A.VEERIYA VANDAYAR MEMORIAL

SRI PUSHPAM COLLEGE (AUTONOMOUS)

POONDI-613 503, THANJAVUR (DT)

SYLLABUS

M.Sc., Bio Technology

(From 2020 - 2021 onwards)

M.Sc.,BIOTECHNOLOGY

Program Outcomes of M.Sc., Biotechnology

PO1. Equipped with an in-depth knowledge in the area of Biotechnology

PO2. Understands about various concepts of biotechnology and its importance in human health

PO3. Apply the knowledge of internal structure of cell, its functions in control of various metabolic functions of organisms.

PO4. Opportunities of continuing education, research and professional development.

PO5.Develops human capital for advanced scientific research and entrepreneurship

PO6. Enable the students to avail career opportunities in teaching, industry and research.

Programme Specific Outcomes of M.Sc., Biotechnology

PSO1. Understanding the functional characteristics at cellularand sub-cellular level

PSO2. Enhancing the technical skills for experimental purposes

PSO3. Understand the applications of biological sciences in Genomics, Proteomics, Recombinant DNA Technology and Medicine

PSO4. Focusing to prepare them with research-oriented approach in frontier areas of research in Biotechnology

PSO5. Perform procedures as per laboratory standards in the areas of Cell culture, Molecular Biology, Biochemistry, Animal biotechnology, Immunology and research methodology

PSO6.Cultivating a generation with Scientific Ethics and Temper.

A. VEERIYA VANDAYAR MEMORIAL SRI PUSPHPAM COLLEGE (AUTONOMOUS), POONDI, THANJAVUR DISTRICT CBCS – FOR M.Sc. BIOTECHNOLOGY STUDENTS
ADMITTED FROM THE ACADEMIC YEAR-2020 - 2021 ONWARDS
DEPARTMENT OF BIOTECHNOLOGY
M.Sc., BIOTECHNOLOGY

S.No.	Semester	Category	Paper Code	Title of the Paper	Maximum Marks			Minimum Marks for Pass			Hours / Week	Credits
					C.I.A.	E.E.	Total	C.I.A.	E.E.	Total		
1.	I	Core	20P1BTC1	Biochemistry	25	75	100	10	30	50	6	5
2.			20P1BTC2	Advances in Microbiology	25	75	100	10	30	50	6	5
3.			20P1BTC3	Environmental Biotechnology	25	75	100	10	30	50	6	5
4.			20P1BTCP1	Practical – I (Biochemistry, Microbial and Environmental Biotechnology)	40	60	100	16	24	50	6	3
5.		Major Elective-I	20P1BTEL1A 20P1BTEL1B 20P1BTEL1C	A) Immunology and Immunotechnology B) Entrepreneur skill Development C) Molecular modeling & Drug designing	25	75	100	10	30	50	6	4
6.	II	Core	20P2BTC4	Molecular Genetics	25	75	100	10	30	50	6	4
7.			20P2BTC5	Plant Biotechnology	25	75	100	10	30	50	5	4
8.			20P2BTC6	Enzyme Biotechnology	25	75	100	10	30	50	5	4
9.			20P2BTC7	Nanobiotechnology	25	75	100	10	30	50	4	4
10.			20P2BTC8	Genomics and Proteomics	25	75	100	10	30	50	6	4
11.			20P2BTCP2	Practical – II (Molecular Genetics, Plant and Animal Biotechnology, Enzyme Biotechnology and Industrial Biotechnology, Nanobiotechnology, Proteomics & Genomics)	40	60	100	16	24	50	6	3
12.		Major Elective-II	20P2BTEL2A 20P2BTEL2B 20P2BTEL2C	A) Bio-Instrumentation and Biometry B) Bio-informatics, IPR & Nanotechnology C) Occupational Health & Industrial Safety	25	75	100	10	30	50	4	4
13		Extra Credit	-	**MOOC** (**M**assive **O**pen **O**nline **C**ourse)	-	-	-	-	-	-	-	-

S.No.	Semester	Category	Paper Code	Title of the Paper	Maximum Marks			Minimum Marks for Pass			Hours / Week	Credits
					C.I.A.	E.E.	Total	C.I.A.	E.E.	Total		
14.	III	Core	20P3BTC9	Bio-Process Technology	25	75	100	10	30	50	5	5
15.			20P3BTC10	Clinical biochemistry	25	75	100	10	30	50	5	4
16.			20P3BTC11	Recombinant DNA Technology	25	75	100	10	30	50	5	5
17.			20P3BTC12	Animal Biotechnology	25	75	100	10	30	50	4	4
18.			20P3BTCP3	Practical – III (Bioprocess Technology, Recombinant DNA Technology and Clinical Chemistry)	40	60	100	16	24	50	6	4
19.		EDC	20P3BTEDC	Trends in Biotechnology	25	75	100	10	30	50	4	---
20.												
21.		Soft Skill	20P3BTSD	Communicative Skill And Personality Development (N.S)	---	---	100	---	---	50	1	---
22.		Extra Credit	-	**MOOC** (**M**assive **O**pen **O**nline **C**ourse)	-	-	-	-	-	-	-	-
23.	IV	Core	20P4BTC13	Research Methodology	25	75	100	10	30	50	9	5
24.			20P2BTC14	Food Technology	25	75	100	10	30	50	9	5
25.		Major Elective	20P4BTEL3A 20P4BTEL3B 20P4BTEL3C	A)Biosafety and Bioethics B)Biodiversity and Bioresources C) Enzymology	25	75	100	10	30	50	6	4
26.			20P4BTCK	Comprehension Knowledge Test	---	---	100	---	---	---	4	2
26.		Project	20P4BTPR	Project	25	75	100	10	30	50	---	4
27.		Soft Skill	20P4BTCPD	Communicative Skill and Personality Development (N.S)	---	---	---	---	---	---	1	---

LIST OF CORE OPTION

S.No.	Semester	Category	Paper Code	Title of the Paper	Maximum Marks			Minimum Marks for Pass			Hours / Week	Credits
					C.I.A.	E.E.	Total	C.I.A.	E.E.	Total		
1.	**I**	Core – Option	20P1BTCO1	Cancer and stem cell Biology	25	75	100	10	30	50	---	----
2.	**II**	Core-Option	20P2BTCO2	Toxicology	25	75	100	10	30	50	---	---
3.	**III**	Core-Option	20P3BTCO3	Endocrinology	25	75	100	10	30	50	**---**	**---**
4.	**IV**	Core-Option	20P4BTCO4	Pharmacology	25	75	100	10	30	50	---	---

M. Sc BIOTECHNOLOGY SYLLABUS (2020 – 2021)

Name of the Courses	TOTAL NO. OF COURSES	TOTAL MARKS	TOTAL CREDITS
Core	17	1700	72
Elective	03	300	12
E.D.C.	01	100	--
Project	01	100	04
Comprehensive Test	01	100	02
Communicative Skill and Personality Development (N.S)	---	---	--
Extra Credit Online Course MOOC	---	---	--
Total	**23**	**2300**	**90**

GRADING OF COURSE PERFORMANCE (10 POINT SCALE)

Aggregate Marks	**Grade**	**Grade point**
96 and above	S+	10
91-95	S	9.5
86-90	D++	9.0
81-85	D+	9.0
76-80	D	8.0
71-75	A++	7.5
66-70	A+	7.0
61-66	A	6.5
56-60	B	6.0
50-55	C	6.5

Comprehensive Knowledge Test: Objective type question pattern with 100 compulsory questions carrying 100 marks to be answered in 3 hourswith 2 Credits. The portion is entire core courses.

Industrial Internship: In second semester, students have to undergo In-Plant training industry or Organization where any process related to Biotechnology is going on. The period of training should be minimum 10 days. Students have to submit the report of the training underwent with the certificate from the concerned authority of the Industry/Organization.

Industrial visit: In Fourth semester, Students have to submit a report on the Industrial visit made with the counter signature of staff in charge for the industrial visit while submitting the Project/industrial internship report.

MOOC: Massive open online course is introduced in the second and third semester as an extra credit course from this academic year 2020-2021. Students can avail any one or more of the courses available in MOOC to equip their skill and knowledge themselves.

Industrial Visit / Hands on training programme having minimum 15 hours of contact time as Extra Credit course is introduced for I year PG students to gain experiential learning.

Evaluation of the Industrial visit report will be held at the end of II Semester.

Components of Evaluation

Internal Marks - 40

External Marks - 60

Total -100

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Question Pattern for UG and PG Programmes for students to be admitted during 2020 – 2021 and afterwards

Total Marks: 75

QUESTION PATTERN

SECTION – A
(Question 1 to 10)

10 x 2 = 20 Marks

1. Short Answer Questions
2. Two Questions from each units (All are answerable)

SECTION – B
(Question 11 to 15)

5 x 5 = 25 Marks

1. 5 Paragraph type questions with "either / or" type choice.
2. One question from each unit of the Syllabus.
3. Answer all the questions.

SECTION – C
(Question 16 to 20)

3 x 10 = 30 Marks

1. 5 Essay type questions – any three are answerable.
2. One questions from each unit of the Syllabus.

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	**20P1BTC1**	**Core – BIOCHEMISTRY**	**6**	**5**

Unit I **Hrs 18**

Chemical foundations of Biology – Chemical bonds Molecular interactions pH – Acids, Bases, Buffers - Determination of pKa of weak acids, Heselbatch and Henderson equation. Bioenergetics - Law of Thermodynamics – Living system and Equilibrium state – Chloroplast, mitochondrial. NADP/NADPH redox couple.

Unit II **Hrs18**

Carbohydrate – Structure, Classification and function. Metabolism – Glycolysis,Glycogenesis, Gluconeogenesis, Glycogenolysis, Pyruvate Oxidation, TCA, Electron Transport chain, Oxidative Phosphorylation. Inborn error of carbohydrates metabolism

Unit III **Hrs18**

Protein – Structure, Classification and function. Metabolism. Overview of biosynthesis of non-essential amino acids. Catabolism of amino acid nitrogen transamination, deamination, ammonia formation. The urea cycle and regulation of urogenesis and their inborn error of protein metabolism.

Unit IV **Hrs 18**

Lipids – Structure, Classification and function. Metabolism - Lipogenesis – Control of Acetyl CoA carboxylase. Oxidation of fatty acids (α, β and γ). Role of ornithine cycle in the regulation of β-oxidation.Lipid inborn error metabolism.

Unit V **Hrs 18**

Nucleic acid -Structure, Classification and function. Metabolism – Purine and Pyrimidine. Inborn error in metabolism.Heterocyclic compounds and secondary metabolites – Prostaglandins, Leukotrienes, Thromboxanes, Interferons, Interleukins, Antibiotics, Alkaloids, Terpenoids and Flavonoids, Sterols, Pigments and Isoprenoids.

Course Outcomes

After completion of this course, students will be able to

- Gain the knowledge of Chemical foundations of Biology and pH, Acids, Bases, Buffers, Weak and Covalent bonds and also Principles of Thermodynamics.
- Promote knowledge in structure and metabolism of biomolecules.
- Know the effect of inborn errors of metabolism on various aspects.
- Understand the Nucleic acid metabolism and its Biosynthesis, Heterocyclic compounds and secondary metabolites biosynthesis and its uses.

Reference:

1. Principles of Biochemistry by A.L.Lehninger, D.L.Nelson and M>M. Cox (2002), Worth publishers, New York.
2. Biochemistry by L.Stryer (2000) Freeman & Co. New York.
3. Biochemistry by G. Zubay (2004), MaacmillanPulishing Co. New York.
4. Harper's Biochemistry by R.K.Murray, P.a. Mayes, D.K. Granne and Vv.W. Rodwell (2002) Lanlge Medical Book.
5. General Chemistry Linus pauling, W.H.Freeman& Company.
6. Biochemical Calulations, Irwin H.Segal, John Wiley and Sons lne.
7. Organic Chemistry, DJCram and GS Hammond, McGraw Hill.
8. Physical Biochemistry Freifilder, Ww.H.Freeman& Company.

Web link:https://catalog.slu.edu/courses-az/bchm/ (NUS)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	**20P1BTC2**	**Core – ADVANCES IN MICROBIOLOGY**	**6**	**5**

Objectives:

1. To study the biology of microorganisms.
2. To study the diversity of microbes
3. To study the diseases reference to the etiology, pathogenesis, treatment, diagnosis and prevention

Unit I **Hrs 18**

Microbiology**:**Systematicof microorganisms – Characteristics of primary domains. Haeckel's three kingdom classification, Whittaker's five kingdom approach - Woese domain system. Major characteristics used in taxonomy – morphological, physiological and metabolic, genetic and molecular taxonomy. Bergey's Classification of bacteria.

Unit II **Hrs 18**

Microbial Techniques: Sterilization, Principles of microbial nutrition, Media composition, Pure Culture techniques (streak plate, spread plate, pour plate, stab culture, slant culture). Anaerobic (thioglycolate, anaerobic chamber, Robertson's media, microaerophilic), liquid shake culture of aerobic bacteria. Control of microbes, construction of culture - enrichment culture techniques - isolation of chemoautotrophs, chemoheterotrophs and photosynthetic microorganisms. Preservation and maintenance of microorganisms.

Unit III **Hrs 18**

Biology of Microorganisms: –Prokaryotic and Eukaryotic Diversity. Bacteria –structure and configuration, Fungi –structure and configuration, Yeast –structure and configuration, virus (bacteriophages)- prions –structure and configuration, algae and Mycoplasma –structure and configuration.Extremophiles: Classification and its characteristics - Applications of extremophiles.

Unit IV **Hrs 18**

Microbial growth**:** Definition of growth. Kinetics expression of growth. Growth curve, measurement of growth and yields, synchronous and continuous growth. Growth affected by environmental factors like temperature, pH, water availability and oxygen. Symbiosis, quorum sensing, biofilms and cell-cell interaction.

Unit V **Hrs 18**

Microbial Diseases**:** Sources, route of transmission, Pathogenicity and control measures Bacterial diseases –, Tuberculosis, Leprosy, Meningitis, Eye infections, Gastroenteritis, Diarrhea. Viral Disease – STD, Polio, Pox, MMR, CORONA, Denque. Fungal Diseases- Tineapedis, Tineaungulum, Tineacapitis,Kerion, Trichophytic granuloma, candidiasis. Protozoan's Disease – Malaria, Amoebiosis and Sleeping sickness.

Course Outcomes

After completion of this course, students will be able to

- **Acquire knowledge and understanding of the microbiology concepts.**
- **Demonstrate key practical skills/competencies in the use of good microbiological practices.**
- **Become competent enough to use microbiology knowledge and skills to analyze problems involving microbes, articulate these with peers/ team**
- **Develop a broader perspective of the discipline of Microbiology to identify challenging societal problems.**
- **Understand the interactions between viruses and the host immune system**
- **Understand the difference between prokaryotes and Eukaryotes integrated understanding of Biomolecules learns the theoretical basis of the tools, technologies and methods common to microbiology.**

Reference:

1. Heritage,J. Evans E.G.V. and Killington, R.A. (1996). Introductory Microbiology. Cambridge University Press.
2. John Webster (1993). Introduction to Fungi.(2nd edition).Cambridge University, press,Cambridge.
3. Prescott LM Harley JP and Klein DA (2006). Microbiology (7th edition) McGraw Hill, Newyork.
4. A Textbook of Microbiology by P. Chakraborty
5. A Textbook of Microbiology by P. Anandanarayanam and JayaramPaniker
6. Microbiology by Frazier and Westhoff.
7. Microbiology by M.J. Pelzar E.C.S. Chan and N.R. Krieg (2004) McGraw Hill.
8. Microbiology by Dubey and Maheswari (2002).
9. General Microbiology, Stainer RY, Ingra Ham JL, Whellis ML & Painter PR. (2004). Macmillan Education Ltd London.
10. Advances in Applied Microbiology, Parihar, Pradeep (2008).
11. Fungi, Bacteria and Viruses, Dube, H.C. (2008).

Web Link:

http://web.mit.edu/microbiology/grad.html - (Massachusetts Institute of Technology)

Unit IV and V

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	**20P1BTC3**	**Core –ENVIRONMENTAL BIOTECHNOLOGY**	**6**	**4**

Objective:

1. Discusses application of microbial environment, microbiological treatment of waste water, bioremediation and biodegradation of xenobiotics.
2. To learn about biodegradation and bioremediation process.
3. To learn about microbial treatment of waste water
4. To learn about microbial life in extreme environments.

Unit I **Hrs 18**

Introduction to environmental pollution.Wastewater – collection, characteristics, treatment methods for domestic and industrial wastewater, disposal and management; sanitation; environmental impact assessment; thermal and marine pollution; common effluent treatment plants, pollution control.

Unit II **Hrs 18**

Principles of aerobic treatment processes-Microbial growth rates; substrate specificities; biochemical interactions; treatment kinetics; food/microorganism ratio; oxygen and nutrient requirements; theory of aeration; oxygen transfer; types of aerators; substrate removal efficiency; removal of nitrogen and phosphorus; treatment methods including activated sludge, extended aeration, sequencing batch reactors, trickling filters, rotating bio-disc systems, nitrification-denitrification systems.

Unit III **Hrs 18**

Principles of anaerobic and advanced treatment processes-General perspective – substrate specificities, biochemical interactions, environmental factors; Anaerobic process design parameters - volumetric organic loading rate, hydraulic and solid retention time, temperature, waste characters; Anaerobic reactor configuration- suspended growth anaerobic reactors and fixed film anaerobic, upflow anaerobic sludge blanket; typical arrangements, design approach, design parameters, nutrient removal, gas recovery, post-treatment methods; Sludge treatment, Composting of biodegradable MSW; vermicomposting; biomethanation; mechanical composting of MSW.

Unit IV **Hrs 18**

Principles of natural treatment processes-Mechanically aerated lagoons - types, design of facultative, aerobic flow-through, dual powered and extended aeration lagoons; algal ponds – types, typical flow sheets, algal growth dynamics, nitrogen and phosphorus removal, advanced integrated pond system; Hyacinth ponds; duckweed ponds; sewage-fed fish ponds; natural wetlands; constructed wetlands (reed beds), design and aspects of municipal and industrial wastewater irrigation system.

Unit V **Hrs 18**

Environmental quality-Quality of environment for life on earth and man; Deterioration of environmental quality with reference to anthropogenic impact; Methods of assessment of environmental quality; Short term studies/surveys; Rapid assessment; Continuous short and long term monitoring. Environmental Impact Assessment - Steps involved in conducting the EIA Studies; Environmental Impact Assessment techniques-Ad-hoc method, checklist method, overlay mapping method,network method, simulation and modeling technique, matrix method, and system diagram technique; Merits and Demerits of EIA studies.

