



B.Tech. (Biotechnology) (AY 2023-24)

Semester wise course details:

Semester – I				
Sl. No.	Course No.	Course Title	Credit Hours	Faculty
1	Bot. 101	Basic Botany	2+1	Dr Avinash Pandey (IIAB) Dr. Shephalika Amrapali (NBPGR RS Ranchi)
2	Math.101	Basic Mathematics – I	3+0	Dr Sakharam Kale (NISA) Dr Priyanka Sakare (NISA) Guest Faculty (IIIT Ranchi)
3	Agron.101	Crop Production Technology	2+1	Dr S Ghosal (NISA) Dr Reshma Shinde (ICAR RC Ranchi)
4	Biotech. 101	Cell Biology	2+0	Dr Madan Kumar (IIAB) Dr Soumen Naskar (IIAB) Dr Sujit Kumar Bishi (IIAB) Dr Sanjay Kumar Gupta (IIABO)
5	Biotech. 102	Basic Genetics	2+1	Dr Soumen Naskar (IIAB) Dr Avinash Pandey (IIAB) Dr Sudhir Kumar (IIAB)
6	Biotech. 103	Introduction of Biotechnology	2+1	Dr Binay Kumar Singh (IIAB) Dr Kishor U Tribhuvan (IIAB) Dr Biplab Sarkar (IIAB) Dr Shambhu Krishan Lal (IIAB)
7	CSPD 101	Communication Skills and Personality Development	1+1	Dr V K Yadav (ICAR RC Ranchi) Gust Faculty (to be identified)
8	Env. 101	Environmental Studies and Disaster Management	2+1	Guest Faculty (to be identified)
9	FT 101	Food Science and Processing	1+1	Dr Prerna Nath (ICAR RC Ranchi) Dr Sakharam Kale (NISA)
10	HD 101	Human Ethics	1+0	Dr V D Lohot (NISA) Guest Faculty (to be identified)
11		NCC/NSO/NSS	0+1 NC	Dr Rahul R Bakade (NISA) Dr Madan Kumar (IIAB) Dr Avinash Pandey (IIAB)
Semester – II				
Sl. No.	Course No.	Course Title	Credit Hours	Faculty
1	Zoo. 101	Basic Zoology	2+1	Dr Biplab Sarkar (IIAB) Dr Sanjay Kumar Gupta (IIAB) Dr Achintya Pramanik (NISA) Dr Jaipal Singh Choudhary (ICAR RC Ranchi)
2	Math. 102	Basic Mathematics – II	3+0	Dr Sakharam Kale (NISA) Dr Priyanka Sakare (NISA) Guest Faculty (IIIT Ranchi)
3	Biotech. 104	Plant Tissue Culture	2+1	Dr Shambhu Krishan Lal (IIAB) Dr Shruti Sinha (NISA) Dr Vijai Pal Bhadana (IIAB)
4	Biotech. 105	Molecular Biology	2+1	Dr Kishor U Tribhuvan (IIAB) Dr Binay Kumar Singh (IIAB) Dr Thamilarasi K (NISA)
5	Bot./Zoo. 102	Biodiversity and its Conservation	2+0	Dr Avinash Pandey (IIAB) Dr Sanjay Kumar Gupta (IIAB) Dr Shephalika Amrapali (NBPGR RS Ranchi)

6	Hort. 101	Production technologies for Horticultural Crops	2+1	Dr B K Jha (ICAR RC Ranchi) Dr Mahesh Kumar Dhakar (ICAR RC Ranchi) Dr Meenu Kumari (ICAR RC Ranchi)
7	AS 101	Anatomy and Physiology of Livestock	3+0	Dr Reena Kumari Kamal (ICAR RC Ranchi) Dr Soumen Naskar (IIAB)
8	Micro. 101	Microbiology	2+1	Dr Rahul R Bakade (NISA) Guest Faculty (to be identified)
9	PB 101	Basics of Plant Breeding	2+1	Dr Vijai Pal Bhadana (IIAB) Dr Sudhir Kumar (IIAB) Dr Bhavana Patnaykuni (ICAR-RCER RC Ranchi) Dr Shashi Bhushan Choudhary (NBPGR RS Ranchi)
10	AS 102	Introduction to Animal Breeding	2+1	Dr Soumen Naskar (IIAB) Dr Vijai Pal Bhadana (IIAB)
11	Stat. 101	Basic Statistics	1+1	Dr Sudhir Kumar (IIAB) Dr Vijai Pal Bhadana (IIAB) Dr Sujay Rakshit (IIAB)
12		NCC/NSO/NSS	0+1 NC	Dr Rahul R Bakade (NISA) Dr Madan Kumar (IIAB) Dr Avinsah Pandey (IIAB)
Semester – III				
Sl. No.	Course No.	Course Title	Credit Hours	Faculty
1	AS 201	Livestock Production and Management	2+1	Dr Reena Kumari Kamal (ICAR RC Ranchi) Dr Soumen Naskar (IIAB)
2	Biotech. 201	Recombinant DNA Technology	2+1	Dr Thamilarsi K (NISA) Dr Shruti Sinha (NISA) Dr Kishor U Tribhuvan (IIAB)
3	Bot. 201	Plant Physiology	2+1	Dr N K Sinha (NISA) Dr V D Lohot (NISA) Dr Madan Kumar (IIAB) Dr Sujit Kumar Bishi (IIAB)
4	ICT 201	Information and Communication Technology	1+1	Dr Priyanka Sakare (NISA) Dr Sakharam Kale (NISA)
5	Econ. 201	Economics and Marketing	2+1	Guest Faculty (to be identified)
6	Ent.-Pl. Path. 201	Fundamentals of Crop Protection	2+1	Dr Ajit Kumar Jha (ICAR-RCER RC Ranchi) Dr Jaipal S Choudhary (ICAR-RCER RC Ranchi) Dr Achintya Pramanik (NISA)
7	AS 202	Livestock Product Technology	2+1	Dr Prerna Nath (NISA) Dr Reena Kumari Kamal (ICAR RC Ranchi)
8	Math. 201	Biomathematics	2+1	Dr Sakharam Kale (NISA) Dr Priyanka Sakare (NISA)
9	PB 201	Breeding of Field Crops	2+1	Dr Shashi Bhushan Choudhary (NBPGR RS Ranchi) Dr Bhavana Patnaykuni (ICAR-RCER RC Ranchi) Dr Sudhir Kumar (IIAB)
10	AS 203	Animal Health Care	2+1	Guest Faculty (to be identified)
11		NCC/NSO/NSS	0+1 NC	Dr Rahul R Bakade (NISA) Dr Madan Kumar (IIAB) Dr Avinash Pandey (IIAB)

Note: *i indicates the core course; Name in bold letter will be course leader

SYLLABUS

1. Deficiency/ Remedial Courses

Students joining degree programme with +2 in medical stream will take Math. 101 and Math. 102 as remedial courses, while the students joining B.Tech. Biotechnology with +2 in Non-Medical stream will take Bot. 101 and Zoo. 101 as remedial courses. These courses will cover syllabus for +1 & +2 classes. There will be a total of six credit hours in each of the deficiency/remedial courses package.

i) Basic Botany 3(2+1)

Theory

UNIT I

Plant kingdom and features of each group; Morphology, modifications and functions of root, stem, leaf, flower and inflorescence; Pollination and fertilization; Fruit types; Structure of dicot and monocot seed, seed germination.

UNIT II

Cell structure; DNA, chromosome and genes; Cell and tissue types; Internal structure of root, stem and leaf.

UNIT III

Plant taxonomy, systems of classification; Characteristics and economic importance of Poaceae, Brassicaceae, Fabaceae, Malvaceae, Rutaceae, Rosaceae, Asteraceae and Solanaceae families.

Practical

Description of one plant species from each group of plant kingdom; Study of morphology and modifications of root, stem, leaf, flower; Types of inflorescence; Structure of various types of seeds and fruits; Demonstration of cell structure, tissue types; Structure of monocot and dicot root, stem and leaf; One flower from each family.

Suggested Readings

- Bendre A & Kumar A. 1999. *Textbook of Practical Botany*. Vol. 2, 7th Ed., Rastogi Publications.
- Bendre AM & Pande PC. 2009. *Introduction to Botany*. Rastogi publications.
- Dutta AC. 1995. *A Class Book of Botany*, 16th Edition. Oxford University Press.

2. Basic Zoology 3(2+1)

Theory

UNIT I

Introduction to Zoology; Structure and functions of cell and cell organelles; Difference between prokaryotic and eukaryotic cell; Cell division – mitosis and meiosis; Structure and function of biomolecules; Types of simple and compound tissues.

UNIT II

Binomial Nomenclature; Classification and general survey of animal kingdom; Functional organization of various systems of a mammal: digestive, circulatory, respiratory, excretory, nervous and reproductive; Laws of inheritance; Multiple allelism - blood groups; Genetic disorders in human and their inheritance.

