DEPARTMENT OF BIOCHEMISTRY
FACULTY OF ARTS, SCIENCE AND HUMANITIES
KARPAGAM ACADEMY OF HIGHER EDUCATION
(*Deemed to be University, Established Under Section 3 of UGC Act 1956*)
Eachanari PO, Coimbatore – 641 021, India.

B.Sc., BIOCHEMISTRY

PREAMBLE

- Biochemistry is the study of chemistry and relating to, biological organisms.
- Biochemistry is sometimes viewed as a hybrid branch of organic chemistry, which specializes in the chemical processes and chemical transformations that take place inside of living organisms.
- All life forms alive today are generally believed to have descend from a single proto-biotic ancestor, which could explain why all known living things naturally have similar biochemistries.
- Biochemistry essentially remains the study of the structure and functions of cellular components (such as enzymes and cellular organelles) and the processes carry out both on and by organic macromolecules - especially proteins, but also carbohydrates, lipids, nucleic acids and other biomolecules.
- Biochemistry is the chemistry of life.

OBJECTIVE

- To inspire and educate students, today and for the future, in the concepts and skills of biochemistry; to prepare them to think about, to work with, and to enjoy the concepts of biochemistry and apply them at appropriate situation in practical life.

KARPAGAM UNIVERSITY
KARPAGAM ACADEMY OF HIGHER EDUCATION
Coimbatore – 641 021
DEPARTMENT OF BIOCHEMISTRY
(Scheme of Examination for 2016- 2017 onwards)
B.Sc., BIOCHEMISTRY CURRICULUM

Course code	Name of the course	Objectives and out comes		Instruction hours / week			Credit(s)	Maximum Marks		
		PEOs	POs	L	T	P		CIA	ESE	Total
								40	60	100
SEMESTER – I										
16LSU 101	Language -I	I	a	4	-	-	4	40	60	100
16ENU101	English	I	a	4	-	-	4	40	60	100
16BCU101	Molecules of Life	I	b, k	3	1	-	4	40	60	100
16BCU102	Cell Biology	I	d, k	4	-	-	4	40	60	100
16BCU103	Membrane Biology and Bioenergetics	I	f	3	1	-	4	40	60	100
16BCU111	Molecules of Life- Practical	III	d	-	-	3	2	40	60	100
16BCU112	Cell biology - Practical	III	d	-	-	3	2	40	60	100
16BCU113	Membrane Biology and Bioenergetics – Practical	III	c, f	-	-	4	2	40	60	100
Semester Total				**19**	**1**	**10**	**26**	**320**	**480**	**800**
SEMESTER – II										
16LSU 201	Language – II	I	a	4	-	-	4	40	60	100
16BCU201	Proteins	III	e, k	4	-	-	4	40	60	100
16BCU202	Enzymes	III	e	4	1	-	4	40	60	100
16BCU203	Human Physiology	I	e	4	-	-	4	40	60	100
16BCU211	Proteins – Practical	III	e	-	-	3	2	40	60	100
16BCU212	Enzymes- Practical	III	e	-	-	3	2	40	60	100
16BCU213	Human Physiology - Practical	III	e	-	-	4	2	40	60	100
16AEC 201	Environmental Studies	IV	h	3	-	-	4	40	60	100
Semester Total				**19**	**1**	**10**	**26**	**320**	**480**	**800**
SEMESTER – III										
16BCU301	Metabolism of Carbohydrates and Lipids	I	f	4			4	40	60	100
16BCU302	Metabolism of Amino acids and Nucleic acids	I	f	4			4	40	60	100
16BCU303	Hormone: Biochemistry and Functions	V	d, e, k	3	1	-	4	40	60	100
16BCU311	Metabolism of Carbohydrates and Lipids – Practical	III	c, f	-	-	4	2	40	60	100
16BCU312	Metabolism of Amino acids and Nucleic acids- Practical	III	c, f	-	-	4	2	40	60	100
16BCU313	Hormone: Biochemistry and Functions – Practical	III	j	-	-	4	2	40	60	100
16BCU304A	Tools and Techniques in Biochemistry	II	c, f	3	-	-	3	40	60	100
16BCU304B	Concepts in Genetics	I	c, f							
16BCU314	A-Tools and Techniques in Biochemistry – Practical	III	c, f	-	-	3	1	40	60	100
16BCU314	B-Concepts in Genetics - Practical	III	c, f							
Semester Total				**14**	**1**	**15**	**22**	**320**	**480**	**800**
SEMESTER – IV										
16BCU401	Gene Organization, Replication and Repair	I, II	g	4	-		4	40	60	100