Course Outcomes

After completion of this course, students will be able to

- Information on environmental issues globally.
- Understand the sources and effect on Environment pollution.
- Gain knowledge on pollution treatment.
- Ensure the role of microbes in pollution degradation.
- Acquire Environmental Impact Assessment techniques

Textbooks and References:

1. Arceivala, S. J. &Asolekar, S. R. (2015). Wastewater Treatment for Pollution Control and Reuse (3rd Edition, 11th Reprint), McGraw Hill Education India Pvt. Ltd., New Delhi. (Chapters 1, 2, 4 to 13)
2. Arceivala, S. J. &Asolekar, S. R. (2012). Environmental Studies: a Practitioner's Approach, McGraw Hill Education (India) Pvt. Ltd., New Delhi. (Chapter 7)
3. Malina, J. F. and Pohland, F. K.(Eds) (1992) Design of Anaerobic Processes for the Treatment of Industrial and Municipal Wastes. Technomic Publishing Company, USA.
4. A. D. Patwardhan (2010). Industrial Wastewater Treatment, PHI Learning Pvt Ltd, New Delhi, 2010. 5. A. D. Patwardhan (2013). Industrial Solid Wastes, TERI, New Delhi, 2013.
5. Tchobanoglous G. and F. L. Burton. (1991). Wastewater Engineering, Treatment, Disposal and Reuse. 3rd Ed., Metcalf and Eddy (Eds). Tata McGraw Hill Publishing Co. Ltd. New Delhi
6. Metcalf and Eddy (Eds). Disposal and Reuse. 3rd Ed., Tata McGraw Hill Publishing Co. Ltd. New Delhi
7. Christopher Forster, (2003), Wastewater Treatment and Technology. Thomas Telford Publishing, London, UK.
8. 9.G. Bruce Wiersma (2004); Environmental Monitoring; by CRC Press

Web Link:

1.https://www.ntnu.edu/studies/courses/TBT4130#tab=omEmnet (Norwegian University)
2.https://www.srh-berlin.com/study-programmes/srh-berlin/master-degrees/meng-engineering-and-sustainable-technology-management-focus-on-digital-building-infrastructure/ (SRH Hochschule Berlin UNIVERSITY)
3.https://www.deakin.edu.au/search?query=environmental+engineering
(DEAKIN UNIVERSITY)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	**20P1BTCP1**	**Core – Practicals – I (BIOCHEMISTRY, ADVANCES IN MICROBIOLOGY, ENVIRONMENTAL BIOTECHNOLOGY AND IMMUNOLOGY & IMMUNOTECHNOLOGY**	**6**	**3**

Objectives:

1. To understand the Chemistry of Proteins, Sugars, Nucleic acids.
2. To learn the microbial Techniques.
3. To acquire the knowledge on Biochemistry and advances in Microbiology, Environmental Biotechnology and Immunology &Immunotechnology

Biochemistry

1. Determination of Pka value of buffers by titration
2. Quantification of sugars from different samples.
3. Isolation and quantification of Proteins
4. Absorption spectra of Proteins and nucleic acids
5. Thin layer chromatography of pigments and amino acids
6. Estimation of Aminoacids by Ninhydrin method
7. Estimation of blood glucose
8. Estimation of Cholesterol.

Advances in Microbiology

1. Sterilization techniques
2. Microscopic examination of bacteria, fungi, protozoa and molds.
3. Biochemical characterization of selected Microbes (Klebsiella, E coli, Salmonella, Shigella, Proteus)
4. Preparation of selective & differential medium.
5. Growth: Growth curve, measurement of fungal growth by linear determination and measurement of bacterial growth by turbidity.
6. Determination of optimum temperature and pH on microbial growth.

7. Pure Culture techniques –Streak, Pour & Spread plate.
8. Enumeration of microorganisms from various samples
9. Antibiotic sensitivity test
10. Isolation of drug resistant auxotrophic mutants.
11. Study of mutation by Ames test.
12. Isolation of Phage DNA.

Environmental Biotechnology

1.Analysis of TDS, DO, BOD& COD from sewage and effluence.

2.Detection of Coli form to determine water purity using membrane filter method.

3. Isolation of root nodules bacteria

Immunology and Immunotechnology

1. Agar gel diffusion
2. Counter immuno-eletrophoresis,
3. Rocket immuno-electrophoresis
4. WIDAL, VDRL Test
5. Haem agglutination Test
6. ELISA

Course Outcomes

After completion of this course, students will be able to

- Understand and exploring the reactions and chemistry of Biomolecules.
- Demonstrate and enrich the practical skills/competencies in the use of microbial techniques and its applications on various fields.
- Understand the sources, effect and gaining knowledge on Environment pollution.
- Ensure the role of microbes in pollution degradation.
- Gain knowledge on immunotechniques.

Reference:

1.Practical Biochemistry : Principles and techniques by Keith Wilson and John Walker, 5th ed., 2000. Cabridge University Press, UK

2.Analytical biochemistry by Dabid J. Holme and Hazel peck, 3rd Ed. 1998. Pearson Edu. Ltd., England.

3.Principles and Practice of Bioanalysis by Richard F. Venn, 2003, Taylor and Francis, London.

4.Microbiology – A laboratory manual Cappuccino, J.G. and Shjeman, N. Addison Wesley (2004)

5.Diagnostic Microbiology by Betty. A. Forbes, aniel F. Sham, 2002.

6. Biochemical methods by A. Pingoud, C. Urbankse, J. Hoggett, 2002, Weiley – VeltVerlagGarbh.

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	20P1BTEL1A	Major Elective - I A) IMMUNOLOGY AND IMMUNOTECHNOLOGY	6	4

Objectives:

1. To study the immune system.
2. To study the immunity against invaded micro-organisms.
3. To study the various immunity Technology.
4. To study the Allergic reactions and Auto immune diseases

Unit I **Hrs18**

Outlines of Immunology**:** Organs and Cells involved in immune responses – Organs of stem cell origin, primary and secondary lymphoid organs – Haemopoietic stem cells, T-cells, B-cells, Macrophages, Monocytes, Polymorphs and Platelets – Immunological memory – Differentiation of Lymphocytes. Immunology of the GI Tract: Anatomical and chemical barriers to intruders.

Unit II **Hrs18**

Antigens, Antibodies and Complements**:** Antigens and antigenicity: Types, structure and requirements for immunogenicity – Antibody specificity – Antigen specific receptor for antibiotics – Regional variation of antigen binding site, Immunoglobulins: Structure, function and biological properties of Ig classes – Organization and expression of Immunoglobulin genes – Ag-Ab reactions: Precipitation, Agglutination, opsonisation and cytolysis.

Unit III **Hrs18**

Humoral immune response**:** Antibody Synthesis – Clonal Selection – Model kinetics of Primary and Secondary responses – Cellular Cooperation – B cell activation for T independent,T-dependent antigens – isotype switching. Cell mediated immune response: Phagocytosis – role of T-cells, macrophages and NK cells, subtypes of T-cells (T_H and T_C cells) and their functions and its biological role.

Unit IV **Hrs 18**

Hypersensitivity**:**Immunodeficiency disorders, Auto immune disease – Auto antibodies, (RA factor),MHC – types and its significance.HLA system – disease association. MHC – types and its significance. Tumours Antigens. Leukemia and Lymphomas. CD1 and Lipid Antigens, Immunology of HIV, Genetic markers in Cancer, Inflammatory Bowel disease. Transplantation Immunology- Bone marrow transplantation.

Unit V **Hrs18**

Immunization: –Types, Immunization schedule - Principles and Methods of Polyclonal and Monoclonal antibody productions and their applications. Principle and Methods in vaccine preparation, Types of Vaccine. Immunotechniques – Principle, Methodology and application of LTT, ELISA, ELISPOT, RIST, RAST, Immunoelectroporesis and Immunoblotting (phosphor specific antibodies) FACSCAN, Immunofluorescence and RIA.

Course Outcomes

After completion of this course, students will be able to

- Understand the roles of immunoglobulins and immune cells in immunological responses.
- Know the characteristics of antigen-antibody interactions and different types of allergic reactions.
- Realize the adverse effect of immune system causing autoimmune diseases and apply the basic techniques for identifying antigen-antibody interactions
- Understand the roles of immune system in protection against tumor and realize the stages of transplantation.

Reference:

1. Kuby's Immunology (6 th Ed.) by Goldsby RA, Kindt TJ, Osborne BA.), W.H. Freeman and Company, New York, (2007).
2. Janeway'sImmunobiology (7 th Ed.) by Murphy K, Travers P, Walport M. Garland Science Publishers, New York, (2008).
3. Cellular and Molecular Immunology (6 th Ed.) by Abbas AK, Lichtman AH, PillaiS.,Saunders Publication, Philadelphia, (2007).
4. Immunology (6 th Ed.) by Richard C and Geiffrey S. Wiley Blackwell Publication, (2009).
5. Immunology, An introduction (1984) 6th Edition – Wiley medical publications; New York.
6. Structure and Functions of Antibodies (1977) Glysm, L. Steward M.W. Johy Wily – New York.
7. Immunology – Dubey (2004).
8. Immunology, 5th Edition, Joshi, K.R. (2007).
9. Immunology, I. Kannan, MJP Publishers (2006).
10. Immunology and Serology, Dr. K.R. Joshi and Dr. N.O. Osamo (2008).
11. Immunobiology, M.S. Aslam (2005).

Web Link:

https://www.immunology.utoronto.ca/sites/default/files/IMM250%20Syllabus_W2020_Jan8.pdf – (University of Tornato)

https://ocw.mit.edu/courses/health-sciences-and-technology/hst-176-cellular-and-molecular-immunology-fall-2005/lecture-notes/tumor_immune.pdf - https://www.immunology.utoronto.ca/sites/default/files/Syllabus%20IMM435%202019.pdf (University of Tornato

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	20P1BTEL1B	**Major Elective – 1** **B) ENTREPRENEURIAL SKILL DEVELOPMENT**	6	4

Objectives:

1. To know Entrepreneurship, Entrepreneurial management and functions.
2. To study the processes, tools and best practices in developing new products.
3. To study about the role of entrepreneurial ventures in the national economy.
4. To understand the entrepreneurial finance .
5. To understand the concept and meaning of science and technology.

UNIT I **18Hrs.**

Entrepreneurship, Entrepreneurial Management

Definition-Entrepreneurship and entrepreneur; creativity, innovation and Entrepreneurship; credentials, competencies and traits of an entrepreneur; factors affecting Entrepreneurship development.

UNIT II **18Hrs.**

New Product Pevelopment

Ideation techniques; Concept development; Processes, tools, and best practices used in developing new products; Product positioning Analyzing consumer preferences; Product and market testing; Product launch; Pretest market forecasting; New product commercialization; reasons for new product failure; barriers to new product adoption; Intellectual property protection in new product development efforts.

UNIT III **18Hrs.**

Venture Creation

Role of entrepreneurial ventures in the national economy; Evaluating and creating a new venture; evaluation of business opportunities - as an entrepreneur and an investor; processes involved in starting a new venture; processes involved in funding and investing in a new and growing entrepreneurial venture.

UNIT IV **18Hrs.**

Entrepreneurial Finance

Process of financial forecasting for a new venture, effective financial management of an emerging business, sources of financing, bootstrapping and exit planning; angel investors and venture capital; Govt grants and loans.

UNIT V **18Hrs.**

Science and Technology Management

Science and Technology management: Concept and meaning of Science & technology; Evolution and growth of Science & technology, role and significance of management of Science & technology, Impact of S&T on society and business; Product development – from scientific breakthrough to marketable product – Role of Government in Science & Technology Development; Linkage between Science, Technology, Development and competition; Managing research and Managing Intellectual Property.

Course Outcomes

After completion of this course, students will be able to

- Understand the factors affecting Entrepreneurship development.
- Study the processes, tools and best practices in developing new products.
- Attempt entrepreneurial ventures in the national economy.
- Understand the entrepreneurial finance.
- Know the concept and meaning of science and technology.

TEXT BOOKS

1.Principles of management –Peter Druker (1979)

2.Managing Technology and Innovation for Competitive Advantage - V K Narayanan - Pearson Education Asia

REFERENCE BOOKS:

1.Bringing New technology To Market - Kathleen R Allen - Prentice Hall India

2.http://www.techno-preneur.net/ - The Technology Innovation Management and Entrepreneurship Information Service

3. http://dst.gov.in/scientific-programme/t-d-tdb.htm

4. http://www.dsir.nic.in/tpdup/tepp/tepp.htm - The Technopreneur Promotion Programme.

Web Link:

https://canvas.harvard.edu/courses/10860/assignments/syllabus (Hardvard University)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	**20P1BTEL1C**	**Major Elective - I C) MOLECULAR MODELING AND DRUG DESIGNING**	**6**	**4**

Objectives:

1. To study the concept of molecular modeling and Molecular mechanics.
2. To study the Molecular dynamics simulation methods.
3. Recent advances in drug design methodologies.
4. To study the Software tools for modeling bio-molecules.
5. To study the Molecular docking.

Unit I Hrs18

Introduction to the concept of molecular modeling, molecular structure and internal energy, applications of molecular graphics, coordinate systems, potential energy surfaces, -local and global energy minima. Molecular mechanics: general features of molecular mechanics- force field, bond stretching, angle bending, torsional terms, non-bonded interactions; force field parametrisation and transferability; energy minimization: derivative and non-derivative methods, applications of energy minimization.

Unit IIHrs18

Molecular dynamics simulation methods: molecular dynamics using simple models, molecular dynamics with continuous potential-setting up and running a molecular dynamic simulation, constraint dynamics; Monte Carlo simulation of molecules. Simulation for conformational analysis. Ab initio, dft and semi empirical methods.

Unit III Hrs18

Recent advances in drug design methodologies- Biomolecular structure, Structure activity relationship, Pharmacokinetics, Pharmacophoric pattern, ADME Properties, quantitative structure activity relationship, Use of genetic algorithms and principle component analysis in the QSAR equations

UnitIV Hrs18

Macromolecular modeling- Software tools for modeling bio-molecules. Molecular electrostatic potentials, charge analyses. Protein conformations, folding and mutation through modeling-design of ligands for known macro molecular target sites. The Phyre2 web portal for protein modeling, prediction and analysis and PyMOL Tutorial.

Unit V Hrs18

Molecular docking: Docking-Rigid and Flexible Structure-based drug design for all classes of targets- Theories of enzyme inhibition – Enzyme Inhibition strategies.- Enzyme inhibition as a tool for drug development –Examples. Finding new drug targets to treat disease- strategies for target identification and lead design- Use of Genomics and Proteomics for understanding diseases at molecular level- - new targets for anti-cancer drugs, Drugs that rescue mutant p53's. De novo drug design.Drug-receptor interaction, classical SAR/QSAR studies and their

implications to the 3-D modeler, 2-D and 3-D database searching, pharmacophore identification and novel drug design.

Course Outcomes

After completion of this course, students will be able to

- Know the concept of molecular modeling and Molecular mechanics.
- Acquire knowledge in Molecular dynamics simulation methods.
- Know recent advances in drug design methodologies.
- Know about Software tools for modeling bio-molecules.
- Develop skills in Molecular docking.

References:

1. Andrew Leach. 1996. Molecular Modelling: Principles and Applications (2nd Edition), Addison Wesley Longman, Essex, England.
2. Alan Hinchliffe. 2003. Molecular Modelling for Beginners, John-Wiley and Sons New York.
3. Cohen, N. (Ed.).1996. Guide Book on Molecular Modeling in Drug Design, Academic Press, San Diego.
4. Frenkel, D. and B. Smit. 1996. Understanding Molecular Simulations. From Algorithms to Applications.Academic Press, San Diego, California.
5. Rauter, C. and K. Horn. 1984. X-ray crystallography and drug design, Elsevier.
6. Kalos, M. and P. A. Whitlock. 1986. Monte Carlo Methods. John Wiley & Sons, New York,.
7. McCammon, J.A. and S.C. Harvey. 1987. Dynamics of Proteins and Nucleic Acids. Cambridge University Press, Cambridge.
8. Rapaport, . D.C. 2004. The Art of Molecular Dynamics Simulation. Cambridge University Press, Cambridge, England

Web Link:

http://www.cbs.umn.edu/sites/cbs.umn.edu/files/public/downloads/BioC%204351,%205351.pdf (University of Minnesota)
https://psb.stanford.edu/previous/psb99/tutorial-cadd.html (Stanford University)
https://web.stanford.edu/class/cs279/index.html#lectures (Stanford University

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
I	**20PIBTCO1**	**Core Optional -CANCER AND STEM CELL BIOLOGY**	**6**	**5**

Objectives:

1. To know the regulation of eukaryotic cell cycle.
2. To know the cancer biomarkers
3. To study the cell signaling in cancer cell lines.
4. To know diagnosis and treatment.
5. To know the concept of stem cells and treatment.

UNIT I **Hrs 18**

Regulation of the Eukaryotic cell cycle, Cell birth, Lineage and cell death. Cancer/ oncogenes, Cancer biomarkers, Cellular morphology, Primary and established cell lines, Kinetics of Cancer cell growth, Genetics of cancer cells. Cancer stem cell culture and their applications. Cell culture based vaccines. Cancer proteomics.

UNIT II **Hrs 18**

Cell Signalling in Cancer Cell lines: Cancer cell lines : MCF-7, HeLa, HepG2, A549 and ZR771. Signaling at the cell surface, Types of signaling pathways that control gene activity, Integration of signals and gene controls. Moving proteins into membranes and organelles, Vascular traffic, secretion and endocytosis, Metabolism and movement of lipids.

UNIT III **Hrs 18**

Etiology, epidemiology, diagnosis and treatment of breast, lung, colorectal, blood, endocrine cancers.Current scenario of RNAi technology in cancer medicine.Role of gene therapy in cancer treatment.

UNIT IV **Hrs 18**

Stem cell concept – Properties of stem cell – Types of stem cell embryonic stem cell – Adult stem cells – Problem of differentiation.Differentiation status of cells – Primordial germ cell - Skin cell - Gastrointestinal cells – Embryonic stem cell differentiation as a model to study haematopoietic and endothelial cell development.

UNIT V **Hrs 18**

Stem cell location and Classification – Neural stem cells – Stem cell niches – Germ line Epithelial and Epidermal and neural niches. Uses of Stem cells - Human stem cells – Renewal of Stem cells- Stem cells and Tissue engineering – Embryonic stem cells and Gene therapy - Therapeutic cloning.Ethical and Social consideration of Stem cell research.

Course Outcomes

After completion of this course, students will be able to

- Know the regulation of eukaryotic cell cycle.
- Develop skills in cancer biomarkers
- Understand cell signaling in cancer cell lines.
- Learn about diagnosis and treatment of cancer.
- Know concept of stem cells and treatment

REFERENCE BOOKS:

1. KursadTurksen 2002. Embryonic Stem Cells Method and Protocols.Humana press.
2. Russell Korobkin and Stephen R. Munzer 2007. Stem Cell Century, Law and Policy for a Breakthrough Technology, Yale University Press.
3. Robert Lanza 2005. Essential of Stem cell Biology.Elsevier press.
4. Robert Lanza, 2004. Hand Book of Stem Cells Volume 1&2, Elsevier press.

Web Link:

https://www.duke-nus.edu.sg/education/our-programmes/phd/ibm-phd/specialty-tracks/cancer-and-stem-cell-biology (National University of Singapore, Singapore)

http://www.nus.edu.sg/nusbulletin/duke-nus-medical-school/graduate-education/curriculum-information-phd-programme/ (National University of Singapore, Singapore)

https://www.a-star.edu.sg/News-and-Events/a-star-news/news/press-releases/singapore-scientists-uncover-how-neural-stem-cells-are-activated-intrinsically-by-spindle-matrix-proteins (National University of Singapore, Singapore)

Semester	Course Code	Title of the Paper	Hours/Week	No.Of Credits
II	**20P2BTC4**	**MOLECULAR GENETICS**	**6**	**4**

Objectives

1. Introduction to the genetic material
2. Describes the application of genetics in the various fields of science.
3. The techniques of genetics and its industrial and medical applications are described

UNIT I **Hrs 18**

Chemical Basis of Heredity: DNA as genetic material. Genome- Genome size, gene density and ultrastructure of chromosome in prokaryotes and eukaryotes; DNA supercoiling and topoisomerases, repetitive DNA, transposons.RNA as genetic material.DNA structure and types.RNA types and structure.Ribozymes. DNA Replication: DNA Replication in prokaryotes (rolling circle model) and eukaryotes. DNA Denaturation and renaturation.

