



Program

M Sc - Molecular Medicine

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PROGRAMME OUTCOMES

Each graduate will be able to:-

- Develop a sound molecular understanding about the different diseases we encounter and how at molecular level one could tackle the issues to develop diagnostics and therapeutics for the betterment of healthcare.
- Student should be able to design strategies using molecular techniques taught to address issues pertaining to biotechnology development.
- Empower the student with capabilities that help them to take up transnationally oriented projects that help the society.
- Students have a wide option of choosing different medically oriented careers.
- Equip them to approach research confidently due to the hands on training of various techniques and writing manuscripts for publication.
- Student develops the skills to present their work in any forum for better projection of their work and biotechnology skills they acquired.
- As they are introduced to the translational aspects of medicine, they are better geared to innovate start-ups and transform themselves into entrepreneurs.

PROGRAMME EDUCATIONAL OBJECTIVES

Molecular medicine is the study of molecular and cellular phenomena in biological systems, molecular aspects of human diseases, the human body's response to diseases, heterogeneity of response and personalized medicine, stem cells, immune response and genetic determinants. The course covers the use of molecular understanding in discovery research in disease prevention, drug development, diagnosis and therapy.

One of the unique strengths of this course is its emphasis on an interdisciplinary approach whereby medical sciences, molecular and biochemical aspects of biology is addressed. All students will be required to conduct a one year thesis research that provides hands-on experience in molecular biology techniques, cell culture, biochemical techniques and genetic analysis.

Molecular medicine deals with the molecular aspects of human diseases, how human body responds to drugs/personalized medicine, to stem cells, to immune therapy and genetic determinants. The course thus aims the student to be skillful in molecular and cellular understanding of the biochemical mechanisms involved in disease context towards developing diagnostics or therapeutics and makes them versatile to choose either academia or an industrial carrier and do service to the community.

CURRICULUM

First Semester

Course Code	Type	Course	LTP	Credits
18MM604	FC	Cell Biology	300	3
18MM602	FC	Basics in Human Physiology and Pathology	400	4
18MM603	FC	Clinical Biochemistry and Proteomics	300	3
18MA613	FC	Statistical Data Analysis	101	2
18MM621	SC	Immunology	300	3
18MM622	SC	Molecular Biology	300	3
18HU604	HU	Amrita Values Programme	100	1
18HU602	HU	Career Competency-I		P/F
18MM623	SC	Biochemistry Lab	101	2
18MM624	SC	Molecular Biology Lab	101	2
18NS623	SC	Cell Culture and Animal Lab	101	2
		Total Credits		25

Second Semester

Course Code	Type	Course	LTP	Credits
18MM626	SC	Molecular Basis of Diseases	200	2
18MM627	SC	Genetic Engineering	300	3
18MM628	SC	Molecular Diagnostics	200	2
18NS602	SC	Pharmacokinetics and Pharmacodynamics	200	2
18NS606	SC	Bioinformatics and Structure based Drug Design	202	4
18MM636	SC	Clinical Microbiology	300	3
18MM633	SC	Genetics	300	3
18MM634	SC	Neurobiology:Chemical and Architectural Organization of Brain	200	2
18HU603	HU	Career Competency-II	100	1
		Total Credits		22

Third Semester

Course Code	Type	Course	LTP	Credits
18RM601	FC	Ethics in Research and Research Methodology	101	2
18MM632	SC	Stem Cell Biology and Therapy	300	3
18MM635	SC	Organoid Culture And Its Applications In Medicine	200	2
18MM796	P	Dissertation		5
		Total Credits		12

Fourth Semester

Course Code	Type	Course	LTP	Credits
18MM797	P	Dissertation		10

		Total Credits		10
		Overall Total Credits		69

SEMESTER I.

18MM604 CELL BIOLOGY 3-0-0-3

LEARNING OUTCOMES

This course will impart vital knowledge to the students on,

- Cell chemistry and biosynthesis
- Internal organization of cells
- Cells in their social context
- Germ cells and fertilization
- Genetic mechanisms underlying development

Course details

Cell Biology: Cell chemistry and biosynthesis: the chemical components of a cell, catalysis and the use of energy by cells, how cells obtain energy from food; Classification and properties of cell: Introduction to different types of cells; Membrane structure: the lipid bilayer, membrane proteins; Membrane transport of small molecules and electrical properties of membranes: principles of membrane transport, active membrane transport, ion channels; Intracellular compartments and protein sorting: compartmentalization of cells, the transport of molecules between the nucleus and cytosol, transport of proteins to different organelle; Intracellular vesicular traffic: molecular mechanisms, transport from the ER through the golgi apparatus, transport from the trans-golgi network to lysosomes, endocytosis, exocytosis; Mechanisms of cell communication: general principles, signaling through GPCRs and enzyme-coupled surface receptors, signaling pathways dependent on regulated proteolysis of latent gene regulatory proteins; Cytoskeleton: self-assembly and dynamic structure of cytoskeletal filaments, molecular motors, cytoskeleton and cell behavior, Cell cycle: an overview, cell cycle control system, control of cell division and cell growth; Apoptosis: cell death, extrinsic and intrinsic pathways; Cell junctions, cell adhesion and extracellular matrix: cadherins and cell-cell adhesion, tight junctions, passageways from cell to cell, integrins and cell-matrix adhesion, extracellular matrix. Germ cells: Primordial germ cells, Meiosis, Eggs, Sperms. Developmental biology: Universal mechanisms of animal development, Development from the perspective of a single cell, The molecular genetics of pattern formation, The patterning of anteroposterior axis, Organogenesis and patterning of appendages, The shaping of the vertebrate body, The mouse development, Neural development.

TEXT BOOKS/REFERENCES:

Alberts B, Johnson A, Lewis J, Raff M, Roberts K and Walter P, "Molecular Biology of the Cell", Fifth Edition, Garland Publishing Inc. 2008

Kim E, Barrett, Susan M, Barman, Scott Boitano, and Heddwen Brooks, "Ganong's Review of Medical Physiology", 24th Edition, McGraw-Hill Medical, 2012

Gerald Karp, "Cell and Molecular Biology", Fifth Edition, John Wiley, 2008

18MM602 BASICS IN HUMAN PHYSIOLOGY AND PATHOLOGY 4-0-0-4

LEARNING OUTCOMES:

- To articulate what is meant by extracellular and intracellular compartments, and how to measure them.
- Be able to differentiate between serum and plasma, and each of their components.
- Be able to articulate the underlying principle of the haemoglobin saturation curve.
- To articulate the mechanisms of the four different types of cellular adaptation.
- To be able to outline the different routes available for a cell to respond under condition of various stressors, with examples.
- Be able to succinctly explain the cellular steps involved in inflammation.
- To articulate the mechanism of cellular regeneration of liver cells.
- Be able to explain the pressure-volume relationship in the context of electrophysiological changes in the cardiac cycle.
- Be able to explain the role of calcium ion in cardiomyocyte function and during ischemia.
- To understand the overall mechanics of respiration in relation to lung volume and transpulmonary pressure, and how these are affected in obstructive lung disorders.
- Be able to discuss the process involved in urine formation, and how this process is affected in glomerular injury.
- To understand the diverse functions of the GI tract and the underlying principle of the peristaltic wave.
- To understand the uniqueness of hepatic blood supply, and functioning of the hepatic lobule.
- To be able to discuss the mechanism of hepatic scar formation.
- Be able to articulate the endocrine function of the pancreas.
- To understand the ionic basis of an action potential and its manifestation in the form of neurotransmitter release for signal transmission in a neuron.
- Be able to describe neuronal excitotoxicity in glutaminergic neurons.
- To describe features of a neurons in a degenerating disease with Alzheimer's disease as an example.
- To describe the overall architecture of the eye ball and explain the signal transduction in the retina
- Be able to explain the mechanism of sound perception in humans. Student should also be able to explain some of the defects of hearing.
- Should be able to identify some of the receptors involved in taste and smell.

