Ph.D. BIOMEDICAL SCIENCE

REGULATIONS
&
CURRICULUM STRUCTURE
2022-23
(Revised on 10.05.2024)

BHARATHIDASAN UNIVERSITY
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SCHOOL OF BIOTECHNOLOGY AND GENETIC ENGINEERING
DEPARTMENT OF BIOMEDICAL SCIENCE

DEPARTMENT OF BIOMEDICAL SCIENCE
School of Biotechnology and Genetic Engineering

Ph.D CURRICULUM STRUCTURE

1. Ph.D in Biomedical Science

The Department of Biomedical Science at Bharathidasan University has a rich tradition of high impact research on medically relevant topics, student-cantered excellence and service within the academic community. Our faculty members are well-known in their area of specialization and support and foster scientific synergy between faculty researcher and research students.

Biomedical Research is the exploration of processes that govern the functioning of molecules, cells and organisms in health and disease. Biomedical scientists bridge the gap between the basic sciences and medicine. The PhD degree is the gateway to a career in biomedical research.

2. Objectives of the programme

- Develop substantive knowledge in their area of specialization
- Demonstrated ability to engage in a productive research career, including publications, grant writing and conference presentations.
- Excel in a variety of institutional settings, including Universities, Industry and Government Research labs
- Demonstrate an understanding and concern for the high ethical standards in business, research, teaching and service

3. Eligibility

A Post Graduate in Biomedical Science/ Biotechnology / Life Science/ Veterinary Science / Pharmacy / Medicine with not less than 55% marks in the aggregate is eligible for registration for the degree of Doctorate of Philosophy.

4. Admission

CSIR/UGC-NET Qualified candidates will be given preference. However in exceptional cases candidates without NET may be considered upon satisfactory performance in written test/interview conducted by the University.

Mode: Full time Regular Program/Part-time Program

5. Structure of the Program

I. Course work*

II. Comprehensive Viva (after passing the Course Work Examination) for confirmation of Registration

III. Submission of the Synopsis of the Thesis &

IV. Defending the Thesis through Public Viva Voce

6. Regulations:

Candidate who fulfils the eligibility requirements of the Bharathidasan University for seeking admission to Ph.D programs can pursue Ph.D program in the University. Candidates are advised to check https://www.bdu.ac.in/academics/regulations.php for further details.

7. Course work:

Candidates who are provisionally registered for Ph.D programme in the Department of Biomedical Science have to complete the prescribed courses within the stipulated time period. Details of the course work are as follows:

Course	Code	Name of the Course	Internal Assessment	University External	Total	Credits
Course 1	24BMSRC01	Research Methodology	25	75	100	4
Course 2	CPE-RPE	Research and Publication Ethics	25	75	100	2
Course 3	Choice of course offered in the Department as per the enclosed List*		25	75	100	4
Course 4			25	75	100	4

*List of Courses offered for Course Paper 3 & 4		
1	Pharmacogenomics	24BMSRC02
2	Molecular Oncology	24BMSRC03
3	Medicinal Chemistry	24BMSRC04
4	Clinical Microbiology	24BMSRC05
5	Drug Discovery and Assay Development	24BMSRC06
6	Molecular Basis of Disease	24BMSRC07
7	Molecular Biology of Liver Cancer	24BMSRC08
8	Advanced Cell and Molecular Biology	24BMSRC09
9	Cell Culture and Embryo-Biotechnology	24BMSRC10
10	Structural Bioinformatics, Molecular Modeling and Drug Design	24BMSRC11
11	Introduction to Antibiotics, Antibiotic Resistance and EffluxPump	24BMSRC12
12	Introduction to Quorum Sensing	24BMSRC13
13	Proteomics and Protein Bioinformatics	24BMSRC14
14	Gastroenterology-special emphasis on gastric diseases and molecular signalling	24BMSRC15

*Any two courses have to be selected from the above list of courses.

Programme Outcomes

- Research Scholars are well trained with **Research** & **Development Competences, Creative Knowledge, Inventive Skill, Resolute Attitude** and **Innovative Pursuits** in their chosen fields.
- Research Graduates are **seasoned** to the demanding Research Environment and explicitly **spirited** enough to the occasion in their scientific/technological quests with exemplary qualities of productive contribution to **society, nation** and **world** in the arena of Science and Technology.
- Research Graduates are ready to espouse **Leadership Responsibilities** in their chosen fields of Science and Technology with **demonstrated perfection** and **benchmark contribution.**
- Research Graduates **Collate** information from a variety of sources and **Enrich** a coherent understanding of the subject concerned pertaining to **Novel** investigation on the problems in everyday life.

Program Specific Outcomes:

The graduate students (Ph.D students) acquire skills in planning and carrying out advanced experiments, able to solve scientific problems by applying a combination of theory, numerical simulation, and experiments to get them placed in:

- Highly reputed research institutions all over the world.
- Academic institutions as teaching faculty.
- As research associates in industries in India and Abroad.
- Pursuing post-doctoral research in premier research institutions in India and abroad.
- Ventured as small scale entrepreneurs.
- As Quality control skilled personals
- As Scientific officers
- In R&D and Hospital based diagnostic centers.

Course: 1 RESEARCH METHODOLOGY

Course Code: 24BMSRC01 **Credits: 4**

Objectives:

- To Gain knowledge in method of analysis and generation of data
- To provide sufficient knowledge in analysis, interpretation of results and preparation of data in research aspects to students
- To provide software knowledge to students
- To make students aware of bioinformatics tools and their interpretation
- To Know about poster and oral presentation

Unit I:

Meaning of research – Objectives of research – Types of research – Pure, applied, historical, analytical, descriptive and experimental – Significance of research – Research methods versus methodology – Scientific and research methods – Induction and Deduction – Research process.

Unit II:

Planning Research – Defining research problem – Identification, selection and Formulation of research problem – Review of literature – Hypothesis – Meaning, sources of hypotheses – Types of hypothesis – Formulation and testing – Research design – Meaning, need, features of a good design – Basic principles of experimental design – Factors affecting research design – Evaluation of research design.

Unit III:

Sampling Design – Census method and sampling method for investigation – advantages and disadvantages of sampling – Principle of sampling – Essentials of good sampling – Methods of sampling – Probability and Non-probability sampling methods – Random sample – Factors affecting sample size – Sampling and non-sampling errors.

Unit IV:

Methods of Data collection – Primary and Secondary data – Modes of data collection – Analytical method – case study – observation method – interview method – Questionnaries in data collection – Collection of data through schedules – Advantages and limitations – Pre-testing and its importance

Unit V:

Processing and analysis of data – Types of analysis – Statistics in research – Editing, Coding, Tabulation and Diagrams – Process of interpretation – Guidelines for making valid interpretations – Report writing – Roles and types of reports – Contents of research reports – Steps involved in drafting reports – Referencing.

Unit VI: Current Advances (Not for exam, only for discussion)

Significance of descriptive research, Hypothesis of planning research, principles of experimental design, importance of good sampling, sampling and non-sampling errors, data collection-observation and interpretation of results, Report wiring and referencing.