UNIT II **Hrs 18**

Gene Expression: Genetic code: Brief account. Protein synthesis in prokaryotes and eukaryotes.Eukaryotic Transcription Gene structure and promoters Basal factors: TFIID, TFIIH, TFIIB, Mediator, preinitiation complex Eukaryotic transcriptional regulation.Plant transcription Epigenetics RNA-based silencing, X-chromosome inactivation, transcriptional memory, silencing of ancient transposons.Post Transcriptional modifications- Translation- Regulation of Gene expression:- Inducible operons – Galactose- Repressible operon – Tryptophan

UNIT III **Hrs 18**

Genome organisation and Fine structure of the Gene: Prokaryotic genome:- Chromosomal and plasmid Eukaryotic genome:- Chromosomal and organellar. Fine structure of the Gene: Cistron, muton and recon. Bacterial Genetics : Transformation, Transduction-Generalized and specialized: Conjugation: F factor mediated, Hfr and Sexduction.

UNIT IV **Hrs 18**

Transposable elements : Maize and Drosophila . Mutations: Introduction and Types of Gene mutations - Base substitution, Frame shift mutation (insertion, deletion, missense, nonsense mutation). Mutagens - Physical and chemical. Reverse mutation in bacteria.DNA repair mechanism (Mismatch repair photoreactivation, excision and SOS repair) Beneficial and harmful effects of mutations. Crisper Cas-9 system.

UNIT V **Hrs 18**

Antisense RNA/DNA.Invertebrate and vertebrate model systems - Drosophila, *C. elegans*, chick, frog, zebrafish, mice, human and itsapplications.

Course Outcomes

After completion of this course, students will be able to

- Knowledge in the Structural and functional aspects of basic unit of life.
- Know the fundamental concept of DNA Replication.
- Grasp in the fundamental concept of transcription , molecular events in Translation ,and Posttranslational modifications (PTM).
- Attain the knowledge in Gene Regulation and structure and function of Transposons.

References:

1. Molecular Biology of the Gene, 4th edition by Watson J.D, N.H.Hopkins, J.W.Roberts,•J.A.Steitz and A.M.Weiner (1987) Benjamin/Cummings.
2. The RNA World (2 edition) Gestel and R, T.Cech and J.Atkins (edition) 1999 Cold•Spring Harbor, New York.
3. Cell Biology and Molecular Biology by EDP Robertis and EMF Robertis, Saunder• College.
4. Advanced Molecular Biology by Twyman R.M (1998) Viva Books Ltd.• Instant Notes in Molecular Biology by P.C.Turneretal (2002) Viva Books.
5. Instant Notes in Biochemistry 2 edition B.D.Hames and N.M.Hooper (2002) Viva .
6. Genomes by T.A. Brown (2002) Viva Books.
7. Molecular cell Biology, 2nd edition by Darnell.J, H.Lodish and D.Baltimore (1990),•Scientific American Books, New York.
8. GENES – IX by Benjamin Lewin
9. Recombinant DNA Technology by Watson
10. Genetics – from genes to genomics – Leland.Hartwelletal. Mc grow Hill publications

Web Link:

https://www.utoledo.edu/nsm/bio/pdfs/syllabii/2016/BIOL3020-001%20Gray%20S2016%20copy.pdf

https://ocw.mit.edu/courses/biology/7-22-developmental-biology-fall-2005/syllabus/

(Massachusetts Institutes of Technology)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	**20P2BTC5**	**Core – PLANT BIOTECHNOLOGY**	**5**	**4**

Objectives:
This course will give an idea about the basic principles and techniques involved in plant cell culture and to understand the concepts of transformation and achievements of biotechnology in Plant systems.

UNIT-I **Hrs15**

History and Application of plant tissue culture - Agriculture, horticulture, forestry,- Laboratory organization - Composition of MS media, Gamborgs media, Nitchs media, Whites media and their preparation. Plant growth regulators.Methods of sterilization - culture initiation and incubation of culture. Callus induction, establishment and maintenance. Cell suspension culture - characteristics.Factors controlling - Physical and chemical.

UNIT-II **Hrs15**

Micropropagation: methods - micro grafting, culturing of meristem and shoot tip, axillary and adventitious budding - advantages. Plant protoplast isolation, culture and fusion.Cell wall regeneration from protoplasts - application of protoplast hybridization.Biotransformation and immobilization of plant cells. Hairy root clones, advantages of hairy root culture .Production of secondary metabolic compounds using cell and tissue culture.

UNIT III. **Hrs15**

Somatic embryogenesis-Synthetic seeds. Haploid plant production – Anther, ovule and microspore culture, triploid production, embryo culture and embryo rescue. In vitro pollination and fertilization.Somatic hybrids and cybrids.Somaclonal and gametoclonalvariation.cryopreservation.

UNIT IV **Hrs15**

Plant genome organization in mitochondria and chloroplast.Role of RFLP in plant breeding.DNA barcoding in plants.Transposable elements in plant. Plant transformation technology: Ti and Ri plasmids, binary & co-integrated vector systems; viral vectors and their applications; 35S and other promoters; genetic markers; reporter genes; virulence genes; Cloning Strategies; Gene transfer methods in plants – Direct DNA transfer methods, Agrobacterium mediated gene transfer.

UNIT V **Hrs15**

Application of gene transformation in plant: Insect resistance, fungus resistance, virus resistance, drought, cold resistance, saline resistance, Transgenic plant with vitamin A, Gene silencing in crop plants, Terminator seed technology, Production of therapeutic antibodies, edible vaccine.

Course Outcomes

After completion of this course, students will be able to

- Gain knowledge in culture animal cells in artificial media.
- Develop the knowledge of animal cells in culture, growth of cell lines.
- Gain insight into culturing of organisms and production of transgenic animals.
- Understand of in vitro culturing of organisms and production of transgenic animals.
- Consider the ethical issues involved in production transgenic animals and BT products.

REFERENCE BOOKS

1. Hammond J, McGarvey P and Yusibov V. (2000). Plant Biotechnology, Springer verlag.
2. Satyanarayana U. (2005).Biotechnology, Books and Allied (p) Ltd.
3. Bhojwani SS and Razdan MK. (2004). Tissue Culture Theory and Practice.
4. Paul Christou and Harry Klee.(2004). Hand Book of Plant Biotechnology Vol.I& II, J John Wiley & Sons.
5. Guptha PK. (1996). Elements of Biotechnology, Rastogi and Co. Meerut.
6. Chawla. HS.(1998). Biotechnology in crop improvement, International Book.
7. Slater, Scott and Fowler. (2003). Plant Biotechnology (The genetic manipulation of plants), Oxford University, UK.

Web Link:

http://sbs.ntu.edu.sg/prospective/undergraduate/Curriculum%20and%20Course%20Descriptions/Pages/Major-PE/Table%20B/BS4015.aspx
(NTU, Singapore)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	**20P2BTC6**	**Core – ENZYME BIOTECHNOLOGY**	**5**	**4**

Objectives:

- To study the enzymes and their properties.
- To learn about the enzyme reactions
- To study the uses and applications of enzymes.

Unit I **Hrs 15**

Enzymes – Nomenclature, Classification, General properties, Influence of factors on enzyme action- pH, Temperature, Ions, substrate and enzymeconcentration.The enzyme structure and prediction - primary and Secondary structure by X-ray Crystallography and Autoradiography.

Unit II **Hrs 15**

Enzyme action-Specificity- Types, lock and key hypothesis, Transition state and stabilization.Serine protease, Oligomeric enzymes- Lactate dehydrogenase, Lactose Synthase, Tryptophan Synthase, Pyruvate dehydrogenase.

Unit III **Hrs 15**

Coenzyme – mode of actions: Nicotinamide nucleotides (NAD^+ and $NADP^+$), Flavin nucleotides (FMN and FAD), Adenosine Phosphates (ATP, ADP and AMP), Coenzyme A (CoASH), Thiamine pyrophosphate (TPP), Pyridoxal phosphate, Biotin,Tetrahydrofolate, Coenzyme B_{12}.

Unit IV **Hrs 15**

Enzyme kinetics: Kinetics of Single, bi and multisubstrate enzyme. Michaelis –Menten and HenddersonHasselbalchequations-Steady state Kinetics.Formation of ES complex. Enzyme inhibition – Competitive and noncompetitive– Mixed, Partial and irreversible inhibition, T_m,K_{cat},andKI.

Unit V **Hrs 15**

Enzyme assay – Determination of catalytic activity, coupled kinetic assay, Radio immune assay of enzymes, extraction of enzymes – extraction of soluble, membrane bound enzymes, nature of extraction medium. Purification of enzymes – preliminary and chromatography methods.

Course Outcomes

After completion of this course, students will be able to

- Learn enzyme actions in biological system
- Develop the skill on enzyme purification techniques
- Learn about the enzyme uses in disease diagnosis
- Gain knowledge about the enzyme applications in pharma, textile, food, environment etc.,

Reference:

1. ENZYMES: Biochemistry, Biotechnology and Clinical chemistry – Trevor Palmer – Nottingham University
2. Enzyme Kinetics by Paul Engel. 1977. John Wiley and Sons. Inc., New York.
3. Enzymes by Dixon and Webb, 3 rd Edition 1979. Academic Press, New York
4. Blazej, A. &Zemek.J. 1987: Interbiotech, 87, Enzyme Technologies, Elsevier
5. Murray Moo – Young 1988 Bioreactor immobilized enzyme and cells.Fundamentals and applications, Elseyler, Applied Science
6. Rehm, H.J. and Reed G. 1988, Biotechnology, Vol 7a, Enzyme Technology, Elsevier
7. Terrance G. Cooper 1977 The tools of Biopchemistry, John Wiley & Son
8. William, b. Jakoby, 1984 Methods in Enzymology, Vol.104, enzyme purification and related techniques.
9. N.C. Price, L. Stevens. 2000. Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins, Oxford University Press, USA.

Web Link:

https://ocw.mit.edu/high-school/biology/exam-prep/chemistry-of-life/enzymes/ - (Massachusetts Institute of Technology)

Semester	Course Code	Title of the Paper	Hours of	No. of

			Teaching / Week	Credits
II	**20P2BTC7**	**Core – NANOBIOTECHNOLOGY**	**4**	**4**

Objectives:

1. To know about the Nanotechnology.
2. To learn about the nanoparticles and targeted drug delivery.
3. To learn the improved diagnostic products and techniques.
4. To study about the applications of nanomaterials

UNIT – I **Hrs 12**

Principles of Nanobiotechnology- Introduction to nanotechnology-History of nanotechnology-Classification of Nanomaterials- Properties of Nanomaterials- Surface to volume ratio-An overview of applications of nanomaterials.

UNIT – II **Hrs 12**

Synthesis of Nanomaterials:- Top-down techniques-Ball milling- Combustion synthesis-Nanolithography:-Photolithography-Electron beam lithography. Bottom-up techniques:- Soft chemical method - Sol-gel method.

UNIT – III **Hrs 12**

Fullerenes-Carbon nanotubes:- Types of Carbon nanotubes - Single walled carbon nanotubes and Multi walled carbon nanotubes- Synthesis of Carbon nanotubes- Plasma are-discharge method-Properties of Carbon nanotubes and biological applications.

UNIT – IV **Hrs 12**

Analytical equipments:- Surface morphology:-Scanning Electron Microscope(SEM)-Scanning Tunneling Microscope(STM)-Transmission Electron Microscope(TEM)- Atomic force microscope(AFM)-Compositional analysis:- Energy Dispersive X-ray Analysis(EDAX)-Fourier Transform Infrared spectroscopy(FTIR)-Optical characterization-UV-vis-NIR double beam spectrophotometer.

UNIT – V **Hrs 12**

Biomedical applications of nanomaterials –Brief descriptions- Targeted drug delivery, Cancer therapy:-Targeted chemotherapy-Radiation therapy-Thermotherapy-Immunotherapy-Gene therapy.Tissue engineering, Biosensing and Bioimaging.

Course Outcomes

After completion of this course, students will be able to

- Understand the classification of nanostructured materials
- Develop the skills in fabricate the nanomaterials using various techniques
- Compare and contrast the types of fullerenes
- Understand the principle and mechanism of analytical equipments
- Realize the applications of nanomaterials in biological system

Reference:

1.ClaupdioNicolini, Nanobiotechnology&Nanobiosciences Pan Stanford Publishing Pte. Ltd.2009.
2.O.Skoseyov, Ilan levy, Nanobiotechnology – BioInspired Devices and Materials of the Future, Humana Press Inc, 2008.
3.N.Yao and Zhong Lin Wang, Handbook of Microscopy for Nanotechnology Kluwer Academic Publishers, 2005.
4.Nanotechnology – N.Arumugam – Saras Publications.
5.Indroduction to Nanotechnology – Neal lane and James .R. Heath.
6.K. Ravichandran, K. Swaminathan, P.K. Praseetha and P. Kavitha- Introduction to Nanotechnology, JAZYM Publications, 2019
https://ivle.nus.edu.sg/lms/public/view_moduleoutline.aspx?CourseID=0472F682-E536-4631-9250-7ACC4F67E670&ClickFrom=StuViewBtn (NUS)

Semester	Course Code	Title of the Paper	Hours of Teaching	No. of

			/ Week	Credits
II	**20P2BTC8**	**Core - GENOMICS AND PROTEOMICS**	**6**	**4**

Objectives:

- To acquaint the student with genome organization, gene identification, expression and applications of genomics analysis.
- Also about proteomics, analysis and its applications.

UNIT I **Hrs 18**

Organization of genomes: Introduction: Genome, Genomics, Omics and importance, General features, C-value paradox. Gene identification; gene ontology,gene prediction rules and software's; Genome databases; Annotation of genome. Overview of comparative genomics.Significance of genomes – bacteria, yeast, Caenorhabditis, *Homo sapiens*, Arabidopsis.Genetic mapping –Cross breeding and pedigree analysis, Physical mapping - Restriction mapping, FISH, Radiation hybrid mapping and STS. DNA markers (RFLPs, SSLPs, SNPs)

UNIT II **Hrs18**Genome projects: Human genome project, HapMap Project and 1000 genome project. Structural genomics: Assembly, contiguous DNA sequence- shotgun method, clone contig method, and whole –genome sequencing. Pattern of genome evolution: The origin of genomes, macromolecules, RNA and DNA world. Acquisition of new genes (By gene duplication) and Gene families – (Types, Pseudogenes, Origin of gene families (lateral gene transfer, allopolyploidy).Synthetic genomes and their applications

UNIT III **Hrs 18**

Proteomics: Introduction – Organization and structure of genomes, Genome size, Sequence complexity, Introns and Exons, Genome structure in viruses and prokaryotes, Isolation of Chromosomes, chromosome micro dissection, Retrofitting. Introduction to Proteomics – The Proteome, Mining proteomes, Bridging Genomics and Proteomics.Proteomics and the new biology.

UNIT IV **Hrs**

18Analysis of Proteomes**:**2DGE and image processing, MALDI –TOF. Mass spectrometry based methods for protein identification- De novo sequencing using mass spectrometric data-Correlative mass spectrometric based identification strategies, 2-DE gel electrophoresis coupled with mass spectrometry, Micro array techniques- Types, Designing a microarray experiment and its applications in Treating Disease.

UNIT V **Hrs 18**

Applications of Genomics and Proteomics Analysis: Analysis of Genomes – Human, Mouse, *Plasmodium falsiparum, Saccharomyces cerevisiae*, *Mycobacterium tuberculosis*. Genomics and Proteomics role in- drug development and Cell cytotoxicity, Pharmaceutical, Proteomics in drug Discovery in human, phage antibodies synthesis, Glycobiology and plant genetics and breeding.

Course Outcomes

After completion of this course, students will be able to

- Gain knowledge of Omics technologies, with emphasis on genomics and proteomics;
- Gain information on the key technological developments enabled modern genomic and proteomic studies;
- Gain the skills on advance genomics and proteomics technologies
- Know about bioinformatics techniques and its implementation on genomic and proteomic databases.
- Acquire the information regarding the genome variation and their relationship with human diseases
- Gain ideas about Biological system information relating to genes, proteins and cellular structures, used to model living cells to create new synthetic cells.

REFERENCES

1. Brown T. A. 2007, Genomes 3. Garland Science Publishing, New York.
2. Dunham, I., 2003. Genome Mapping and sequencing. Horizon Scientific
3. Graur, D and W H Li, 2000. Fundamentals of molecular evolution. Sinauer Associates.
4. Hartwell, L. H., L. Hood, M. L. Goldberg, A. E. Reynolds, L. M. Silver and R. G. Veres. 2004. Genetics from Genes to Genomes. McGraw Hill.
5. Lewin B. 2003. Genes VIII. Oxford University Press. Oxford.
6. The Human Genome 2001, Nature Vol. 409.
7. The Drosophila Genome. 2000, Science Vol. 267.
8. The Caenorhabditiselegans genome 1998. Science Vol. 282.
9. The Arabidopsis Genome 2000 Nature vol. 408.
10. Primrose, S. B., and R. M. Twyman . 2006. Principles of gene manipulation and Genomics, Blackwell Publishing MA. USA

Web Link:

1.http://www.moleculargenetics.utoronto.ca/functional-genomics-and-proteomics.
(UNIVERSITY OF TORONTO)

2.http://www.sbs.ntu.edu.sg/prospective/undergraduate/Curriculum%20and%20Course%20Descriptions/Pages/Major-PE/Table%20C/BS3012.aspx (NANYANG UNIVERSITY)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	**20P2BTCP2**	**Core – Practical – II – MOLECULAR GENETICS, PLANT BIOTECHNOLOGY,ENZYME BIOTECHNOLOGY, NANOBIOTECHNOLOGY AND PROTEOMICS & GENOMICS**	**6**	**3**

Objectives:

1. To study the Isolation of DNA, Electrophoresis and GUS Assay.
2. To study the Tissue Culture methods.
3. To understand the role of Bioinformatics tools

Molecular Genetics

1. Plasmid extraction: Alkaline lysis, Mini preparation.
2. Chromosomal DNA isolation (Animal tissue, plants, bacteria and fungi)
3. Quantification of DNA & RNA
4. Electrophoresis of DNA & RNA
5. Bacterial transformation
6. Study of mutation by Ames test.
7. Bacterial mutagenesis – physical & chemical

Plant Biotechnology

1. Preparation of Tissue Culture medium for plant.
2. Micro propagation of shoot tip & seed culture.
3. Cell counting and cell viability
4. Cryopreservation and Thawing
5. Isolation of DNA and demonstration of apoptosis of DNA laddering.
6. Isolation and Fusion of Protoplast
7. Preparation of chloroplast from pea (Hands on)

8. Photoperiodism.
9. Transformation of leaf discs with Agrobacterium (Hands on)
10. Effect of different light wavelengths on germinating corn embryos (Hands on).

Enzyme Biotechnology

1. ELISA
2. Immobilization of enzymes.
3. Effect of pH & temperature on enzyme activity.
4. Enzyme assay: Estimation of salivary amylase from saliva & phosphatase from potato

Genomics and Proteomics

1. Sequence alligenment- Local and Global allignment.
2. Sequence retrieval from biological databases- NCBI, EMBL, DDBJ, SWISSPROT.
3. Protein structure visualization- Rasmol.

Nanobiotechnology

1. Synthesis of Nanoparticles.
2. Metal microbes interactions.

Course Outcomes

After completion of this course, students will be able to

- Develop skill about Isolation of DNA, Electrophoresis and GUS Assay.
- Students train for the process and techniques of Tissue Culture methods.
- Understand the role of Bioinformatics tools.
- Ensure the role of microbes in nanoparticle synthesis and its applications on various fields.
- Gain knowledge about the animal cell culture techniques.