Practical

Study of animal cell structure and cell division; Histological preparation of simple and compound tissues; General survey of animal kingdom up to phyla in invertebrates and up to classes in vertebrates; Demonstration of mammalian anatomy; Blood grouping.

Suggested Readings

- Bhatia KN & Tyagi MP. 2012. *Trueman's Elementary Biology*. 24th ed. Trueman Book Company.
- Dhami PS & Mahindru RC. 1996. *A Text Book of Biology for 10+2*. Pradeep Publications.

3. Basic Mathematics-I 3(3+0)

Theory

UNIT I

Complex numbers: Properties of real numbers, complex numbers, their addition, multiplication and division, square root of complex numbers, cube roots of unity and their properties, De-Moivre's theorem; Theory of equations: Solution of quadratic equation, equation reducible to quadratic equation, relation between roots and coefficients, nature of roots and formation of quadratic equation with given roots.

UNIT II

Geometric series: nth term of G.P. series, sum of G.P. series, geometric mean; Harmonic series, harmonic mean; Arithmetic geometric series and special series $\sum n$, $\sum n^2$, $\sum n^3$. Partial fractions; Logarithms; Binomial theorem for any index: Expansion, middle term, general term, terms independent of x.

UNIT III

Trigonometry: Trigonometric ratios, allied angles, graphs of trigonometric functions;

Addition and subtraction formulae; Product and sum formulae; Multiple and sub-multiple angles, sine, cosine and projection formulae; Area of a triangle.

Suggested Readings

- NCERT 2012. *Mathematics of Class XI*. NCERT India.
- Sharma RD. 2014. *Mathematics of Class XI*. Dhanpat Rai Publisher.

4. Basic Mathematics-II (3+0)

Theory

UNIT I

Functions; Limit: Introduction, left handed and right handed limits, general rules for calculation of limits Standard limits $\lim_{x \rightarrow a} \frac{x^n - a^n}{x - a}$, $\lim_{x \rightarrow 0} \frac{\sin x}{x}$, $\lim_{x \rightarrow 0} (1+x)^{\frac{1}{x}}$, $\lim_{x \rightarrow 0} \frac{a^x - 1}{x}$, $\lim_{x \rightarrow 0} \frac{\log(1+x)}{x}$. Continuity: Definition of continuity, continuity of algebraic functions, Continuity of trigonometric and exponential functions.

UNIT II

Differentiation: Differentiation by first principle, sum, difference, product and quotient formulae, differentiation using chain rule, differentiation of functions in parametric and implicit form, logarithmic differentiation, geometrical interpretation of derivative, Successive differentiation, geometrical interpretation of derivative, maxima and minima, tangent and normal.

UNIT III

Integration: Integration by substitution, integration by partial fractions, integration by parts, integration by trigonometric substitution.

UNIT IV

Matrices and Determinants: Definition of matrix, addition, subtraction and multiplication, inverse of matrix; Solution of linear equations: By Cramer's rule and inverse of matrix.

Suggested Readings

- NCERT 2012. *Mathematics of Class XII*. NCERT India.
- Sharma RD. 2014. *Mathematics of Class XII*. Dhanpat Rai Publisher.

General / Common Courses

1. Communication Skills and Personality Development 2(1+1)

Theory

UNIT I

Communication skills: Structural and functional grammar; Meaning and process of

communication; Verbal and nonverbal communication; Listening and note taking; Writing skills; Oral presentation skills; Field diary and lab record; Indexing, footnote and bibliographic procedures; Reading and comprehension of general and technical articles; Precise writing, summarizing, abstracting; Individual and group presentations; Impromptu presentation; Public speaking; Group discussion and interviews; Organizing seminars and conferences.

UNIT II

Voice modulation basics and their usage for meaningful impact on people; Attributes of an effective leader; Stress and conflict management; Time management: Personal organization, prioritizing and balancing; Cosmopolitan culture; Impact of non verbal communication; Science of body language; Role of team work.

Practical

Listening and note taking, writing skills, oral presentation skills; Field diary and lab record; Indexing, footnote and bibliographic procedures; Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; Individual and group presentations; Video recorded mock group discussions and interviews; Attitude management; Setting and achieving a short term goal; Creating a personal vision statement of life; Voice modulation; Practicing conscious body postures and movements; Rapport building; Video recorded practical to evaluate change in confidence level; Team work exercises; Time management.

Suggested Readings

- Carnegie, Dale. 2012. *How to Win Friends and Influence People in the Digital Age*. Simon & Schuster.
- Covey Stephen R. 1989. *The Seven Habits of Highly Successful People*. Free Press.
- Spitzberg B, Barge K & Morreale, Sherwyn P. 2006. *Human Communication: Motivation, Knowledge & Skills*. Wadsworth.
- Verma, KC. 2013. *The Art of Communication*. Kalpaz.

2. Entrepreneurship Development and Business Management 2(1+1)

Theory

UNIT I

Concept of entrepreneur; Entrepreneurship development; Assessment of entrepreneurship skills; SWOT analysis and achievement motivation; Entrepreneurial behaviour; Government policy and plan for entrepreneurship development; Setting up of a new entrepreneurial venture; Environmental factors influencing entrepreneurship; Constraints in setting up of agro based industries;

UNIT II

Definition of business; Value chain concept in business; Stakeholders in business; Stages of Indian business; Importance of agribusiness in Indian economy and factors transforming Indian agribusiness; Government as a regulatory body in agribusiness; Opportunities and challenges to Indian agribusiness.

UNIT III

Management: Definition, importance and functions; Levels of management; Planning: Definition, steps in planning, types of plan; Organizing: Meaning of organizing and organization; Developing leadership skills; Encoding and decoding communication skills; Developing organizational and managerial skill; Problem solving skill; Supply chain management and total quality management; Project planning, formulation and report preparation.

Practical

Preparation of project report for starting a new venture; Case studies of successful entrepreneurs, analysis and discussion; Preparation of complete marketing plan of selected product/service; Case studies related to project management; Visits to industrial and agri-business houses; Numerical problems; Preparation of project report for various business ventures.

Suggested Readings

- Harold Koontz & Heinz Weihrich. 2004. *Essentials of Management: An International Perspective*, 2nd Ed. Tata Mc-Graw Hill Publishing Pvt Ltd.
- Mukesh Pandey & Deepali Tewari. 2010. *The Agribusiness Book*. IBDC Publishers.
- Nandan H. 2011. *Fundamentals of Entrepreneurship*. PHI Learning Pvt Ltd India.
- Philip Kotler, Kavin Lane Keller, Abraham Koshy & Mithileshwar Jha. 2012. *Marketing Management: A South Asian Perspective*. Pearson Education.
- Poornima Charantimath. 2006. *Entrepreneurship Development: Small Business Enterprise*. Pearson Education.
- Stephans P Robbins & Mary Coulter. 2003. *Management*. Pearson Education.

3. Economics and Marketing 3(2+1)**Theory****UNIT I**

Economics – Terms and definitions; Consumption, demand, price and supply; Factors of production; Gross Domestic Product; Role of Biotechnology/ Agriculture sector in national GDP.

UNIT II

Marketing – definition; Marketing process; Need for marketing; Role of marketing; Marketing functions; Classification of markets; Marketing of various channels; Price spread; Marketing efficiency; Constraints in marketing of agricultural produce; Market intelligence.

UNIT III

Basic guidelines for preparation of project reports; Bank norms; Insurance; SWOT analysis; Crisis management.

Practical

Techno-economic parameters for preparation of projects; Preparation of bankable projects for various biotechnology/ agricultural products and value added products; Identification of marketing channel; Calculation of price spread; Identification of market structure; Visit to

different markets, market institutions; Study of SWC, CWC and STC; Analysis of information of daily prices; Marketed and marketable surplus of different commodities.

Suggested Readings

- Acharya SS & Aggarwal NL. 2011. *Agricultural Marketing in India*. Fifth Edition. Oxford and IBH Publishing Company Pvt. Ltd.
- Ahuja HL. 2007. *Advanced Economic Theory*. S Chand and Company.
- Chandra P. 1984. *Projects: Preparation, Appraisal & Implementation*. McGraw Hill Inc.
- Dewett KK. 2005. *Modern Economic Theory*. S Chand and Company.
- Gupta RD & Lekhi RK. 1982. *Elementary Economic Theory*. Kalyani Publishers.
- Sampat Mukherjee. 2002. *Modern Economic Theory*. New Age International.

4. Environmental Studies and Disaster Management 3(2+1)

Theory

Environmental Studies

UNIT I

Multidisciplinary nature of environmental studies; Definition, scope and importance.

UNIT II

Natural Resources: Renewable and non-renewable resources; Natural resources and associated problems.