References:

1. C.R. Kothari (2004). Research Methodology – Methods and Techniques (2nd Edn.)
2. Gupta, Santosh (2005) Research Methodology and Statistical Techniques, Deep and Deep
   Publications.
3. Best, J. W. and Kahn J. V. (2005) Research Introduction, New Delhi, PHI.
4. Bhattacharya, D. K. (2004) Research Methodology, New Delhi, Excel Books
5. Mikkelsen, Brita (2005). Methods for Development Work and Research. (2nd Edn.), New Delhi, Sage Publications.
6. E-source- Research Methodology, libguides.wits.ac.za
7. E-link- https://en.wikipedia.org/wiki/Methodology
8. E-link - https://explorable.com/research-methodology

Course Outcomes:

After completing the course, the students would able to;

- This subject target student to provide right knowledge in instrumental method of analysis and to generate a data.
- The aim of the paper is to empower the students in the statistical analysis, interpretation of results and preparation of data for writing report, thesis, dissertation and research paper.
- This paper provides hands on experience with model sum to extend the acquired skill and software knowledge.
- This paper mainly constructed with research students, to gain basic knowledge about the biological instruments and its application in research.
- It includes the Bioinformatic tool to analysis and interpretation
- Mainly it contains journal, citation index, LCD, Google, PubMed, GenBank.
- This paper includes poster presentation, oral presentation, facing viva-voce.
- Finally, this paper applied for research purpose

Course: 2 RESEARCH AND PUBLICATION ETHICS

Course Code: CPE-RPE **Credits: 2**

Unit I
Philosophy and Ethics
1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgements and reactions

Unit -II
Scientific Conduct
1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconducts: Falsification, Fabrication and Plagiarism (FFP)
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data

Unit – III
Publication ethics
1. Publication ethics: definition, introduction, and importance
2. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc
3. Conflicts of interests
4. Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, types
5. Violation of public ethics, authorship and contributor ship
6. Identification of publication misconduct, complaints and appeals
7. Predatory publishers and journals

Unit – IV
Open access publishing
1. Open access publications and initiatives.
2. SHERPA/RoMEO online resource to check publisher copyright and self archiving policies.
3. Software tool to identify predatory publications developed by SPPU.
4. Journal Finder/Journal suggestion tools viz JANE, Elsevier Journal finder, springer journal suggester etc.

Unit – V
Publication Misconduct

A. Group Discussion
1. Subject specific ethical issues, FFP, authorship.
2. Conflicts of interest.
3. Complaints and appeals: examples and fraud from India and abroad.

B. Software Tools

Use of plagiarism software like Turnitin, Urkund and other open source software tools.

Unit – VI
Database and Research Metrics

A. Databses
1. Indexing databases.
2. Citation databases: Web of Science, Scopus etc.

B. Research Metrics
1. Impact factor of Journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score.
2. Metrics: h-index, g index, g-h Index, i10 index, h-b index, z-index and altmetrics.

References

1. Bird, A. (2006). *Philosophy of Science.* Routledge.
2. MacIntyre, Alasdair (1967) *A Short History of Ethic*. London.
3. P. Chaddah, (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN: 978-9387480865
4. National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009). On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition. National Academic Press.
5. Resnik, D.B. (2011). What is ethics in research & why is it important. *National Institute Health Sciences*,1-10. Retrieved from https://www.niehs.nih.gov/research/resource/bioethics/whatis/index.cfm http://doi.org/10.1038/489179a
6. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance (2019), ISBN:978-81-939482-1 http://www.insaindia.res.in/pdf/Ethics_Book.pdf

For Course Paper: 3 & 4

PHARMACOGENOMICS

Course Code: 24BMSRC02 **Credits: 4**

Objectives:

- This course Explains Basics of Pharmacogenetics and Drug development.
- Elaborates about drug intake and its responses
- Explains about the cancer medicine, Personalized medicine and Bioinformatics tools.

UNIT I: INTRODUCTION TO PHARMACOGENETICS AND PHARMACOGENOMICS

Definition, Pharmacogenetics and drug response variation, Types of genetic variants, Pharmacogenetic measures, Pharmacogenetics and drug targets, Pharmacogenetics and drug development.

UNIT II: PHARMACODYNAMICS AND PHARMACOKINETICS

Physicochemical factors in transfer of drugs through membranes, Drug absorption, extent and rate of bioavailability, cellular sites and drug action.

UNIT III: DRUG METABOLISM

Phases of Drug metabolism, Sites of drug metabolism, Induction of drug metabolism, Importance in drug development process, Drug targets.

UNIT IV: NEOPLASMS AND PHARMACOLOGY

Cancer medicine overview, Cell cycle – therapeutic balance and efficiency, Antineoplasmic drugs - pharmacological actions, toxicity, Development of personalized medicine.

UNIT V: MANAGEMENT OF PHARMACOGENOMIC INFORMATION

The Pharmacogenomics knowledge base, Systems for the Management of Pharmacogenomic Information – Bioinformatics tools and database for compiling and analyzing microarray data.

UNIT VI: RECENT ADVANCES - PRACTICUM (NOT FOR EXAMINATION)

Application of Metabolomics in Pharmacogenomics, types of omic and pharmaco-omic study designs and analyses, Pharmacogenomics: Regulatory Issues, Pharmacogenomics: Translation to Practice.

TEXT BOOKS:

1. Pharmacogenomics: Methods and Protocols (Methods in Molecular Biology) First Edition (2005) Federico Innocenti, Humana Press Inc, New Jersey, USA.
2. Pharmacogenomics and Personalized Medicine (Methods in Pharmacology and Toxicology)
First Edition (2005) Nadine Cohen, Humana Press Inc, New Jersey, USA

REFERENCES:

1. An A-Z Guide to Pharmacogenomics, First Edition (2006) M.C. Catania, Published by American Association for Clinical Chemistry
2. Pharmacogenomics: Social, Ethical, and Clinical Dimensions, First Edition (2003) Mark A. Rothstein, Wiley-Liss Publications

OUTCOME:

After completing the course, the students would able to;

- Learn about the concept of pharmacogenetics and phamacogenomics.
- Understand the influence of genetic variants with drug metabolism.
- Gain Knowledge about the concept and importance of pharmacodynamics and pharmacokinetics and factors associated.
- Exposed to various phases of drug metabolism.
- Understand the steps involved in drug development.
- Would learn about Cancer therapeutics and influence of pharmacogenomics.
- Understand the about the concept of personalized medicine and need for personalized medicine.
- Learn about various managements associated with pharmacy and need of pharmacogenomic information.

WEBLINK:

https://ghr.nlm.nih.gov/primer/genomicresearch/pharmacogenomics

https://www.nature.com/scitable/topicpage/pharmacogenomics-and-personalized-medicine-643
https://www.fda.gov/Drugs/ScienceResearch/ucm572617.htm

MOLECULAR ONCOLOGY

Course Code: 24BMSRC03 **Credits: 4**

Objectives:

- To acquire knowledge about molecular basis cancer and its properties.
- Elaborates about the various signaling pathways associated with cancer.
- Explains briefly about tumor progression and targeted therapy for cancer.