Reference:

1. Genetic Transformation of plants (Molecular Methods of Plant Analysis 2003 Publisher : Springer)
2. Plant Tissue Culture by S.S. Purohit, 2004, Mrs. SaraswatiPurohit for Student edition.
3. Animal Cell Culture – Practical approach, Ed. Martin Clynes, Springer.
4. Animal Cell Culture Techniques. Ed. Martin Clyines, Springer.
5. Culture of Animal Cells, 3rd End, R.IanFreshney, Wiley Liss.
6. Animal Cell Culture – Practical Approach, Ed. John R.W. Masters, Oxford.
7. Animal Cells : Culture and Media : Essential Data (Essential Data Series) by D.C. Darling, S.J. Morgan, 195, John Wiley and Sons Ltd.

8. Priniciples of Tissue Englineeringby :Rovert P. Lanza, Robert Langer, Joseph P. Vacanti, 2000 Academic Press.
9. Handbook of Industrial Cell Culture : Mammalian, Microbial, and Plant Cells 2002.

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	**20P2BTEL2A**	**Major Elective – II BIOINSTRUMENTATION**	**4**	**4**

Objectives:
To enrich the knowledge of students on Bio-instrumentation.
To enhance the knowledge on chromatographic and electrophoresis techniques.
To know about structural analysis of biomolecules, PCR techniques and tracer techniques.

Unit I **Hrs12**

Microscope – Types, principles and applications: Light, Phase contrast, Fluorescent, Bright field, Dark field, Electron microscope (SEM and TEM). Centrifugation: Preparative and Analytical centrifuges, Sedimentation analysis RCF, Density gradient centrifugation and ultra centrifugation.

Unit II **Hrs12**

Chromatographic techniques: Theory and application of paper chromatography, TLC, Gel filteration chromatography, ion exchange chromatography, Affinity chromatography , GLC, HPLC, and HPTLC.
Electrophoretic techniques: Theory and application ofSDS PAGE, Agarose Gel electrophoresis, PFGE, Immuno electrophoresis

Hrs12

Unit III

Structural analysis of Biomolecules: UV, IR, NMR, LASER Raman spectroscopy, Mass spectroscopy, Flourescence Spectroscopy, Differntialcolorimetry, X-ray crystallography, X-ray computer tomography and patch clamping

Hrs12

Unit IV

PCR – Principles, types and applications –Cytophotometry, flow cytometry, FACS, MACS and Microarray . - Theory and applications of Polarography and Manometry. Biosensors.

Hrs12

Unit V

Tracer techniques: Radioactive decay , units of radioactivity, detection- Geiger muller counter, Scintillation counter, Autoradiography, Applications of radio isotopes in biological and medical

sciences.

Course Outcomes

After completion of this course, students will be able to

- Equip the knowledge in principle and application of instruments used in biological laboratory.
- Gain the depth knowledge of separation technique.
- Develop Skill of PCR and Microarray techniques
- Get Sound knowledge in spectroscopy and crystallographic applications.
- Understand the tracer techniques adopted in biological studies.

Reference:

1. Step Guide to Photography, Ebury, Press – London.
2. Practical methods in Electron Microscopy – Glamet (2000). Vol.3 North Holl and Publishing Co.
3. Hand book of Immunodiffusion and Immuno Electrophoresis, Ann-Arbor Science Publishers – Michigan.
4. Principles of Biochemistry, Lehninger (2006).
5. Basic Biophysics of Biologist, Daniel (2007).

Web Link:

https://isn.ucsd.edu/courses/beng186b/syllabus.pdf
https://biomedical.njit.edu/academics/syllabi.php (University Heights, Newark, New Jersey 07102 USA)
https://bioeng.berkeley.edu/undergrad/program/bioefundamentals (Department of bioengineering, University of California)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	**20P2BTEL2B**	**Major Elective – II B)OCCUPATIONAL HEALTH AND INDUSTRIAL SAFETY**	**4**	**4**

Objectives:

- To impart knowledge on various occupational health hazards and also safety measures to be taken in the work place.
- To gain information on first aid and management

Unit I Hrs 12

Parameters of safety - Factors affecting the conditions of occupational and Industrial safety - Concept of safety organization and Management - Safety Regulations.Definition and Role of Ergonomics in Designing Work-Place

Unit II Hrs12

Work Environment - Effects of Light, Ventilation, Vibration, Noise etc - The Work Physiology and their Relevance to Safety - Performance Evaluation of Man - Environment systems.

Unit III Hrs12

Occupational Health and Safety – Occupational Health and Hazards – Physical, Chemical and Biological hazards. Occupational Diseases and their Prevention and Control. Health Protection Measures for Workers. Principles of Arthropod Control

Unit IVHrs 12

Health Education Medical First-Aid and Management of Medical EmergenciesIndustrial Safety management Techniques - Industrial Safety Standards. Accidents-Definition, Frequency Rate, Prevention and Control. Work Study - Method of Study and Measurement. Measurement of Skills. Safety - Cost of Expenses

Unit V Hrs 12

Principles of Functions in Safety Management Case Study - Visit to an Industry - Preparation of report on safety measures followed in Airport/Industry.

Course Outcomes

After completion of this course, students will be able to

- Impart knowledge on various occupational health hazards and also safety measures in the work place.
- Gain the Concept of safety organization and Management
- Know about the Occupational Health and Safety
- Gain knowledge about prevention, control and measurement skill of safety measures

Reference:

1. Environmental Strategies–Hand Book, Kolluru R. V, (1994) McGraw Hill Inc., New York.
2. A B C of Industrial Safety, Walsh, W and Russell, L, (1984) Pitma Publishing United Kingdom (1984)
3. Environmental and Industrial Safety, (1989) Hommadi, A. H (1989). I.B.B Publication, New Delhi (1989)
https://www.hotcoursesabroad.com/india/course/australia/bachelor-of-occupational-therapy-honours-health-and-behavioural-sciences/828844/program.html
(The University of Queensland)
https://studyspy.ac.nz/courses/2842/national-certificate-in-occupational-health-and-safety-workplace-safety-level-3(Northland Polytechnic)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	**20P2BTEL2C**	**Major Elective – II** **C) BIO-INFORMATICS, INTELLECTUAL PROPERTY RIGHTS AND NANOTECHNOLOGY**	**6**	**4**

Objectives:

1. To know the ultra structure of Prokaryotic and Eukaryotic cellular organisms.
2. With the help of instruments, to know the basic principles of protein.
3. To know the principle and applications of bioinformatics.
4. General aspects of patenting.
5. To know about Nanotechnology.

Unit I **Hrs18**

Cell structure, Ultra structure and genomic organization of Prokaryotes and Eukaryotes Cellular Organisms. Chromosome and chromatin structure.

Unit II **Hrs18**

Protein confirmation – Predication of Protein structure – fold recognition, comparative modelling (homology), Basic principles of X – ray diffraction studies, NMR, Mass

spectroscope in identifying protein confirmation.

Unit III **Hrs18**

Basic concepts of Bioinformatics, sequence Databases, sequence formats – Gene basic - use of databases biology, Sequence databases, Sequence Analysis – Search for homologous sequence for BLAST and FASTA programmes. Protein and Nucleic acids, Structural comparisons.

Unit IV **Hrs18**

History of intellectual property rights. Trade related aspects of intellectual property rights. A general account of patenting- India and TRIPs, Copy right and commercialisation - Environmental impact-Ethical issues and ethical committees. Geographical indications.

Unit V **Hrs18**

Nano biotechnology – Basic principles and scope of Nanotechnology –Protein and DNA based nanostructure. Use of DNA in nanomechanics and computing. Structural and Brownian assembly – Molecular manufacturing – Decisive military capabilities – Molecular mills – in the fields of agriculture, Medicine -Applications of Nanotechnology.

Course Outcomes

After completion of this course, students will be able to

- Understand about the ultra structure of Prokaryotic and Eukaryotic cellular organisms.
- Improve ideas about the Basic principles of protein prediction.
- Know the principle and application of bioinformatics.
- Gain more ideas about general aspects of patenting.
- Know about Principles, scope and applications of Nanotechnology.

REFERENCES:

1. Sequence Analysis primer by M Gribskov, J. Devercux (1989) Stockton Press.
2. Nucleic acid and protein sequence analysis, A practical approach by MJ Bishop and C.J. Ramslings (1987) IRL Press.
3. Information theory and living system by L.I. Garfield, (1992), Columbia University Press.
4. Glossary of Biotechnology and Nanobiotechnology – Narendhra Publications.
5. Molecular databases for for protein and structure studies by Sillince, J.A. and Sillince M (1991) Springer Verlag.
6. Biotechnology Fundamentals and Application – S.S.Purohit, Agrobios, India
7. Nanotechnology – A gentle introduction to the next big idea, Ratner – Tamil Nadu Book House.

8. Information of Biostatitics by Sokal and Rhld (1973) Toppan Company, Japan
9. Biotechnology expanding horizons. B.D. Singh. Kalyani Publishers

Web Link:

http://www.nus.edu.sg/nusbulletin/faculty-of-science/undergraduate-education/degree-requirements/bachelor-of-sciencebachelor-of-science-hons-programme-requirements-b-sc-b-sc-hons/computational-biology/ (NUS)
https://ttic.uchicago.edu/~jinbo/TTIC31050-2014.htmhttps://www.suniv.ac.in/upload/Syllabus-for-MTech-Nanoscience_NEW.pdf (The University of Queensland)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
II	**20P2BTCO2**	**Core Optional - TOXICOLOGY**	**6**	**5**

Objectives:

1. To know the scope of toxicology
2. To study the classification of toxicology.
3. To know the toxicological testing methods.
4. To know the environmental toxicology
5. To know the biomonitoring of toxic chemicals

Unit- I

Introduction and scope **Hrs18**

Introduction – Scope of Toxicology.Disciplines of Toxicology. Goals of Toxicology.

Unit II

Toxicological testing methods &Classification of toxicants **Hrs18**

Acute and chronic , Risk and Hazard, Bioassays. Determination of LC50 and LD 50

Chemical Pesticides- Types – Uses

Unit III

Routeof exposure & persistence of toxicant **Hrs18**

Absorption – Distribution – Excretion.Factors affecting toxicity of Xenobiotic chemicals.Fate of Pesticide residues.Fate of heavy metals. Fate of toxicants in the atmosphere

Unit IV

Environmental toxicology & effect of xenobiotics **Hrs18**

Toxicants in the Environment: Atmosphere- Ozone Depletion- Photochemical smog, Acid rain, Global warming; Hydrosphere- Eutrophication; Lithosphere- Biodegradable wastes. Mechanism of Toxicants: Bioaccumulation, Biotransformation and Biomagnification

Unit V

Biomonitoring of toxic chemicals &safetyevaluation of toxicants **Hrs18**

Risk and safety analysis: Margin of safety, Therapeutic index, Ideal therapeutic index.– Cumulative toxicity. Calculation of safe level. Specific toxicity studies: Carcinogenecity, teratogenicity, in-vitro, mutagenicity tests.

Course Outcomes

After completion of this course, students will be able t**o**

- Understand the Scope of toxicology and its impact on environment
- Know about classification and methods of toxicology.
- Develop skill on toxicological testing methods.
- Lear about the Mechanism and implementation of Toxicants
- Understand the Biomonitor of environmental toxicology

References

1. Regulatory Toxicology- Shayne C Gad
2. Goodman and Gilman's : The Pharmcological Basis of Therapeutics, edited by Alfred Goodman Gilman, Theodore W. Rall, Alan S Nies, and Palmar Taylor
3. Clinical Pharmcology by D.R. Laurence and P.N. Benett
4. The toxicologist's pocket handbook, Michael J derelanko 2nd Ed, 2008, CRCpress
5. Relevant OECD, ICH, SCHEDULE Y guidelines
6. Modern Medical Toxicology-VV Pillay, Jaypee Publishers, 4th Ed.

Link:

https://canvas.harvard.edu/courses/8161/assignments/syllabus
https://envsci.rutgers.edu/academics/envsci/syllabi/375%20407%20Environmental%20Toxicology%20VanOrden.pdf
https://www.uu.se/en/admissions/master/selma/kursplan/?kpid=39471&kKod=1BG209

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	**20P3BTC9**	**Core – BIO-PROCESS TECHNOLOGY**	**5**	**5**

Objectives

- To study the Designing of bioreactors and control measurements.
- To know the Selection and optimization of media for production of high yield product with quality.
- To gain the knowledge about strain improvement and separation of bio product after fermentation process.

Unit I

Hrs15 Introduction of bioprocess technology – Selection and improvement of industrially important microorganisms for inoculum preparation, Preservation.Media formulation and optimization.Microbial growth kinetics.Types of fermentation process.Measurement of bioprocess parameters - temperature; pressure and pH; dissolved Oxygen; foam etc.

Unit II **Hrs15**

Designing of Bioreactor, Types of Bioreactor, Aeration and agitation systems; Stirrer glands and bearings; Baffles; Valves and steam traps; Pressure-control valves; specialized bioreactors; membrane bioreactors; tower bioreactors; fluidized bed bioreactors; Immobilized system and packed bed reactors and Photo bioreactor.

Unit III

Hrs15 Downstream Processing – Biomass removal and Disruption of Microbial Cells, Centrifugation, sedimentation, flocculation, Filtration methods, sonication, beadmills,

homogenizer, chemical and enzymatic lysis. Liquid-Liquid Extraction, Chromatography - Ion Exchange, size exclusion chromatography, Molecular Sieve, Affinity, HPLC. Distillation, Fluid Extraction & Electro dialysis, Drying and cystralization.Process analytical technology (PAT).

Unit IV **Hrs15**

Industrial production of Organic acids – Citric acid, Lactic acid, acetic acid.Antibiotics- Wide and Narrow spectrum antibiotics.Aminoacids- Glutamic acid, Lysine, Isoleucine, Aspartic acid and Proline.Production of SCP.Enzyme Production - Amylase, Pectinase and Cellulase.Immobilization and Applications of Enzymes.Clinical implications of bioprocesses.

Unit V **Hrs15**

Biofuel – glycerol, ABE production, Biodiesel, biogas and biohydrogen. Computer aided bioprocess design, Biotechnology industries and Production of Biotechnological products in India. Bioprocess economy - Raw material, Typical stages in commercialization of biotechnology processes / products; Financial appraisal of biotechnology projects.

Course Outcome

After completion of this course, students will be able to

- Understand the Designing of bioreactors and control measurements.
- Learn about Optimization of media for production of high yield product with quality.
- Learn Strain improvement techniques
- Develop Skill on production of organic acids, enzymes, antibiotics, fuels using microbes
- Gain Practice on Purification techniques for desired product

Text Book

1. Peter F Stannbury, Allan Whitaker, Stephen J Hall. Principles of Fermentation Technology. (2016) Butterworth-Heinemann Press. UK.

Reference Book

2. John E. Smith. Biotechnology. (2009). Cambridge University Press.UK.
3. H. J. Peppler, D. Perlman. Microbial Technology: Fermentation Technology. (2014). Academic Press.
4. T. El-Mansi, C. Bryce, Arnold L. Demain, A.R. Allman. Fermentation Microbiology and Biotechnology. Second Edition. (2006). CRC Press, USA.
5. Hongzhang Chen. Modern Solid State Fermentation: Theory and Practice. (2013). Springer Press, Germany.
6. Celeste M. Todaro, Henry C. Vogel. Fermentation and Biochemical Engineering Handbook. (2014). William Andrew Press. Norwich, NY.
7. G. Lancini, R. Lorenzetti. Biotechnology of Antibiotics and other Bioactive Microbial Metabolites. (2014). Springer publications, Germany.

Web Link:

https://bee.cals.cornell.edu/research/biological-engineering/ - (Cornell university) Unit V Biofuel production

https://professional.mit.edu/course-catalog/fermentation-technology - (Massachusetts Institute of Technology).Unit V - Computer aided bioprocess design

https://professional.mit.edu/course-catalog/fermentation-technology - Unit III and IV - Process analytical technology (PAT), clinical implication of bioprocess. (Massachusetts Institute of Technology)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	**20P3BTC10**	**Core -CLINICAL BIO-CHEMISTRY**	**5**	**4**

Objectives:

1. To study the lab setup and safety measures
2. To learn about the metabolic disorders
3. To study about the disorders of kidney and liver
4. To know about the hormonal imbalances.

UNIT I:

Laboratory setup and safety **Hrs 18**

Requirements of setting up of clinical laboratory, SI units in clinical laboratory, Collection preparation, preservation, and handling of clinical samples, quality control, Safety measures in clinical laboratory. Formulation of clinical and diagnostic kits, Safety aspects

UNIT II

Metabolic disorders **Hrs 18**

Disorders of CarbohydrateMetabolism – Diabetes mellitus, glucose and galactose tolerance tests, sugar levels in blood, renal threshold for glucose, factors influencing blood glucose level, glycogen storage diseases, pentosuria, galactosemia.

Disorders of Lipid metabolism – Plasma lipoproteins, cholesterol, triglycerides & phospholipids in health and disease, hyperlipidemia, hyperlipoproteinemia, Gaucher's disease, Tay-Sach's and Niemann-Pick disease, ketone bodies, Abetalipoproteinemia.

UNIT III **Hrs18**

Inborn errors of Metabolism-Disorders of amino acid metabolism – Phenylalanaemia, homocystinuria, tyrosinemia; Disorders of nucleic acid metabolism- Disorders in purine/pyrimidine metabolism

Impact of Hormonal imbalances: GH, TSH, ACTH, FSH, LH, Testoteran, Oestrogen.

UNIT IV **Hrs18**

Disorders of liver and kidney – Jaundice, fatty liver, normal and abnormal functions of liver and kidney.Inulin and urea clearance. Digestive diseases – Maldigestion, malabsorption, creatorrhoea, diarrhoea and steatorrhoea- Electrolytes and acid-base balance – Regulation of electrolyte content of body fluids and maintenance of pH. Disorders of acid-base balance and their respiratory and renal mechanisms

UNIT V **Hrs 18**

Neurological and psychiatric disorders**:** Symptoms, diagnosis and treatment of Schizophrenia, Alzeimer's disease, Wernicke-Korsakoff syndrome, dementia, Wilson's disease, antipsychotic drugs – anti depressants.

Ageing- Physiological and biochemical changes in ageing. Different theories of ageing, importance of superoxide dismutase in ageing, plasticity and regeneration

Course Outcomes

After completion of this course, students will be able to

- Learners understand in laboratory set up and safety measures.
- Improve the Sound knowledge in metabolic disorders
- Know about the hormonal imbalances
- Acquire the knowledge of metabolic, neurologic and psychiatric disorders.
- Gain information on diagnostic techniques

Reference:

1. Burger, A., Med. Chem.
2. Wilson and Gisvold, Organic Med. Pharmaceutical Chem.
3. Ariens, Drug Design, Academic press, NY,1975.
4.Allan Gen, Clinical Biochemistry, 1995.
5. John W. Baynes. Med H.Dominick

Web Link:

https://www.medsci.uu.se/education/courses/course- syllabus/?kpid=34117&lasar=&typ=2
https://www.uu.se/en/admissions/master/selma/kursplan/?kKod=3KK014&lasar=

(Uppsala University, Sweden)
https://makautwb.ac.in/syllabus/BSc%20(Medical%20Lab%20Technology)28.02.2018.pdf

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	**20P3BTC11**	**Core – RECOMBINANT DNA TECHNOLOGY**	**5**	**5**

Objectives

- To know the production of desired product by using rDNA technology.
- To gain the methods involved in rDNA technology
- To study the importance of rDNA technology in medicine, agriculture and criminal investigation.