16BCU402	Gene Expression and Regulation	I, II	g	4	-		4	40	60	100
16BCU403	Immunology	V	i, j	3	1	-	4	40	60	100
16BCU411	Gene Organisation, Replication and Repair-Practical	III	c, g	-	-	4	2	40	60	100
16BCU412	Gene Expression and Regulation- Practical	III	c, g	-	-	4	2	40	60	100
16BCU413	Immunology Practical	III	i, j	-	-	4	2	40	60	100
16BCU404A	Bioinformatics	III	c, g	3	-	-	3	40	60	100
16BCU404B	Protein Purification Techniques		c, g							
16BCU414A	Bioinformatics - Practical	III	c, g	-	-	3	1	40	60	100
16BCU414B	Protein Purification Techniques - Practical		c, g							
Semester Total				**14**	**1**	**15**	**22**	**320**	**480**	**800**
SEMESTER – V										
16BCU501A	Clinical Biochemistry	II, III	d, e	3	-	-	3	40	60	100
16BCU501B	Biochemical Correlation of Diseases	II, III	d, e							
16BCU511A	Clinical Biochemistry	III	j	-	-	4	1	40	60	100
16BCU511B	Biochemical Correlation of Diseases	III	j							
16BCU502A	Basic Microbiology	I	d, e,	4	-	-	4	40	60	100
16BCU502B	Nutritional Biochemistry	I	i, l							
16BCU503A	Plant Biochemistry	V	D	4	-	-	4	40	60	100
16BCU503B	Advanced cell biology	I	d, k							
16BCU504A	Molecular Basis of Non-Infectious diseases	V	d, e	4	-	-	4	40	60	100
16BCU504B	Molecular Basis of Infectious diseases	V	d, e							
16BCU512A	Basic Microbiology- Practical	III	j	-	-	4	2	40	60	100
16BCU512B	Nutritional Biochemistry- Practical	III	j							
16BCU513A	Plant Biochemistry-- Practical	III	j	-	-	4	2	40	60	100
16BCU513B	Advanced Cell Biology- Practical	III	j							
16BCU514A	Molecular Basis of Non-Infectious Diseases-Practical	III	j	-	-	4	2	40	60	100
16BCU514B	Molecular Basis of Infectious Diseases-Practical	III	j							
Semester Total				**15**	**-**	**15**	**22**	**320**	**480**	**800**
SEMESTER – VI										
17BCU601A	Genetic Engineering and Biotechnology	I	g, n, l	3	-	-	3	40	60	100
17BCU601B	Recombinant DNA Technology	I	g, n, l							
16BCU611A	Genetic Engineering and Biotechnology-Practical	III	e	-	-	3	1	40	60	100
16BCU611B	Recombinant DNA Technology-Practical	III	e							
16BCU602A	Biostatistics	III	e, l	4			4	40	60	100
16BCU602B	Fundamentals of nanotechnology	III	e, l							
16BCU603A	A- Drug Biochemistry	II	i, j, l	4			4	40	60	100
16BCU603B	B-Food Preservation Technology	II	i, j, l							
16BCU612A	A-Biostatistics- Practical	III	e			4	2	40	60	100
16BCU612B	B-Fundamentals of nanotechnology- Practical	III	e							
16BCU613A	A- Drug Biochemistry- Practical	III	e			4	2	40	60	100
16BCU613B	B-Food Preservation Technology- Practical	III	e							
17BCU691	Project work	IV	j	2	-	6	6	40	60	100
ECA / NCC / NSS / Sports / General interest etc							**Good**			
Semester Total				**13**	**-**	**17**	**22**	**280**	**420**	**700**
Program Total				**94**	**4**	**82**	**140**	**1880**	**2820**	**4700**