- Be able to identify the main endocrine glands, their secretions and their regulating hormones, along with function.
- Explain the functioning of the thyroid, pancreatic and the adrenal glands.

SYLLABUS:

Physiology: This module pertains to the study and understanding of organ-based physiological processes in the human body during homeostasis. The module covers the following topics: Body water and distribution, regulation of water within extracellular, transcellular and intracellular compartments, determination of compartmental fluid volumes, blood and lymphatic system, function-regulation of the cardiovascular system, the cardiac cycle, hepato-biliary system, pancreas physiology, regulation and processes involved in urine formation, the musculoskeletal system and calcium regulation, control of respiration, lung volumes and flow, nervous system – generation of action potential, role of voltage gated ion channels, synapse physiology, and basics of neural networks in brain, special senses, and reproductive physiology.

Pathology: This module is divided into two segments: The first segment covers the basic pathological processes such as inflammation, compensatory cellular changes – Hypertrophy, hyperplasia, atrophy and metaplasia, fluid handling disturbances, malignant cellular changes, immunological & metabolic responses, and healing. The second segment covers the study of diseases based on organ systems: Cardiovascular, pulmonary, gastrointestinal, hepato-biliary, renal, musculoskeletal and nervous system disorders. Changes at the level of tissues and cells will be studied within each disease. Conditions such as diabetes, obesity, and hypertension, that are estimated to form the bulk of healthcare load in the next few years, will be given special emphasis. Etiological and mechanistic basis of these conditions will be discussed in detail.

Prescribed text books:

- 1. Guyton and Hall Textbook of Medical Physiology, 13th Edition*
- 2. Robbins & Cotran Pathologic Basis of Disease, 9th Edition*

18MM603CLINICAL BIOCHEMISTRY AND PROTEOMICS 3-0-0-3

LEARNING OUTCOMES

Student will learn

- How the fundamental biochemical mechanisms are tightly regulated
- How alteration of molecular signals in biochemical pathway leads to disease like cancer.
- How the biochemical changes at protein level during disease process can be identified using proteomics technology.
- The use of proteomics techniques for identification of biomarkers of diagnostics and therapeutic significance.

SYLLABUS:

Clinical Biochemistry: Biochemistry & Medicine, how cells can respond to changes in biochemical environments, key organic molecules used by living systems, bioenergetics: the role of ATP, biologic oxidation, glycolysis & the oxidation of pyruvate, clinical significance

of glycolytic pathway, the citric acid cycle, metabolism of glycogen, gluconeogenesis, the Calvin cycle and the pentose phosphate pathway, control of the blood glucose and associated clinical diseases, the respiratory chain & oxidative phosphorylation, biosynthesis of fatty acids, oxidation of fatty acids: Structures & function of proteins & enzymes, mechanism of action of enzymes and its regulation.

Proteomics: What is proteome and proteomics, how it is different from genomics, different types of proteomics, significance of sample preparation in proteomics, significance of choosing different methods for proteome analysis, different methods used for proteomic analysis, principles of mass spectroscopy, how proteins are identified using mass spectrometry, Protein fragmentation; Peptide enrichment and separation; Ionization and its Importance; Time of Flight, MS/MS analysis, Peptide fragmentation and peptide sequencing, Identification of proteins using search engines/programs, Accuracy of these identified proteins with respect to protein identity, significance of mass spectrometry in clinics, clinical proteomics and examples of clinical proteomics.

TEXT BOOKS:

Fundamentals of Biochemistry: Life at the Molecular Level Kindle Edition by Donald Voet (Author), Judith G. Voet (Author), Charlotte W. Pratt (Author) 5th edition 2016

Nawin C. Mishra, "Introduction to Proteomics: Principles and Applications" Wiley, 2010, ISBN: 0471754021

REFERENCE:

Lehninger Principles of biochemistry 7th Edition (2017), Publisher: WH Freeman, Authors Michael Cox, David L. Nelson.

18MA613 STATISTICAL DATA ANALYSIS 1-0-1-2

LEARNING OUTCOMES:

Students who complete the course will understand the following:

- *The basic concepts of statistics and the need for statistical methods in research*
- *Data Analysis Methods*
- *The fundamental theory of probability and standard distributions*
- *Tests of Significance used in Statistical analysis*
- *The different types of multivariate analysis used in research*
- *Practical analysis of data using standard softwares like SPSS, SAS*
- *Practical understanding of Descriptive Data Analysis, Sampling Theory, Biostatistical Inference, Testing of Hypotheses, Nonparametric Methods and Multivariate Regression Analysis*

SYLLABUS:

Introduction to Statistics-Need for Statistical Methods –Their uses and Misuses, Types of Variables, Data collection Methods, Population and Sample.

Descriptive Data Analysis Methods- Statistical Tables, Diagrams & Graphs, Measures of Averages, Measures of Dispersion, Correlation Analysis Methods, Regression Analysis Methods.

Theory of probability and Standard Distributions - Binomial, poisson & Negative Binomial, Standard univariate continuous distributions – Normal, Log normal & Exponential. Sampling distributions – Chi- square distribution and F & ‘t’ distributions.

Tests of Significance of Statistical Hypotheses- Concept of Statistical Hypotheses –Null and Alternative hypotheses, Type I and Type II errors, Significance level, Critical region and Power of a test , P- value and its interpretation; Large and Small Sample Test – Normal test, Student’s ‘t’ test, Chi-square tests, Analysis of variance & Non parametric methods.

Nonparametric methods-Non-parametric methods for estimation, Methods for tests of significance for the independent and correlated samples, Nonparametric Methods for more than two populations.

Multivariate analysis Methods- Principles of Multivariate analysis, Multivariate regression analysis, Multivariate logistic regression analysis.

Practicals- (Statistical Software to be used: SPSS & SAS): (i) Practical in Descriptive Data Analysis Methods, (ii) Practical in Sampling Theory, (iii) Practical in Biostatistical Inference, (iv) Practical in Testing of Hypotheses, (v) Practical in Nonparametric Methods, (vi) Practical in Multivariate Regression Analysis.

TEXT BOOKS/REFERENCES:

Statistical Techniques for data Analysis: J.K. Taylor & Cheryl C, 2004 Chapman & Hall (CRC).

Performing Data Analysis Using IBM SPSS: Lawrence S Meyers, 2015, John Wiley.

18MM62**1IMMUNOLOGY****3-0-0-3****LEARNING OUTCOMES:**

Students who complete the course will understand the following:

- Principles of innate and adaptive immune system, the mucosal immune system and immunological memory.
- Understand the antigen receptor structure and the mechanisms of antigen recognition by B-cell and T-cells.
- Mechanisms of immunoglobulins, B- and T-cell receptors gene rearrangement.
- Gain knowledge about the major histocompatibility complex and its functions.
- Understand scientific principles behind T and B Cell-Mediated immune Response.
- Immune response against infectious agents and tumor cells.
- Inherited immunodeficiency diseases.
- Understand the mechanism of allergic responses and hypersensitivity reactions.

- Understand the mechanism of autoimmunity and transplantation
- Immunization and manipulation of the immune system to fight disease. Immunization (haptens and adjuvants) and route of immunization
- Techniques for immunological disease diagnosis.

