution. Historical biogeography, phylogeography. Genetic diversity: Genes, genomes, mutations, karyotypes. Sources of phenotypic variation. Genetic variation in populations. Variation among populations.		
UNIT-3- <i>18 Hours</i>	Unit-3- Microevolution: Genetic drift, sampling, coalescence. Founder effects. Neutral theory of molecular evolution. Natural selection. Adaptation in action. Experimental studies. Levels of selection. Genetical theory of natural selection. Fitness, modes and models of selection. Evolution of phenotypic traits, Conflict and co-operation. Species and speciation. Reproductive success. Co-evolution.		
UNIT-4- <i>18Hours</i>	Unit-4- Macroevolution: Inferring phylogenies. Gene trees, species trees. Patterns of evolutionary change. Adaptive radiation. Evolution and development.		
UNIT-5- <i>18Hours</i>	Unit-5-. Biodiversity: Estimating changes in biodiversity. Taxonomic diversity through the Phanerozoic. The future of biodiversity.		
SUGGESTED READINGS	<ol style="list-style-type: none"> 1. David Briggs, Stuart Max Walters (1997). Plant Variation and Evolution, Cambridge University Press. 2. Douglas J. Futuyma (1998). Evolutionary Biology (3rd Edition), Sinauer Associates. 3. Mark Ridley (2003) Evolution (3rd edition), Blackwell. 4. Roderic D. M. Page, Edward C. Holmes (1998). Molecular Evolution: A Phylogenetic Approach, Blackwell. 5. Scott R, Freeman and Jon C. Herron (2003). Evolutionary Analysis, Prentice Hall. 		

M.Sc (BOTANY)		IIIRD SEMESTER	
COURSE CODE: MBTC04COURSE TYPE: ECC/CB			
COURSE TITLE: BIOINFORMATICS, COMPUTATIONAL BIOLOGY AND BIOSTATISTICS			
CREDIT:6		HOURS:90	
THEORY: 6	PRACTICAL:0	THEORY:90	PRACTICAL: 00
MARKS			
THEORY: 100 (30+70)		PRACTICAL:00	
OBJECTIVE: This course is aimed towards generating fundamental knowledge, concepts and dimensions of Botany/ Plant Science.			
UNIT-1- <i>18 Hours</i>	Unit-1-Bioinformatics and Computational Biology: 1. Databases - NCBI, EMBL, DDBJ, Genbank, Pubmed, Patent databases, TAIR, PDB, ATIDB). 2. Online tools - BLAST, ORF finder, Primer3, protein motif and structure prediction tools; Vector NTI, DNASTAR. 3. Bioinformatics in genome sequencing and annotation. 4. Fundamentals of computer programming. 5. Programming in PERL. 6. Introduction to <i>in silico</i> drug design and molecular modeling.		
UNIT-2- <i>18Hours</i>	Unit-2- Biostatistics: 1. Introduction: The scope of biostatistics; Classification of study design, Observational studies and Experimental studies (uncontrolled studies, trials with external controls, crossover studies, trials with self controls, trials with independent concurrent controls). 2. Exploration and presentation of data: Scales of measurement, Tables, Graphs, Histograms, Box and Whisker plots, Frequency polygon, Scatter Plots.		
UNIT-3- <i>18 Hours</i>	Unit-3- 3. Descriptive statistics: measures of central tendency, measures of dispersion, rates and proportions. 4. Probability: Definition, mutually exclusive events and addition rule, independent events and multiplication rule. Sampling: Reasons for sampling, methods of sampling, SRS, Systematic, Stratified, Cluster, NPS. Probability distribution: Binomial, Poisson, Gaussian, Standard normal distribution. Drawing inferences from data: Confidence intervals, Confidence limits, Hypothesis tests, Types of errors, P-values.		
UNIT-4- <i>18Hours</i>	Unit-4-5. Estimating and comparing means: Decision about single mean (normal population and non-normal population), decision about single group, decision about paired groups, decision about two independent groups, equality of population variances, computer-aided illustration for comparison of means. 6. Comparing three or more means: ANOVA – one way, two way, A priori comparison, Posterior or Post Hoc comparison, randomized block design, LSD, Kruskal-wallis one way ANOVA. 7. Estimating and comparing proportions: Proportion in single group, Comparing two independent proportions, Risk ratios v/s χ^2 , comparing proportions in more than two groups, comparing proportions in paired groups, χ^2 as goodness of fit.		
UNIT-5- <i>18Hours</i>	Unit-5-8. Correlation and Regression: Pearson's correlation coefficient, Spearman's rho, Linear regression, Least Square method, Predicting with regression equation, Comparing two regression lines, Dealing with nonlinear observation, Common errors in regression, Comparing correlation and regression. 9. Statistical methods for multiple variables: Multiple regression, Predicting with more than 1 variable, Statistical test for regression coefficient, Role of R and R ² in multiple regression, Confounding variable (ANACOVA), Predicting categorical outcomes – logistic regression, discriminant analysis.		