Blue – Employability
Green – Entrepreneurship
Red – Skill Development

Code: 16BCU101

16 -Academic Year

BC -Biochemistry

U - Bachelor's Degree

First Digit - Semester number (1, 2, 3 and)

Second digit - Theory (0); Practical (1); Project (9)

Last digit - Paper number in the concerned semester (1, 2…)

SKILL ENHANCEMENT COURSE

Semester	Subject Code	Skill Enhancement Course
III	16BCU304A	Tools and Techniques in Biochemistry
	16BCU304B	Concepts in Genetics
	16BCU314A	Tools and Techniques in Biochemistry - Practical
	16BCU314B	Concepts in Genetics - Practical
IV	16BCU404A	Bioinformatics
	16BCU404B	Protein Purification Techniques
	16BCU414A	Bioinformatics- Practical
	16BCU414B	Protein Purification Techniques- Practical
V	16BCU501A	Clinical Biochemistry
	16BCU501B	Biochemical Correlations and Diseases
	16BCU511A	Clinical Biochemistry- Practical
	16BCU511B	Biochemical Correlations and Diseases- Practical
VI	16BCU601A	Genetic Engineering and Biotechnology
	16BCU601B	Recombinant DNA Technology
	16BCU611A	Genetic Engineering and Biotechnology- Practical
	16BCU611B	Recombinant DNA Technology- Practical

DISCIPLINE SPECIFIC ELECTIVE

Semester	Subject Code	Discipline Specific Elective
V	16BCU502A	Basic Microbiology
	16BCU502B	Nutritional Biochemistry
	16BCU512A	Basic Microbiology- Practical
	16BCU512B	Nutritional Biochemistry- Practical
V	16BCU503A	Plant Biochemistry
	16BCU503B	Advanced Cell Biology
	16BCU513A	Plant Biochemistry- Practical
	16BCU513B	Advanced Cell Biology- Practical
V	16BCU504A	Molecular basis of non-infectious human diseases
	16BCU504B	Molecular basis of infectious diseases
	16BCU514A	Molecular basis of non-infectious human diseases- Practical
	16BCU514B	Molecular basis of infectious diseases- Practical
VI	16BCU602A	Biostatistics
	16BCU602B	Fundamentals of nanotechnology
	16BCU612A	Biostatistics- Practical
	16BCU612B	Fundamentals of nanotechnology- Practical
VI	16BCU603A	Drug Biochemistry
	16BCU603B	Food Preservation Technology
	16BCU613A	Drug Biochemistry- Practical
	16BCU613B	Food Preservation Technology- Practical
VI	16BCU691	**Project**

CORE COURSE

CC-1: Molecules of Life
CC-2: Cell Biology
CC-3: Membrane Biology and Bioenergetics
CC-4: Proteins
CC-5: Enzymes
CC-6: Human Physiology
CC-7: Metabolism of Carbohydrates and Lipids
CC-8: Metabolism of Amino Acids and Nucleotides
CC-9: Hormone: Biochemistry and Function
CC-10: Gene Organization, Replication and Repair
CC-11: Gene Expression and Regulation
CC-12: Immunology

SKILL ENHANCEMENT COURSE

SEC-1: Tools and Techniques in Biochemistry
SEC-2: Protein Purification Techniques
SEC-3: Clinical Biochemistry

SEC-4: Bioinformatics
SEC-5: Recombinant DNA Technology
SEC-6: Concepts in Genetics
SEC-7: Genetic Engineering and Biotechnology
SEC-8: Biochemical Correlations and Diseases