- a) Forest resources: Use and over-exploitation; Deforestation; Case studies. Timber extraction, mining; Dams and their effects on forest and tribal people.
- b) Water resources: Use and over-utilization of surface and ground water; Floods; Drought; Conflicts over water; Dams-benefits and problems.
- c) Mineral resources: Use and exploitation; Environmental effects of extracting and using mineral resources; Case studies.
- d) Food resources: World food problems; Changes caused by agriculture and overgrazing; Effects of modern agriculture; Fertilizer-pesticide problems; Water logging; Salinity; Case studies.
- e) Energy resources: Growing energy needs; Renewable and non-renewable energy sources; Use of alternate energy sources; Case studies.
- f) Land resources: Land as a resource; Land degradation; Man induced landslides; Soil erosion and desertification.

Role of an individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles.

UNIT III

Ecosystems; Concept of an ecosystem; Structure and function of ecosystem; Producers, consumers and decomposers; Energy flow in ecosystem; Ecological succession; Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of forest ecosystem, grassland ecosystem, desert ecosystem and aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

UNIT IV

Biodiversity and its conservation; Introduction, definition, genetic, species and ecosystem diversity and biogeographical classification of India; Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values; Biodiversity at global, national and local levels; India as a mega-diversity nation; Hot-spots of biodiversity; Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; Endangered and endemic species of India; Conservation of biodiversity: *In-situ* and *Ex-situ* conservation of biodiversity.

UNIT V

Environmental Pollution: definition, cause, effects and control measures air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, nuclear hazards; Solid waste management: causes, effects and control measures of urban and industrial wastes; Role of an individual in prevention of pollution; Pollution case studies.

UNIT VI

Social issues and the environment; From unsustainable to sustainable development; Urban problems related to energy; Water conservation, rain water harvesting, watershed management; Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust; Wasteland reclamation; Consumerism and waste products; Environment Protection Act; Air (Prevention and Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; Issues involved in enforcement of environmental legislation; Public awareness.

UNIT VII

Human population and environment: population growth, variation among nations, population explosion, Family Welfare Programme; Environment and human health: human rights, value education, HIV/AIDS; Women and child welfare; Role of information technology in environment and human health; Case studies.

Disaster Management**UNIT I**

Natural disasters - Meaning and nature of natural disasters; their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold waves; Climatic change: global warming, sea level rise, ozone depletion.

UNIT II

Man-made disasters - Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents.

UNIT III

Disaster management - Effect to migrate natural disaster at national and global levels; International strategy for disaster reduction; Concept of disaster management; National disaster management framework; Financial arrangements; Role of NGOs, community-based organizations

and media; Role of central, state, district and local administration; Armed forces, police and other organizations in disaster response.

Practical

Visit to a local area to document environmental assets: river/ forest/ grassland/ hill/ mountain; Visit to a local polluted site - urban/ rural/ industrial/ agricultural; Study of common plants, insects, birds and study of simple ecosystems - pond, river, hill slopes, etc.; Visit to disaster management organizations; Collection of statistics of national disasters occurred since 20th century.

Suggested Readings

- Ahluwalia VK & Malhotra S. 2006. *Environmental Science*. Ane Books India.
- Anjaneyulu Y. 2004. *Introduction to Environmental Science*. BS Publications.
- Chauhan AS. 2009. *Environmental Studies*. 3rd Edition. Jain Brothers.
- Das RC & Behera DK. 2008. *Environmental Science - Principles and Practice*. Prentice –Hall of India Pvt Ltd.
- Dhaliwal GS & Kukal SS. 2005. *Essentials of Environment Science*. Kalyani Publishers.
- Santra

5. Food Science and Processing 2(1+1)

Theory

UNIT I

Definition: Food and nutrition; Food production and consumption trends in India; Major deficiencies of calories, proteins, vitamins and micronutrients; Food groups and concept of balanced diet; RDA.

UNIT II

Causes of food spoilage; Principles of processing and preservation of food by heat, low temperature, drying and dehydration, chemicals and fermentation; Preservation through ultraviolet and ionizing radiations.

UNIT III

Post-harvest handling and technology of fruits, vegetables, cereals, oilseeds, milk, meat and poultry; Food safety, adulteration and food laws; Status of food industry in India

Practical

Physical and chemical quality assessment of cereals, fruits, vegetables, egg, meat and poultry; Value added products from cereals, millets, fruits, vegetables, milk, egg and meat; Visit to local processing units.

Suggested Readings

- Potter NN & Hotchkiss JH. 1995. *Food Science*. Chapman and Hall Publishers.
- Swaminathan M. 2005. *Handbook of Foods and Nutrition*. Ganesh and Co. Pvt. Ltd.
- Swaminathan M. 1990. *Food Science, Chemistry and Experimental Foods*. BAPPCO.

- Vickie A., Vaclavik & Elizabeth W. Christian. 2003. *Essentials of Food Science*, 2nd Ed. Kluwer Academic/ Plenum Publishers, New York.

6. Human Ethics 1(1+0)

Theory

UNIT I

Universal human aspirations: Happiness and prosperity; Human values and ethics: Concept, definition, significance and sources; Fundamental values: Right conduct, peace, truth, love and non-violence; Ethics: professional, environmental, ICT; Sensitization towards others particularly senior citizens, developmentally challenged and gender.

UNIT II

Spirituality, positive attitude and scientific temper; Team work and volunteering; Rights and responsibilities; Road safety; Human relations and family harmony; Modern challenges and value conflict: Sensitization against drug abuse and other social evils; Developing personal code of conduct (SWOT Analysis); Management of anger and stress.

Suggested Readings

- Gaur RR, Sangal R & Bagaria GP. 2011. *A Foundation Course in Human Values and Professional Ethics*. Excel Books.
- Mathur SS. 2010. *Education for Values, Environment and Human Rights*. RSA International.
- Sharma RA. 2011. *Human Values and Education -Axiology, Inculcation and Research*. R. Lall Book Depot.
- Sharma RP & Sharma M. 2011. *Value Education and Professional Ethics*. Kanishka Publishers.
- Srivastava S. 2011. *Human Values and Professional Ethics*. S K Kataria & Sons.
- Srivastava S. 2011. *Environmental Science*. S K Kataria & Sons.
- Tripathi A.N. 2009. *Human Values*. New Age International (P) Ltd Publishers.

7. Information and Communication Technology 2(1+1)

Theory

UNIT I

IT and its importance; IT tools; IT-enabled services and their impact on society; Computer fundamentals; Hardware and software; Input and output devices; Word and character representation.

UNIT II

Features of machine language, assembly language, high-level language and their advantages and disadvantages; Principles of programming - algorithms and flowcharts.

UNIT III

Operating systems (OS) - definition, basic concepts; Introduction to WINDOWS and LINUX

Operating Systems; Local area network (LAN); Wide area network (WAN); Internet and World Wide Web; HTML and IP.

UNIT IV

Introduction to MS Office - Word, Excel, Power Point; Audio visual aids - definition, advantages, classification and choice of A.V. aids; Criteria for selection and evaluation of A.V aids; Video conferencing; Communication process, Berlo's model, feedback and barriers to communication.

Practical

Exercises on binary number system; Algorithm and flow chart; MS Word; MS Excel; MS Power Point; Internet applications: web browsing, creation and operation of email account; Analysis of data using MS Excel; Handling of audio visual equipments; Planning, preparation, presentation of posters, charts, overhead transparencies and slides; Organization of an audio visual programme.

Suggested Readings

- Gurvinder Singh, Rachhpal Singh & Saluja KK. 2003. *Fundamentals of Computer Programming and Information Technology*. Kalyani Publishers.
- Harshawardhan P. Bal. 2003. *Perl Programming for Bioinformatics*. Tata McGraw-Hill Education.
- Kumar A 2015. *Computer Basics with Office Automation*. IK International Publishing House Pvt Ltd.
- Rajaraman V & Adabala N. 2015. *Fundamentals of Computers*. PHI
- Recommended Latest Online Tutorials (over Internet).

8. Agricultural Informatics 3(2+1)

Theory

UNIT I

Introduction to computers; Anatomy of computers; Memory concepts, units of memory; Operating system, definition and types; Applications of MS-Office for creating, editing and formatting a document; Data presentation, tabulation and graph creation; Statistical analysis, mathematical expressions; Database, concepts and types, creating database; Uses of DBMS in Agriculture; Internet and World Wide Web (WWW), concepts, components and creation of web; HTML & XML coding.

UNIT II

Computer programming, concepts; Documentation and programme maintenance; Debugging programmes; Introduction to Visual Basic, Java, Fortran, C/ C++, etc.; Standard input/output operations; Variables and constants; Operators and expressions; Flow of control; Inbuilt and user defined functions; Programming techniques for agriculture.

UNIT III

e-Agriculture, concepts, design and development; Application of innovative ways to use information and communication technologies (IT) in agriculture; ICT for data collection; Formation of development programmes, monitoring and evaluation; Computer models in agriculture: statistical, weather analysis and crop simulation models - concepts, structure, input-output files, limitations, advantages and application for understanding plant processes, sensitivity, verification, calibration and validation; IT application for computation of water and nutrient requirement of crops; Computer-controlled devices (automated systems) for agri-input management; Smartphone mobile apps in agriculture for farm advice, market price, post-harvest management, etc; Geospatial technology, concepts, techniques, components and uses for generating valuable agri-information; Decision support systems, taxonomy, components, framework, classification and applications in agriculture; Agriculture Information/Expert System; Soil Information Systems, etc. for supporting farm decisions; Preparation of contingent crop-planning and crop calendars using IT tools.