UNIT I: INTRODUCTION TO ONCOLOGY

Definition, Hallmarks of cancer, Causes of cancer; Cancer associated genes – Proto-oncogenes, Oncogenes and Tumour suppressor genes.

UNIT II: MOLECULAR BASIS OF CANCER

Mutations and cancer, Chemical carcinogenesis – Effect of chemical in tumour initiation and progression, DNA repair and cancer, Effect of telomerase in cancer progression, Diet and cancer – Influence of diet in tumour development.

UNIT III: CELL SIGNALING AND CANCER

Signaling pathways involved in tumour initiation; Cell cycle regulation – Proteins in cell cycle, Cell cycle check points; Signaling and tumour progression – Cancer cell invasion, angiogenesis, formation of secondary tumors; Cell death and cancer - Apoptotic and anti-apoptotic signaling.

UNIT IV: FACTORS INFLUENCING TUMOR PROGRESSION

Influence of microenvironment on tumour progression, Growth factors – effect of growth factors on tumour development; viral systems relevant to cellular transformation and human cancer

UNIT V: CANCER TARGETS AND THERAPY

Selection of right targets for cancer therapy, Importance of tumour markers in cancer prediction and treatment, Principles of chemotherapy, Novel approaches to gene therapy and endocrine therapy.

UNIT VI: RECENT ADVANCES - PRACTICUM (NOT FOR EXAMINATION)

Basic aspects of molecular diagnostics, Current state of drug search directed against molecular targets, clinical trial methodology and application of molecular targets in addition to diagnosis and prognosis, problems and prospects.

TEXTBOOKS

1. The Biology of Cancer – Robert A. Weinberg, Garland Science Publishers, 2006 Edition.
2. Principles of Molecular Oncology – Miguel H. Bronchud, Mary Ann Foote, *et.al.*, Humana Press, Third Edition (2008).

REFERENCE

1. Principles of Cancer Biology – Lewis J. Kliensmith, Benjamin Cummings Publisher; 1 edition (2005).
2. Advances in Molecular Oncology - FabrizioD'Adda di Fagagna et.al.;Publisher: Springer, 2007-07-12, ISBN: 0387691146.

OUTCOME:

After completing the course, the students would able to;

- Understand the basic definition and hall marks of cancer.
- Exposed to genetic or molecular basis of cancer.
- Learn about chemical mutagenesis and influence of diet on development of cancer.
- Understand the various signaling molecules and pathways involved in cancer pathogenesis.
- Learn about the factors influencing cellular transformation.
- Understand the factors influencing tumor progression.
- Gain knowledge about chemotherapeutic drugs and various targets for chemotherapy
- Understand about predictors of cancer and diagnosis of cancer.

WEBLINK:

http://www.medicalstaygroup.com/definition-of-the-molecular-oncology-and-its-importance/

https://public.csr.nih.gov/aboutcsr/CSROrganization/Pages/CSRReorganizationPages/Study-Sections-in-the-Oncology-1--Basic-Translational-IRG-Modified-for-Reviewing-Research-Involving-Telomeres-and-Epigeneti.aspx

https://www.moga.org.au/patients-carers

MEDICINAL CHEMISTRY

Course Code: 24BMSRC04 **Credits: 4**

Course Objectives:

- To understand the chemistry of drugs with respect to their pharmacological activity
- To understand the drug metabolic pathways and adverse effects of drugs
- To know the basics of Pharmacodynamics and Pharmacokinetics of drugs
- To Study the chemical synthesis of selected drugs and small molecule inhibitors

Unit – I

Drug- Definition, Drug targets, Intermolecular bonding forces, Classification of drugs: based on pharmacological effect- based on chemical structure-based on target system and based on target molecule, Naming of drugs.

Unit – II

Pro-drugs: Basic concepts and application of prodrugs design. Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism. Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient, Hammet's electronic parameter, Tafts steric parameter and Hansch analysis

Unit – III

Pharmacodynamics: - Enzymes as drug targets, Receptors as drug targets, Nucleic acids as drug targets, Miscellaneous drug targets

Unit – IV

Pharmacokinetics: - Drug absorption, Drug distribution, Drug metabolism: Drug metabolism principles- Phase I and Phase II. Factors affecting drug metabolism including stereo chemical aspects, Drug excretion, Drug administration, Drug dosing, Formulation, Drug delivery, Toxicology of drugs. Pharmacokinetic issues and medicines.

Unit – V

Anticancer agents & Therapies: Intercalating agents, non-intercalating agents, alkylating and metallating agents and chain cutters, antimetabolites, Drugs acting directly on structural proteins, miscellaneous anticancer agents, De nova synthesis of small molecule inhibitors. Therapies: Hormone-based therapies, Antibodies, antibody conjugates and gene therapy, Photodynamic therapy, H1 & H2–antagonists: Miscellaneous enzyme inhibitors.

Reference:-

1. An Introduction to medicinal Chemistry: Fourth Edition Graham L. Patrick
2. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry
3. Foye's Principles of Medicinal Chemistry
4. Introduction to principles of drug design- Smith and Williams.
5. Designing Organic Synthesis: Stuart Warren
6. Principles of medicinal chemistry- S SKadam, K R Mahadik and K G Bothara

COURSE OUTCOMES:

After completing the course, the students would able to;

- Correlate pharmacology of a disease and its mitigation.
- Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs
- Gain knowledge about different class of medicinal compounds and their synthesis process.
- Acquire knowledge about anticancer agents and therapies
- Get clear idea on the physicochemical properties in relation to biological action.
- Better understanding on classification of drugs
- Understand the chemistry of drugs with respect to their pharmacological activity.

CLINICAL MICROBIOLOGY

Course Code: 24BMSRC05 **Credits: 4**

OBJECTIVES:

- To acquire depth knowledge in medically important bacteria
- To gain information about the bacterial infection occur in digestive, reproductive, urinary system.
- To study about the *Nesseria* and *Clostridium tetani*
- To get information about the fungi and their toxins and pathogenesis of parasitology
- To study Disease control organization

UNIT I:

General

Classification and general properties of medically important bacteria. Recommendation for collection, transport of clinical specimens, isolation of bacteria from clinical specimens- Primary media for isolation and their quality control – Antibiotic sensitivity disc, testing procedure and their quality control

UNIT II:

Bacteriology - I

a) Digestive system – *Escherichia coli, Salmonella, Shigella* and *Vibrio*.
b) Urinary system – *Leptospira sp.,* and *Proteus*
c) Respiratory system – *Mycobacteriumtuberculosis*

UNIT III:

Bacteriology – II

a) Reproductive system – *Nesseria*and*Treponema*
b) Nervous system – *Clostridium tetani*

UNIT IV:

Mycology: Introduction to medical mycology – morphology of fungi. Detection and recovery of fungi from clinical speciemens.Yeast of medically importance – *Candida* and *Cryptococcus.*Mycotoxins

UNIT V:

Parasitology:.Introduction to Medical parasitology – Protozoan – *Entamoeba* – *Plasmodium, Trypanosoma*. Laboratory techniques in parasitology- Examination of faeces for ova and cysts – Concentration methods.