DISCIPLINE SPECIFIC ELECTIVE

DSE-1: Nutritional Biochemistry
DSE-2: Basic Microbiology
DSE-3: Molecular basis of non-infectious human diseases
DSE-4: Molecular basis of infectious diseases
DSE-5: Research Project
DSE-6: Advanced cell biology
DSE-7: Plant Biochemistry
DSE-8: Research Methodology
DSE-9 : Biostatistics
DSE-10: Fundamentals of nanotechnology
DSE-11: Food Preservation Technology
DSE-12: Drug Biochemistry

ABILITY ENHANCEMENT COMPULSORY COURSE

AECC-1: English communication

AECC-2: Environmental Studies

PROGRAMME OUTCOME (POs).

The Biochemistry graduate will be able to acquire

a. **Critical Thinking and Language Training:** The ability to analyze information objectively and make a reasonable judgment and conclusion by evaluating data, facts, observable phenomenon, and research findings from a set of information and distinguish among priorities to solve a problem To train them to communicate science by improving their English vocabulary. Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

b. **Ethics:** Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

c. **Social Interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings. Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

d. **Understanding cellular function:** To equip them with basic and advanced knowledge in cell biology in order to get entry/placed in cell based research and development institution/laboratories.

e. **Protein based skills:** To make them understand protein, enzymes and human physiology to lay solid foundation and to get through competitive examinations. To equip them to get placed in recombinant protein production industries/laboratory.

f. **Understanding of endocrine system and metabolism:** To train them on the regulatory role of hormone on the metabolism of carbohydrates, lipids, amino acids and nucleic acid.

g. **Molecular and Genetic understanding:** To train them on the genetic regulation of immune system and to use computational tools.

h. **Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.

i. **Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

j. **Skill development:** To gain hands on experience on various biochemical experiments and to equip them to interpret the data.

PROGRAMME SPECIFIC OUTCOME (PSOs)

k. Be able to demonstrate foundation knowledge in the areas of Biochemistry like Cell biology, Biomolecules, Protein Biochemistry, Molecular Biology, Pharmaceutical Chemistry and Hormonal Biochemistry.

l. Be able to integrate knowledge learned in discipline specific courses like Microbiology, Plant Biochemistry, Nutritional Biochemistry, Biostatistics, Drug Biochemistry and Biotechnology.

m. To use standard laboratory protocols in biochemistry, modern instrumentations, proper laboratory safety protocols and classical techniques to carry out experiments and also use computers in data acquisition and processing and use available software as a tool in data analysis.

n. To understand the applications of biological sciences in Genetics, Biochemical Correlations of Diseases, Microbiology, Genetic Engineering and Biotechnology.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

I. To give students a basic knowledge in biochemistry and to teach on ethics.

II. To develop analytical and critical-thinking skills that allows independent exploration of biological phenomena through the scientific methods.

III. To acquaint knowledge on modern methods of biochemical experimentation to implement for future studies.

IV. To motivate students for social responsibilities and to educate them on ethical values in addition to inculcating environmental awareness.

V. To enable them to execute a research objective through experimentation.

Mapping of PEOs and POs

POs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
PEO I	X	X		X		X	X				X			
PEO II			X			X	X				X	X	X	X
PEO III			X	X	X		X				X	X	X	X
PEO IV								X		X				X
PEO V				X	X				X	X	X	X	X	X

16LSU101 **TAMIL-1** **4H-4C**

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

பாடத்திட்டப்பொதுநோக்கம்

- கற்றல் வழி சிந்தனைத் திறனையும், கருத்து வெளிப்பாட்டுத் திறனையும், மேம்படுத்துதல்.
- ஆய்வுநோக்கைமேம்படுத்துதல்.
- இலக்கியங்கள் உணர்த்தும் வாழ்வின் நுட்பமான பகுதிகளை உணர்த்துதல்.
- மனித மனத்தினைப் பக்குவப்படுத்துதலில் இலக்கியம் தரும் பங்கினை உணர்த்துதல்.
- வளர்ந்து வரும் சமூகத்தில் அறஉணர்வு, பண்பாடு போன்றவை குறித்து அறிவூட்டல்.
- அரசுத் தேர்வுகளுக்கு மாணவர்களை ஆயத்தமாக்குதல்.