UNIT-I **Hrs 18**

Enzymes in genetic engineering - restriction endonucleases - ligases – alkaline phosophatase - polynucleotide kinase - terminal deoxynucleotidyltransferase - S1nuclease - DNA polymerase I, holoenzyme - DNA polymerase III, Klenow fragment - Thermostable DNA polymerases - RNases – ribonuclease – Mungbean nuclease - reverse transcriptase –- deoxyribonuclease.

UNIT-II **Hrs 18**

Biology of Cloning vectors - plasmids - replication - size - copy number - amplification - types – isolation of plasmid DNA, bacteriophage - lambda - M13 bacteriophage - genetic organization & construction; cosmid, animal vector – SV 40 – Plant vector; shuttle vectors, BAC, MAC, YAC –

expression vectors – Induced vector – Vectors with tags(Histidine, Signaling peptides), Gene fusion vector, Yeast two hybrid system.

UNIT-III **Hrs 18**

DNA Cloning strategies – Linkers and adopters, construction of genomic and cDNA libraries – Gene transfer techniques, Screening of recombinants, DNA & RNA probe construction, labeling. Blotting Techniques (Southern, Northern, Western, Dot and Zoo blot).

UNIT IV **Hrs 18**

Sequencing Methods – Sanger, Maxaum and Gilbert Method, MPSS (Massive parallel signature *sequencing*), Polony, SOLID Sequencing, Ion Semi conductor sequencing, DNA Nano ball, Illumina and Solexa Sequencing, Next generation Sequencing, Site Directed Mutagenesis, Protein Engineering.

UNIT V **Hrs 18**

Purification of Protein from cloned genes, cell-free protein production - Production of Health care Products, Medical and Forensic application (RFLP, RAPD, DNA finger printing, DNA profiling).Applications of PCR and LCR in disease diagnosis.

Course Outcomes

After completion of this course, students will be able to

- Gain knowledge in steps of genetic engineering procedure.
- Know the mechanism of action and the use of restriction enzymes in biotechnology research and recombinant protein production.
- Gain the information techniques used to probe DNA for specific genes of interest.
- Learn the principle of bacterial transformation
- Develop Skills in plasmid preparation techniques.

Reference

1. Molecular Biotechnology: Principles and Applications of Recombinant DNA (2017) 5 th ed., Glick B.R., Pasternak, J.J. and Patten, C.L., ASM Press (Washington DC).
2. Molecular cloning,M.R.Green and J. Sambrook (2012) A Laboratory Manual Vol. IIII. (Fourth edition) Cold Spring Harbor Laboratory Press.
3. Genomes 4, T.A. Brown. (2017). (IV edition), Garland Science,
4. Principles of gene manipulations, R.N. Old and S.B. Primrose, 1994. Blackwell Scientific Publications.
5. DNA Cloning I & II, D.M. Glover & B.D. Hames, 1995. IRL Press.
6. PCR Strategies, M.A.Innis, D.H. Gelfant&J.J.Sninskey, 1995. IRL Press.

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	**20P3BTC12**	**Core – ANIMAL BIOTECHNOLOGY**	**4**	**4**

Objectives:

1. This course is designed to have an understanding about the basics of Animal cell culture, transgenic animals, pest & animal management,
2. Molecular markers and regulations about the use of Biotechnology.

7. Recombinant DNA (2nd Ed), J.D.Watson, M.Gillman, J.Witknow Ski and M.Zoller, 1992. Scientific Americans books, N.Y.
8. Genetic Engineering of Animals, A.Puhler, 1993. VCH Publishes, Weninheim FRG.
9. Gene Transfer and expression protocols - methods is molecular biology volume E.T. Murray, 1991. Humana Press.
10. Lewin, B., Genes VIII, International Edition, Pearson Education (2003).

Web Link:

https://myplan.uw.edu/course/#/courses/BIOL302?states=N4Ig7gDgziBcLADrgJYDsAmB7MAJApigOYAWALsrAJxUAMANMmOtmAApZQpkpZqW0AviEFA- (University of Washington)- Unit III

http://courses.cornell.edu/preview_program.php?catoid=31&poid=15391#-(Cornell University) Unit IV - cutting-edge technologies of recombinant DNA, next-generation DNA sequencing.

Unit - I **Hrs 12**Animal Cell, Tissue and Organ Culture History – Definitions – steps for preparation of cell culture room, culture Environment, Media types and preparation,– Techniques for establishment of various types of cell lines – insect cell culture – organ and embryo culture, 3D Culture Systems. Cryopreservation.

Unit – II **Hrs 12**

Artificial insemination (IUI, ICSI) Estrus synchronization; semen collection, evaluation, storage, Assisted Reproductive technology, *invitro* fertilization,– Embryo transfer – cloning (DOLLY, MOLLY and POLLY). Nuclear transplantation, Transgenic Animals Development and uses - mice, goat, fish and sheep.Tendered meat production.Transgenic breeding strategies – Molecular farming (products with strategic importance).Insulin production using GMO.Embryonic stem cell preservation and its uses in endangered animals.

Unit - III **Hrs 12**

Pest and Animal Management Juvenile hormone analogues – pheromones and genetic manipulation.Biotechnology of silkworms.Transgenic silk production – Baculoviruses vector and foreign gene expression.Biotechnological approach to the production of live feed. Animal management: cat, dog, pig, horse using appeasing pheromones and their products.

Unit – IV **Hrs 12**

Use of nucleic acid probes and antibodies in clinical diagnosis and tissue typing.Mapping of human genome – HGP (Human genome project), Regulating DNA technology – DNA barcoding. Animal right activities Blue cross in India – Society for prevention of cruelty against animals. Ethical limits of Animal use –Human Rights and Responsibilities.

Unit – V **Hrs 12**

Stem cell - Cellular potency, lineage commitment, cellular development, differentiation, dedifferentiation and trans differentiation, Cell cycle control.ES cells, Germline and AS cells.Cancer stem cells – biomarkers and molecular mechanisms.Soft tissue engineering (Breast and Urinary bladder), Hard tissue engineering (Bone and cartilage), Complex tissue engineering (Cardio vascular system and muscular joints).

Course Outcomes

After completion of this course, students will be able to

- Learn various concepts, principles of biotechnology.
- Gain knowledge in concepts of isolation, cloning and insertion of various genes into a prokaryote.
- Acquire biotechnological applications in various biological fields.
- Develop Skills in stem cell techniques
- Know the use of Biotechnological tools in different live stocks.

Text Books

1. B Singh, SK Gautam and MS Chauhan. 2015. Textbook of Animal biotechnology. Teri Publication.
2. M.K. Sateesh. 2010. Biotechnology: V: (Including Animal Cell Biotechnology, Immunology and Plant Biotechnology). 2nd Edition. New Age International Pvt. Ltd. Publishers.

REFERENCE BOOKS

1. Freshney RI. (2005). Culture of animal cells: A manual of basic techniques, 5th Edition, John Wiley and Sons.
2. John R W Masters. (2000). Animal cell culture, 3rd Edition, Oxford University Press.
3. Migel J. (2005). Animal cell Biotechnology- Methods and Protocols, Humana press.
4. Florence PR. (2006). Animal Biotechnology, Dominant Publishers and Distributors.
5. Sandy Primrose, Richard Twyman and Bob Old. (2001). Principles of Gene Manipulation, 6th Edition, Blackwell Science Ltd. p: 174-319.
6. Ranga MM. (2006). Animal Biotechnology.
7. Stem cell Biology by Marshak (2001), Cold Spring Harbour Symposium publication.

8. Stem Cells by AriffBongso and EngHir Lee (2005). World Scientific Publication Co. Pvt.Ltd.

Web Link:

https://ocw.mit.edu/courses/biology/7-342-pluripotent-stem-cells-and-genome-engineering-for-modeling-human-diseases-spring-2015/syllabus/

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	**20P3BTCP3**	**Core – Practical – III – BIO-PROCESS TECHNOLOGY, RECOMBINANT DNA TECHNOLOGY, CLINICAL BIOCHEMISTRY & ANIMAL BIOTECHNOLOGY**	**6**	**3**

Objectives:

1. To produce desired product using Bioprocess technology.
2. To learn the rDNA techniques.
3. To estimate the chemical constituents in human samples.
4. To study animal cell culture

Bio-Process Technology

1. Isolation of industrially important microorganisms (Amylase, Pectinase, Cellulase) for microbial process.
2. Study of optimal culture conditions for the production of Amylase, Pectinase and cellulose in a bioreactor.
3. Production of amylase, cellulase, pectinase, wine and beer in a bioreactor.
4. Determination of thermal death point and thermal death time of microorganisms for design of a sterilizer.
5. Microbial production of citric acid using *Aspergillusniger*.
6. Microbial production of Penicillin, (Biosynthesis of Antibiotics).
7. Production and Estimation of Alkaline Phosphatase.
8. Identification of micro organisms in preserved food product (Milk, Fruit juice, animal meat).
9. Isolation and enumeration of lactic acid bacteria.
10. Ethanol production by yeast.

Recombinant DNA Technology

1. Restriction analysis of plasmid (PBR322, PUC) and Ligation
2. Selection methods (Blue white screening, Insertional inactivation).
3. Primer design and PCR amplification of Beta galactosidase.
4. Cloning of PCR product into PBR.
5. Introduction of cloned genes and analysis by SDS – PAGE.
6. SOUTHERN BLOTTING of Beta galactosidase.
7. Reporter gene assay (GUS/beta galactosidase).
8. Isolation of phage DNA.
9. RFLP analysis.
10. Genetic diversity of Pseudomonas by RAPD.

Clinical Biochemistry

1. Estimation of Haemoglobin in blood samples
2. Estimation of Bile pigments
3. Estimation of Creatinine
4. Estimation of triglycerides, steroids

Animal Biotechnology

1. Preparation of Tissue Culture medium for animals.
2. Preparation of single cell suspension from spleen and thymus.
3. Macrophage monolayer from PBMC and measurement of Phagocyte activity
4. Macrophage monolayer and subculturing
5. Cryopreservation and Thawing
6. Measurement of doubling time
7. MTT assay for cell viability and growth

Course Outcomes

After completion of this course, students will be able to

- Demonstrate the Production of desired product using Bioprocess technology.
- Learn about the rDNA techniques.
- Develop Skills in analytical methods of the chemical constituents of human samples.
- Know the techniques in animal cell culture and its applications
- Gain information on genetic engineered products

References

1. Short Protocols in Protein Science – A Compodium Methods from Current Protocols in Protein Science by John E. Coligan, Ben M. Dunn, 2003, John Wiley and Sons Ltd.
2. Enzymes, Biochemistry, Biotechnology, Clinical Chemistry, Trevor Palmer, Horwood Publishing, Chichester, 2001.
3. Analytical Biochemistry by David J. Holme and Hazel Peck, 3rd ed., 1998, Pearson Education Ltd., England.
4. Principles and Practice of Bioanalysis by Richard F. Venn, 2003. Taylor and Francis, London.

5. Biochemical Methods by A. Pingoud, C. Urbanke, J. Hoggett, 2002. Weiley-VeltVerlagGarbh.
6. Molecular Cloning, A Laboratory Manual, Vol.I-III by Sambrook et al. (1989), Cold Spring Harbor Laboratory.
7. Genetic Analysis of Bacteria by Stanley R. Maloy, Valley J. Stewart, 1996, Cold Spring Harbor Laboratory Press.
8. PCR Protocols by John M.S. Barlett, David Stirling, 2003, Humana Press Inc.
9. RNA Methodologies, 2nd Edn. by Robert E. Farrel Jr. 1996, Academic Press Inc.
10. Short Protocols in Molecular Biology, Vol.I& II, 5th Edn., by Frederick M. Ausubel, Roger Breuyt, 2002, John Wiley & Sons, Inc.
11. PCR Strategies by Mixchael, A. Immis, David, II. Gelfand, 1995, Academic Press, Inc.
12. Bio-chemical method by A.PINGOUD, C. URBANKE, J.HOGGETT, 2002 – Weily – ValtVerlagGarbh.

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	**20P3BTEDC**	**EDC – TRENDS IN BIOTECHNOLOGY**	**4**	**--**

Objectives

1. To study the concept and scope of Biotechnology.
2. To Understand applications of r-DNA Technology in pharmaceuticals and Human
3. To study the Bioprocess technology and their applications.
4. To study the Environment Biotechnology and their conservation.

Unit I **Hrs 12**

Biotechnology – Introduction and scope of biotechnology –Gene cloning, Cell-free protein production - Production of Health care Products, Medical and Forensic application (RFLP, RAPD, DNA finger printing). Applications of PCR and LCR in disease diagnosis.

Unit II **Hrs 12**

Nuclear transplantation, Transgenic Animals Development and uses - mice, goat, fish and sheep.Tendered meat production. Transgenic Plant: Insect resistance, fungus resistance, virus resistance, drought, cold resistance, saline resistance, Transgenic plant with vitamin A, Gene Production of therapeutic antibodies and edible vaccine.

Unit III **Hrs 12**

Bioprocess technology – Scope – Fermentor — Bioprocess products: Organic acids – Citric acid, Lactic acid, acetic acid. Antibiotics- Wide and Narrow spectrum antibiotics.Aminoacids-Glutamic acid, Lysine, Isoleucine, Aspartic acid and Proline.Production of SCP.Enzyme Production - Amylase, Pectinase and Cellulase. Dairy products and Biofuel production

Unit IV **Hrs 12**

Biofertilizers – N_2 fixing microbes (Azolla, Azatobacter, Azospirillum) for use in Agriculture – *A. tumifasciens* for crop improvement –Biopesticides. Biopolymer and its Application – Biosensor and its application – Bioleaching – Biomining – Biotechnology in oil recovery – Bioremediation of Xenobiotics – superbug – its application. Biodegradation.

Unit V **Hrs 12**

Regulations of Biosafety: Possible dangers of GEOs, Biohazards of rDNA technology. National and International biosafety guidelines, Primary and secondary containments and implementation. Web based information of biosafety on GMO.

Course Outcomes

After completion of this course, students will be able to

- Learn about the applications of Biotechnology in Human
- Know the applications of Biotechnology in Agriculture
- Gain knowledge on applications of Biotechnology in Environment
- Impart about the production and purification techniques of organic acids, enzymes, antibiotics, fuels
- Learn about the Biosafety guidelines

References

1. Dubey, R.C. – A Text Book of Biotechnology, S. Chand & Co., Ltd, New Delhi, 1996.
2. Gupta, P.K. – Elements of Biotechnology, Rastogi and Co., Meerut, 1994.
3. Kumar, H.F. A text book on Biotechnology, Affiliated East & West Press Pvt., Ltd, N-Delhi.
4. D.Balasubramanianet. al., - Concepts in Biotechnology.
5. Singh, R.S. – Introductory Biotechnology, Central book deport, Allahabad.
6. Primrose, R. – Molecular Biotechnolgoy, ASM Press.
7. Lick, E.R. and Pastenak – J.J. Molecular Biotechnology.
8. Ignachimuthu – Plant biotechnology, Oxford IBH Publishers, New Delhi.
9. Ranga – Fishery Biotechnology.
10. Primrose, R. – Molecular Biotechnology, ASM Press.
11. Purohit – A Text Book of Biotechnology, Agrobions, Jodhpur.

Web Link:

https://bee.cals.cornell.edu/research/biological-engineering/
https://ocw.mit.edu/courses/biology/7-342-pluripotent-stem-cells-and-genome-engineering-for-modeling-human-diseases-spring-2015/syllabus/
https://bee.cals.cornell.edu/research/biological-engineering/ -
https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-89-environmental-microbiology-fall-2004/syllabus/

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	**20P3BTCO3**	**Core Optional - ENDOCRINOLOGY**	**6**	**5**

Objectives:
1. To make the students to learn the objectives and scope of comparative Endocrinology.
2.To know the anatomy, morphology and histology of endocrine tissues of vertebrates, crustacean and insect endocrine organs and their functions

UNIT-I **Hrs 18**Introduction to endocrinology: Introduction, objectives and scope of endocrinology - modern concepts and problems in Endocrinology - endocrine glands in crustaceans, insects and vertebrates. Experimental methods of hormone research - general classes of chemical messengers.

UNIT-II **Hrs 18**
Pituitary and thyroid glands: Pituitary gland - characteristics, structural organization - hormone secretion and its functions - Hypothalamic control. Thyroid gland - structural organizations, metabolic effects of thryroid - effects on reproduction - parathyroid its structure and functions.

UNIT-III Hrs 18
Pancreas and adrenal glands**:** Structure of pancreas, pancreatic hormones and their functions. Structural organizations of adrenals, functions of cortical and medullary hormones.

UNIT-IVHrs 18
Insects and crustacean endocrinology:Concepts of neurosecretions - endocrine systems in crustaceans - endocrine control of moulting and metamorphosis - neuroendocrine system in insects - endocrine control of moulting - metamorphosis and reproduction.

UNIT-V **Hrs 18**

Veratebrate reproductive endocrinology**:**Structure of mammalian testis and ovary - male and female sex accessory organs - hormones of testis and ovary - estrous and menstrual cycle - hormones of pregnancy - parturition - hormonal control of lactation.Hormonal control of metamorphosis in an anuran amphibian.

Course Outcomes

After completion of this course, students will be able to

- Acquire knowledge in comparative Endocrinology.
- Know the anatomy, morphology and histology of endocrine tissues of Vertebrates, crustacean and insect endocrine organs and their functions.
- Understand the metamorphosis of invertebrates and vertebrates
- Acquire knowledge in Reproductive endocrinology

Reference

1. Haris, G.W. and B.T. Donovan. 1968. The Pituitory Gland. S. Chand and Co.,
2. Bentley, P.J. 1985. Comparative vertebrate endocrinology, Second Edition, Cambridge University Press. Cambridge.
3. Mac Hadley. 1992. Endocrinology, 3rd Edition.Prentice - Hall Inc. A Simon & Schuster Company, Englewood Cliffs, New Jersey. USA.

Web Link:

https://canvas.harvard.edu/courses/63071/assignments/syllabus

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
IV	**20P4BTC13**	**Core - RESEARCH METHODOLOGY**	**9**	**5**

Objectives:

1. The Paper aims to train students in the statistical analysis and presentation of the data.
2. To write the report / thesis / dissertation and or for publications in appropriate research journals,
3. The aim of the Paper thus is to lay a strong foundation for the student for thesis writing, editing, analysis and interpretation of the generated data with hands on experience with model sums.

Unit I **Hrs12**

Data Collection and analysis**:** Collection of data- diagrammatic representation: Bar, Pie diagrams; graphic representation-Histogram, frequency polygon; Measures of central tendency: Arithmetic mean, median & mode - direct methods and model sums; Measures of dispersion – sampling methods: random sampling, stratified random sampling – standard deviation – standard error – coefficient of variation: elucidation with model sums.

Unit - II **Hrs12**

Statistics – Correlation and Regression**:** Types of Correlation and Karl Pearson's correlation coefficient: model sums with elucidation – Regression analysis: Components of regression equation – Confidence intervals of regression line. Fitting simple regression lines: model sums, calculations of equation and fitting of regression line, estimated and calculated Y. Comparison between correlation and regression.

Unit III **Hrs12**

Statistics – Significance of test and comparison**:** Probability- Theorems: Addition and Multiplication – Patterns of distributions: Poisson, Normal and Binomial; Test of significance - Comparison of means: Chi square test, student t test, ANOVA, model sums on one way ANOVA with interpretation of data – Use of statistical softwares.