Practical

Study of computer components, accessories; Practice of important DOS commands; Introduction of different operating systems such as windows, Unix, Linux; Creating files and folders; File management; Use of MS-WORD and MS Power point for creating, editing and presenting a scientific document; Handling of tabular data; Animation, video tools, art tool, graphics, template and designs; MS-EXCEL - Creating a spreadsheet, use of statistical tools, writing expressions, creating graphs, analysis of scientific data, handling macros; MS-ACCESS: Creating database, preparing queries and reports, demonstration of agri-information system; Introduction to World Wide Web (WWW) and its components, creation of scientific website, presentation and management agricultural information through web; Introduction of programming languages - Visual Basic, Java, Fortran, C, C++, and their components; Hands-on practice on writing small programmes; Hands-on practice on Crop Simulation Models (CSM); DSSAT/Crop-Info/ CropSyst/ Wofost; Preparation of input file for CSM and study of model outputs; Computation of water and nutrient requirements of crop using CSM and IT tools; Use of smart phones and other devices in agro-advisory and dissemination of market information; Introduction of Geospatial Technology; Demonstration of generating information important for agriculture; Hands on practice on preparation of Decision Support System.

Suggested Readings

- Gurvinder Singh, Rachhpal Singh & Saluja KK. 2003. *Fundamentals of Computer Programming and Information Technology*. Kalyani Publishers.
- Harshawardhan P. Bal. 2003. *Perl Programming for Bioinformatics*. Tata McGraw-Hill Education.
- Kumar A 2015. *Computer Basics with Office Automation*. IK International Publishing House Pvt Ltd.
- Maidasani D. 2016. *Learning Computer Fundamentals, MS Office and Internet & Web Technology*. 3rd edition, Laxmi Publications.

Compulsory Basic Science Courses

1. Plant Physiology 3(2+1)

Theory

UNIT I

Plant physiology, its scope in agriculture; Osmosis, imbibition, water absorption, water translocation and transpiration; Stomatal mechanisms; Physiological role and deficiency symptoms of major and minor elements, Absorption and translocation of minerals.

UNIT II

Concepts of photosynthesis, photorespiration, respiration and translocation of photoassimilates; Dynamics of growth; Stress physiology; Nitrogen and sulphur metabolism; Plant growth regulators: Their biosynthesis and physiological roles, seed germination & seed dormancy, senescence, vernalization.

Practical

Demonstration of processes of diffusion, osmosis, imbibition and plasmolysis; Ascent of sap, transpiration; Deficiency symptoms of nutrients in crop plants; Plant growth analysis; Quantitative and qualitative estimation of plant pigments; Experiments on photosynthesis and respiration; Effects of plant growth regulators on plant growth and seed germination; Experiments on seed dormancy; Relative water content and plant water potential; Proline estimation.

Suggested Readings

- Bhatia KN & Prashar AN. 1990. *Plant Physiology*. Trueman Book Company.
- Salisbury FB. & Ross CW. 1992. *Plant Physiology*. Wordsworth Publishing Company. Srivastava HN. 2000. *Plant Physiology*. Pradeep Publications.

2. Biomathematics 3(2+1)

Theory

UNIT-I

Rolle's theorem; Lagrange's theorem; Taylor's and Maclaurin's series; Partial differentiation, Euler's theorem on homogeneous function, change of variable; Jacobian, maxima and minima of two or more than two variables eigen values and eigen vectors of a matrix; Reduction formulae, definite integrals and its applications.

UNIT-II

Solution of ordinary differential equation of first degree and first order and their application for determination of volume of blood and drug distribution; Epidemic models, Simultaneous differential equation of first order and their applications to predator models; Linear differential equations of higher order and their applications to simple biological problem; Numerical methods for solving algebraic and transcendental equations.

Practical

Tutorials on Taylor's and Maclaurin's expansions; Partial differentiation; Euler's theorem; Change of variable, total derivative, implicit function, maxima and minima, eigen values and eigen vectors of matrix, reduction formulae, definite integrals and their properties; Epidemic models, predator models; Determination of volume of blood and drug distribution; Ordinary differential equation of first order, linear differential equation of higher order and their applications to biological problems, numerical methods.

Suggested Readings

- Grewal BS. 2013. *Higher Engineering Mathematics*. Khanna Publishers, India.
- Rastogi SK. 2008. *Biomathematics*. Krishna Prakashan Media Pvt. Ltd.
- Srivastava AC & Srivastava PK. 2011. *Engineering Mathematics*. Vol.I . PHI Learning Pvt. Ltd.
- Srivastava AC & Srivastava PK. 2011. *Engineering Mathematics*. Vol.III . PHI Learning Pvt. Ltd.

3. Biophysics 3(2+1)

Theory

UNIT I

Quantum mechanics; Electronic structure of atoms; The wave particle duality, wave length of de-Broglie waves; Phase and group velocity; Some basic concepts of quantum mechanics; Schrodinger's wave equations; Particle in a box; Quantum mechanical tunneling; Ist and IInd law of thermodynamics; Enthalpy; Entropy; Statistical and thermodynamic definition of entropy; Helmholtz free energy, Equilibrium thermodynamic; Near-equilibrium thermodynamic; Gibbs free energy; Chemical potential; Thermodynamic analysis of membrane transport.

UNIT II

Hydration of macromolecules; Role of friction; Diffusion; Sedimentation; The ultracentrifuge; Viscosity; Rotational diffusion; Light scattering, Small angle x-ray scattering; Ultraviolet and visible spectroscopy; Circular dichroism(CD) and optical rotatory dispersion(ORD); Fluorescence spectroscopy; Infrared spectroscopy; Raman spectroscopy; Electron spin resonance; NMR spectroscopy; Light microscopy.

UNIT III

Electron optics; Transmission electron microscope (TEM); Scanning electron microscope(SEM); Preparation of the specimen for electron microscopy; Image reconstruction; Electron diffraction; Tunnelling electron microscope; Atomic force microscope; Crystals and symmetries, crystal systems, point group and space groups; Growth of crystals of biological molecules; X-ray diffraction.

Practical

Refractive index and dispersive power of the prism using spectrometer; Calibration of prism spectrometer; Newton's rings; Polarimeter; Diffraction grating; Resolving power of telescope

and grating; Ostwald viscometer; Planck's constant using photovoltaic cell; Photospectrometer; Photoelectric effect; Stefan's constant; Thermal diffusivity in metals.

Suggested Readings

- Chang R. 2005. *Physical Chemistry for the Biosciences*. University Science Books.
- Glaser. 2012. *Biophysics*. Springer.
- Pattabhi V & Gautam N. 2002. *Biophysics*. Narosa Publishing House.
- Rodney Cotterill. 2002. *Biophysics: An Introduction*. John Wiley & Sons.
- Srivastava PK. 2006. *Elementary Biophysics: An Introduction*. Narosa Publishing House.

4. Basic Statistics 2(1+1)

Theory

UNIT I

Definition of statistics, its use and limitations; Frequency distribution and frequency curve and cumulative frequency curve; Measures of central tendency; Measures of dispersion; Probability: Definition, additive and multiplicative law for two events; Normal distribution and its properties; Introduction to sampling; Sampling techniques.

UNIT II

Tests of significance: Null hypothesis, alternate hypothesis, Type I & II Error, one and two tail tests, level of significance and confidence interval; SND test for means: Single sample and two samples Z-test; Student's t-test for means, single sample, two samples and paired t-test; F-test;

UNIT III

Chi-square test in 2x2 contingency table; Yate's correction for continuity; Correlation: Scatter diagram and Karl Pearson's coefficient of correlation for ungrouped data and its testing; Linear regression and its properties; Analysis of variance and its assumptions, Analysis of CRD and RBD; Analysis of Latin Square Design.

Practical

Construction of frequency distribution tables and frequency curves; Computation of Arithmetic: Mean, median, mode; Standard deviation; Variance and coefficient of variation for ungrouped and grouped data; SND test for means; Student's t-test; F-test and Chi-square test; Correlation coefficient 'r' and its testing; Fitting of regression equations; Analysis of CRD, RBD and LSD.

Suggested Readings

- Freud JE & Perles BM. 2006. *Modern Elementary Statistics*. 12th Ed. Pearson India.
- Kapoor VK. 2003. *Problems and Solutions in Statistics*. 7th Edition. Sultan Chand and Sons.
- Snedecor GW. & Cochran WG. 1989. *Statistical Methods*. Iowa State University Press.

5. Biostatistics 3(2+1)

Theory

Unit I

Random variables: expected value and its variance; probability distribution of random variables; Conditional probability; Baye's theorem and its applications; Introduction to Uniform, Binomial, Poisson, Normal, Exponential and Gamma probability distributions.