பாடத்திட்டப்பயன்விளைவு

1. இந்தியகுடியுரிமைப்பணிமுதலானபோட்டித்தேர்வுகளில், விருப்பப்பாடமாகஇந்தியகுடியுரிமைப்பணிமுதலானபோட்டித்தேர்வுகளில், விருப்பப்பாடமாகஇடம்பெறுகின்ற, ‘தமிழ்இலக்கியவரலாறு’ குறித்தமுழுமையானஅறிமுகம்பெற்றிருத்தல்.
2. கல்வெட்டியல், ஓலைச்சுவடியியல்மற்றும்தொல்லியல்சார்ந்தஆவணத்தேடலுக்குரியஆய்வு மனப்பான்மையுடன், இலக்கியங்களைஅணுகுதல்.
3. தமிழின்வளர்ச்சித்துறையாகிய, ‘அறிவியல்தமிழ்’ ; ‘இணையதமிழ்’ குறித்தபன்நோக்குஅணுகுமுறையிலானஆய்வுச்சிந்தனைமேம்பாடு.
4. வேலைவாய்ப்புக்குரியசுயதிறன்மேம்பாட்டுடன், படைப்பாக்கத்திறன்மேம்பாடும்பெற்றிருத்தல் .
5. சமுதாயமற்றும்வாழ்வியல்மதிப்புகளைப்பேணுவதற்குக்கருவியாகஇலக்கி யங்களைநாடுகின்றமனப்பான்மைவளர்ச்சி.
6. மொழிபெயப்புத்துறைசார்ந்தவேலைவாய்புத்திறன்பெற்றிருத்தல்

தாள்கள்வரிசையும்தேர்வுச்செயல்திட்டமும்பகுதி-I தமிழ்

பருவம்	தாள்	கற்பிக்கும் நேரம்/வாரம்	தேர்வு மணிகள்	மதிப்பெண் அக/எழுத்து	மொத்தம்	மதிப்பீடு
ஒன்று	I	4	3	40 / 60	100	4

பகுதி - I தமிழ்ப்பாடத்திட்டம் (2016-2017)

பகுதி – I, **தமிழ்பருவம்** I

16LAU101 : தமிழ்முதல்தாள் 4-H,4-C

(இளநிலைஅறிவியல்பட்டவகுப்புகளுக்குரியது)

பொதுநோக்கம்

- கற்றல்வழிகருத்துவெளிப்பாட்டுத்திறனைஅதிகரித்தலும் , சிந்தித்தலைமேம்படுத்துதல்.
- இலக்கியங்கள்உணர்த்தும்வாழ்வின்நுட்பமானபகுதிகளைஉணர்த்துதல்.மனிதமனத்தினைப்பக் குவப்படுத்துதலில்இலக்கியம்தரும்பங்கினைஉணர்த்துதல்.
- வளர்ந்துவரும்சமூகத்தில்அறஉணர்வு , பண்பாடுபோன்றவைகுறித்து அறிவூட்டல்.
- அரசுத்தேர்வுகளுக்குமாணவர்களைஆயத்தமாக்குதல்.

அலகு – I :இக்காலஇலக்கியம்: (10 மணிநேரம்)

கல்வி: மகாகவிபாரதியார் – சுயசரிதை - ஆங்கிலக் கல்வி.
இன்றைய நிலை : கவிமணிதேசிகவிநாயகம்பிள்ளை– ஒற்றுமையேஉயிர்நிலை.
மனிதநேயம் :கவிஞர்சிற்பிபாலசுப்பிரமணியன் –மலையாளக்காற்று.
சூழலியல் :கவிஞர்.வைதீஸ்வரன் - விரல்மீட்டியமழை.
பெண்ணியம் :கவிஞர்.சுகந்திசுப்பிரமணியம் – புதையுண்டவாழ்க்கை.