**SUGGESTED
READINGS**

1. Attwood TK and Parry-Smith DJ (2004) Introduction to Bioinformatics, Pearson Education (Singapore) Pvt. Ltd.
2. David Edwards (Ed.) (2007) Plant Bioinformatics: Methods and Protocols, Humana Press, New Jersey, USA.
3. Kulas JT (2008) SPSS Essential: Managing and Analyzing Social Science Data. John Wiley & Sons, New York.
4. Pagano M, Gauvreau K (2007) Principles of Biostatistics. Thomson India Edition, New Delhi.
5. Randal Schwartz, Tom Phoenix and Brian d Foy (2005) Learning Perl (4th edition), O'Reilly & Associates, ISBN: 0-596-10105-8.
6. Rex A. Dwyer (2004) Genomic Perl: From Bioinformatics Basics to Working Code, Cambridge University Press, 1st South Asian Edition.
7. Rosenkrantz WA (2009) Introduction to Probability and Statistics for Science, Engineering and Finance. CRC Press, Boca Raton.

M.Sc (BOTANY)		IIIRD SEMESTER	
COURSE CODE: MBTC05 COURSE TYPE: ECC/CB			
COURSE TITLE: GENOMICS AND PROTEOMICS			
CREDIT:6		HOURS:90	
THEORY: 6	PRACTICAL:0	THEORY:90	PRACTICAL: 00
MARKS			
THEORY: 100 (30+70)		PRACTICAL:00	
OBJECTIVE: This course is aimed towards generating fundamental knowledge, concepts and dimensions of Botany/ Plant Science.			
UNIT-1- <i>18 Hours</i>	Unit-1-Genomics: Genome sequencing strategies and programs, new technologies for high through put sequencing, methods for sequence alignment and gene annotation; Approaches to analyze differential expression of genes - ESTs, SAGE		
UNIT-2- <i>18Hours</i>	Unit-2- microarrays and their applications; gene tagging; gene and promoter trapping; knockout and knock-down mutants; dynamic modulation of protein structure and function; Comparative genomics of model plants and related crop species; Recombination-based cloning techniques; RNAi and gene silencing, genome imprinting, small RNAs and their biogenesis, role of small RNAs in heterochromatin formation and gene silencing, genomic tools to study methylome and histone modifications.		
UNIT-3- <i>18 Hours</i>	Unit-3- Proteomics: Analysis of proteins by different biochemical and biophysical procedures like CD (Circular Dichroism), NMR, UV/Visible and fluorescent spectroscopy, protein identification and analysis on ExPASy server, other protein related databases, 1-D and 2-D gel electrophoresis for proteome analysis		
UNIT-4- <i>18Hours</i>	Unit-4- Sample preparation, gel resolution and staining; Mass spectrometry based method for protein identification like PMF (protein mass fingerprinting) and LCMS; Image analysis of 2D gels: Data acquisition, spot detection & quantitation, gel matching, data analysis, presentation, databases, conclusions; DIGE (Differential In Gel Electrophoresis)		
UNIT-5- <i>18Hours</i>	Unit-5- alternatives to 2-DE for protein expression analysis; Analysis of post-translational modifications and protein-protein interactions; protein chips and arrays, future directions in proteomics, scope of functional proteomics.		

**SUGGESTED
READINGS**

1. Buchanan B, Gruissem G, and Jones R (2000) *Biochemistry and Molecular Biology of Plants*, American Society of Plant Physiologists, USA.
2. Hammes GD (2005) *Spectroscopy for the Biological Sciences*; Wiley Interscience, USA.
3. Harlow and Lane D (Eds.) (1988) *Antibodies – A Laboratory Manual*; Cold Spring Harbor Laboratory, USA.
4. Lieber DC (2006) *Introduction to Proteomics: Tools for New Biology*; Humana Press, NJ.
5. Pennington SR, Dunn MJ (Eds.) (2002) *Proteomics: From Protein Sequence to Function*, BIOS Scientific Publishers, United Kingdom.
6. Sambrook J and Russell DW (2001). *Molecular Cloning – A Laboratory Manual*, Vols I – III, Cold Spring Harbor Laboratory, USA.
7. Singer M and Berg P (1991). *Genes and Genomes: A Changing Perspective*; University Science Books, CA, USA.

M.Sc (BOTANY)		IIIRD SEMESTER	
COURSE CODE: MBTC06COURSE TYPE: ECC/CB			
COURSE TITLE: IMMUNOLOGY			
CREDIT:6		HOURS:90	
THEORY: 6	PRACTICAL:0	THEORY:90	PRACTICAL: 00
MARKS			
THEORY: 100 (30+70)		PRACTICAL:00	
OBJECTIVE: This course is aimed towards generating fundamental knowledge, concepts and dimensions of Botany/ Plant Science .			
UNIT-1- 18 Hours	Unit-1-Fundamentals of Immunology: Basic principles and overview of immunity, antigens and antibody production, cellular interactions in the immune system, Innate immunity, Complement, antibody structure and antigen recognition		
UNIT-2- 18Hours	Unit-2- Immunoglobulin genes, Ig/TCR gene rearrangement and generation of diversity, Introduction to Immunogenetics & the MHC		
UNIT-3- 18 Hours	Unit-3- Antigen recognition by T cells, TCR, Co-receptors & MHC structure, antigen processing and presentation.		
UNIT-4- 18Hours	Unit-4-Immunity in Health & Disease: Immune response to infectious diseases, Immunodeficiency and AIDS		
UNIT-5- 18Hours	Unit-5- .Hypersensitivity, transplant rejections, autoimmunity, vaccines, evolution of the immune system.		
SUGGESTED READINGS	1. Kuby Immunology; by Richard A. Goldsby, Thomas J. Kindt, Barbara A. Osborne, Janis Kuby, W. H. Freeman Publishing (4e-6e).		