Suggested books :

1. *Janeway's Immunobiology*, Ken Murphy, Paul Travers, Mark Walport, 9th edition, Garland science publishing, 2007.
2. *Cellular and Molecular Immunology*, Abul K Abbas, Andrew H. Lichtman, Shiv Pillai 9th edition 2017.

Basic concepts in immunology: Cells and organs of the immune system, Principles of innate and adaptive immunity, The effector mechanisms of immunity, The complement system and innate immunity. The induced responses of innate immunity; Pattern recognition by cells of the innate immune system, Induced innate responses to infection.

Antigen Recognition by B-cell and T-cell Receptors: The structure of a typical antibody molecule, The interaction of the antibody molecule with specific antigen, Antigen recognition by T cells. Antigen presentation to T lymphocytes: The generation of $\alpha \beta$ T-cell receptor ligands, The major histocompatibility complex and its function, Generation of ligands for unconventional T-cell subsets. Development of B and T lymphocytes: Development of B lymphocytes, Development of T lymphocytes, Positive and negative selection of T cells.

T cell mediated Immunity: Development and function of secondary lymphoid organs, Priming of naive T cells by pathogen-activated dendritic cells, General properties of effector T cells and their cytokines, T-cell-mediated cytotoxicity.

The humoral immune response: B-cell activation by antigen and helper T cells, The distributions and functions of immunoglobulin classes, The destruction of antibody-coated pathogens via Fc receptors.

Integrated dynamics of innate and adaptive immunity: Integration of innate and adaptive immunity in response to specific types of pathogens, Effector T cells augment the effector functions of innate immune cells, Immunological memory.

Manipulation of the immune response: Treatment of unwanted immune responses, Using the immune response to attack tumors, Fighting infectious diseases with vaccination.

Modulating the immune system through nanotechnology: Nanoparticles and the immune system, Nanoscale immune activation, Nanotechnology in vaccination, Nanoparticle-based vaccine carriers, Nanotechnology and immunosuppression, Nanoparticles as vehicles for immunosuppressants.

18MM622

MOLECULAR BIOLOGY3-0-0-3

LEARNING OUTCOMES:

After successful completion of the course, students will be able to:

- *Understand the structure and function of DNA, RNA and proteins*
- *Understand the basics of DNA and RNA replication, transcription, translation and DNA-repair systems*
- *Understand how genetic switches work, the basics of gene regulation in prokaryotes and eukaryotes*
- *Understand the consequences of different types of mutations and recombinations*
- *Understand basic and advanced molecular biology concepts and techniques.*
- *Ability to read, comprehend and communicate latest research findings through oral presentations and written assignments.*

SYLLABUS

Cell and its molecules , DNA : Structure and function, Chromosome and chromatin, Genetic code, wobble hypothesis, RNA and types of RNA basic siRNA and its Dicer, RISC function, shRNA, miRNA and its function, siRNA and miRNA mediated pathways, miRNA and its function on disease, rasiRNA, tasiRNA, nat-siRNA, piRNA, PIWI, Piwi subfamily MIWI, MIWI2, MILI,, Proteins and their structure, DNA replication and its regulation(prokaryotes and eukaryotes), Homologous and site specific recombination, DNA repair ,Transcription and its regulation(prokaryotes and eukaryotes) , Translation and its regulation (prokaryotes and eukaryotes),Gene structure, Repeats and clusters , Genome evolution, Gene expression , Gene expression regulations(prokaryotes and eukaryotes),operon, phage strategies , Epigenetics, Methylation ,Histone modifications, Regulation of epigenetics, Regulatory RNAs, Gene regulation in development and evolution, DNA Mutation, Types of mutations, Genetic system of Mitochondira and plastids, Gene recombination, Systems biology, Gene identification, promoter identification, molecular biology techniques : Isolation and Quantification of DNA/RNA,PCR, Reverse transcriptase PCR,,Real Time PCR, Bioinformatics ,SDS PAGE, 2D gel electrophoresis,hybridization (southern, northern and western), sequencing, protein interaction studies.

TEXT BOOK:

Lewin's Essential Genes, Jocelyn E. Krebs, Benjamin Lewin, Elliott S. Goldstein, Stephen T. Kilpatrick, Jones & Bartlett Publishers, 2013 - Science - 847 pages

REFERENCES

Molecular Biology of the Gene, Seventh Edition, James D. Watson, Cold Spring Harbor Laboratory; Tania A. Baker, Massachusetts Institute of Technology; Alexander Gann, Cold Spring Harbor Laboratory; Michael Levine, University of California, Berkeley; Richard Losick, Harvard University, 2013

18HU604 HU

AMRITA VALUES PROGRAM

1-0-0-1

LEARNING OUTCOMES:

Students who complete the course will have demonstrated the following:

- *The basic concept of culture and values*
- *The relationship of culture with education, research, spirituality*
- *How culture is linked with gender, especially women*
- *The influence of media and politics in culture*

SYLLABUS:

Culture – definition and scope. Values and culture, cultural freedom

Culture and Education

Culture of Research – creativity and responsibility in research

Spirituality and Culture – spirituality as a way of life, spirituality and religion

Culture and women – gender oppression, motherhood

Culture and the Media

Culture and Politics – national values and political harmony

Philosophy and Culture, epistemology

18MM623

BIOCHEMISTRY LAB 1-0-1-2

LEARNING OUTCOMES:

Upon successful completion, students will have the knowledge and skills to:

- *Estimate the presence of amino acids and peptides in a given sample qualitatively*
- *Estimate the concentration of proteins quantitatively*
- *Estimate the concentration of enzyme (eg., amylase) in serum quantitatively*

- *To separate proteins in the given sample using SDS-PAGE [Sodium Dodecyl Sulfate -Poly Acrylamide Gel Electrophoresis]*

- *To separate amino acids from the mixture by chromatographic techniques (mainly Thin layer chromatography)*

SYLLABUS

Using balances and pipettes, making of solutions of given normality, Knowing pH meters: Preparation of buffers, determination of pKa values and Dissociation constant of a given acid, Titration of amino acids, Spectrophotometry: Determination of concentration of proteins, Recording absorption, Spectra of a given protein and chromophore, Difference spectra, Cell culture and extraction of proteins, Centrifugation and ultracentrifugation, Protein estimation: Lowry, BCA and Bradford methods, Protein fractionation: Salting-in and salting-out, Enzyme assays, Chromatography: Gel filtration; Ion exchange; affinity; high

performance liquid chromatography (HPLC), SDS Electrophoresis, western blotting

TEXT BOOKS:

D. T. Plummer: An Introduction to Practical Biochemistry, 369 pages. McGraw-Hill Book Co. (U.K.) Ltd.

S. Chaykin Biochemistry Laboratory Techniques, 169 pages. John Wiley & Sons Inc., New York.

18MM624 MOLECULAR BIOLOGY LAB 1-0-1-2

LEARNING OUTCOMES:

After successful completion of the course, students should be able to:

- *Explain the principles of the DNA & RNA isolation methods, PCR, agarose gel electrophoresis, RFLP, sequencing methods.*
- *Can isolate DNA, RNA, plasmids*
- *Can perform PCR, RT-PCR and Real-time PCR, RFLP and sequencing*
- *Can follow general safety routines for laboratory work in molecular biology*
- *Can plan experimental work based on a protocol*
- *Can critically evaluate and discuss experimental results*

SYLLABUS

Isolation of chromosomal DNA from *Escherichia coli*, Isolation of chromosomal DNA from human blood; Isolation of plasmid DNA from *Escherichia coli*, RNA isolation from *Escherichia coli*, Nucleic acid quantification, Agarose gel electrophoresis, Polymerase chain reaction (PCR), Restriction digestion, Restriction fragment length polymorphism (RFLP), cDNA synthesis, Reverse Transcriptase PCR, DNA sequencing, Real time PCR.