UNIT VI: Current Advances (Not for exam only for Discussion)

Disease Control: Awarnesss-prevention-Treatment-Role played by NGOs and Health officials.Recommendation prescribed-World Health Organization-Center for Disease Control-Indian Council for Medical Research

Reference Books:

1.Prescott, L.M., J.P. Harley and D.A.Klein. 1993. Microbiology .2nd edition. W.M.C BRown publishers.
2.Medical Microbiology – David Greenwood, Richard B Slack and John F. Peutherer.Chirchill Livingstone (London) 16th edition, 2002.
3.Jawetz., E. J.L. Melnic and E.A. Adelberg (2000). Review of Medical Microbiology. 19th edition. Lange medical publications.U.S.A
4.Ananthanarayan R. and C.K. JeyaramPanikar. 1994. Text book of Microbiology. Orient Longman.
5.Timbury M.C.1986. Medical Virology, 9th edn., Churchill Livingston London.
6.JagadishChandar, 1996. A Text book of Medical Mycology. Interprint. New Delhi.
7.Text book of Medical parasitology – subash Chandra Parija

COUSRE OUTCOMES:

After completing the course, the students would able to;

- Understanding the basic knowledge on medically important microbes
- Acquire the information on culture collection, transportation and quality control
- Get a clear idea on enterobacetriacea family and its pathogenicity
- This study helps in understanding the pathogenicity of the microbes in nervous system
- This study reveals the information about the microbial diseases.
- Acquire information on mycology, mycotoxins and medically important yeasts
- Get information on Parasites and its pathogenicity
- Better understanding of laboratory techniques used in parasitology

DRUG DISCOVERY & ASSAY DEVELOPMENT

Course Code: 24BMSRC06 **Credits: 4**

OBJECTIVES:

- To know about the Drug discovery, sources of drugs
- To study about the pharmacodynamic and pharmacokinetics of drug action
- To understand about the MIC and MBC, chromatography techniques
- To learn the HPLC, and SDS PAGE
- To study about the Toxicity assays and screening

UNIT I :

Introduction to the Drug Discovery: Drug Discovery – Definition, Historical perspective, Stages of drug discovery, Source of Drugs - Drugs from Plants, Animals, and Microorganisms - Drugs from Organic Synthesis.

UNIT II :

Drugs Action and Classification: Drug Action – Pharmacodynamic Phase and Pharmacokinetic Phase. Drug Classification – Chemical Structure, Pharmacological Action, Physiological Classification and Prodrugs.Bioavailability, Pharmacophore, Drug release and activation mechanisms.

UNIT III :

Chemotherapeutic Agents and Separation techniques: Antibiotics and Antimicrobial agents, MIC and MBC, Antiparasitic agents, Antifungal agents, Antimycobacterial agents, Antiviral agents and Anticancer agents. Separation techniques - Chromatography - TLC, GC & HPLC. Electrophoresis – SDS PAGE.

UNIT IV:

Bioassays and High throughput Screening: Types of Bioassays – Chemical bioassays – Antimicrobial assays – immunoassays – toxicity assays – Genotoxicity assays – High throughput screening – Enzyme assays – Cell based receptor functional assays – Radioligand binding assays.

UNIT V:

Proteomics and Drug Designing: Introduction, Drug designing – Rational drug design, Computer based drug design, target based drug design. Target identification, Target Validation, Screening of Hits, Lead Optimization, Pharmacology and LADME, Drug development cycle, Tox and Clinical trials.

UNIT VI :

APPLICATIONS: (Not for exam only for Discussion)

Drug release and activation mechanism – Simple one-step activation, Cascade release/activation systems.

REFERENCES:

1. Drug Discovery and Development edited by Mukund S. Chorghade published by John Wiley & Sons, Inc., Hoboken, New Jersey,**2006**.
2. Principles of Medicinal Chemistry, 6th Edition, edited by W.O. Foye, T.L. Lemke, and D. A. Williams, Williams and Wilkins: Philadelphia, **1995**.
3. Text book of drug design and discovery edited by PovlKrogsgaard-Larsen, Tommy Liljefors and Ulf Madsen, 3rd edition, published by Taylor & Francis 11 New Fetter Lane, London, **2002.**
4. Medicinal chemistry an Introduction-Gareth Thomas, 2nd edition, Published by John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, **2007**.
5. Medicinal Chemistry – A Molecular and Biochemical Approach 3rd edition, Thomas Nogrady and Donald F. Weaver, **2005**.
6. Drug Delivery: Principles and Applications - Edited by Binghe Wang, TerunaSiahaan and Richard Soltero, **2005**, John Wiley & sons, Inc.
7. Bioassay Techniques for Drug Development – Atta-ur-Rahman, M.IqbalChoudary and William J. Thomson – Harwood academic publishers, **2005**.
8. High Throughput Screening in Drug Discovery – Edited by Huser, Wiley – VCH,**2006.**
9. E-Source: NPTEL ,Biotechnology , Cell Biology Joint initiative of IITs and IISc Module 15 Drug Design and Discovery Lecture 38.
10. Scienceonline special "Drug discovery" http://www.sciencemag.org/sciext/drugdisc/ Links to additional articles of interest will be placed on the course pages on Moodle.
11. Nature Reviews: Drug Discovery

COURSE OUTCOMES:

After completing the course, the students would able to;

- Get the basic information on Various sources of drugs leads in drug discovery.
- Basic information on Different stages of drug discovery
- Get knowledge on the Steps involved in drug designing
- Learn the basic information about High throughput screening and functional assays.
- Better understanding on chromatography techniques GC and HPLC.
- Clear idea on Prodrug, bioavailability of prodrug system
- The outcome of the study provides the information on Antibiotics and its mode of action.
- Acquire basic information on mechanism of action on drug release and activation system.

MOLECULAR BASIS OF DISEASES

Course Code: 24BMSRC07 **Credits: 4**

Course Objectives

- This course is designed for the biomedical scientists and biochemists to explore the molecular aspects of human disease and how this has contributed to knowledge based treatment strategies and the development of novel therapeutics.
- Focus on the underlying molecular basis of the disease process in humans. Core topics and Research challenges in Pathology are presented as themed 'Units'.
- The course provides an insight into how molecular studies can be employed to further medical research and aid in the development of novel treatments and therapeutics.
- The course will cover a number of areas including the analysis of carbohydrate, lipid, proteins, inborn error metabolism induced disorders.

Unit-I: Introduction to molecular markers in diagnosis - Electrolytes and acid-base balance Regulation of electrolyte content of body fluids and maintenance of pH, reabsorption of electrolytes. Respiratory & renal mechanism, Acidosis & Alkalosis.

Unit-II: Disorders of Carbohydrate Metabolism - Diabetes mellitus, glucose and galactose tolerance tests, sugar levels in blood, renal threshold for glucose, factors influencing blood glucose level, glycogen storage diseases, pentosuria, and galactosemia.