Unit II

Random mating populations, Hardy-Weinberg Law; Introduction to Poisson process and Markov chains: Transition probability matrix, n-step transition probabilities, steady state. Random walk models; Sensitivity and specificity.

Unit III

Chi-square test: testing heterogeneity, use in genetic experiment, detection of linkage, linkage ratios and its estimation; Analysis of variance: One-way and two-way classification with interaction; Analysis of covariance; Incomplete block designs; Estimation and significance of genotypic and phenotypic variation.

Practical

Expected value and variance of discrete and continuous distributions; Uniform, Binomial, Poisson, Normal, Exponential and Gamma Probability distributions; Hardy-Weinberg Law; Construction of transition probability matrix in Markov Chains; Calculation of sensitivity and specificity; Detection and linkage using Chi-square test; One-way and two-way analysis of variance; Analysis of covariance; Incomplete block designs; Testing of heritability.

Suggested Readings

- Biswal PC. 2009. *Probability and Statistics*. PHI Learning Pvt. Ltd.
- Kaps M. & Lamberson W. 2007. *Biostatistics for Animal Science*. CABI Publishing.
- Narayan P, Bhatia VK & Malhotra PK. 1989. *Handbook of Statistical Genetics*. Indian Agricultural Statistics Research Institute, New Delhi, India.
- Pal N. & Sahadeb Sarkar. 2009. *Statistics – Concepts and Applications*. 2nd Ed. PHI Learning Pvt. Ltd.

Core Courses in Biotechnology

1. Cell Biology 2(2+0)

Theory

UNIT I

Origin and evolution of cell; Introduction to microscopy; Sub-cellular structure of prokaryotic and eukaryotic cells; Membrane structure and function: plasma membrane, cell wall and extracellular matrix; Structural organization and function of intracellular organelles and organelle biogenesis: Nucleus, mitochondria, endoplasmic reticulum, Golgi apparatus, lysosomes, peroxisomes, plastids, vacuoles.

UNIT II

Structure and function of cytoskeleton and its role in motility; Cell membrane transport; Introduction to cell signalling; Cell growth, cell cycle and its control; Cell death and cell renewal.

Suggested Readings

- Alberts B, Johnson A, Lewis J, Raff M, Roberts K & Walter P. 2008. *Molecular Biology of the Cell*. 5th Ed. Garland Science/ Taylor and Francis Group.
- Lodish H, Berk A, Kaiser CA, Krieger M, Bretscher A, Ploegh H, Amon A & Scott MP. 2012. *Molecular Cell Biology*. W. H. Freeman.
- Sadava DE. 1993. *Cell Biology: Organelle Structure and Function*. Jones and Bartlett Publishers.

2. Basic Genetics 3(2+1)**Theory****UNIT I**

History of Genetics; Mendel's principles and rediscovery; Cell division; Chromosomes structure and function; Chromosome theory of inheritance; Sex-linked, sex-limited and sex-influenced inheritance; Sex determination and sex differentiation.

UNIT II

Multiple allelism; Linkage and crossing-over; Gene-gene interaction; Genetic analysis in prokaryotes and eukaryotes; Extra chromosomal inheritance; Mutations; Hardy-Weinberg law; Quantitative inheritance; Introduction to Human genetics; Genetic basis of evolution.

Practical

Life cycle in model plants and animals; microscopy; Mitosis and meiosis; Monohybrid crosses (segregation); Dihybrid crosses (independent assortment); Probability and use of Chi-square; Sex-linked inheritance; Multiple allelism; Detection and estimation of linkage.

Suggested Readings

- Gupta PK. 2014. *Genetics* 4th ed. Rastogi Publications.
- Inbasekar P. 2009. *Cell Biology and Genetics*. Panima Publications.
- Miglani GS. 2000. *Basic Genetics*. Narosa Publishing house, New Delhi.
- Russell PJ. 2013. *iGenetics: Pearson New International Edition: A Molecular Approach*. Pearson.
- Watson JD, Bakee TA, Bell SP, Gann A, Levine M & Losick R. 2008. *Molecular Biology of the Gene*. 6th Ed. Pearson Education International.

3. Introduction to Biotechnology 3(2+1)**Theory****UNIT I**

History, definitions, concepts, scope and importance of Biotechnology: Plant, microbial, animal, medical, environmental, industrial, Marine, Agricultural and food Biotechnology; Nanobiotechnology.

UNIT II

Introduction to recombinant DNA technology and its applications: Vectors, DNA restriction and modifying enzymes, gene cloning; Introduction to genomics and proteomics: Molecular markers, DNA sequencing; Genetic transformation and transgenic organisms; Bioinformatics. Biosafety guidelines.

Practical

Orientation to the laboratories: glass houses, screen houses, transgenic facilities and field area; General guidelines for working in Biotechnology laboratories; Familiarization with basic equipment's used in biotechnology; Selection of chemicals (different grade), buffer preparation, calculations and scientific notations used in laboratories.

Suggested Readings

- Brown T A. 2002. *Genomes 2*. 2nd ed. New york:Wiley-Liss.
- Prave P, Faust U, Sittig W & Sukatsch DA. 1987. *Basic Biotechnology: A Student's Guide*. VCH Verlagsgesellschaft.
- Prave P, Faust U & Sittig W. 1987. *Fundamentals of Biotechnology*. VCH Verlagsgesellschaft.
- Renneberg R. 2008. *Biotechnology for Beginners*. Academic Press Publishers.

4. Plant Tissue Culture 3(2+1)**Theory****UNIT I**

History of plant tissue culture; concept of totipotency; Concept of aseptic culture practices; Components of *in vitro* culture media and role of different macro and micro nutrients, vitamins, plant growth regulators and growth supplements; Sterilization techniques.

UNIT II

Various plant cell, tissue and organ culture techniques and uses; Somatic cell cultures; morphogenesis: organogenesis and somatic embryogenesis; Micropropagation: *In vitro* grafting, meristem culture; Anther, pollen, embryo, ovule, ovary culture; Protoplast culture and somatic hybridization; Somaclonal variation.

Practical

Good laboratory practices;Media preparation and sterilization; Surface sterilization of explants; Establishment of callus/cell suspension cultures; Micropropagation; Embryo culture; Anther and pollen culture; Induction of plant regeneration; Hardening and transfer to soil.

Suggested Readings

- Bhojwani SS & Razdan MK. 1996. *Plant Tissue Culture: Theory and Practice*.Elsevier.
- Bhojwani SS & Dantu PK. 2013. *Plant Tissue Culture: An Introductory Text*. Springer

- Dixon RA & Gonzales RA. 2003. *Plant Cell Culture: A Practical Approach*. Oxford University press.
- Helgason CD & Miller CL. 2005. *Basic Cell Culture Protocols*. 3rd Ed. Humana Press.

5. Molecular Biology 3(2+1)

Theory

UNIT I

History of molecular biology; Central dogma of life; Structure of DNA and RNA; Gene structure and function; DNA replication; transcription; Genetic code and translation; Structure of prokaryotic and eukaryotic nuclear and organelle genomes; Gene regulation in prokaryotes; Lac operon concept, tryp concept.

UNIT II

Introduction to microbial genetics; conjugation, transformation and transduction; Tools in molecular biology: Role of enzymes in molecular biology; Principles of Polymerase Chain Reaction; Electrophoresis; PCR and hybridization based molecular markers. \

Practical

Preparation of bacterial competent cells and transformation; Isolation and purification of plant and animal DNA; Measurement of nucleic acid concentration using spectrophotometer and gel electrophoresis; DNA amplification using RAPD, microsatellite primers and analysis; CAPS primers; Generation of linkage maps and mapping of qualitative genes; Estimation of genetic similarities and generation of dendrograms.

Suggested Reading

- Allison LA. 2011. *Fundamental Molecular Biology*. Wiley Global Education.
- Carson S, Miller HB & Witherow DS. 2012. *Molecular Biology Techniques A Classroom Laboratory manual*. Elsevier.
- Kreuzer H & Massey A. 2008. *Molecular Biology and Biotechnology: A Guide for Teachers*. ASM Press.
- Lodish H, Berk A, Kaiser CA, Krieger M, Bretscher A, Ploegh H, Amon A & Scott MP. 2012. *Molecular Cell Biology*. W. H. Freeman.
- Sambrook J, Russel D. 2001. *Molecular Cloning: A Laboratory Manual*. 3rd Ed Cold Spring Harbor Laboratory Press.
- Surzycki S. 2000. *Basic Techniques in Molecular Biology*. Springer Berlin Heidelberg
- Voet D, Voet JG & Pratt CM. 2004. *Fundamentals of Biochemistry*. 2nd Ed. New York: Wiley.
- Walker JM & Rapley R. 2000. *Molecular Biology and Biotechnology*. 4th Ed. The Royal Society of Chemistry.
- Watson JD, Bakee TA, Bell SP, Gann A, Levine M & Losick R. 2008. *Molecular Biology of the Gene*. 6th Ed. Pearson Education International.