Unit IV **Hrs12**

Reporting and thesis writing**:** Structure and components of scientific reports - Types of report – Technical reports and thesis – Significance – Different steps in the preparation – Layout, structure and Language of typical reports – Illustrations and tables - Bibliography, referencing and footnotes - Oral presentation – Planning – Preparation – Practice – Making presentation – Use of visual aids - Importance of effective communication; Standard of research journals – paid and refereed journals; impact factor, citation index, H-index. Information retrieval: access to archives and databases.

Unit V **Hrs12**

Research and ethics- Planning of research: Research proposals, time schedule of research, available sources and generation of funds and facilities. Environmental impacts - Ethical issues - ethical committees - Commercialisation – Copy right – royalty - Intellectual property rights and patent law – Trade Related aspects of Intellectual Property Rights – Reproduction of published material – Plagiarism - Citation and acknowledgement - Reproducibility andaccountability.

Course Outcomes

After completion of this course, students will be able to

- Understand on various kinds of research, objectives of doing research, research process, research designs and sampling.
- Get more ideas on qualitative research techniques
- Acquire adequate knowledge on measurement & scaling techniques as well as the quantitative data analysis
- Aware of data analysis-and hypothesis testing procedures
- Identify appropriate research topics parameters
- Learn about Research report, thesis and research proposal (grants) writing techniques

Reference:

1. Davis, G.B. and C.A. Parkar 1997, Writing the doctoral dissertation. Barons Educational series, 2nd edition. Pp 160. ISBN : 0812098005.
2. Duncary, P. 2003. Authoring a Ph.D. thesis: how to plan, draft, write and finish a doctoral dissertation. Plagrave Macmillan, Pp 256. ISBN 1403905843.
3. Saxena, S. 2001, MS office, Vikas Publishing House Pvt. Ltd. New Delhi 110014.
4. Snedecor, G.W. and W.G. Cocharn, 1978. Statistical methods. Oxford and IBH Publishing Co Pvt. Ltd.
5. Sokal, R.R. and F.J. Rohif, 1981. Biometry. W.H. Frecman, New York.
6. Zar. J.H. 1996. Biostatistical analysis. Prentice Hall, Uppar Saddle River, New Jersey, USA
7. Biostatisitcal Analysis, Zar (2004).

8. Leedy, P.D. and Ormrod, J.E., 2004 *Practical Research: Planning and Design,* Prentice Hall.
9. Satarkar, S.V., 2000. *Intellectual property rights and Copy right*. EssEss, Publications

Note:

1. Central University of Punjab, Amirtha University - Unit – IV and V
2. University of Kerala - Unit – I, II, III

Web Link:

1.http://courses.aiu.edu/RESEARCH%20METHODOLOGY.html
2.https://www.liverpool.ac.uk/translational-medicine/departmentsandgroups/molecular-and-clinical-cancer-medicine/methodology-course/
3.http://yukiyanai.github.io/teaching/methodology/docs/syllabus-methods-2017spring.pdf
4.https://shmzlab.jp/Lecture/University/ResearchMethodology/Lecture/160114Lec01_Introduction&Syllabus.pdf

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
IV	**20P4BTC14**	**Core – FOOD TECHNOLOGY**	**9**	**4**

Objectives:

- To gain theoretical knowledge and practical abilities required to work in the food industry
- To study nutritional science and its importance for human health
- To develop entrepreneur through product development with food safety regulations

Unit I **Hrs 18**

Basics of Food Technology**-** constituents of food - contribution to texture, flavour and organoleptic properties, colorants,Flavors, Additives – intentional, non-intentional - functions. Enzymes in food processing.Natural occurrence of certain phytochemicals- Antioxidants and flavonoids: omega – 3 fatty acids, carotenoids, dietary fiber, phytoestrogens; glucosinates; organosulphur compounds. Sources and activity of microorganisms associated with food fermentation,

Unit II **Hrs 18**

Nutraceuticals and functional foods: Evolution, Classification, Significance and management of diseases and disorders. Research and Development of Nutraceuticals and functional foods - immunomodulators.Nutrigenomics- personalized medicine, dosage for control of disease and regulatory issues.

Unit III **Hrs 18**

Food Processing - Raw material characteristics; cleaning, sorting and grading of foods; physicaloperations(mixing, emulsification, extraction, filtration, centrifugation,membrane

separation, crystallization and heat processing). Bread and baked foods.Dairy products - milk processing, cheese, butter, ice-cream.Edible oils and fats.Meat, poultry and fish products.Confectionery, beverages.Vegetable and fruit products.Production of fruit nectars and purees.

Unit IV **Hrs 18**

Food Contaminant **-**Identify major toxins, chemical and biological agents capable of causing foodborne illness. (e.g., heavy metals, nitrites, sulfites, mushroom toxins, PSP and domoic acid (ASP), parasites, Noro- and Rotaviruses, and *Staphylococcus*, *C. perfringens, C. botulinum, Salmonella Shigella*, *Yersinia, Campylobacter, E. coli*.Food preservation (high temperatures sterilization, pasteurization, blanching, canning), Low temperature storage. Factors affecting quality of frozen foods.Irradiation preservation of foods.Modern methods of Preservation – Fruit, Vegetables, meat and other animal products.

Unit V **Hrs 18**

Quality, safety and regulatory aspects: product stability; evaluation of shelf life, sensory attributes and environmental conditions. Food quality standard: IPM, GAP, Organic farming, GMP, Standard of food quality and control system, Food industries and quality assurance in food production, ISO certifications. Indian Food regulations: BIS, ISI, FPO, PFA, FSSAI and FDA.

Course Outcomes

After completion of this course, students will be able to

- Learn about Nutritional science and its importance for human health
- Gain knowledge on formulation of Nutraceuticals and functional foods
- Know the food analysis techniques
- Impart about food safety regulations and practices
- Know about the fund sources for Entrepreneur development

Reference

1. Byong H Lee. (2016). Fundamentals of food Biotechnology, 2nd Edition, Wiley - Blackwell
2. RavishankarRai V. (2016). Advances in Food Biotechnology, Wiley- Blackwell
3. Kalidasshetty . (2005). Food Biotechnology, Taylor & Francis group.
4. Lopez, G.F.G. and Canovas, G.V.B. “Food Science and Food Biotechnology” CRC Press, Florida, USA. 2003.
5. Joshi, V.K., and Pandey, A. Biotechnology: Food Fermentation. Vols.I,II. Education Publ. 2002.
6. Robertson, G.L. 2006 Food Packaging: Principles and Practice (2nd ed.), Taylor & Francis
7. NIIR. (2003). Food Packaging Technology Handbook, National Institute of Industrial Research Board, Asia Pacific Business Press Inc.
8. Early, R. (2005): Guide to Quality Management Systems for the Food Industry, Blackie, Academic and professional, London.

9. Pomeraz, Y. and MeLoari, C.E. (2006): Food Analyasis: Theory and Practice, CBS publishers and Distributor, New Delhi.
10. Bryan, F.L. (2000): Hazard Analysis Critical Control Point Evaluations A Guide to Identifying Hazards and Assessing Risks Associated with Food Preparation and Storage. World Health Organisation, Geneva.
11. Vaclavik V, Christian EW. 2014. Essentials of food science, 4 ed. New York Springer. •
12. Aluko RE. 2012. Functional foods and nutraceuticals. New York: Springer.
13. FSSAI, FSIS, EU and FAO website for updates

Web Link:
https://www.washington.edu/students/crscat/nutrit.html - Universtiy of Washington- Unit I
http://sfs.wsu.edu/wp-content/uploads/2011/08/FS-510-syllabus-2017.pdfUniverstiy of Washington- Unit II and III
https://deohs.washington.edu/sites/default/files/course-materials/2018_SPR_ENV_H_441.pdf - Universtiy of Washington – Unit I, IV and V

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
IV	**20P4BTEL3A**	**Major Elective - III BIOSAFETY, BIOETHICS AND IPR**	**6**	**4**

Objective
- To know the principles of ethics and safety for science and social knowledge in sustainable development.
- To study the technical procedures and protection of intellectual property and related rights.

Unit I **Hrs 18**

History, evolution and concept of biosafety; biosafety guidelines and regulations for laboratories and industries, international and national norms of biosafety; Implementation of biosafety guidelines; Classification and Description of Biosafety levels; Risk assessment analysis and containment levels; biohazard, bio-medical and hazardous wastes, handling and disposal.biosafety protocol (Cartagena biosafety protocol). Biosafety database.

Unit II **Hrs 18**

Definition of GMOs & LMOs: Roles of institutional Biosafety committee, RCGM, GEAC etc. GMO applications in food and agriculture: Environmental release of GMOs: Regulations to protect nature, growers and consumers interest and nation interest; Good laboratory practice (GLP) and Good manufacturing practice (GMP). Web based information of biosafety on GMO.

Unit III **Hrs 18**

Concept of IPR, Designs, Trademarks TM, Trade Secret (TS), Domain Names, Geographical Indications, Copyright. Classification of WIPO. IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies Agreements and Treaties, History of GATT & TRIPS Agreement, Madrid Agreement; Hague Agreement, WIPO Treaties; Budapest Treaty.

Unit IV **Hrs 18**

Patents, Types of IP patents, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Differences between patent and copyright protection, Copyright infringement distinguished from plagiarism. PCT, Indian Patent Act 1970 & recent amendments, Basics of Patents and Concept of Prior Art, Introduction to Patents; Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition, Specifications: Provisional & complete; Forms & fees, Invention in context of "prior art".

Unit V **Hrs 18**

Patent databases: Searching International Databases; Country-wise patent searches (USPTO, esp@cenet(EPO), Patent filing procedures, National & PCT filing procedure; Time frame& cost; Status of patent applications filed, Precautions while patenting – disclosure/non-disclosure, Financial assistance for patenting - Introduction to existing schemes, Patent licensing and agreement, Patent infringement meaning, scope, litigation, case studies.

Course Outcomes

After completion of this course, students will be able to

- Learn about the Biosafety and bioethics of modern biotechnology
- Understand the laboratory procedures and practices
- Know the design of confinement facilities at different Biosafety levels
- Acquire knowledge about Social and ethical issues related to plant and animal biotechnology
- Gain more ideas about the relevance of intellectual property rights to modern biotechnological innovations

Reference:

1. Diane O. Fleming; Debra A. Long; Biological Safety: Principles and Practices, ASMPress; 4th edition, 2006
2. Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information, 2007
3. Nancy Ann SilbergeldJecker; Albert R. Jonsen; Robert A. Pearlman; Bioethics: Introduction to History, Methods, and Practice; Jones & Bartlett Publishers; II edition, 2007
4. 21st Century Complete Guide to Biosafety and Biosecurity (CD-ROM): by U.S. Government, Publisher: Progressive Management, 2004
5. Bonnie Steinbock; The Oxford Handbook of Bioethics (Oxford Handbooks): Oxford University Press, USA; 1st edition, 2007.
6. Sasson A., Biotechnologies in developing countries present and future, UNESCO Publishers, 1993.
7. Intellectual property rights- Ganguli-Tat McGrawhill. (2001) ISBN-10: 0074638602, 5. Intellectual Property Right- Wattal- Oxford PublicatiopnHouse.(1997) ISBN:0195905024.
8. Thomas, J.A., Fuch, R.L. (2002). Biotechnology and safety Assessment (3rd Ed) Academic press.
9. B.D. Singh. Biotechnology expanding horizons.
10. H.K.Das. Text book of biotechnology - 3rd edition.

Web Link:
https://ocw.mit.edu/courses/sloan-school-of-management/15-628j-patents-copyrights-and-the-law-of-intellectual-property-spring-2013/syllabus/ - (**Massachusetts Institute of Technology)**
Unit III, IV and V

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
IV	**20P4BTEL3B**	**Major Elective - III BIODIVERSITY AND BIORESOURCES**	**6**	**4**

Objectives:
1. To study the diversity of genes, species of eco system.
2. To study the Loss, uses, values, of conservation of Bio-diverting.

Unit I **Hrs 18**

Biodiversity – Definition – Genetic diversity - Species (species diversity) and ecosystems diversity. Genetic Diversity – Nature and origin of Genetic Variation – Measuring Genetic variation using RFLP, RAPD, DNA sequencing (Elementary account on each one of these only); Species Diversity – Measurement – Concepts of species richness, abundance, and turnover species / area relationship, global distribution of species richness – Centres of species diversity (CUP) – Megadiversitycentres – Hot spot analysis. A general account on Ecosystem diversity.

Unit II **Hrs18**

Loss of Biodiversity

Species extinction – Fundamentals causes – Deterministic and stochastic processes – current and future extinction rates - methods of estimating loss of biodiversity – The IUCN threat categories – common threat plant and animal taxa of India Red Books. Threat factors

Unit III **Hrs18**

Uses and values of Biodiversity

Plant uses: Food, timber, medicinal ornamental and other uses; Animals uses - food animals (terrestrial and aquatic) - Domestic livestock – uses of microbes.

Valuing Biodiversity – Instrumental (Goods, services, information and psychospiritual values) and Inherent or Intrinsic values - ethical and aesthetic values

Unit IV **Hrs 18**

Conservation and sustainable management of Biodiversity and Bioresources

National policies and Instruments relating the protection of the wild / domesticated flora and fauna as well as habitats – International policies and Instruments – A general account on multilateral treaties – the role of CBD, IUCN, GEF, IBPGR, NBPGR, WWF, FAO, UNESCO and CITES – Bioresources, Biotechnology and Intellectual property rights. Biopyracy right of farmers, breeders and indigenous people – Biodiversity and Bioresources data bases.

Unit V **Hrs18**

Social issues and the Environment

Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Wasteland reclamation – Consumerism and waste products – Environment Production 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; Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people.

Course Outcomes

After completion of this course, students will be able to

- Know the Diversity of genes, species of eco system.
- Know about the Loss, uses, values, of conservation of Bio-diverting.
- Acquire knowledge about Conservation and sustainable management of Biodiversity and Bioresources
- Get knowledge about Social issues and the Environment management.
- Gain information on Social issues and the Environment

Reference:

1.Biodiversity Conservation in Managed and Forests and Protected Areas, Kotwal, P.C. (2009).

2.Biodiversity: Assessment and Conservation, Trivedi, A.C. (2006).

Biodiversity: Principles and Conservation (2^{nd} Ed.).

3.Trends in Wild Life Biodiversity Conservation and Management in 2 Vols.

Groombridge, B (Ed.) 1992. Global Biodiversity – Status of the Earth's Living Resources. Chapman & Hall, London.
4.UNEP, 1995, Global Biodiversity Assessment, Cambridge Univ. Press, Cambridge.
5.Virchow, D. 1998. Conservation & Genetic Resources, Springer – Verlag, Berlin.
6. Krishnamurthy, K.V. 2003. Text Book of Biodiversity, Science Publishers Inc,

Web Link:

https://www.brown.edu/Research/Sax_Research_Lab/Documents/Syllabus/Revised_Course_Syllabus_-_Biol_1470_-_Fall_2009%5B2%5D.pdf
https://qcnr.usu.edu/wild/courses/syllabi/Syllabus_for_Undergrad_46002016.pdf
https://www.amherst.edu/academiclife/departments/courses/0910S/BIOL/BIOL-48-0910S/syllabus
https://www.uu.se/en/admissions/master/selma/kursplan/?kKod=1BG318
https://biology.njit.edu/sites/biology/files/lcms/docs/biol_375-S17_0.pdf
https://canvas.disabroad.org/courses/1366/assignments/syllabus

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
IV	**20P4BTEL3C**	**Elective - ENZYMOLOGY**	**6**	**4**

Objectives:

1. To learn the Classification, nomenclature & general properties.
2. To study the Enzyme kinetics.
3. To understand the Techniques of enzyme immobilization & their applications.
4. To study the Industrial utilization of enzymes and Enzyme therapy

Unit I **Hrs18**

Classification, nomenclature & general properties, Factors, affecting enzyme action pH, temperature, ions, substrate concentration, enzyme concentration, inhibitors, Extraction, assay and purification of enzymes units of activity and kinetics of enzyme catalysed reactions –

the transition state.

Unit II **Hrs18**

Steady state kinetics – bisubstrate and multisubstrate reaction – enzyme catalysed reaction – different types of inhibitors and activators – MachaliesMenton, Lineweaver and Burke equations, Km, Kcat and KI value Enzyme specificity – absolute and rigid specificity, Nucleophilic& electrophilic attack.

Unit III **Hrs18**

Role of co-enzyme in enzyme catalysis: Co-enzyme regeneration, Mechanism of enzyme actioneg., lysozyme, chymotrypsin, DNA polymerase, ribonuclease& LDH, zymogen & enzyme activation, allosteric enzymes & metabolic regulations. Clinical & industrial uses of enzymes.

Unit IV **Hrs18**

Techniques of enzyme immobilization & their applications – medical, food, leather,textile and Paper industries.A brief account of modification of enzymes (enzyme engineering) and its products through r-DNA technology.Biosensors, Mechanism of light activation of enzymes.

Unit V **Hrs18**

Industrial utilization of enzymes, practical aspects of large-scale protein purification, use of soluble enzymes, enzyme reactors, membrane reactors, continuous flow, packed bed reactors, large-scale application of microbial enzymes in food and allied industries.Antibiotics production, medical application of enzymes in reverse glycosidase synthetic reaction. Interesterification of lipids, Enzyme therapy.

Course Outcomes

After completion of this course, students will be able to

- Learn the Classification, nomenclature & general properties of Enzyme.
- Acquire sound knowledge in Enzyme kinetics.
- Understand the Techniques of enzymeimmobilization & their applications.
- Learn the techniques of enzyme immobilization & their applications
- Know the Industrial utilization of enzymes and Enzyme therapy on various fields.

References:

1. Blazej, A. &Zemek.J. 1987: Interbiotech, 87, Enzyme Technologies, Elsevier
2. Murray Moo – Young 1988 Bioreactor immobilized enzyme and cells.Fundamentals and applications, Elseyler, Applied Science
3. Rehm, H.J. and Reed G. 1988, Biotechnology, Vol 7a, Enzyme Technology, Elsevier

4. Terrance G. Cooper 1977 The tools of Biopchemistry, John Wiley & Son
5. William, b. Jakoby, 1984 Methods in Enzymology, Vol.104, enzyme purification and related techniques.

Web Link:

https://canvas.harvard.edu/courses/7956/assignments/syllabus
https://canvas.harvard.edu/courses/4242/assignments/syllabus (Harvard University)

Semester	Course Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
IV	**20P4BTCO4**	**PHARMACOLOGY**	**6**	**5**

Objectives:

1. This subject will provide an opportunity for the student to learn about the drug with regard to classification, pharmacodynamic and pharmacokinetic aspects, adverse effects, uses, dose, route of administration, precautions, contraindications and interaction with other drugs.
2. In this subject, apart from general pharmacology, drugs acting on autonomic nervous system, cardiovascular system, central nervous system, blood and blood forming agents and renal system will be taught. In addition to theoretical knowledge, the basic practical knowledge relevant to therapeutics will be imparted.

UNIT I **Hrs 18**

Drugs acting at Synaptic and neuro effector junctional sites.
Autonomic & Somatic nervous systems - Muscarinic receptor agonists &antagonists.Anticholinesterases.Agents acting at Neuro Muscular Junction and autonomic ganglia.Sympathomimetic drugs, Catecholamines and Adrenergic antagonists.

UNIT II **Hrs 18**

Drugs acting on the Central Nervous System.Neurotransmission and CNS. Drugs used in the treatment of Anxiety & Psychosis , Depression &Mania , Epilepsy , Migraine , CNS degenerative disorders , Parkinson's Disease and Pain ; Drug addiction,dependence and abuse.