Suggested books:

Joseph Sambrook, David William Russell, Molecular Cloning: A Laboratory Manual, Volume 1-2-3 CSHL Press, 2001.

18NS623 CELL CULTURE AND ANIMAL LAB 1-0-1-2

LEARNING OUTCOME

Upon successful completion of the module 'Cell culture', the students will have adequate knowledge about

- *Theoretical and practical aspects of a safe cell culture practice*
- *Aseptic techniques that need to be followed in cell culture facility*

- *Hands on experience of culturing mammalian cells*
- *Cell viability assays and how to plan cell viability experiment.*

SYLLABUS

Cell culture module introduces the students to the basics of cell culture. The course provides students with sufficient knowledge and laboratory skills needed in the academia and industry for carrying out basic cell culture techniques properly and safely. On completion of the

course, the student should be able to: account at a general level for the function, maintenance and working of Bio-safety Cabinets (BSC) and be able to work in BSCs with a good sterilisation technique, account for different preventive measures to avoid contamination of cell cultures and how a contaminated cell culture may be treated, account in detail for sterilisation equipment and sterilisation techniques, account for different cell-culture media and important components in the media; be able to apply basic cell-culture techniques, such as cell counting using hemocytometer and harvesting of cells. Explain different factors of significance in the cultivation of cells in vitro and be able to maintain cell lines in culture for a longer period of time without contamination. Contents-The course starts with theory i.e. basic lecture about a general lay out of a cell culture lab, physical environment needed for the cell culture, growth media and its composition, Biosafety cabinets (BSC), its use in cell culture and how to work in a BSC, contamination during cell culture and how to control it, culturing and splitting of cell lines, cryopreservation of cells and cell viability assays. After qualifying the Biosafety examination, students start working in the cell culture lab. The laboratory work starts in small groups. In the practical laboratory work, the students will have hands-on experience in counting, harvesting, culturing and maintaining cell lines. Animal handling techniques – animal feed, gavage, different routes of injection, ethical treatment of animals and Institutional Animal Ethics Committee policies.

TEXT BOOK: R. Ian Freshney. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 6th ed. 2010. Wiley-Blackwell.

REFERENCE: 1. CPCSEA Guidelines for Laboratory Animal Facility, 2004. 2. Guide for the Care and use of Laboratory Animals – 8th Edition, 2011, The National Academic Press

18HU602 CAREER COMPETENCY I

Credits: Pass/Fail

LEARNING OUTCOME:

- Effectively improve employability in the professional world. Gives training to assist the student to prepare for interviews

SYLLABUS:

Soft Skills

Introduction to ‘campus to corporate transition’:

Communication and listening skills: communication process, barriers to communication, verbal and non-verbal communications, elements of effective communication, listening skills, empathetic listening, role of perception in communication.

Assertiveness skills: the concept, assertiveness and self-esteem, advantages of being assertive, assertiveness and organizational effectiveness.

Self-perception and self-confidence: locus of control (internal v/s external), person perception, social perception, attribution theories-self presentation and impression management, the concept of self and self-confidence, how to develop self-confidence.

Goal setting: the concept, personal values and personal goals, goal setting theory, six areas of goal setting, process of goal setting: SMART goals, how to set personal goals

Time management: the value of time, setting goals/ planning and prioritizing, check the time killing habits, procrastination, tools for time management, rules for time management, strategies for effective time management

Presentation skills: the process of presentation, adult learning principles, preparation and planning, practice, delivery, effective use of voice and body language, effective use of audio visual aids, dos and don'ts of effective presentation

Public speaking-an art, language fluency, the domain expertise (Business GK, Current affairs), self-confidence, the audience, learning principles, body language, energy level and conviction, student presentations in teams of five with debriefing

Verbal

Vocabulary building: introduction to the methods and practices of learning vocabulary, learning through practice sets to face questions on antonyms, synonyms, spelling error, analogy, wrong form of words, frequently confused words, understanding the nuances of spelling changes and wrong use of words.

Grammar: Analyzing subject verb agreement, pronoun agreement, tense consistency, and misplaced or dangling modifiers, parallel construction, active and passive voices, faulty comparison

Students take a few online practice tests to understand the test taking strategy and work on their specific areas of improvement.

Aptitude

Introduction to numbers – number line, classification of numbers, prime and composite numbers, co-prime numbers, number of zeros in an expression, LCM, HCF, remainder theorem, rules of divisibility, base system

Basics of equations- introduction to simple and quadratic equations, roots of an equation, word

problems, problems on ages, consistency of equations

Percentages, profit and loss: introduction to percentages, percentage change, value appreciation and depreciation, comparison observations, fundamentals concepts of business/commercial terminologies like cost price, selling price, profit, loss, marked price and discount

Ratio proportion and variation/partnership – fundamentals of ratios, duplicate ratio, triplicate ratio, sub duplicate ratio and sub triplicate ratio, direct and inverse proportion, joint variation, partnership and profit sharing

Averages and mixtures – mean, median and mode, measure of central tendency, concept of assumed average and weighted average, AM, GM and HM – relationship between AM, GM and HM, cheaper quantity and dearer quantity, rule of allegation, profit v/s quality of items getting mixed.

Simple interest and compound interest – time value of money, capital/principle, period of investment, rate of return, period of compounding, SAGR and CAGR

Data interpretation – representation of data using tables, bar charts, pie charts, case study, line graph, scatter diagram – analyzing the data for decision making

Venn diagrams- set theory – concept of sets, types of set, forms of set representation, power set, sub set and super set, 2 and 3 variable venn-diagrams, familiarity with words like AND, OR, atleast, atmost, exactly ‘n’ elements

Cubes – importance of aligning cuts to minimize/maximize the number of pieces of small cubes, painting a cube and cutting the cube, disintegration and integration of cubes, diagonal cutting, volume/LSA/TSA of cubes

References

Communication and listening skills:

- Andrew J DuRbin , “Applied Psychology: Individual and organizational effectiveness”, Pearson- Merril Prentice Hall, 2004
- Michael G Aamodt, “An Applied Approach, 6th edition”, Wadsworth Cengage Learning, 2010

Assertiveness skills:

- Robert Bolton, Dorothy Grover Bolton, “People Style at Work..and Beyond: Making Bad Relationships Good and Good”, Ridge Associates Inc., 2009
- John Hayes “Interpersonal skills at work”, Routledge, 2003
- Nord, W. R., Brief, A. P., Atieh, J. M., & Doherty, E. M., “Meanings of occupational work: A collection of essays (pp. 21- 64)”, Lexington, MA: Lexington Books, 1990

Self-perception and self-confidence:

- Mark J Martinko, “Attribution theory: an organizational perspective”, St. Lucie, 1995
- Miles Hewstone, “Attribution Theory: Social and Functional Extensions”, Blackwell, 1983

Time management:

- Stephen Covey, “The habits of highly effective people”, Free press Revised edition, 2004
- Kenneth H Blanchard ,”The 25 Best Time Management Tools & Techniques: How to Get More Done Without Driving Yourself Crazy” , Peak Performance Press, 1st edition 2005
- Kenneth H. Blanchard and Spencer Johnson, “The One Minute Manager”, William Morrow, 1984