6. Recombinant DNA Technology 3(2+1)

Theory

UNIT I

Recombinant DNA technology; Restriction endonucleases: Types and uses; DNA ligases; Vectors: plasmids, cosmids, phagemids, BACs, PACs, YACs, transposon vectors, expression vectors, shuttle vectors, binary plant vectors, co-integrating vectors.

UNIT II

Competent cells; Gene isolation and cloning; Genetic transformation of *E. coli*; Gel electrophoresis; Preparation of probes; Southern blotting; Northern blotting; Western blotting; PCR and gene amplification.

Practical

Orientation to recombinant DNA lab; preparation of stock solutions and buffers; Plasmid DNA isolation; Genomic DNA isolation; Quality and quantity determination of DNA; restriction digestion of DNA; Agarose gel electrophoresis, SDS-PAGE; PCR; Genetic transformation of *E. coli*; Screening of recombinant DNA clones in *E. coli*.

Suggested Readings

- Brown TA. 1998. *Genetics: A Molecular Approach*. 3rd Ed. Stanley Thornes.
- Singer M & Berg P. 1991. *Genes & Genome*. University Science Books.
- Winnacker EL. 2003. *From Genes to Clones: Introduction to Gene Technology*. 4th Ed. Panima Publishers.
- Watson JD & Zoller M. *Recombinant DNA*. 3rd Ed. Panima Publishers

7. Introductory Bioinformatics 3(2+1)

Theory

UNIT I

Introduction to bioinformatics; Development and scope of bioinformatics; Applications of computers in bioinformatics: Operating systems, hardware, software, Internet, www resources, FTP.

UNIT II

Primary databases: Nucleotide sequence databases (GenBank, EMBL), protein sequence databases; Secondary databases: SwissProt/TreMBL, conserved domain database, Pfam;

Structure databases: Protein Data Bank (PDB), MMDB, SCOP, CATH; File formats: Genbank, EMBL, Fasta, PDB, Flat file, ASN.1, XML.

UNIT III

Introduction to sequence alignment and its applications: Pair wise and multiple sequence alignment, concept of local and global alignment; Algorithms: Dot Matrix method, dynamic

programming methods (Needleman–Wunsch and Smith–Waterman); Tools of MSA: ClustalW, TCoffee; Phylogeny; Introduction to BLAST and FASTA.

Practical

Basic computing: Introduction to UNIX, LINUX; Nucleotide information resource: EMBL, GenBank, DDBJ, Unigene; Protein information resource: SwissProt, TrEMBL, Uniprot; Structure databases: PDB, MMDB; Search Engines: Entrez, ARSA, SRS; Similarity Searching: BLAST and interpreting results; Multiple sequence alignment: ClustalW; Structure visualization of DNA and proteins using Rasmol.

Suggested Readings

- Baxevanis AD. & Ouellette BFF. 2001. *Bioinformatics: A practical guide to the analysis of genes and proteins*. John Wiley and Sons.
- Mount DW. 2001. *Bioinformatics: Sequence and Genome Analysis*. Cold Spring Harbor.
- Xiong J. 2006. *Essential Bioinformatics*. Cambridge University Press.

8. Plant Genetic Transformation 3(2+1)

Theory

UNIT I

History of plant genetic transformation; Generation of gene construct and maintenance; Genetic transformation: *Agrobacterium* mediated, biolistics, electroporation, liposome, Polyethylene glycol, *in planta* methods.

UNIT II

Selection and characterization of transgenic plants using selectable and reportable markers; PCR; qRT-PCR; Southern, Northern, ELISA and Western techniques; Application of genetic transformation: for quality, yield, biotic, and abiotic stresses; Biosafety aspects of transgenic plants and regulatory framework.

Practical

Preparation of stock solutions, Preparation of competent cells of *Agrobacterium tumefaciens*; Restriction mapping of plasmid, Construction of binary vector and its transfer to an *Agrobacterium* strain; Confirmation of transformed bacterial colonies; *Agrobacterium tumefaciens* mediated and biolistic plant transformation; Colony hybridization.

Suggested Readings

- Green & Sambrook. 2014. *Molecular Cloning: A Laboratory Manual*. 4th Ed. 3 Vol Sets. Cold Spring Harbor Laboratory Press.
- Grierson D. 2012. *Plant Genetic Engineering*. Springer Netherlands.
- Primose SB & Twyman RM. 2006. *Principles of Gene Manipulation and Genomics*, 7th Ed. Black Well Publishing.
- Sambrook J, Russel D. 2001. *Molecular Cloning: A Laboratory Manual*. 3rd Ed Cold Spring Harbor Laboratory Press.

- Stewart NC Jr. 2008. *Plant Biotechnology and Genetics: Principles, Techniques and Applications*. John Wiley & Sons Inc.

9. Electronics and Instrumentation in Biotechnology 2(1+1)

Theory

UNIT I

Electronics

PN junction diode, diode forward and reverse characteristics; Diode as a circuit element; Application of PN junction diode such as: half wave, full wave bridge rectifier, clipper, clamper and voltage multiplier circuit; Construction and working of bipolar transistor, load line concept, analysis and design of various biasing methods of NPN transistor with common emitter configuration; AC model and analysis of small signal NPN transistor with common emitter configuration; Concept of generalized instrumentation system; Transducers for the measurement of temperature using thermometer and thermocouple, linear displacement measurement using LVDT; Force measurement using the strain gauge.

UNIT II

Principles and working of laboratory equipments: Table top, refrigerated and ultra centrifuges; Laminar air flow; Autoclaves, pH meter; Fermenters; Temperature control shakers, BOD shakers; Gel electrophoresis, 2-D gel electrophoresis, gel documentation, gel driers; ELISA readers; Freeze driers/lyophilizers; Spectrophotometers; Gene pulser; Particle gun; Plant growth chambers; Thermal cyclers; Realtime PCR; DNA synthesizer; DNA sequencer; Microscopes: Light, stereo, phase contrast and inverted.

Practical

To familiarize laboratory equipment and its equipment working; Forward and reverse VI Characteristics of a PN junction diode; To study half wave, full wave and bridge rectifier using diode; Clipper, Clamper and Voltage multiplier circuit; To determine input V-I Characteristics of bipolar transistor for common emitter configuration; To determine output V-I Characteristics of bipolar transistor for common emitter configuration; To analyse a biasing circuits for CE transistor; To design and test a biasing circuits for CE transistor; To study the measure of temperature using the available sensor; To measure displacement with the available sensor; To study force with the available sensor.

Suggested Readings

- Edward William Golding & Frederick Charles Widdis. 1969. *Electrical Measurements and Measuring Instruments*. Pitman.
- Gupta JB. 2009. *Basic Electronics*. S. K. Kataria & Sons.
- Malvino. 2007. *Electronics Principles*. Tata McGraw-Hill Education.
- Manhas P. & Thakral S. 2010. *Digital Electronics*. S. K. Kataria & Sons.
- Sharma Sanjay. 2012. *Electronics Devices & Circuits*. S. K. Kataria & Sons.

10. Classical and Molecular Cytogenetics 3(2+1)

Theory

UNIT I

Introduction and history; Mitosis and meiosis; Structure of chromatin; Chromosome structure and chromosome landmarks; Specialized chromosomes; Differential staining of the chromosomes- Q-banding, G banding, C banding, R banding; *In situ* hybridization-FISH, GISH.

UNIT II

Changes in chromosome number: aneuploidy- monosomy, trisomy and tetrasomy, haploidy and polyploidy- autopolyploidy and allopolyploidy; Methods of doubled haploid production; Structural aberrations of chromosomes: deletions, duplications, inversions and translocations; Locating genes on chromosomes; Genome analysis.

Practical

Preparation of chromosome stains; Pollen fertility; Preparation of mitotic and meiotic slides of plant/animal cells; Preparation of karyotypes; C/G banding of the chromosomes; Genomic *in situ* hybridization; Microphotography.

Suggested Readings

- Becker K & Hardin. 2004. *The World of Cell*. 5th Ed. Pearson Edu.
- Carroll M. 1989. *Organelles*. The Guilford Press.
- Charles B. 1993. *Discussions in Cytogenetics*. Prentice Hall.
- Gupta PK. 2007. *Cytogenetics*. Rastogi publications.
- Khush GS. 1973. *Cytogenetics of Aneuploids*. Academic Press.
- Mahabal Ram. 2010. *Fundamentals of cytogenetics and genetics*. PHI Learning Pvt. Ltd.
- Yao-Shan Fan. 2002. *Molecular Cytogenetics: Protocols and Applications*. Humana Press.

11. Immunology 3(2+1)

Theory

UNIT I

History and scope of immunology; Components of immune system: organs, tissues and cells, Immunoglobulin structure and functions; Molecular organization of immunoglobulins and classes of antibodies; Antibody diversity; antigens, haptens, antigens antibody interactions; Immuno-regulation and tolerance.