Unit-III: Disorders of Lipids and Proteins - Plasma lipoproteins, cholesterol, triglycerides & phospholipids in health and disease, hyperlipidemia, hyperlipoproteinemia, Gauchers disease, Tay-Sachs and Niemann-Pick disease, ketone bodies, Abetalipoproteinemia. Abnormalities in Nitrogen Metabolism Uremia, hyperuricemia, porphyria and factors affecting nitrogen balance.

Unit-IV: Disorders of liver and kidney Jaundice, fatty liver, normal and abnormal functions of liver and kidney. Liver function test, renal function test. Diagnostic Enzymes - Enzymes in health and diseases. Biochemical diagnosis of diseases by enzyme assays SGOT, SGPT, CPK, cholinesterase, LDH.

Unit-V: Inborn Errors of Metabolism Phenylketonuria, alkaptonuria, albinism, tyrosinosis, maple syrup urine disease, Lesch-Nyhan syndrome, sickle cell anemia, Histidinemia.

Reference:

1. Methods in Molecular Medicines by Derek Kinchingto and Raymond F.Schinazi Humana Press
2. Molecular Basis of Health and Disease. Undurti N. Das
3. Molecular Pathology: The Molecular Basis of Human Disease 2nd Edition William B. Coleman, Gregory J. Tsongalis
4. The Molecular Basis of Human Disease, 2nd Edition:
5. Molecular Diagnostics: Fundamentals, Methods and Clinical Applications: by Lela Buckingham.
6. Diagnostic Molecular Pathology: A Guide to Applied Molecular Testing: by William B. Coleman
7. Robbins & Cotran Pathologic Basis of Disease (Robbins Pathology by Vinay Kumar MBBS MD FRCPath

http://www.theonlinelearningcenter.com/free-medical-games/ID6015/blood-flow-through-the-heart.html

Course Outcomes: After completing the course, the students would able to;

- Understand the molecular basis of metabolic and genetic diseases.
- Demonstrate how metabolisms are linked to particular disorders.
- Able to demonstrate patho physiological difference in diseases and functions.
- Understand the molecular processes that lead to development of Liver, kidney diseases and demonstrate how this knowledge is driving the development of potential therapeutic strategies
- An ability to critically evaluate and discuss current research centred on our molecular understanding of disease.
- Discuss and debate state-of-the-art research and concepts of disease.
- Can able to teach community about inborn error diseases and their root causes.
- Educate community people about the disease process in vernacular language.

MOLECULAR BIOLOGY OF LIVER CANCER

Course Code: 24BMSRC08 **Credits: 4**

Objective:

This course stresses the Liver cancer and its associated factors for its development. Also it includes the anatomical and physiological aspects of normal and malignant liver. The molecular pathogenesis of liver cancer, liver cancer cell lines, Animal models for liver cancer, Sub types of liver cancer, Current Diagnostic and therapeutic strategies which help students to understand the Biology of liver cancer for the research point of view.

Unit.I:

Introduction: Cancer cell and its properties, Classification of cancer (Carcinoma, Sarcoma, Leukaemia, Lymphoma), Hallmarks of cancer, apoptosis, proliferation, angiogenesis and metastasis, Cancer stem cells.

Unit.II:

Liver cancer-Introduction, Gross anatomy & physiology of liver, Epidemiology, Etiology-Alcoholisim, Aflatoxins, Viral, Induced liver cancer chemical carcinogens, Types of liver cancer, Hepatocellular Carcinoma (HCC), Cholangiocarcinoma, Hepatoblastoma, Angiosarcoma and Hemangiosarcomas. Molecular Pathogenesis of liver cancer.

Unit.III:

Viral replication, HBV genome, HBV transcription and replication, viral proteins, HBX protein- cellular interaction and transactivation, Interaction of AFB1 with genome, HBX in proliferation, Epigenetic mechanism in HCC. Liver cancer cell lines, Primary and secondary liver cancer and its subtypes.

Unit.IV:

Diagnostic tools and early biomarkers-Signs and symptoms of liver cancer, Imaging, test for viral infection, Laboratory diagnosis, Serum markers, Development of early diagnostic molecular markers-RPS27a, β-Catenin- micro RNA, Si RNA.

Unit.V:

Therapeutics: Surgery, Chemotherapy, Radiotherapy, Gene therapy- Drug resistance:Genes involved in drug resistance-Identification of new therapeutic targets-Herbal and synthetic drugs, Targeted drug delivery-Viral and nanomaterial for drug delivery-Animal models for Liver cancer-Personalized medicine for liver cancer.

Unit.VI:

Practicum: Genomics and proteomics in liver cancer- Current Pre-clinical and clinical trials for liver cancer- Current advancements in liver cancer research- Liver Transplantation-Immuno histopathology of liver cancer reports. Case study reports of liver cancer

References:

1. Cancer Biology, 2nd edition, Ruddon R.W., Oxford University Press, 1987
2. The molecular biology of cancer.Ed. Stella elengaries and Michal Khan. Blackwell ublishing,
2006
3. Stem cells (Bench to Bedside)AriffBongso, EngHin Lee (Editors)- 2005 world Scientific Publishong Co.
4. Liver cancer, Steven A Curley. Springer Verlog, New York,1998.
5. https://www.mayoclinic.org/diseases-conditions/liver-cancer/symptoms-causes/syc-20353659
6. https://www.medicinenet.com/liver_cancer_hepatocellular_carcinoma/article.htm
7. http://www.cancerresearchuk.org/about-cancer/liver-cancer

Outcome:

After completing the course, the students would able to;

- Know the basics of cancer cell and its properties.
- Understand the liver anatomy and its physiology
- Describe the types of liver cancer and its molecular pathogenesis
- Understand the HBV association in liver cancer
- Understand the different types of liver cell lines in biomedical research
- Explain the different diagnostic methods in liver cancer
- Describe the early diagnostic biomarkers for liver cancer.
- Know the current treatment options and challenges in liver cancer

ADVANCED CELLULAR & MOLECULAR BIOLOGY

Course Code: 24BMSRC09 **Credits-4**

Objectives

- To explain about DNA structure, mechanism and regulation of replication and Transcription in prokaryotes and eukaryotes
- To describe the process of proteinsynthesis& post transcriptional modification
- To explain about post translational modification &process of proteindegradation
- To explain the functionalsignificance of RNAi&microRNA.
- To explain the process of proteintrafficking
- To explain the principle and methodology of basic techniques employed in researcheg : PCR, Realtime PCR, Gene Cloning& Western blotting.
- To explain the principle and methodology of advancedmolecular techniques employed in researcheg. FACS, Co-IP &Yeasttwohybrid screening etc).

Unit I

DNA structure & replication- Mapping of replication origin: prokaryotic replication- Mapping of replication origin: eukaryotic replication - Modes of replication, regulation

Unit II

Transcription & Translation: general outline - Protein synthesis in eukaryotes and bacteria

Unit III

Post transcriptional & translational modification: capping, poly A tail - Glycosylation, Phosphorylation - Ubiquitination, RNA splicing - Protein trafficking: UPR, ERAD, retrograde protein transport

Unit IV

PROTEIN DEGRADATION: - Intracellular protein degradation: machinery & mechanism, functional significance - RNAi& microRNA: - (RNAi: biology, mechanism & applications, MicroRNA: cloning, identification, biogenesis and function.