Verbal

- Lewis Norman, “Word Power Made Easy”, Goyal Publishers, Reprint edition, 1 June 2011
- S. Upendran, “Know Your English”, Universities Press (India) Limited, 2015
- Green, Sharon, and Ira K. Wolf, “Barron's New GRE”, Barron's Educational Series, 2011
- Kaplan, “New GMAT Premier”, Kaplan Publishing, U.K., 2013
- www.merriam-webster.com
- www.bbc.co.uk/learningenglish
- www.cambridgeenglish.org

Aptitude

- Arun Sharma, “How to Prepare for Quantitative Aptitude for the CAT Common Admission Test”, Tata Mc Graw Hills, 5th Edition , 2012
- Arun Sharma, “How to Prepare for Logical Reasoning for the CAT Common Admission Test”, Tata Mc Graw Hills, 2nd Edition, 2014
- Arun Sharma, “How to Prepare for Data Interpretation for the CAT Common Admission Test”, Tata Mc Graw Hills, 3rd Edition, 2015
- R.S. Aggarwal, “Quantitative Aptitude For Competitive Examinations”, S. Chand Publishing, 2015
- R.S. Aggarwal, “A Modern Approach To Verbal & Non-Verbal Reasoning”, S. Chand Publishing, Revised -2015
- Sarvesh Verma, “Quantitative Aptitude-Quantum CAT” , Arihant Publications, 2016
- www.mbatious.com
- www.campusgate.co.in
- www.careerbless.com

Semester II

18MM626 MOLECULAR BASIS OF DISEASES 2-0-0-2

LEARNING OUTCOMES:

- *To demonstrate ability to approach a scientific report in a systematic manner*
- *To be able to highlight the significance of specific signaling pathways in cardiac hypertrophy*
- *To be able to identify and understand key protein functions within adipocytes in obese condition*
- *To demonstrate understanding of the role of neutrophils in infection induced necrosis*
- *To be able to discuss one signaling pathway involved in metaplasia*
- *To be able to discuss the role of proteins involved in circadian rhythm and how they affect inflammation*
- *To demonstrate understanding of how neural component modulates tissue regeneration*

SYLLABUS:

Concepts pertaining to the fundamental basis and underlying cellular dysfunction in the pathogenesis of diseases. Signaling pathways and their disruption in cellular adaptation mechanisms including hypertrophy, hyperplasia, atrophy and metaplasia, leading to manifestation of signs and symptoms in diseases such as cardiac failure, obesity, diabetes, cancer, etc. Important methodologies related to the determination of protein, and gene expression in various diseases.

Prescribed references:

1. *Selected Journal articles distributed before class.*
2. *Robbins & Cotran Pathological Basis of Diseases, 9th Edition,*

18MM627 GENETIC ENGINEERING 3-0-0-3

LEARNING OUTCOMES

Students who complete the course will demonstrate the following:

- *Knowledge of fundamentals of genetic engineering*
 - *1a: Tools in genetic engineering (hosts, vectors, enzymes, techniques) ,*
 - *1b: expression systems*
 - *1c: steps in PCR cloning and advanced methods of cloning*

- *Id: Analysis of recombinant end product*
- *Ie: protein expression and purification*
- *If: bioprocess mechanisms*
- *Knowledge of upstream and downstream processing with regard to bioprocess engineering*
- *Knowledge of steps in bio-therapeutic development and gene therapy methodology.*
- *Knowledge of applications of genetic engineering in various fields like forensics , biomedical technology etc.*
- *Knowledge about latest technologies in the field of genome editing and synthetic biology.*
- *Ability to read, comprehend and communicate latest research findings through oral presentations and written assignments.*

Suggested books :

Principles of Gene Manipulation ,Sandy B. Primrose, Richard Twyman, Bob Old,Wiley, 08-Feb-2002

From Genes to Genomes: Concepts and Applications of DNA Technology. Jeremy W Dale and Malcom von Schantz Copyright 2002 John Wiley & Sons, Ltd.

Synthetic Biology: Tools and Applications. Edited by Huimin Zhao.Academic Press. Amsterdam (The Netherlands) and Boston (Massachusetts): Elsevier. ISBN: 978-0-12-394430-6. 2013.

Most of the topics will be from latest published review articles and journal articles that will be provided to the students.

18MM628MOLECULAR DIAGNOSTICS 2-0-0-2

LEARNING OUTCOME

- *By finishing this module, the students will have clarity about the molecular diagnostic aspects, its significance and goal.*
- *Students will get clarity on various techniques used in the clinical diagnostic laboratory for the diagnosis of various pathogenic situations.*
- *Students will get an idea about the Quality assurance that needs to be followed in the molecular diagnostic lab.*

SYLLABUS

Introduction: An Historical Perspective on the Clinical Diagnostic Laboratory. Basic Molecular Biology: Nucleic Acid Blotting Techniques: Theory and Practice, The Polymerase Chain Reaction. Bioinformatics: Computer-Based Approaches to Genetic Analysis. Molecular Diagnostic Technologies: PCR-Based Methods for Mutation Detection, Alternative Methods for Mutation Detection and DNA Sequencing for Disease Association, Microarray Approaches to Gene Expression Analysis, Methods for Analysis of DNA Methylation, Other Clinical Diagnostic Technologies: Flow Cytometry, Medical Cytogenetics, Fluorescence In Situ Hybridization, Immunohistochemistry, Laser

Capture Microdissection (FFPE). Quality Assurance in the Molecular Diagnostics Laboratory: Framework for Quality Assurance in Molecular Diagnostics, Verification of Molecular Assays, Standards and Standardization of Molecular Diagnostics, Laboratory-Developed Tests in Molecular Diagnostics. Applications of Molecular Diagnostics for Genetic Diseases, Molecular diagnostics of Coagulation, Cystic Fibrosis; Prenatal Genotyping for Identification of Fetuses at Risk for Immune Cytopenic Disorders. Applications of Molecular Diagnostics for Human Cancers. Applications of Molecular Diagnostics for Infectious Diseases, for Identity-Based Testing: HLA Typing Using Molecular Methods. Molecular Analysis for Forensic Casework and Parentage Testing, Molecular Assessment of Bone Marrow Transplant Engraftment. Personalized Medicine., Genetic Counseling Considerations in Molecular Diagnosis, Ethical, Social, and Legal Issues Related to Molecular Genetic Testing.

TEXT BOOK: Molecular Diagnostics: For the Clinical Laboratorian / Edition 2 William B. Coleman (Editor), Gregory J. Tsongalis (Editor) Publisher: Springer-Verlag New York, LLC.

REFERENCES:

Buckingham and Flaw's, "Molecular Diagnostics: Fundamentals, Methods and Clinical Applications", F.A. Davis Company; First edition , 2007.