UNIT II

Allergies and hypersensitive response; Immunodeficiency; Vaccines; Immunological techniques; Immunological application in plant science, monoclonal antibodies and their uses; Molecular diagnostics.

Practical

Preparation of buffers and reagents; Precipitation and agglutination test; HA, HI test; Immunoblotting, immunoelectrophoresis and fluorescent antibody test; Enzyme immunoassays including ELISA variants, western blotting; Raising of antisera in laboratory animals; Collection and preservation of antisera – separation, filtration and aliquoting.

Suggested Readings

- Murphy K. 2012. *Janeway's Immuno Biology*. 8th Ed. Garland Science/ Taylor & Francis Group.
- Owen JA, Punt J, Kuby J & Sharon A. 2013. *Kuby Immunology*. 7th Ed. W.H. Freeman.

12. Molecular Genetics 2(2+0)

Theory

UNIT I

Structures, properties and modification of DNA; Molecular mechanisms of DNA replication, repair, mutation, and recombination; Centromere and telomere sequences and DNA packaging; Synthesis and processing of RNA and proteins; Regulation of gene expression; Mutations and DNA repair.

UNIT II

Repetitive DNA sequences and transposable elements; Promoters and their isolation; Transcription factors – their classification and role in gene expression; Epigenetic control of gene expression; Small RNAs, RNA interference and its applications.

Suggested Readings

- Allison LA. 2011. *Fundamental Molecular Biology*. Wiley Global Education.
- Brown TA. 1998. *Genetics: A Molecular Approach*. 3rd Ed. Stanley Thornes.
- Lewin B. 2009. *Genes 9*. Jones & Bartlett Learning.
- Tropp BE. 2014. *Principles of Molecular Biology*. Jones & Bartlett Learning.
- Tropp BE. 2012. *Molecular Biology Genes to Proteins*. 4th Ed. Jones & Bartlett Learning.

13. Nanobiotechnology 2(2+0)

Theory

UNIT I

Introduction to nanotechnology; Concepts and Terminology; Nano-Bio Interface; Biological based Nanosystems, molecular motors, biosensors and other devices.

UNIT II

Self assembly of molecules for nanotechnology applications; Biomimetics, Biotemplating and *de novo* designed nanostructures and materials; DNA-Nanotechnology; Nanomanipulations, material design, synthesis and their applications.

Suggested Readings

- David E. Reisner. 2009. *Bionanotechnology: Global Prospects*. CRC Press.
- Gabor L. Hornyak, John J. Moore, Tibbals HF., Joydeep Dutta. 2008. *Fundamentals of Nanotechnology*. CRC Press.
- Jesus M. de la Fuente, V. Grazu. 2012. *Nanobiotechnology: Inorganic nanoparticles Vs Organic nanoparticles*. Elsevier.
- Yubing Xie. 2012. *The Nanobiotechnology Handbook*. CRC Press.

14. Animal Biotechnology 4(3+1)

Theory

UNIT-I

History and development of animal biotechnology; Basic techniques in animal cell culture: Introduction to embryo biotechnology: oocyte collection and maturation; Sperm preparation; in vitro fertilization; Cryopreservation of oocyte, sperm and embryos; Embryo transfer technology.

UNIT II

Breeds of livestock and their characteristics; Marker assisted breeding of livestock; Introduction to animal genomics: RFLP, RAPD, SSRs, QTL, SNP, STR, Mitochondrial DNA polymorphism; Rumen and its environment: Rumen microbes-manipulation of rumen microbes for better utilization of feed; Introduction to nutrigenomics; Milk biome; Manipulation of lactation by biotechnological tools; Application of biotechnology in meat and meat products.

UNIT III

Genome and protein based diagnostics of important animal diseases: FMD, brucellosis, PPR, Mastitis, Blue tongue, Newcastle disease; Introduction to vaccinology: live attenuated vaccines, killed vaccines, cell culture based vaccines, recombinant vaccines.

Practical

Basic cell culture techniques; oocyte aspiration from ovaries; sperm preparation; In vitro fertilization; PCR based detection of animal pathogens; PCR-RFLP; Immuno histochemical localization of protein marker in tissues/cells – meat species identification by PCREDIT

Suggested Readings

- Aberle Elton D, Forrest John C, Gerrard David E & Mills Edward W. 2012. *Principles of Meat Science*. 5th Ed. Kendall Hunt Publishing.
- Lawrie & Ledward. Lawrie's. 2006. *Meat Science*. 7th Ed. Woodhead Publishing. Sukumar De. 1997. *Outlines of Dairy Technology*. Oxford University Press-New Delhi.
- Sharma BD. 1999. *Meat and Meat Products Technology: Including Poultry Products Technology*. Jaypee Bros. Medical Publishers.
- Varnam A & Jane P. 1994. *Milk and Milk Products: Technology, Chemistry and Microbiology*. Sutherland Springer Science & Business Media.

15. Molecular Marker Technology 2(2+0)

Theory

UNIT I

Types of molecular markers- RFLP; PCR based markers like RAPD, SCAR, SSR, STS, CAPS, AFLP, SNP and their variants; Uses of molecular markers: Application as a genetic tool for genotyping and gene mapping; Mapping populations: F₂, DH, RILs, NILs; Bulk segregant analysis; Linkage maps; Physical maps.

UNIT II

Application of molecular markers: Assessing genetic diversity, variety protection; Marker-assisted breeding for accelerated introgression of trait/transgene and quantitative traits; Human and animal health: Association with genetic-based diseases, Paternity determinations; Forensic studies.

Suggested Readings

- Huges S. & Moody A. 2007. *PCR: Methods Express*. Royal College of General Practitioners.

16. Genomics and Proteomics 3(3+0)

Theory

UNIT I

Introduction to Genomics, Functional Genomics and Proteomics; Structural genomics: Classical ways of genome analysis, BAC and YAC libraries; Physical mapping of genomes; Next generation sequencing; Genome analysis and gene annotation; Genome Projects: *E. coli*, Arabidopsis, Bovine, Human; Comparative Genomics: Orthologous and Paralogous sequences, Synteny, Gene Order, Phylogenetic footprinting.

UNIT II

Functional genomics: Differential gene expression techniques: ESTs, cDNA-AFLP, microarray, Differential display, SAGE, RNAseq, Real time PCREDIT

UNIT III

Introduction to proteomics; Analysis of proteome: Native PAGE, SDS PAGE, 2D PAGE; Edmann Degradation; Chromatographic techniques: HPLC, GC, Mass Spectrometry: MALDI-TOF, LC-MS; Post Translational modifications.

Suggested Readings

- Branden C & Tooze J. 1999. *Introduction to Protein Structure*. 2nd Ed. Garland Science.
- Connor DO & Hames BD. 2007. *Proteomics: Methods Express*. Royal College of General Practitioners.
- Pennington S R & Dunn M J. 2001. *Proteomics from protein sequence to function*. BIOS Scientific Publishers Ltd.
- Singer M & Berg P. 1991. *Genes & Genome*. University Science Books.
- Tropp BE. 2012. *Molecular Biology Genes to Proteins*. 4th Ed. Jones & Bartlett Learning

17. IPR, Biosafety and Bioethics 2(2+0)

Theory

UNIT I

Introduction to Intellectual Property, concepts and types; International treaties for protection of IP's; Indian Legislations for the protection of various types of Intellectual Property; Patent search, filing process; Material transfer agreements.

UNIT II

Biodiversity definition, importance and geographical causes for diversity; Species and population biodiversity, maintenance of ecological biodiversity hot spots in India; Convention on biological diversity; Cartagena Protocol of bio-safety, and risk management for GMO's; Bio-safety guidelines, rules and regulations and regulatory frame work for GMOs in India.

Suggested Readings

- Singh BD. 2007. *Biotechnology: Expanding Horizon*. Kalyani Publishers.
- <http://patentoffice.nic.in>
- www.wipo.org
- www.dbtindia.nic.in
- www.dbtbiosafety.nic.in

18. Computational Biology 2(2+1)

Theory

UNIT I

Introduction to computational biology; Web based servers and software for genome analysis: Ensembl, UCSC genome browser, MUMMER, BLASTZ; Sequence submission.

UNIT II

Protein interaction databases: BIND, DIP, GRID, STRING, PRIDE; Principles of Protein structure prediction; Fold Recognition (threading); Homology modeling; SCOP, CATH, PDB, PROSITE, PFAM; Methods for comparison of 3D structures of proteins.

UNIT III

Phylogenetic analysis: Evolutionary models, tree construction methods, statistical evaluation of tree methods; PHYLIP, dendroscope, MEGA; DNA barcoding database-BOLD.

Practical

Application of Genome browsers in genomic research; Exploring protein-protein interaction databases; Working with protein structural classification databases; SNP and SSR identification tools; PHYLIP.