Unit V

Techniques - Plasmid isolation, RNA isolation, cDNA preparation, Realtime PCR, Gene Cloning & expression, Mammalian tissue culture work, Mammalian cell transfection, viral infection, SDS-PAGE, Western blotting, Reporter gene assay eg- Luciferase assay, FACS, Confocal Microscopy, Ultracentrifugation, Protein interaction studies using Co-IP & Yeast two hybrid screening.

REFERENCE BOOK:-

1. Essential of Molecular biology. David Freifelder, Jones and Bartlett Publishers, 1985
2. Molecular Biology by Robert Weaver, 2nd Edition
3. Molecular Cell Biology | Arnold Berk, Harvey Lodish&Chris A. Kaiser
4. https://www.thesisscientist.com/docs/Study%20Notes/12a79a12-7a79-4d08-8f16-a84e0d70b65d
5. https://www.docsity.com/en/subjects/cellular-and-molecular-biology/
6. http://ashipunov.info/shipunov/school/biol_250/

Course Outcomes

After completing the course, the students would able to;

- Central dogma of molecularbiology.
- The process of proteinsynthesis& post transcriptional modification.
- Fundamentalstepsinvolved in post translational modification &itssignificance.
- The process of proteindegradation.
- The functionalsignificance of RNAi&microRNA.
- The process of proteintrafficking
- The principle and methodology of basic techniques employed in researcheg : PCR, Realtime PCR, Gene Cloning& Western blotting.
- The principle and methodology of advancedmolecular techniques employed in researcheg. FACS, Co-IP &Yeasttwohybrid screening etc.

CELL CULTURE AND EMBRYO BIOTECHNOLOGY

Course Code: 24BMSRC10 **Credits: 4**

Objectives:

- Understand the basic requirements for growing mammalian cells in culture and methods to assess cell viability
- Understand sources of contamination, methods to prevent contamination, and identify contaminated cell cultures.
- Understand methods commonly used to transform and select cells.
- Demonstrate ability to grow and main adherent and suspension cell cultures without contamination
- Demonstrate ability to freeze viable cells and recover these cells for future use
- Demonstrate ability to prepare cells to be used in assays
- Demonstrate ability to transform and isolate clones from cell lines
- Isolate and grow primary cells

UNIT-I:

Good Laboratory Practice (GLP):

Equipment and general practice**:** The cell culture laboratory, autoclaves and hot air ovens, tissue culture hoods, incubators, centrifuges, microscopes.

Cell culture media: Sources, functions of the main ingredients of culture media, serum free media, choice of media formulation – requirement – liquid media preparation - from powder.

Primary culture: Why use primary cells? – Methods of isolation – isolation of chicken embryo fibroblasts – isolation of rat hepatocytes

Human primary cells: Isolation of thyrocytes – isolation of umbilical vein endothelial cells – special requirements for primary cell culture – immortalization of primary cells.

Continuous cell line: Types of established cell lines – preparation – assessment of cell cultures – cell counting – suspension culture – adherent culture – subculturing of cells – setting up growth curve scaling up production: roller bottles, spinner cultures, microcarrier beads.

UNIT-2:

Contamination: Types of contamination – curing – antimicrobial agents – fumigation.

Cryopreservation:Cryopreservatives – freezing mixture – freezing down cells – thawing procedure.

Cloning techniques:Cloning by limiting dilution – mathematical design, feeder layers, cloning efficiency – soft agar cloning – ring cloning.

Cell fusion: Aims and requirements - fusion partners - fusion technique - hybrid screening - expanding and cloning of hybrid.

Transfection:Principle - DNA source - Transfection of DNA in to eukaryotic cells - electroporation - identification and use of transfected cell - applications.

Cell synchronization:

Cytotoxicity assays**:** Killer cells - effector cell proliferation - target cell lines - cytotoxicity assay - interpretation

Measurement of cell death**:** Apoptosis, necrosis and anoikis - visual methods - biochemical methods - applications.

UNIT- 3:

Cell culture technology: Animal cell culture forprocesses and products - In vitro hormone, enzyme, growth factors etc. - production - Monoclonal antibody production - Cell culture based products - Diagnostic purpose (Karyological studies - cytotoxicity testing).

Stem cell culture and applications**:** Stem cells - Types of stem cells (Adult and Embryonic stem cells) - sources - separation and isolation - culture techniques- characterization with markers - applications.

UNIT-4:

Assisted Reproductive technology (ART):Introduction to ART - Indications for ART - Male and female ART - Collection and processing of sperm - Sperm cryopreservation - Induced ovulation and acquisition of ovum - IUI - ICSI - IVF - Embryo culture - Embryo and sperm sexing - Embryo transfer - Embryo cryopreservation - Monitoring of implantation and pregnancy - outcome.

UNIT-5:

Reproductive cloning and organ / tissue transplantation: Principles and strategies of reproductive cloning in animals and man - Bioreactor - Success so far, ethical considerations, and laws - Testis transplantation and ovarian tissue transplantation - Xeno transplantation

REFERENCE BOOKS:

CELL CULTURE:

1. General techniques of cell culture, Maureen Anne Harrison & Ian Frasar Rae; 1997.
2. Animal Cell Biotechnology : Methods and Protocols, Nigel Jenkins; 1999
3. Embryonic Stem cells: Methods and Protocols, KursadTurksen; 2001

EMBRYO TECHNOLOGY:

1. Prinon, R. Jr. Biology of Human Reproduction. University Science Books, Saualito, California. 2002.
2. Gerris, J., Olivennes, F. and De Suter, P. Assisted Reproductive Technologies. Taylor and Francis, London and New York. 2004.
3. Basu, S.C. Male Reproductive Dys function. Jaypee Brothers, New Delhi. 2005.

4. Ian Gordern, Laboratory Production of Cattle Embryo - Ireland; Duplin.
5. E-Book: Cloning Human Organs: Potential Sources and Property Implications by Laura J. Hilmerthttps://pdfs.semanticscholar.org/955f/b73cb529c1d97144a58cd74fa7e4949c6ddc.pdf
6. Scientific and Medical Aspects of Human Reproductive Cloning (2002) https://www.nap.edu/read/10285/chapter/4
7. CELL CULTURE TECHNOLOGIES https://swayam.gov.in/course/3713-cell-culture-technologies

Course Outcomes: After completing the course, the students would able to;

- The student will be able to describe the basic components of culture media and the conditions required to grow and maintain cells in culture.
- The student will be able to explain sterile technique used for growing cells in culture, the sources of bacterial and fungal contamination and be able to identify contamination.
- The student will be able to demonstrate techniques used to transform, identify, and isolate cells of interest.
- The student will be able to preserve and retrieve cells for future use
- The student will be able to isolate and culture primary cells
- The student will be able to prepare cells for assays.
- Students can able to handle cells for transfection using chemical and /or physical methods.
- Able to infect primary and cell-lines using various virus and capable to over express proteins, knock-down particular protein, and RNAs

STRUCTURAL BIOINFORMATICS, MOLECULAR MODELING AND DRUG DESIGN

Course Code: 24BMSRC11 **Credits: 4**

OBJECTIVES:

- To learn bioinformatics in detail.
- To study process involved in molecular modeling.
- To learn how to design a drug.
- To acquire detailed knowledge in proteomics and genomics for understanding the human disease.
- To learn the implications of SAR/QSAR.