18NS602 PHARMACOKINETICS AND PHARMACODYNAMICS 2-0-0-2

LEARNING OUTCOMES:

- *To articulate the general process of drug development*
- *To define basic PK parameters of a drug such as volume of distribution, clearance terms, extraction ratio, elimination half- life, unbound fraction and to understand how these are related.*
- *To understand the role of compartment models in elucidating the time course of plasma concentration of drug molecules in the body.*
- *To describe the effect of plasma and tissue protein binding on pharmacokinetic parameters*
- *To understand the time course of drug accumulation in the body during a constant rate infusion and the concept of steady state.*
- *To formulate a compartmental model for a given drug*
- *To understand the roles of transporters in drug absorption, distribution and elimination*
- *To understand the functional outcome of a drug action based on receptor ligand binding*
- *To articulate drug-receptor interaction and downstream events for atleast 3 model drugs*
- *To understand the role of non-receptor mediated drug outcomes and toxicity*
- *To discuss generic drug formulations and bioequivalence.*

SYLLABUS:

Nature of drugs, drug-body interactions, permeation of drugs, drug groups, macromolecular nature of drug receptors, drug concentration and response, drug distribution and elimination of single and multiple drugs in single and multi-compartment models, derivation of relationships between various pharmacokinetic parameters like clearance, volume of distribution, elimination rate constant, half-life etc. Fundamental principles guiding absorption, distribution, metabolism and elimination of drug molecules, basics of population pharmacokinetics, pharmacogenomics, and single-gene pharmacokinetic disorder. Pharmacodynamic concepts related to affinity and efficacy of drug molecules, drug binding, receptor actions, transport proteins, enzyme action, ion channel function and extrusion mechanisms using specific drugs – acetaminophen, warfarin, certain antibiotics, and anti-malignant drugs. Mechanism of action of selected drugs will be discussed.

Prescribed text books:

The Pharmacological Basis of Therapeutics, Goodman and Gilman, current Edition
Essentials of Pharmacokinetics and Pharmacodynamics, Thomas Tozer and Malcolm Rowland, current edition

18NS606 BIOINFORMATICS AND STRUCTURE BASED DRUG DESIGN 2-0-2-4**Learning Outcomes:**

- Molecular modeling strategies towards ligand-based and structure-based drug design
- Basic understanding on different scientific software used in computational biology
- Integration of different databases and its significant outcomes in data retrieval.
- Skills in working in Linux environment; Linux operating system update. Different linux commands and linux editor will be taught.
- Basic concepts in Chemoinformatics methods: Combinatorial library generation, Geometry optimization, Molecular modeling, virtual screening techniques.
- Molecular docking, pharmacophore modeling, protein ligand complex interactions and its mechanism of action, QSAR, QSPR, QSTR techniques used in computer aided drug design.
- Different computational biology software usage, relevance and management will be taught for general awareness.
- How these chemoinformatics techniques can be integrated with the wet-lab (in vitro or in vivo) experiments will be discussed.
- Basic concepts on eXtensible Markup Language (XML) and its applications in bioinformatics/chemoinformatics.
- Multiple sequence alignment methods, algorithms and applications.
- Practical aspects of pairwise sequence alignment and its optimization using different scoring matrix and other statistical parameters.
- Practical aspects of protein-ligand interactions and its molecular mechanism will be elucidated using different visualization software.

SYLLABUS

Introduction to Concept of Genomics, Proteomics and Bioinformatics; Databases on web: Genome, Proteome and Molecular biology; Sequence alignment: Near-optimal sequence alignment; Global pair wise sequence alignment; Multiple sequence alignment; Genome rearrangement; Evolutionary Bioinformatics: Phylogenetic tree construction and analysis. Different methods used for protein evolution; Protein Modeling: Protein structure prediction and analysis, Protein visualization software, Protein dynamics and Protein structure validation tools.

Chemoinformatics: Basic idea of molecule design, Visualization and generation of 2D and 3D molecular structures, Chemical databases and its implications, Pharmacophore model, Virtual screening, Ligand based and structure-based molecular design; Commands and Languages: Basic Unix and Linux commands, Extensible markup language and its use in Bioinformatics; Sequence similarity and database search: Pattern recognition and matching; Quantitative and probabilistic pattern matching; Sequence pattern databases, Spectral pattern matching, String matching algorithm.

Pharmacy Informatics: Medical databases and clinically relevant drug-drug interactions, Pharmacy information system, Telemedicine and Telehealth.

Lab course work:

Basic linux commands and linux editors, X-windows and linux environment used for learning different linux commands and text editors like vi, xedit etc. Pairwise and multiple sequence analysis techniques, Sequence alignment studies of protein family to understand its conserved residues including the percentage similarity/identity and its function relationship using BLAST/FASTA and ClustalW software. Exposure to different useful databases, virtual screening and Data mining, Different biologically important databases were explored. Structural similarity search of drug like molecules were mined from different small molecular databases. Basic molecular modeling and optimization techniques, Molecule drawing in ChemDraw. Molecular structure optimization to get the least stable form and other physico-chemical property calculations. Molecular visualization and analysis study using PyMOL software.

TEXT BOOKS / REFERENCES:

P. Clote and R. Backofen "Computational Molecular Biology- An Introduction" (2000), ISBN- 978-0-471-87252-8

Carl Branden and John Tooze "Introduction to Protein Structure" , Garland Science; 2 edition (17 Dec 1998), ISBN-13: 978-0815323051

Mount D W, "Bioinformatics Sequence and Genome Analysis", Cbs Publishers & Distributors (2003), ISBN: 8123909985

S. Mitra and T. Acharya, "Data Mining: Multimedia, Soft Computing, and Bioinformatics", New York: John Wiley, ISBN 0-471-46054-0, 2003

Andrew RL and Gillet VJ "Introduction to Chemoinformatics", Springer PUBLISHER | ISBN / ASIN:1402062907, 2007.

Practical Bioinformatics; Editors: Bujnicki, Janusz M. (Ed.), Series: Nucleic Acids and Molecular Biology, Springer publisher, 10.1007/978-3-540-74268-5, 2008.

18MM636

CLINICAL MICROBIOLOGY

3-0-0-3

LEARNING OUTCOMES:

After successful completion of the course, students will be able to:

- *Gain knowledge about the historical events in microbiology, phylogenetic classification and type cultures, understand the anatomy/structure of microbes.*
- *Gain knowledge in basic microbiology skills: simple stain, negative staining, impregnation methods and differential staining, physical and chemical agents/methods for sterilization, dry and moist heat etc, understand various methods to culture and identify different bacteria.*
- *Understand the concepts of growth and reproduction of bacteria, bacterial growth requirements, bacterial cultivation and various phases of bacterial growth curve.*
- *Understand the role of bacterial protein secretion mechanisms in development of diseases: Sec and Tat secretion pathways (a); and protein secretion in Gram negative bacteria (b).*
- *Understand the genetic regulatory systems present in bacteria: lactose (a) and tryptophan operon (b).*
- *Understand the cellular architecture of fungus and virus (bacteriophages).*
- *Understand the mechanism of action of different antimicrobial agents.*
- *Understand how bacteria and fungus evade antimicrobial agents mediated killing by forming biofilms and using quorum sensing systems.*
- *The students will know about the organisms (bacteria, fungus, virus and parasites) causing human diseases.*
- *To be able to develop knowledge about human diseases caused by bacteria, virus, mosquito borne diseases, and learn about the importance of immunization programmes (a) and how vaccines work (b).*
- *Understand how bacteria transfer genetic material from one bacterium to another using conjugation, transduction and transformation.*
- *Understand the use of Restriction and modification enzymes for molecular cloning.*
- *Understand the need for cDNA and genomic DNA library constructions and requirements plasmid, yeast artificial chromosome etc for molecular cloning.*
- *Understand activities of different bacteriocins, their application in foods and pharmaceuticals industries.*
- *Understand how host use innate immune receptors to detect conserved microbial structures.*

SYLLABUS

History of microbiology; general properties of bacteria, bacteriophages, fungus, virus and parasites; Bacterial cell structure: Cell wall and components external to cell wall, Capsules,

Slime layer, S-layers, Pilli, Fimbriae, Flagella, cell membrane, cytoplasmic matrix, inclusion bodies, ribosomes, mitochondria, nucleoid, plasmids, endospores; cytoskeleton structure; fungal, viral and parasitic cell structure; clinically important bacteria, fungus, viruses and parasites; sterilization, disinfection, control of microbes by physical and chemical agents; culture media, culture methods and growth; mechanism of action of common antimicrobial agents, molecular mechanism of drug resistance, bacterial protein secretions systems; operons (lactose and tryptophan); biofilm and quorum sensing; Conjugation; Transduction; Transformation; Restriction and modification enzymes; cloning vectors: plasmid, yeast artificial chromosome; cDNA and genomic DNA library; bacteriocins; Pathogen-associated molecular patterns; Human diseases caused by bacteria, fungus, virus and parasites (Examples: *Staphylococcus*, *Pneumococcus*, *Pseudomonas*, *Chlamydiae*, *Clostridium*, *Mycobacterium*, *Salmonella*, *Streptococcus*, *Neisseria*, *Vibrio*, *Helicobacter*, Hepatitis, HIV, HPV, Dengue, filaria and Malaria etc); Currently available vaccines.