Suggested Readings

- Creighton TE. 1993. *Proteins: Structures and Molecular Properties* 2nd Edition. W.H Freeman.
- DovStekel. 2003. *Microarray Bioinformatics*. 1st Ed. Cambridge University Press.
- Mount D. 2001. *Bioinformatics: Sequence and Genome Analysis*, 2nd Ed. Cold Spring Harbor Laboratory Press.
- Malcolm Campbell A. & Laurie J. Heyer. 2007. *Discovering Genomics, Proteomics and Bioinformatics*. 2nd Ed. Benjamin Cummings.
- Setubal Joao & Meidanis Joao. 2004. *Introduction to Computational Molecular Biology*, PWS Publishing Company.

19. General Biochemistry 4(3+1)

Theory

UNIT I

Introduction and importance; Cell structure; Bio molecules: Carbohydrates, lipids, proteins and nucleic acids - structure, functions and properties; Enzymes: Classification, factors affecting activity; Structure and role of water in biological system; Acids, bases and buffers of living systems; The pK of biomolecules; Vitamins and hormones.

UNIT II

Bioenergetics; Metabolism - basic concept: Glycolysis, Citric acid cycle, Pentose phosphate pathway, Oxidative phosphorylation, Fatty acid oxidation; General reactions of amino acid degradation; Biosynthesis - carbohydrates, lipids, proteins, nucleic acids.

UNIT III

Secondary metabolites: Terpenoids, alkaloids, phenolics and their applications in food and pharmaceutical industries.

Practical

Qualitative tests for carbohydrates, amino acids, proteins and lipids; Extraction and characterization of lipids by TLC; Determination of acid, iodine and saponification values of oil; Extraction, quantitative estimation and separation of sugars by paper chromatography; Determination of phenols; Determination of free amino acids and proteins.

Suggested Readings

- Berg JM, Tymoczko JL, & Stryer L. 2002. *Biochemistry*. 5th Ed. W.H. Freeman & Co.
- Com EE & Stumpf PK. 2010. *Outlines of Biochemistry*. 5th Ed. John Wiley Publications.
- Goodwin, TW & Mercer EI. 1983. *Introduction to Plant Biochemistry*. 2nd Ed. Oxford, New York. Pergaman Press.
- Murray RK, David B., Botham KM & Kennelly PJ. 2012. *Harper's Illustrated Biochemistry*. 29th Ed. Lange Medical Books/Mc. Graw Hill.
- Nelson DL & Cox MM. 2000. *Lehninger Principles of Biochemistry*. 5th Ed. C.B.S Publishers, Prentice Hall.

- Wilson K & Walker J. 1994. Principles and Techniques of Biochemistry and Molecular Biology. 7th Ed. Cambridge University Press.

20. Enzymology and Enzyme Technologies 3(2+1)

Theory

UNIT I

Classification and nomenclature of enzymes; General characteristics of enzymes, active site, cofactors, prosthetic groups; Metalloenzymes; Isolation, purification, characterization and assays of enzyme and international units; Criteria for purity.

UNIT II

Enzyme kinetics: effect of pH, temperature, determination of K_m and V_{max} ; Regulation of enzyme activity; Enzyme inhibition: competitive, non-competitive and uncompetitive; Isoenzymes, schizomers and isoschizomers; Ribozymes; Immobilization of enzymes; Applications of enzymes: biotechnology, industry, environment, agriculture, food and medicine.

Practical

Isolation, purification and assay of enzymes; Determination of optimum pH and optimum temperature of enzymes; Thermostability of enzymes; Activators and inhibitors of enzyme catalysis; Determination of kinetic parameters of enzymes; Immobilization of enzymes; Isoenzymes analysis.

Suggested Readings

- Bisswanger H. 2011. *Practical Enzymology*. 2nd Ed. Wiley-Blackwell.
- Cook PF & Cleland WW. 2007. *Enzyme Kinetics and Mechanism*. Garland Publishing Inc.
- Cornish-Bowden A. 2012. *Fundamentals of Enzyme Kinetics*. 4th Ed. Wiley-Blackwell.
- Price NC & Stevens L. 1999. *Fundamentals of Enzymology: Cell and Molecular Biology of Catalytic Proteins*. 3rd Ed. Oxford University Press.

21. Biodiversity and its Conservation 2(2+0)

Theory

UNIT I

Concepts of biodiversity, bioresource and wildlife management, conservation strategies: *in situ* and *ex situ* conservation; Wild life conservation projects in India; Protection of biodiversity for its suitable utilization; Threats to biodiversity; WCU Red data book; Biodiversity hotspots in India; National bureaus of genetic resources.

UNIT II

Sustainable development; Diversification of cropping system; Diversity of indigenous livestock; Vulnerability and extinction of flora and fauna; Endangered species in various ecosystems; Germplasm banks; Environmental impact assessment; Bioremediation and biosafety; Introduction to regulatory agencies and legislation.

Suggested Readings

- Das MK & Choudhury BP. 2008. *A Text book on Plant Nomenclature and Biodiversity Conservation*. Kalyani Publishers.
- Hopsetti BB. & Venketashwarlaru M. 2001. *Trends in Wild Life Conservation and Management*. Vol. 2, Daya Publishing House.
- Singh MP & Singh BS. 2002. *Plant Biodiversity and Taxonomy*. Daya Publishing House, Delhi.

22. Microbiology 3(2+1)

Theory

UNIT I

History of Microbiology-its applied areas; Microorganisms and their role in fermentation; Germ theory of diseases and protection; Introduction to eukaryotic and prokaryotic cell; Major groups of eukaryotes- fungi, algae and protozoa; Major groups of prokaryotes – Actinomycetes, Cyanobacteria, Archaeobacteria, Rickettsias and Chlamydia; Preservation of microorganisms; Microbial repositories at national and international level.

UNIT II

Bacterial growth; Metabolism in bacteria- ATP generation, chemoautotrophy, photoautotrophy, respiration, fermentation; Viruses: Bacteriophages - structure and properties, lytic and lysogenic cycles; viroids, prions.

UNIT III

Microbial groups in soil; Microbes in biotic and abiotic stressed environments; Microbial transformation of carbon, nitrogen and sulphur; Biological nitrogen fixation; Beneficial microorganisms in agriculture-biofertilizers, microbial pesticides; Plant microbe interaction; Microbes in composting and biodegradation; Microbiology of water and food.

Practical

Microscope and other instruments in a microbiological laboratory; Media preparation, sterilization and aseptic methods for isolation, identification, preservation and storage; Identification of bacteria by staining methods; Enumeration of bacteria by pour plate and spread plate methods; Micrometry.

Suggested Readings

- Brock TD. 1961. *Milestones in Microbiology*. Infinity Books.
- Pelczar MJ, Chan ECS & Kreig NR. 1997. *Microbiology: Concepts and Application*. Tata McGraw Hill.
- Stainier RY, Ingraham JL, Wheelis ML & Painter PR. 2003. *General Microbiology*. MacMillan.
- Tauro P, Kapoor KK & Yadav KS. 1996. *Introduction to Microbiology*. Wiley Eastern.

23. Microbial Genetics 3(2+1)

Theory

UNIT I

Microorganisms as tools for genetic studies; Genetic variability in microorganisms; Genetic analysis of representative groups of bacteria, fungi and viruses; Random and tetrad spore analysis; Recombination and chromosomal mapping; Complementation - intergenic and intragenic.

UNIT II

Bacterial plasmids; Structure, life cycle, mode of infection and their role in genetic engineering; Transfer of genetic material in bacteria: Conjugation, transformation and transduction; Genetics of bacteriophage: T4, lambda and M13 - fine structure of gene, life cycle, mode of infection; Mutation: types, mutagens, DNA damage and repair; Transposable elements; Lac operon; Yeast genetics.

UNIT III

Concept and application of recombinant DNA technology; Use of genetic tools to improve the microbial strains with respect to industry, agriculture and health.

Practical

Conjugation and transformation in bacteria; Spontaneous and auxotrophic mutation; Chemical and UV mutagenesis in fungi and bacteria; Complementation in fungi; Identification of mutants using replica plating technique; Isolation of genomic DNA from *E. coli*; Isolation and curing of plasmid; Identification of plasmid by electrophoresis / antibiotic plates.

Suggested Readings

- Birge EA. 1981. *Bacterial and Bacteriophage Genetics*. Springer Verlag.
- Gardner JE, Simmons MJ & Snustad DP. 1991. *Principles of Genetics*. John Wiley & Sons.
- Lewin B. 1999. *Gene*. Vols. VI-IX. John Wiley & Sons.
- Maloy A & Friedfelder D. 1994. *Microbial Genetics*. Narosa.
- Scaife J, Leach D & Galizzi A 1985. *Genetics of Bacteria*. Academic Press.
- William Hayes 1981. *Genetics of Bacteria*. Academic Press.

Student READY programme

Student READY - In-house Skill Development Modules 20(0+20)

Four Modules (Only one to be opted as per chosen elective)

1. Plant Biotechnology
2. Animal Biotechnology
3. Microbial and Environmental Biotechnology
4. Bioinformatics