UNIT I:

Structural bioinformatics- understanding structural basis for biological phenomena - challenges in structural bioinformatics-integration of structural data with other data - Structure Databases -PDB, NDB molecular modelling data bank(MMDB), secondary structure predictions protein folding and functionality sites, protein structure prediction, homology modeling - protein identification and characterization AAcompIdent, TagIdent, pepIdent, proresearch, PepMAPPER, Findpept, Pepsea, method of sequence based protein Identification.

UNIT II:

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 dynamics simulation methods; molecular dynamics using simple models, molecular dynamics with continuous potential-setting up and running a molecular dynamic simulation, constraint dynamics; montecarlo simulation of molecules-simulation for conformational analysis-Ab initio –Density-functional theory and semiemperical methods.

UNIT III:

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.

UNIT IV:

Macromolecular modeling -software tools for modeling bio-molecules.molecular electrostatic potentials, charge and analyses. protein conformations, folding and mutation through modeling-design of ligands for known macro molecular target sites.

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.

UNIT V:

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 disease at molecular level - new targets for anti-cancer drugs,Drug that rescue mutant p53's.

UNIT VI: Current Advances (Not for exam only for Discussion)

Genome Database: GOLD – Genome Features of Prokaryote and Eukaryote – Genome annotation – Gene finders: GLIMMER and GENSCAN - Genome browser: UCSC –Genome projects: E.coli, A.thaliana and Human – Genomic Variations (SNP) – Genome Expressions (Microarray) – Computational approaches in Comparative Genomics: CMR, MUMMER and ACT

REFERENCES:

1. C.R.cantor&P.R.Schimmel,Biophysical chemistry part -I ,W.H.Freeman&Co.,in San Fransisco,1980.

2. C.Branden and J.Tooze, Introduction to Protein Structure,Garland Publishing Inc.,New York.,1999.

3. P.E.Bourne and H.Weissig(Eds.) Structural Bioinformatics,John-Wiley and Sons,2003.

4. Andrew leach,MolecularModelling : Principles and applications(2nd Edition),Addison Wesley Longmank,Essex,England,1996.

COURSE OUTCOMES:

After completing the course, the students would able to;

- This paper aim to introduce the bioinformatic approach for molecular modeling and drug designing.
- This paper for structure prediction, sequencing, protein structure identification.
- It contains pharmacophore, pharmacokinetics.
- Implication of SAR/QSAR
- Advances of drug design
- It contains Genomics and proteomics for understanding a disease.
- The paper contains molecular tool for structure analysis and molecular electrostatic potential.

INTRODUCTION TO ANTIBIOTICS, ANTIBIOTIC RESISTANCE AND EFFLUX PUMP

Course Code: 24BMSRC12 **Credits: 4**

OBJECTIVES:

- To gain in-depth knowledge of antibiotics, antibiotic resistance and efflux pump.
- To review the mechanism of efflux pump network.
- To understand the negative impact of antibiotic resistance and efflux pump.
- To disclose the potential target to suppress the antibiotic resistance against bacteria.
- To design the novel inhibitor against antibiotic resistance

UNIT I:

Introduction to antibiotics

Definition – history – classes – types – production – medical uses – side effects – indiscriminate use.

UNIT II:

Drug resistance

Multi drug resistance – antibiotic resistance – bacterial resistance strategies – mechanism of resistance against different antimicrobial classes – antibiotic mode of action – intrinsic resistance – acquired resistance – mutations – preventing the emergence of antimicrobial resistance.

UNIT III:

Detection of antibiotic resistance

Antibiotic sensitivity methods – dilution methods – disk diffusion methods – E – test – automated methods – genotypic methods – mechanism specific tests – minimum inhibitory concentration methods.

UNIT IV:

Introduction to efflux pump

Definition – history – classification – physiology of efflux pumps – role of efflux pump in extrusion of drug – importance of efflux pumps in antibiotic resistance – efflux pump inhibitors.

UNIT V:

Efflux pumps in bacteria

Plasmids and resistance genes in multidrug resistance organisms - *E. coli – Klebsiella– Staphylococcus – Mycobacterium tuberculosis.*

UNIT VI: Current Advances (Not for exam only for Discussion)

Efflux pumps in fungi and antifungal agents

Efflux pump in *Candida albicans – Aspergillusterreus - Cryptococcus neoformans – antifungal agents – inhibitors.*

REFERENCES:

1. Antibiotic Resistance Mechanism & New Antimicrobial Approaches – KaterynaKon and MahendraRai.

2. Microbial Efflux Pumps: Current Research –H. Brown, Stephanie Baugh.
3. Review Article Efflux pumps as antimicrobial resistance mechanisms,Keith Poole
4. The importance of efflux pumps in bacterial antibiotic resistance ,M. A. Webber L. J. V. Piddock

COURSE OUTCOMES:

After completing the course, the students would able to;

- The outcome of the study is to provide detailed knowledge about antibiotics, antibiotic resistance and efflux pump.
- The proposed study discloses the potential target for the retardation of antibiotic resistance mechanisms.
- This study reveals the efflux pumps normal physiology and mode of action.
- This study explains the significance of efflux pump in antibiotic resistance mechanism.
- This study designs the potential inhibitors against the antibiotic resistance.
- It also leads to the improvement of effective antibiotic therapies.
- This study discloses the development of multi – drug resistance mechanism.
- Moreover, it sheds the lights on designing of new effective antibiotics with the consideration of the efflux pump mechanism.

INTRODUCTION TO QUORUM SENSING

Course Code: 24BMSRC13 **Credits: 4**

OBJECTIVE:

- To gain knowledge about how bacteria communicate with each other
- To know about their signaling molecules
- To understand their regulation of gene expression
- To get idea about their virulence mechanism
- To understand their roles in pathogenesis

Unit I:

Quorum sensing

Introduction to Quorum sensing- history-types of quorum sensing circuits- QS in gram positive bacteria- QS in gram negative bacteria- and their types of signal transduction

Unit II:

Signalling molecules

Auto-inducers – introduction - synthesis and secretion – functions - regulation of gene expression - quorum quenching - and its applications

Unit III:

Processes controlled by QS

Bio-film formation - virulence factor secretion – bioluminescence - antibiotic production- sporulation - signals and mechanism involved

Unit IV:

Techniques

Cell culture techniques - Western Blotting - PCR- RT-PCR - antibiotic sensitivity assay - determination of MIC - genotyping-pulse field electrophoresis-DNA sequencing -Molecular docking

Unit V:

QS in pathogenesis

Role of quorum sensing in pathogenesis - control of virulence factor production - Inhibition of QS as a therapeutic approach - Impact on gene regulation- Quorum sensing inhibitors - and their biomedical applications