Suggested books:

Essentials of Medical Microbiology by ApurbaSankarSastry (author), Sandhya Bhat K (author); Publisher: Jaypee Brothers Medical Publishers. ISBN: 9789352704798
2nd Revised edition
Prescott Harley Klein's Microbiology by Willey, Joanne and Sherwood, Linda Publisher: McGraw-Hill Higher Education, ISBN: 978 007 126727 4 7th Edition.
Ananthanarayan and Paniker's Text book of Microbiology 9th Edition, Universities Press

18MM633GENETICS3-0-0-3

LEARNING OUTCOMES

This course will enable the students to understand,

- *Mendelian inheritance*
- *Chromosome transmission during cell division and sexual reproduction*
- *Extensions of Mendelian inheritance*
- *Non-Mendelian inheritance*
- *Genetic linkage and mapping in eukaryotes*
- *Variation in chromosome structure and number*
- *Chromosome organization and molecular structure*
- *Gene regulation in eukaryotes*
- *Non-coding RNAs*
- *Medical genetics and cancer*

- *Developmental genetics*
- *Population genetics*
- *Complex and quantitative traits*
- *Evolutionary genetics*

SYLLABUS

Overview of genetics: Relationship between genes and traits, Fields and science of genetics, Patterns of inheritance: Mendelian inheritance, Law of segregation, Law of independent assortment, Studying inheritance patterns in humans, Chromosome transmission during cell division and sexual reproduction: General features of chromosomes, Cell division, Mitosis and cytokinesis, Meiosis, Sexual reproduction, The chromosome theory of inheritance and sex chromosomes, Extensions of Mendelian inheritance: Overview of simple inheritance patterns, Dominant and recessive alleles, Environmental effects on gene expression, Incomplete dominance, overdominance and codominance, X-linked inheritance, Sex-influenced and sex-limited inheritance, Lethal alleles, Pleiotropy, Gene interactions, Non-Mendelian inheritance: Maternal effect, Epigenetic inheritance: dosage compensation and genomic imprinting, Extranuclear inheritance, Genetic linkage and mapping in eukaryotes: Overview of linkage, Relationship between linkage and crossing over, Genetic mapping in animals and haploid eukaryotes, Mitotic recombination, Variation in chromosome structure and number: Changes in chromosome structure: an overview, Deletions and duplications, Inversions and translocations, Changes in chromosome number: an overview, Variation in number of chromosomes within a set and in the number of sets of chromosomes, Chromosome organization and molecular structure: Organization sites along eukaryotic chromosomes, Sizes of eukaryotic genomes and repetitive sequences, Structure of eukaryotic chromosomes in nondividing cells and during cell division, Gene regulation in eukaryotes: Epigenetics: Epigenetics and development, Paramutation, Epigenetics and environmental agents, Medical genetics and cancer: Inheritance patterns of genetic diseases, Genetic basis of cancer, Personalized medicine, Developmental genetics: Vertebrate development and sex determination in animals, Population Genetics: Genes in populations and the Hardy-Weinberg equation, Overview of microevolution, Natural selection, Genetic drift, Migration, Nonrandom mating, Sources of new genetic variation, Complex and quantitative traits: Overview of complex and quantitative traits, Polygenic inheritance, Heritability, Selective breeding, Evolutionary genetics: Origin of species, Phylogenetic trees, Molecular evolution.

TEXT BOOKS/REFERENCES:

Genetics: Analysis & Principles, Robert J. Brooker, 6th Ed., McGraw-Hill International Edition, 2017 (Course plan is prepared based on this book)

Principles of Genetics, 8th Ed., Gardner, Simmons, Snustad, Wiley, 2006 (For reference)

18MM634 NEUROBIOLOGY: CHEMICAL AND ARCHITECTURAL ORGANIZATION OF BRAIN 2-0-0-2

LEARNING OUTCOMES

Student will learn

- *How brain is organized*
- *How the different types of cells form the functional unit of neuron*
- *How the functional unit is achieved.*
- *How the functional unit carries out various functions such as impulse conduction, transport of molecules and molecular complexities.*
- *How this organization chemically organized towards carrying out the function.*

SYLLABUS:

Introduction: Concept of neurobiology; Levels of neural organization. Neurons and Glia. Importance of neuronal polarity and Axonal integrity. Molecular and architectural organization of neuron and oligodendrocytes and its role in impulse conduction. Importance of myelin and myelination. Electrical properties of membrane; Membrane potential; Ion channels; Properties of axons and dendrites; Action potential; Synapse; Synaptic potential and integration; Directly and indirectly gated neurotransmitter receptors; Secretion, Axonal transport, vesicle trafficking and regulation; Neuronal growth, survival and development; Glia biology, role of astrocytes, oligodendrocytes and their concerted action in supporting neuronal function, myelin biology. Different levels of brain organization. Diseases affecting the nervous system.

TEXT BOOK:

Principles of Neural Science, Fifth Edition (Principles of Neural Science (Kandel) 2012 McGraw-Hill Education / Medical by Eric Kandel and James Schwartz

REFERENCES:

Basic Neurochemistry: Principles of Molecular, Cellular, and Medical Neurobiology by Scott Brady and George Siegel (2011)

18HU603

CAREER COMPETENCY II

Credits: 1-0-0-1

LEARNING OUTCOME:

- To provide skills and techniques to clear and interview to get employed.
- Gives training to assist the student to prepare resumes and attending of interviews

SYLLABUS:

Soft Skills

Interpersonal skill: ability to manage conflict, flexibility, empathetic listening, assertiveness, stress management, problem solving, understanding one's own interpersonal needs, role of effective team work in organizations

Group problem solving: the process, the challenges, the skills and knowledge required for the same.

Conflict management: the concept, its impact and importance in personal and professional lives, (activity to identify personal style of conflict management, developing insights that helps in future conflict management situations.)

Team building and working effectively in teams: the concept of groups (teams), different stages of group formation, process of team building, group dynamics, characteristics of effective team, role of leadership in team effectiveness. (Exercise to demonstrate the process of emergence of leadership in a group, debrief and reflection), group discussions.

Interview skills: what is the purpose of a job interview, types of job interviews, how to prepare for an interview, dos and don'ts of interview, One on one mock interview sessions with each student

Verbal

Reasoning: Introduction to higher order thinking skills and deductive reasoning through critical thinking and syllogisms exercises. Students are trained to think critically and analyze an argument critically. They practice these skills extensively.

Logical ordering of sentences: to improve logical thinking and ability to put ideas cohesively.