UNIT III **Hrs 18**

Drugs affecting renal and cardiovascular function-Drug-induced renal disorders. Diuretics, Drugs used in the treatment of Myocardial Ischemia - Hypertension - CHF - Hyperlipidemia – Arrhythmias.

UNIT IV **Hrs 18**

Drugs acting on the blood & blood forming organs-Hemopoietics, Plasma expanders, Thrombolytics, Anticoagulants, Antihemorrhagics, Antiplatelet Drugs, Blood Substitutes, Aspirin, Vitamin K.

UNIT V **Hrs 18**

Dermatological pharmacology, Vitamins, Chelating agents: Chelation therapy-Pharmacogenetics: Inter racial and individual variability in drug metabolism.

Course Outcomes

After completion of this course, students will be able to

- Understand to provide an opportunity for the student to learn about the drug with regard to classification, pharmacodynamic and pharmacokinetic aspects, adverse effects, uses and dose.
- Gain ideas about the route of administration, precautions, contraindications and interaction with other drugs.
- Impart general pharmacology, drugs acting on autonomic nervous system, cardiovascular system, central nervous system, blood and blood forming agents and renal system
- Acquire the basic practical knowledge relevant to therapeutics will be imparted.

References

1. Regulatory Toxicology- Shayne C Gad
2. Goodman and Gilman's : The Pharmcological Basis of Therapeutics, edited by Alfred

Goodman Gilman, Theodore W. Rall, Alan S Nies, and Palmar Taylor
3. Clinical Pharmcology by D.R. Laurence and P.N. Benett
4. The toxicologist's pocket handbook, Michael J derelanko 2nd Ed, 2008, CRCpress
5. Relevant OECD, ICH, SCHEDULE Y guidelines
6. Modern Medical Toxicology-VV Pillay, Jaypee Publishers, 4th Ed.

Web Link:

https://medicine.nus.edu.sg/medphc/education/medical.html (National University of Singapore, SIngapore)

https://www.bath.ac.uk/courses/undergraduate-2020/pharmacology/bsc-pharmacology/ (University of Bath, UK)

COMMUNICATION SKILL AND PERSONALITY DEVELOPMENT

SEMESTER	SUBJECT CODE	TITLE	HOURS OF TEACHING/ WEEK	NO OF CREDITS
IV	20P4-CPD	Communication Skill and Personality Development	1	

COURSE OBJECTIVES:

- To cultivate positive personality traits for successful life.
- To groom Winning Attitude among the learners.
- To assist the learners to identify their own potential and realize their aspirations.
- To enable a holistic development.
- To facilitate optimum means of improving personal performance.

UNIT 1

1. Personality- Definition.
2. Determinants of Personality.

3. Perceptual Process.
4. Personality Traits.
5. Developing Effective Habits.
6. Self Esteem (Freud and Erikson).
7. Self Appraisal and Self Development.
8. Dos and Don'ts to develop positive self esteem.
9. Interpersonal Relationship.
10. Difference between Aggressive, Submissive and Assertive behaviour.
11. Mind Mapping, Competency Mapping, 360 degree assessment.
12. Presentation Skills – Opening, ending, Handling nerves, Handling audience, Power Storytelling, Visual aids, Question and answer session

UNIT 2

1. Projecting Positive Body Language.
2. Conflict Management.
3. Change Management.
4. Stress Management.
5. Time Management.
6. Goal Setting.
7. Assertiveness and Negotiating Skill.
8. Problem Solving Skill.
9. Decision Making Skills.
10. Leadership Qualities of a Successful Leader.
11. Attitudes – Positive Attitudes.
12. Public Speaking – Engaging, Connecting, and Influencing the audiences.
13. Employability Skill – Group Discussion, Interview Questions, Psychometric analysis.

COURSE OUTCOMES:

After completion of the course, Students will be able to:

- Gain self confidence and broaden perception of life.
- Maximize their potential and steer that into their career choice.
- Enhance one's self image&self esteem.
- Find a means to achieve excellence and derive fulfilment.

References:

Hurlock.E.B (2006) : Personality Development, 28th Reprint. New Delhi: Tata McCraw Hill.
Stephen.P.Robbins and Timothy. A.Judge (2014) : Organisation Behaviour.16thEdition.Prentice Hall.
Andrews, Sudhir. How to Succeed at Interviews. 21st (rep) New Delhi.Tata McGrew Hill 1988.
Lucas, Stephen. Art of Publication. New Delhi. Tata McGrew Hill. 2001.
Kumar, Pravesh. All about Self Motivation. New Delhi. Goodwill Publication House. 2005.

EXTRA DISCIPLINARY COURSES

Sl. No.	Subject Code	Title of the Paper	Department
1.	20P3HYEDC	**INDIAN ADMINISTRATION**	History
2.	20P3ECEDC	**ISSUES IN INDIAN ECONOMY**	Economics
3.	20P3TAEDC	***தமிழ்மொழி வரலாறு***	Tamil
4.	20P3ENEDC	**SHAKESPEARE STUDIES**	English
5.	20P3CMEDC	**ENTREPRENEURIAL DEVELOPMENT**	Commerce
6.	20P3MAEDC	**APPLICABLE MATHEMATICAL TECHNIQUES**	Mathematics
7.	20P3PHEDC	**FUNDAMENTALS OF NANOTECHNOLOGY**	Physics
8.	20P3CHEDC	**CHEMISTRY IN EVERY DAY LIFE**	Chemistry
9.	20P3BOEDC	**MEDICAL BOTANY AND PHARMACOGNOSY**	Botany
10.	20P3MBEDC	**MUSHROOM TECHNOLOGY**	Microbiology
11.	20P3ZOEDC	**CLINICAL LAB TECHNOLOGY**	Zoology
12.	20P3BTEDC	**RECENT TRENDS IN BIOTECHNOLOGY**	Biotechnology
13.	20P3CSEDC 20P3ITEDC	**E-LEARNING TECHNOLOGIES**	Computer Science
14.	20P3LSEDC	**DOCUMENTATION CENTERS IN INDIA**	Library and Information Science

Semester	Course Code	Title of the Course	Hours of Teaching /Week	No. of Credits
III	**20P3HYEDC**	**Extra Disciplinary Courses – Indian Administration**	**5**	**--**

Objectives:

1. To know the evolution of Indian Administration.
2. To prepare the students for the competitive examination.
3. To give up-to-date knowledge on Indian administration.
4. To trace economic planning of India, through which the students may get practical knowledge on budget, etc.
5. To expose the state administration and the latest issues like Lok Ayukt and LokPal through which the students may get awareness about the latest issues.

Unit I ***Hrs 15***

The evolution of Indian administration: Structure and Functions–Mauryan and Mughal legacy; British Indian system: Company's experiments–Warren Hastings, Lord Cornwallis, Lord Hastings and Lord Dalhousie; Administrative consolidation since 1861 – Famine policy - Financial, Police and judicial administration.

Unit II ***Hrs 15***

Indian Administration since 1950: Parliamentary Democracy–Federation–Structure of Central Administration–Central Secretariat–Cabinet Secretariat, Ministries–Department of Boards.

Unit III ***Hrs 15***

Machinery for planning: Plan formulation at the National level – National Development Council – Planning Commission – Public undertaking – Controls of Public expenditure.

Unit IV ***Hrs 15***

State Administration–Executives–Secretariat–Chief Secretary–Directorates–District and Local Administration–District Rural Development Agency–Special development programmes.

Unit V ***Hrs 15***

Center-State relations – Public services – Police and Judicial administration – Lok Ayukt – Lok Pal – issues on Indian administration – Integrity in administration – Administrative reforms.

General References:

1. Altekar, A.S., State and Government in Ancient India, 1958.
2. Bhambri, C.H., Public Administration in India.
3. Vidya Bhushan, Indian Administration, Delhi, 2000.
4. Vishnoo Bhagawan & Vidhya Bhushan., Indian Administration, New Delhi, 1996.

Course Outcome: The students have clearly understood about the evolution of Indian Administration, State and Central administration, police and judicial administration, Centre State relations, etc.

Semester	Subject code	Title of paper	Hours of Teaching / Week	No. of Credit
III	**20P3ECEDC**	**Extra Disciplinary Courses – Issues in Indian Economy**	**4**	**-**

Objective:

- This Elective paper is offered to the Non-Economics Students to make them familiar with the recent trends in Indian Economy. The syllabus is framed accordingly with the Civil Service Examination.

Course Outcomes

- To understand the status of Indian economy before the reforms
- To assess the rationale of introducing reforms in India
- To familiarize with the package of LPG
- to get insight on the recent trends in EXIM policy

Unit I **Hrs 15**

Economic development and growth – determinants of growth and development – Market Economy – Indian Economy – a shift form mixed economy to Market economy – Reform measures introduced in India – First and second generation reforms – (Brief out line)

Unit-II **Hrs 15**

Economic reforms in India – background, rational – implementation – Trade policy – Industrial policy – exchange rate and capital market reforms

Unit-III **Hrs 15**

Dis-investment of public enterprises – rational – changing profile of PSUs comparison of public and private sector

Unit-IV **Hrs 15**

Privatization – Meaning and scope – Globalization – impact on India – foreign capital – Types FDI and FII, Policies and pattern.

Unit-V **Hrs 15**

Foreign Trade – Exim Policies – Recent exim policy – BOP- Trends in BOP – Economic reforms and BOP.

References:

Uma kapila – Indian Economy (Issues in Development and Planning and Sectoral aspects) Fifth Edition, 2006-07, Academic Foundation, New Delhi

Datt Ruddar &

Sundharam K.P.M. - Indian Economy (2007)

Misrapuri - Indian Economy

Semester	Subject Code	Title of the Paper	Hours of Teaching/Week	No. of Credits
III	**20P3TAEDC**	**கூடுதல் சிறப்புப் பாடம்: தமிழ்மொழி வரலாறு**	**4**	**-**

கூறு: 1 இந்திய மொழிக் குடும்பங்கள் நேரம்: 12

இந்தோ ஆரிய மொழிகள் - ஆஸ்டிக் மொழிகள் - சீன திபெத்திய மொழிகள் - திராவிட மொழிக் குடும்பம் - டாக்டர் கால்டுவெல், திராவிட மொழிகளின் சிறப்பியல்புகள் - தென் திராவிட மொழிகள் - தென் திராவிட மொழிகளில் தமிழ் - நடுத்திராவிட மொழிகள் - வட திராவிட மொழிகள்.

கூறு: 2 தமிழ் நேரம்: 12

தமிழ் என்பதன் வடிவம் பற்றியும் பொருள் பற்றியும் பல்வேறு செய்திகள் - பெயரெச்சங்கள் - வினையெச்சம் - சங்க இலக்கியத்தில் வினையெச்சங்கள் - தொல்காப்பிய உரைகாரர்களும் வினையெச்சங்களும்.

கூறு: 3 நேரம்: 12

தமிழ் எழுத்தின் தோற்றமும் வளர்ச்சியும் - ஆய்வெழுத்து இராசியெழுத்து, நாள், எழுத்து - ஓவியம், பானை ஓடுகள், இலங்கை முத்திரை முதலானவற்றில் காணப்படும் உருவ எழுத்துகள் - வட்டெழுத்து, பண்டைத் தமிழ் எழுத்து. தமிழ்மொழி வரலாறு: தமிழின் தொல் வரலாறு, தமிழ்மொழி வரலாறு - பழந்தமிழ்க் காலம், இடைத்தமிழ்.

கூறு: 4 நேரம்: 12

தொல்காப்பியமும் ஒலியியலும் - தொல்காப்பியமும் சொல்லியலும் - தமிழ் ஒலிகளின் பிறப்பு விளக்கம் - புணர்ச்சி வகை. தமிழ் உருபனியலும் தொடரியலும் - தலைமை இலக்கணக் கூறுகள் - தொடரமைப்பு இலக்கணம். பெயர்த்தொடர் அமைப்புகள்: மொழியின் பெருமை - எழுத்தும் பேச்சும் - கிளை மொழிகள் தோற்றம் - இலக்கியக் கிளைமொழி- வட்டாரக்கிளை மொழிகள்.

கூறு: 5 நேரம்:12

தமிழ் வளர்ச்சி - தமிழ் ஆட்சிமொழி வரலாறு - தமிழ் கல்விமொழி வரலாறு - கலைச் சொல்லாக்கம் - அறிவியல் தமிழ் வளர்ச்சி-உலகத் தமிழ் மாநாடுகள்- உலக அரங்கில் தமிழ் - தமிழ் அமைப்புகள்- உலகத் தமிழாராய்ச்சி நிறுவனம் - தமிழ்ப்பல்கலைக் கழகம்-செம்மொழி ஆய்வுமையம் - அயல் மாநிலங்களில் தமிழ்.

பார்வை நூல்கள்:

1. *தமிழ் வரலாறு - தேவநேயன். ஞா.*
2. *தமிழ் மொழி வரலாறு - பரிதிமாற்கலைஞர்*
3. *பழந்தமிழ் - இலக்குவனார் . சி*
4. *தமிழ் வரலாறு - குணா*
5. *தமிழ் மொழி வரலாறு - தமிழ் வளர்ச்சி இயக்ககம்*
6. *ஆட்சித் தமிழ் - புதுவை மொழியியல் பண்பாட்டுக் கழக வெளியீடு*
7. *இந்திய ஆட்சிப்பணி வழிகாட்டி - முனைவர் ெர. குமரன்.*
8. *உலகத்தமிழ் மாநாடுகள் - சாலை இளந்திரையன்*
9. *தாய்மொழியில் படிக்க வைப்போம் - NCBH வெளியீடு.*
10. *தமிழ் ஆட்சி மொழி வரலாறு - தமிழ்ப்பல்கலைக்கழகம்.*
11. *தமிழ் ஆட்சிமொழி வரலாறு - தெ.பொ.மீ.*
12. *தமிழ் மொழி வரலாறு - சக்திவேல்*

Semester	Course Code	Title of the Course	Hours of Teaching / Week	No. of Credits
III	**20P3ENEDC**	**Extra Disciplinary Course - Shakespeare Studies**	**4**	

Objective

- To initiate the non English majoring students to study Shakespeare's plays, and his sonnets.

Outcome

- Gaining appreciative and analytical understanding of Shakespeare's dramas and sonnets.
- Achieving potentiality to situate and relate Shakespeare's wisdom in various current disciplines and media cultures.
- Obtaining a profound perspectives on handling racism, class divisions, gender roles, crime, love, war, death betrayal, hope, loyalty etc., derived from the works

Unit – I

Shakespeare's Sonnets 1, 18, 29, 33, 35, 65 and 130

Unit – II

The Merchant of Venice

Unit – III

Henry IV, Part I

Unit – IV

Othello

Unit – V

Antony and Cleopatra

References:

- Bates, Jonathan. *The Genius of Shakespeare.* London: Picador, 1997.
- Leishman, J.B. *The Theme and Variation in Shakespeare's sonnets.* London: Routledge, 2005.

Semester	Subject Code	Title of the paper	Hours of Teaching/ Week	No. of Credits
III	**20P3CMEDC**	**Entrepreneurial Development**	**4**	**-**

Objective:

- To make the students to become a successful entrepreneur and to know the process involved in entrepreneurship.

Course Outcome:

- Learn the incentives and subsidies provided to budding entrepreneurs and Become familiar with institutions offering various forms of assistances.

Unit - I

Entrepreneurship - Nature and Characteristics of an Entrepreneur - Difference between Entrepreneur and Manager - Qualities, Types, and Functions of an Entrepreneur - Role of Entrepreneur in Economic Development.

Unit - II

Business Ideas - Sources of Idea - Idea Processing and Selection - Start up Process - Project Identification and Selection - Project Formulation - Project Appraisal.

Unit - III

Factory Design and Layout - Importance - Factors affecting Factory Design - Factory Layout - Objectives - Types - Consideration in Designing Layout - Design Requirements.

Unit - IV

Institutions Assisting to Entrepreneurs - NSIC - SIDCO - SSIB - DIC – TIIC – KVIC – TCO – ITCOT - Commercial Banks and New Entrepreneurial Development Agency.

Unit - V

Entrepreneurship Development Programmes - Need - Objectives - Institutional efforts in Developing Entrepreneurship – Evaluation of EDPs – Problems in the conduct of EDPs – Suggestions to make EDPs effective – Planning EDPs - Role of SISI, SIPCOT and SIDBI – Recent Development in Small Enterprises in India – Government rules and regulations – Rural Entrepreneurship – Need for Rural Entrepreneurship Problems – SHGs and Rural Development – MUDRA Banking /MSME Loans.

Text book:

1. C.B.Gupta., N.P.Srinivasan, (2018), Entrepreneurial Development, Sultan Chand & Sons, New Delhi.

Reference Books

1. Khanka S.S., (2019) Entrepreneurial Development, S.Chand & Co, New Delhi.
2. Saravanavel, P. (2016), Entrepreneurial Development, Principles, Policies and Programmes, Ess Pee Kay Publishing House, Tanjore.
3. Renu Arora, Sood S.K., (2018)Fundamentals of Entrepreneurship and Small Business, Kalyani Publications, Ludhiana.
4. Jayashree Suresh, (2019)Entrepreneurial Development, Margham Publications, Chennai.

Semester	Subject Code	Title of the Paper	House of Teaching / Week	No.of Credits
III	**20P3MAEDC**	**Extra Disciplinary Course- Applicable Mathematical Techniques**	**4**	**-**

Objectives:

- To discuss various methods of Interpolation

Out comes: After studying this course the student will be able to

- Student will demonstrate the ability to solve financial math problem.

Unit I **12 Hrs**

Interpolation with unequal intervals: Newton's divided difference formula - Lagrange's interpolation formula and inverse interpolation. (Only simple Problems)

Unit II **12 Hrs**

Assignment problems

Unit III **12 Hrs**

Replacement problems (Only simple Problems)

Unit IV **12 Hrs**

Decision Analysis

Unit- V **12 Hrs**

Game Theory

Text Book:

1. *For unit I,* ***Numerical Methods*** *– P. Kandasamy, K. Thilagavathy, K. Gunavathy, S.Chand*
2. *For units II to V,* ***Operation Research 12th Edition 2004:****KanthiSwarap, P.K. Gupta and Manmohan, Sultan Chanda and sons, New Delhi.*

   Unit I : Chapter - 8 (Sec: 8.5, 8.7)

   Unit II : Chapter - 11 (Sec: 11.1 to 11.4)

   Unit III : Chapter - 18 (Sec: 18.1 to18.3)

   Unit IV : Chapter - 16 (Sec: 16.1 to 16.5)

   Unit V : Chapter - 17 (Sec: 17.1 to 17.6)

General Reference:

1. *S.S. Sastry Introductory Methods of Numerical Analysis Prentice Hall of India 2000.*
2. *H.A. Taha Operation Research Prentice Hall of India 1995.*

Semester	Subject Code	Title of the paper	Hours of Teaching / Week	No. of Credits
III	**20P3PHEDC**	**Extra Disciplinary Course- Fundamentals of Nanotechnology**	**4**	**-**

Unit – I Introduction to Nanotechnology

Nanotechnology – Definitions - History of nanotechnology – Nanomaterials: classification – zero, one and two dimensional nanomaterials – Classification based on the composition of materials (metal, semiconductor, ceramic, polymeric and carbon-based nanomaterials) - Properties of nanomaterials – Surface area to volume ratio (S.A/V) – Quantum dots - Challenges in nanotechnology.