Unit VI: **Recent trends (Not for exam only for Discussion)**

Quorum sensing circuits

The LuxR/I ,LasR/I , RhlR/I, AI-2 type quorum sensing circuits – Quorum sensing in fungi- *C.albicans* - mechanism

References:

1. Quorum sensing: Methods and protocols – Kendra P.Rumbaugh
2. Quorum sensing – Jesse Russell, Ronald cohn
3. Quorum Sensing vs Quorum Quenching: A Battle with No End in Sight – Vipin Chandra Kalia
4. https://en.wikipedia.org/wiki/Quorum_sensing
5. https://www.britannica.com/science/quorum-sensing
6. http://iai.asm.org/content/68/9/4839.full

COURSE OUTCOME:

After completing the course, the students would able to;

- The main outcome is to reduce the pathogenicity of bacteria which is regulated by quorum sensing mechanism
- Quorum sensing inhibitors would inhibit quorum sensing and aids in multiple therapies
- It's virulence factors can be controlled either using natural or chemical compounds
- The knowledge on their impact on gene regulation can be useful to the scientists in this field of research
- Role of quorum sensing in pathogenesis can be helpful in reducing the risk of many chronic diseases
- Antibiotic resistant bacteria can be treated by inhibiting quorum sensing
- Quorum quenching is a new field of research and helps the future perspectives.

PROTEOMICS AND PROTEIN BIOINFORMATICS

Course Code: 24BMSRC14 **Credits: 4**

Objective:

- To learn protein detection and purification methods.
- To understand the proteins databases with respect to structure, function and post transcriptional modifications.
- To learn protein – protein interactions, techniques for separation and analysis, database and applications

Unit-I: Chemical and biochemical Protein synthesis, Protein Determination, Gels, Staining Gels, Precipitate and Concentrating, Blotting, Autoradiography of Gels and Blots, Ligand Binding, Radioactive Ligand Marking, Binding, Analysis of Binding Data, Crosslinking of Ligands, Purposes, Solubilization of Membrane Proteins, Detergents, Solubilization

Unit-II: Protein Detection via Functional Measurements, Translocators, Reconstitution, Flux Assay, Cleaning and Purifying, Conventional Purification Methods, Affinity Chromatography, The Purity Test,Profiting.

Unit-III: Immunoprecipitation, Immunoaffinity Chromatography, Antibodies Against Unpurified Proteins, Immunological detection techniques, Glycoproteins, Detecting Glycoproteins in Gels, Detection of Glycoproteins on Blots, Deglycosylation,The Sugar Chains.

Unit-IV: Proteomics: Sample taking, 2D gel electrophoresis, Mass Spectroscopy of Peptides and Proteins, Protein Chips, Microsequencing, Protein Bioinformatics Databases and Resources, UniProt Protein Knowledgebase, Protein Ontology Resources, Generation of the Resource and Its Use in Obtaining Structural and Functional Annotations for Protein Sequences, Structure-Based Virtual Screening, Protein Post-Translational Modification Bioinformatics, , Navigating the Glycome Space and Connecting the Glycoproteome Analysis of Protein Phosphorylation and Its Functional Impact on Protein–Protein Interactions.

Unit-V: Protein Network Bioinformatics: Functional Interaction Network Construction and Analysis for Disease Discovery, Prediction of Protein Interactions by Structural Matching: Prediction of PPI Networks and the Effects of Mutations on PPIs that Combines Sequence and Structural Information Bioinformatics Analysis of Functional Associations of PTMs Bioinformatics Analysis of PTM-Modified Protein Interaction Networks and Complexes.

Text book:

1. Protein Biochemistry and Proteomics Rehm1st Edition by Hubert
2. Protein Bioinformatics by Cathy H. Wu, Cecilia N. Arighi, Karen E. Ross

3. Proteomics: Methods and protocols by Lucio Comai, Jonathan E.Katz and Parag Malick

Student Learning Outcome:

Upon successful completion of the course student will be able to:

- Give a detailed description on protein synthesis and determination
- Provide an overview about protein detection
- Understand the protein purification methods
- Explain the details about protein analysis using Mass spectroscopy
- Analysing the identified proteins by comparing in protein databases like UniProt
- Describe the features of protein interaction database
- Construction of protein – protein interaction networks
- Predicting the PPI networks for structural and functional associations.

GASTROENTEROLOGY-SPECIAL EMPHASIS ON GASTRIC DISEASES AND ITS MOLECULAR SIGNALLING

Course code: 24BMSRC15 **Credits: 4**

Objectives:

- To gain knowledge on gastric anatomy and physiology.
- Explains about various gastric diseases their epidemiology, treatment and prevention.
- Provides knowledge about gastric cancer and some of its molecular signalling pathways.

UNIT-I

Gastrointestinal Anatomy- Anatomy, Histology and Development- Hollow organs: Oral cavity- Oesophagus- Stomach- Small, Large Intestine (Colon, rectum and Anus). Solid organs: Pancreas- Biliary Tract- Liver- Gall bladder.

UNIT-II

Gastric Physiology- Layers of Stomach- Cells of Stomach- Gastric glands- Gastric Secretions- Formation and Secretion of Gastric Acids- Gastric Hormones- Regulation of Gastric Secretion.

UNIT-III

Gastritis and Gastropathies- Classification, Treatment and Prevention- Helicobacter pylori- Infection, Epidemiology- Diagnosis, Treatment- **Peptic Ulcer Disease-** Pathophysiology- Types and causes- History- Anti-secretory and Acid-Neutralizing Agents- Ulcers Associated with Helicobacter pylori infection- Peptic Ulcer Associated with Non-steroidal Anti-inflammatory Drugs- Refractory Peptic Ulcers- Stress-Related Mucosal Injury- Treatment of Complications

UNIT-IV

Gastric cancer- Epidemiology- Types- Pathophysiology- Signs and symptoms- Causes- Dietary causes- Environmental causes- Genetic mutations- Other causes- Risk factors- Diagnosis and staging- Treatment and prevention.

UNIT-V

Molecular signaling in GC- Dysregulation of developmental pathways- TGF-β pathway- Signaling mechanism- TGF-β targeting EMT process- TGF-β based therapies- HAA metabolism- AHR receptor pathway- Signaling mechanism- Dysregulation of receptor- Inhibitors and drugs in treatment.

References:

1. Stomach Anatomy and Structural Anomalies - Yamada's Textbook of Gastroenterology.
2. Gastritis and Gastropathies – Textbook of clinical gastroenterology and Hepatology, Second edition, 2012.
3. Gastric cancer - The book *Gastric Cancer*: diagnosis and treatment of gastric cancer.
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5949124/pdf/IBJ-22-217.pdf.

Course outcomes:

After completing this course students would be able to,

- Understand about gastrointestinal anatomy and physiology.
- Learn about various gastric diseases and the epidemiological reasons.
- Know about the available treatments for the diseases and preventive measures.
- Understand specifically about gastric cancer and its ailments.
- Exposed to specific genetic and molecular mutations in gastric cancer.