Reading comprehension: intermediate & advanced level reading passages are provided to the students for practice. Students are taught techniques to read a dense passage in a fast & accurate manner.

Punctuation and e-mail writing: students hone their e-mail writing skills and are taught the essentials of punctuation and e-mail etiquette.

Aptitude

Time and distance: speed, distance, displacement, relative speed, average speed, races, boats and streams-upstream and down-stream movement, problems on trains, concept of relative speed, motion in circular track – clockwise and anti-clockwise rotations

Time and work- unitary method, concept of man-days, efficiency in task completion, sharing of wages proportionately, questions on pipes and cisterns

Geometry, mensuration-line/ray/angles, length of segments, area and properties of geometrical figures, properties of angles, diagonals, LSA, TSA and volume of solids

Seating arrangements/ puzzles- linear arrangements, circular arrangements, selection, comparison and distribution of objects under given constraints, analysing given constraints and present definitive or probable solutions for a given problem.

Permutations and combinations- fundamental principle of counting-selection and arrangement of objects, factorial notations, permutations with/without repetition, rank of a word, sum of all permutations, team formation with certain constraints

Probability- chances, odds in favour and odds against favour, events-independent and mutually exclusive types, conditional probability

Nonverbal reasoning – picture based series, mirror image, water image, paper folding, paper cutting, grouping of figures, figure matrix

Quant Based Reasoning – case study, application oriented problems

References

Team Building

- Thomas L.Quick, "Successful team building", AMACOM Div American Mgmt Assn, 1992
- Brian Cole Miller, "Quick Team-Building Activities for Busy Managers: 50 Exercises That Get Results in Just 15 Minutes", AMACOM; 1 edition, 2003.
- Patrick Lencioni, "The Five Dysfunctions of a Team: A Leadership Fable", Jossey-Bass, 1st Edition, 2002

Verbal

- Kaplan GMAT 2012 & 13
- www.campusgate.co.in
- www.indiabix.com
- www.bristol.ac.uk/arts/skills/grammar/grammar_tutorial/page_55.htm

Aptitude

- Arun Sharma, "How to Prepare for Quantitative Aptitude for the CAT Common Admission Test", Tata Mc Graw Hills, 5th Edition, 2012
- Arun Sharma, "How to Prepare for Logical Reasoning for the CAT Common Admission Test", Tata Mc Graw Hills, 2nd Edition , 2014
- Arun Sharma, "How to Prepare for Data Interpretation for the CAT Common Admission Test", Tata Mc Graw Hills, 3rd Edition , 2015
- R.S. Aggarwal, "Quantitative Aptitude For Competitive Examinations", S. Chand Publishing , 2015
- R.S. Aggarwal, "A Modern Approach To Verbal & Non-Verbal Reasoning", S. Chand Publishing , Revised -2015
- SarveshVerma, "Quantitative Aptitude-Quantum CAT" , Arihant Publications , 2016
- www.mbatious.com
- www.campusgate.co.in
- www.careerbless.com

Semester III

18RM601 ETHICS IN RESEARCH AND RESEARCH METHODOLOGY 1-0-1-2

LEARNING OUTCOMES:

Students on completion of this course will –

- *Understand the basic concepts of ethics in proper conduct of research*
- *Understand about plagiarism in research and how it should be avoided*
- *Gain a clear idea about the importance of proper data documentation*
- *Students will have a clear idea about the research methodologies that need to be adopted during their research*

Plagiarism, regulatory principles, safety in research, ethics in stem cell research, ethics in clinical research, ethics in nanomaterials based research Principles of data documentation, protocol development, research questions and hypothesis driven research.

TEXTBOOKS:

Research Ethics for Scientists, C. Neal Stewart Jr., Wiley-Backwell Publishers, 2011

Ethics in Science, Ethical Misconduct in Scientific Research, John D'Angelo, CRC Press, 2012.

18MM632 STEM CELL BIOLOGY AND THERAPY 3-0-0-3

LEARNING OUTCOMES

- *After finishing this module the students will be able to get an idea about what is a stem cell, various adult stem cells in the human body.*
- *Student will get clarity on what are embryonic stem cells (ESCs), Induced pluripotent stem cells (iPSCs), regulatory and ethical issues associated with the use of these cells for research in India*
- *Student will also get a clarity on the SC therapies for various diseases*

SYLLABUS:

Introduction to stem cells, basic principles and methodologies, classification of stem cells, major developments in stem cell biology, clinical use of stem cells. History of the origin of stem cells. Molecular mechanisms controlling the cell cycle: stem cell self-renewal and maintenance. Cell proliferation versus cell differentiation. Normal stem cells: hematopoietic stem cells, mesenchymal stem cells, cardiac stem cells. Embryonic stem cells (ESC): difference between mouse and human ESCs, derivation of ESCs, scientific and ethical hindrance to ESC therapy. Tissue Stem Cells, Translational Stem Cell Medicine,

Identification and characterization of pluripotent stem cells in animal and humans; sources of pluripotent cells – blastocysts, parthenogenesis, nuclear transfer, iPSCs. Stem cell microenvironment: Stem cell niche and signaling, Stem cells and Gene Therapy: Signaling pathway involved in self-renewal and differentiation of stem cells. Identifying and isolating stem cells. Cancer stem cells: Historical perspective, isolation and characterization of cancer stem cells. Solid cancer stem cells (Breast, Lung, prostate, liver, stomach, Glioma). Targeting cancer stem cells. Hematological malignancies and stem cells. Side population cells in flow cytometry, Induced pluripotent stem cells, its derivation and applications. Regulatory and ethical issues of stem cell research in India. Stem cell therapy for various diseases (neurodegenerative, retinal, leukemia, heart).

TEXT BOOK:

Robert Lanza, “Essentials of Stem cell Biology”, Elsevier, 2006

REFERENCE:

Daniel R. Marshak, Richard L. Gardner and David Gottlieb, “Stem cell Biology”, Cold Spring Harbour Laboratory Press, 2001

18MM635 ORGANOID CULTURE AND ITS APPLICATIONS IN MEDICINE 2-0-0-2

LEARNING OUTCOMES

Upon successful completion, students will have the

- *Knowledge on the fundamental concepts on organoids, development of organoids and its importance and advantages compared to conventional cell culture systems.*
- *Knowledge on the state-of-the-art technologies including 3D bioprinting that can be used for developing organoids.*
- *Knowledge on the application of organoid technology in tissue development and regeneration and in modelling diseases for drug testing.*

SYLLABUS

Mini organs – organoids: Basics of organoid development, experimental strategies, essential reagents and choice of 3D matrices, technical challenges; Characterization of organoids – marker screening, immunostaining and imaging of organoids, genomic profiling of organoids; In vitro models of development and disease using cerebral, liver, intestinal, pancreas and salivary gland organoids. Applications of organoids – in cancer research, tissue regeneration and development, personalised drug testing, ethics of organoid biobanks. 3D bioprinting: Basics and importance of 3D printing of living cells for medical

applications, choice of bio-inks, current advances and challenges in 3D bioprinting.

TEXT BOOK:

Jamie Davies and Melanie Lawrence, Organoids and Mini Organs, Academic Press, 2018

DISSERTATION

Choosing research topics and understanding the literature pertaining to the chosen topic. Formulation of research question and hypothesis, presentations, strategizing the work plan and learning the techniques involved in the proposed research.

FOURTH SEMESTER

DISSERTATION

Fulltime research on the proposed research, meticulous experimentation, generation of data, interpretation of data and conclusion of the research outcome. Manuscript writing on the research work conducted for publication. Dissertation preparation and presentations.