Unit – II Preparation Methods

Top-down and Bottom-up approaches – Top down methods: Ball milling - Electron beam lithography – Advantages – Limitations. Bottom-up methods: Vacuum evaporation - Sputter deposition process - Laser ablation

– Advantages – Limitations.

Unit – III Fullerenes

Fullerenes – Types of fullerenes – Bucky ball/Buckminster fullerene - Carbon nano tubes (CNTs) - Single walled CNTs – Multi walled CNTs – Differences – mechanical and electrical properties of CNTs - preparation of CNTs – Plasma discharge method – Applications.

Unit – IV Characterization Techniques

Construction, working principle, merits and demerits of X-ray diffractometer - Scanning Electron Microscope (SEM) – Atomic Force Microscope (AFM) - UV-Vis–NIR double beam spectro photometer – Energy dispersive X-ray analysis (EDAX) .

Unit – V Applications

Nanoelectronics – Nanophotonics – Nanomaterials in energy conversion and storage – Nanomaterials as antibacterial agents – Nanomaterials as photocatalysts – Nanomaterial in industrial applications – Bio-medical applications : Targeted drug delivery – Nanomaterial based radiation therapy – Photodynamic therapy (PDT) – Bio imaging.

Books for Study

1. K. Ravichandran, K. Swaminathan, P.K. Praseetha, P. Kavitha, Introduction to Nanotechnology, JAZYM publications.
2. M.Ratner.et al., Nanotechnology; A Gentle intro Practices – hall ISBN 0-13-101400-5, 2003.
3. Nanotechnology; Basic Science and Emergining Technologies, CRC Press

Books for Reference

1. Charles P.Poole Jr and Frank J.Owens. "Introduction to Nanotechnology" Wiley, 2003.
2. A. S. Edelstien and R.C. Cornmarata, Nanomaterials; synthesis, Properties and Applications, 2ed, Iop (U.K), 1996.

Semester	Subject code	Title of the paper	Hours of Teaching/ Week	No. of Credits
III	**20P3CHEDC**	**Extra Disciplinary Course - Chemistry in Every Day Life**	**4**	

OBJECTIVES

Students learn about the scientific and chemical principles underlying in everyday life.

- Students learn about the cleaning agents and water chemistry,
- Students understand about the food chemistry,
- Students shall learn about the cosmetic and their effect in health aspects
- Students shall know about the green chemistry and their significance for clean environments
- Students learn about the nano technology and their importance.

Unit-I

Cleaning agents - manufacture and uses of soaps, detergents, baking powder, shampoo, washing powder and bleaching powder **Water –** uses of water Characteristics' of water, soft water and hard water - removal of hardness – ion exchange method. Reverse osmosis method, Water pollution, causes and prevention.

Unit-II

Food – importance – spoilages – causes, preservation – additives – colouring and flavouring agents, beverages. Soft drinks aerated water – manufacturing – mineral water. Fruits, vegetables, dairy product – storage, preservation. Minerals in food and anti oxidants. Preparation of fruit Jam and pickle.

Unit-III

Cosmetics – Face powder – constituents, uses – side – effects. Nail polish, hair dye – composition and side effects. Tooth powder – lotions. Preparation of phenyl, liquid blue and incense sticks.

Unit-IV

Basic concepts of Green chemistry and its significance in day to day life. Polymers – Classification – Types of polymerization – plastics – classification – types of plastics – PVC, Teflon, PET, Bakelite – Rubber – Natural and synthetic – Bunas rubber, Butyl Rubber. Vulcanization of rubber, neoprene rubber, Plastic pollution and prevention.

Unit-V

Basic concepts of Nano Technology and its importance in day to day life.

Dyes – importance of food colours – PFA (Prevention of Food Adulteration Act) Natural dyes – Synthetic Classification importances – Uses of the following Synthetic dyes - Direct dyes, acid dye, Basic dye, mordant dye, Reactive dye, Disperse dye, Fastness – Light and Washing. Application of dyes in food, paper, plastic and lather.

COURSE OUTCOME:

- Students should able to learn about the cleaning agents and water chemistry,
- Students should able to understand about the food chemistry,
- Students should able to learn about the cosmetic
- Students shoud able to know about the green chemistry
- Students should able to learn about the nano technology

References:

1. Norrish Shreave. R. and Joseph A. Brink Jr Chemical Process Industries, McGraw Hill, Industrial Book Company London 1978.
2. Brain A.C.S. Reinhold, Production and properties of Industrial chemicals 11th Ed, John Wiley & Sons, New York.
3. Burgh, A. Fermentation Industries, Inter science, 4th Ed, 1983, A *Inter science*, New York.
4. Ramani,V. Alex, Food Chemistry(2009),MJP publishers.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	**20P3BOEDC**	**Extra Disciplinary Course – Medicinal Botany and Pharmacognosy**	**4**	**-**

Objectives

- To enable the students to identify local medicinal plants.
- To enable the students to prepare herbal medicines for curing human ailments.
- To impart knowledge to students on Botany and Phyto chemistry of medicinal plants.

Unit I

Medicinal Botany: Definition, Introduction, History, – Classification – Common medicinal plants cultivation, storage, collection and habitats of medicinal plants (*Catharanthus, Coleus*, *Aloe*) – Importance of medicinal plants.

Unit II

Indian systems of medicine – AYUSH - Siddha, Ayurveda, Homeopathy and Unani – Indigenous medicinal plants – Useful parts –Chemical constituents – medicinal uses – medicinal plant drugs.

Unit III

Herbal medicines for human ailments – Heart, kidney, liver, eye, skin, hair, stomach problems, diabetics, blood pressure, headache, cough, cold, fever, digestive problems, joint pains and wounds.

Unit IV

Pharmacognosy – History, Introduction, commercial drugs, crude drugs – classification of drugs – Chemistry of drug and drug evaluation of natural products.

Unit V

Drug adulteration and detection – Substitution – Detection of Adulterations - Elementary knowledge on alkaloids and flavonoids – Preparation of herbal oil, herbal tooth powder, herbal soup, herbal immune boosters.

Books for Reference

- Kumar, N.C., (1993). An introduction to Medical Botany and Pharmacognosy.
- Shah, S.C. and Quadry (1990). A text book of Pharmacognosy.
- Nadkarni, (1981). Indian MateriaMedica.
- Jain, S.K., (1980). Indian Medicinal Plants.
- Balu, S., Murugan, R. and Pandiyan, P., (2005). Herbal Technology.

Outcome

After completion of this course, students would be able to

- Understand the various Indian system of medicine
- Learn about the vital role of herbal medicines for human ailments
- Outline and classify the crud drugs
- Trained about drugs adulteration and direction

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	**20P3MBEDC**	**Extra Disciplinary Course – Mushroom Technology**	**4**	**-**

Objectives

- To know the various types of edible mushroom and their nutritional value.
- To understand the methods of cultivation of mushrooms.
- To know the types of food prepared from mushroom and their importance in human health.
- Marketing of mushrooms in India and abroad.
- Mushroom cultivation unit visit- mandatory –Neighbouring District –one day.

Unit I

Introduction – history – scope of edible mushroom cultivation – Types of edible mushrooms available in India – *Calocybeindica, Volvariellavolvacea, Pleurotuscitrinopileatus*, and *Agaricusbisporus.*

Unit II

Pure culture – preparation of medium (PDA and Oatmeal agar medium) sterilization – preparation of test tube slants to store mother culture – culturing of *Pleurotus*mycelium on petriplates, preparation of mother spawn in saline bottle and polypropylene bag and their multiplication.

Unit III

Cultivation Technology: Infra structure – Mushroom bed preparation – paddy straw, sugarcane thrash, maize straw, banana leaves. Factors affecting the mushroom bed preparation – Low cost technology. Composting technology in Mushroom production.

Unit IV

Storage and nutrition: Short-term storage (Refrigeration – upto 24 hours) Long term Storage (canning, pickles, papads), drying, storage in salt solutions. Nutritive value – proteins – amino acids, mineral elements – Carbohydrates, Crude fibre content – Vitamins.

Unit V

Food Preparation – Types of food prepared from mushroom; Soup, Cutlet, Omlette, Samosa, Pickles, Curry – Research Centres – National level and Regional level – Cost benefit ratio – Marketing in India and abroad, Export value.

Books for Reference:-

- Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayaranjan, R., (1991). Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
- Swaminathan, M., (1960). Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No.88, Mysore Road, Bangalore 560 018.
- Tewari, Pankaj Kapoor, S.C., (1988). Mushroom Cultivation, Mittal Publications, Delhi.
- Nita Bahi (1984-1988). Handbook of Mushrooms, II Ed, Vol. I & II.
- Paul Stamets, J.S and Chilton J.s (2004). Mushroom cultivation. A practical guide to graining mushroom at home Agarikon Press.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	**20P3ZOEDC**	**Extra Disciplinary Course – Clinical Lab Technology**	**4**	**-**

Objectives:

1. To study the various sterilization techniques.
2. To know the disposal of waste.
3. To identify the blood group and urine sugar.
4. To identify the bacteria and fungus.
5. To know the various diagnostic equipment.

Unit I **12 Hrs**

Scope for study of Clinical Technology. Sterilization – Methods of Sterilization – Dry heat method – Wet heat method – Chemical method of sterilization – Disposal of hospital wastes and infected material - Disinfection laboratory glassware and equipments.

Unit II **12 Hrs**

Composition of blood–ABO blood typing–Rh blood typing–Blood cells counting – Total erythrocyte count, total WBC count and differential count – Sugar level in Blood – Hypoglycemia, Hyperglycemia conditions. Composition of urine – Physical characters of urine–Method of urine analysis for sugars.

Unit III **12 Hrs**

Analysis of Semen, Sputum and stool, Identification of blood parasites, Bacterial culture in NA medium, Fungal culture in PDA medium, Histological study of cells – Histological procedure for the preparation of tissue slides.

Unit IV **12 Hrs**

Diagnostic equipment and apparatus – ECG, EEG, Colorimeter, pH meter, PCR, laminar airflow inoculation chamber, Binocular microscope and Incubator.

Unit V **12 Hrs**

Immuno techniques – ELISA, HLA typing, VDRL Test.

Viral , bacterial and fungal diseases, First aid- definition and types and applications

Reference:

1. Medical Laboratory Technology (1994) (4th edition), By Ramik Sood, Jaypee Brother Medical Publishers (P) Ltd., New Delhi 110 002.
2. Medical Laboratory Technology, K.M. Samuel.
3. Clinical Pharmacology (1987), by Dr. Lawrance and P.N. Bennett (Sixth Edition), ELBS, English Language Book Society, Churchil Livingstone, England.
4. District Laboratory Practice in Tropical countries, part I, By Mouica Cheesbrough, Cambridge Las Priced Edition, Cambridge University Press, Cambridge, U.K.
5. Basic Clinical Paraitology (1993), W.Harold Brown and A.Franklin Neva (5th edition), Prntice Hall Internation Edition.
6. Biological Chemistry – Leringer.

7. Human Physiology by Pearse.
8. The Biology of Animal Paraistes (1984), Cheng, T.Toppan C9 Ltd., Japan.
9. Medical Laboratory Technology: A procedure manual for routine diagnostic tests Volume – I-II By Kanai, L.Mukherjee, Tata McGraw – Hill Publishers, New Delhi.
10. Basic Clinical Paraitology 5th Edn, Harrold, W.Harold Brown and A. Franklin Neva-prentice Hall Internation Editions, U.S.A.

Web Links:

https://www.sunydutchess.edu/academics/catalog/current/courses/medical_laboratory_tech/index.pdf(Dutchess Community College, New York).
https://www.sunydutchess.edu/academics/catalog/current/programs/medicalandalliedhealth/mlt.pdf(Dutchess Community College, New York).
https://makautwb.ac.in/syllabus/BSc%20(Medical%20Lab%20Technology)28.02.2018.pdf

Course Outcome

- Pare the way for basic idea of various aseptic technique.
- Understanding the significance of waste disposal.
- Knowledge on Blood grouping and Blood sugar & urine sugar level.
- Gaining knowledge on culture of Bacteria, fungi and expertise on histological slide preparation.
- Operation technique of Diagnostic apparatus.
- Understanding for various immune techniques.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	**20P3BTEDC**	**Extra Disciplinary Course – Trends in Biotechnology**	**4**	**-**

Objectives:

1. To study the concept and scope of Biotechnology.
2. To Understand r-DNA Technology.
3. To aware the programmes of cell culture, preparations of hormones and vaccines, transgenic animals and human genome project.
4. To study the Bioprocess technology and their applications.
5. To study the Environment Biotechnology and aware the biodiversity and their conservation.

Unit I **Hrs12**

Biotechnology – Introduction and Scope of Biotechnology – Gene Cloning, Cell –free protein production – Production of Health care Products, Medical and Forensic application (RFLP, RAPD, DNA finger printing). Applications of PCR and LCR in disease diagnosis.

Unit II **Hrs12**

Nuclear transplantation, Transgenic Animals Development and uses – mice, goat, fish and sheep. Tendered meat production. Transgenic Plant: Insect resistance, fungus resistance, virus resistance, drought, cold resistance, saline resistance, Transgenic plant with vitamin A, Gene Production of therapeutic antibodies and edible vaccine.

Unit III **Hrs12**

Bioprocess technology – Scope – Fermentor –Bioprocess products: Organic acids – Citric acid, Lactic acid, acetic acid. Antibiotics – Wide and Narrow specxtrum antibiotics. Aminoacids – Glutamic acid, Lysine, Isoleucine, Aspartic acid and Proline. Production of SCP. Enzyme Production – Amylase, Pectinase and Cellulase. Dairy products and Biofuel production.

Unit IV **Hrs12**

Biofertilizers – N_2 fixing microbes (Azolla, Azatobacter, Azospirillum) for use in Agriculture – A. tumifasciens for crop improvement – Biopesticides. Biopolymer and its Application – Biosensor and its application – Bioleaching- Biomining – Biotechnology in oil recovery – Bioremediation of Xenobiotics – superbug – its application. Biodegradation.

Unit V **Hrs12**

Regulations of Biosafety: possible dangers of GEO, Biohazards of rDNA technology. National and International biosafety guidelines, Primary and secondary containments and implementation. Web based information of biosafety on GMO.

Reference:

1. Dubey, R.C. – A Text Book of Biotechnology, S. Chand & Co., Ltd, New Delhi, 1996.
2. Gupta, P.K. – Elements of Biotechnology, Rastogi and Co., Meerut, 1994.
3. Kumar, H.F. A text book on Biotechnology, Affiliated East & West Press Pvt., Ltd, N-Delhi.
4. D.Balasubramanian *et. al.,* - Concepts in Biotechnology.
5. Singh, R.S. – Introductory Biotechnology, Central book deport, Allahabad.
6. Primrose, R. – Molecular Biotechnolgoy, ASM Press.
7. Lick, E.R. and Pastenak – J.J. Molecular Biotechnology.
8. Ignachimuthu – Plant biotechnology, Oxford IBH Publishers, New Delhi.
9. Ranga – Fishery Biotechnology.
10. Primrose, R. – Molecular Biotechnology, ASM Press.
11. Purohit – A Text Book of Biotechnology, Agrobions, Jodhpur.

Semester	Subject code	Title of the course	Hours of Teaching/ Week	No. of Credits
III	**20P3CSEDC/ 20P3ITEDC**	**Extra Disciplinary Course- E-Learning Technologies**	**4**	**-**

Objective

- To learn the various E-learning approaches and components.
- To understand the types of design models of E-Learning.
- To explore the models for E-learning courseware development.
- To learn about E-learning authoring tools.
- To know about evaluation and management of E-learning solutions.

UNIT I INTRODUCTION

Need for E-Learning – Approaches of E-Learning – Components of E-Learning – Synchronous and Asynchronous Modes of Learning – Quality of E-Learning – Blended Learning: Activities, Team and Technology – Work Flow to Produce and Deliver E-Learning Content – Basics of Design Thinking.

UNIT II DESIGNING E-LEARNING COURSE CONTENT

Design Models of E-Learning – Identifying and Organizing E-Learning Course Content: Needs Analysis – Analyzing the Target Audience – Identifying Course Content – Defining Learning Objectives – Defining the Course Sequence – Defining Instructional Methods – Defining Evaluation and Delivery Strategies – Case Study.

UNIT III CREATING INTERACTIVE CONTENT

Preparing Content: Tips for Content Development and Language Style – Creating Storyboards: Structure of an Interactive E-Lesson – Techniques for Presenting Content – Adding Examples – Integrating Multimedia Elements – Adding Examples – Developing Practice and Assessment Tests – Adding Additional Resources– Courseware Development Authoring Tools – Types of Authoring Tools – Selecting an Authoring Tool

UNIT IV LEARNING PLATFORMS

Types of Learning Platforms – Proprietary Vs. Open – Source LMS – LMS Vs LCMS – Internally Handled and Hosted LMS – LMS Solutions – Functional Areas of LMS.

UNIT V COURSE DELIVERY AND EVALUATION

Components of an Instructor-Led or Facilitated Course – Planning and Documenting Activities – Facilitating Learners Activities – E-Learning Methods and Delivery Formats – Using Communication Tools for E-Learning – Course Evaluation.

REFERENCES:

1. Clark, R. C. and Mayer, R. E, "eLearning and the Science of Instruction", Third Edition, John Wiley, 2016.
2. Means, B., Toyama, Y., and Murphy, R, "Evaluation of Evidence – Based Practices in Online Learning: A Meta – Analysis and Review of Online Learning Studies", Centre for Learning Technologies, 2010.
3. Crews, T. B., Sheth, S. N., and Horne, T. M, "Understanding the Learning Personalities of Successful Online Students", Educause Review, 2014.
4. Johnny Schneider, "Understanding Design Thinking, Lean and Agile", O'Riley Media, 2011.
5. Madhuri Dubey, "Effective E – learning Design, Development and Delivery", University Press, 2011.

Course Outcomes:

On completion of the course, the students will be able to:

- Distinguish the phases of activities in the models of E-learning.
- Identify appropriate instructional methods and delivery strategies.
- Choose appropriate E-learning authoring tools, Create interactive E-Learning courseware, Evaluate the E-learning courseware, Manage the E-learning courseware.

Semester	Subject Code	Title of the Paper	Hours of Teaching / Week	No. of Credits
III	**20P3LSEDC**	**Extra Disciplinary course Documentation Centers in India**	**4**	**-**

Objectives:

- To promote and support adoption of standards in library operations.
- To coordinate with other regional, national & international network for exchange of information and documents

Unit I

Components of information systems-Libraries, Documentation centers, Information centers.

Unit II

Data banks, Information analysis centers, Referral centers, Clearing Houses, Reprographic and translation centers-Their function and services.

Unit III

National Information systems: DESIDOC, NASSDOC, SENDOC, NISCAIR and INFLIBNET.

Unit IV

Information Aggregators, Databases Proquest, EBscohost, J-gate, POPLINE, Shodhganga, NDL,.

Unit V

Information products and series – Newsletters, House Bulletins in – house Journals, state of art reports, digest and Technical Digest.

Outcome:

The students shall be able to:

- Know the standards in library operations.
- Understand the regional, national & international network for exchange of information and documents

Reference:

1. Date, C.J. An Introduction to Database System, ed.7, Delhi: Pearson Education (Singapore), 2002
2. Desai, Bipin C. An Introduction to Database System, New Delhi, Galgetia, 2001
3. Karts Henry F, DBS Computer, New Delhi, McGraw Hill, 2000.
4. Raghu Ramakrishnan, DBMSS, New Delhi, McGraw Hill, 2000.
5. Gangadharaiah G, Management of Information Products and Services in University Libraries, Common Wealth, New Delhi, 2012.