அலகு – II :அறஇலக்கியம்: (10 மணிநேரம்)

கொன்றைவேந்தன்: 1-50 பாடல்கள்
திருக்குறள்: பண்புடைமை, வினைத்திட்பம் – 20 குறள்கள்
பழமொழிநானூறு: 5 பாடல்கள்

அலகு - III :சிற்றிலக்கியம்: (10 மணிநேரம்)

மூவருலா: 1-26 கண்ணிகள்
திருச்செந்தூர்முருகன்பிள்ளைத்தமிழ்: 2 பாடல்கள்
கலிங்கத்துப்பரணி: போர்பாடியது - 9 பாடல்கள்

அலகு – IV :கட்டுரை: (10 மணிநேரம்)

1. **உயர்தனிச்செம்மொழி-பரிதிமாற்கலைஞர்**
2. **கட்டிடக்கலை-** அ. இராசமாணிக்கனார்
3. **வாழ்க்கை** - இளவழகனார்
4. ஆளுமைத்திறன்அறிவோம் - ஸ்ரீகண்ணன்
5. மணற்கேணி - நெ.து.சுந்தரவடிவேலு

அலகு- V :மொழிப்பயிற்சி: (8 மணிநேரம்)

1. படைப்பிலக்கியப் பயிற்சிகள் (கதை,கவிதை, கட்டுரை, உரைநடை)
2. மொழிபெயர்ப்பு

16ENU101 **ENGLISH -I** **4H- 4C**

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives:

- To help students enhance their Language skills
- To introduce different kinds of literary works
- To familiarize different genres of Literature
- To instruct moral values through literature
- To improvise their productive and receptive skills
- To strengthen the basic knowledge about grammar

Course Outcomes (CO's):

1. Develop the four types of skills
2. Reading and comprehending literary works
3. Genres of literature to provide moral education
4. Develop communication skills in business environment
5. Interpersonal skills will be developed
6. Betterment of language competence

Unit 1

Prose: Google Guys (Extract) – Richard L Brandt
Poetry: The Blind Pedlar – Osbert Sitwell
Short Story: A Garden So Rich – Christie Craig
Vocabulary: Prefix, Antonyms, Sentence Completion
Grammar: Article, Adverb, Pronoun

Unit 2

Prose: Happiness 101 – Geeta Padmanabhan
Poetry: An Old Woman **–** Arun Kolatkar
Vocabulary: Suffix, Analogies
Grammar: Noun, Adjective

Unit 3

Prose: Structured Procrastination – John Perry
Short Story: The Umbrella Man – Roald Dahl
One-Act Play: The Boy Who Stopped Smiling – Ramu Ramanathan
Vocabulary: Synonyms, Euphemisms, Word Definitions
Grammar: Verb, Conjunction and Interjection, Indirect/Reported Speech

Unit 4

Poetry: No Sentence – Anjum Hassan
One-Act Play: While the Auto Waits- O' Henry
Vocabulary: Words Often Confused, Anagrams

Grammar: Preposition, Voice- Active and Passive

Unit 5

Short Story: The Bird **–** Amar Jalil
One-Act Play: The Cellphone Epidemic – Claudia I. Haas
Vocabulary: Portmanteau Words, One Word Substitution
Grammar: Question, Pronunciation

Prescribed Text:

Rao, G. Chandralekha et al. *Spring* 2013**.** Emerald Publishers: Chennai.

Suggested Reading:

Shyamala, V. , (2006). *English for Communication*. Emerald Publishers: Chennai

Semester I

16BCU101 **MOLECULES OF LIFE** **4H-4C**

Instruction hours/week: L: 3 T: 1 P: 0 Marks: Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- To understand the properties and importance of water in biological system
- To know the biological significance of aminoacids and proteins in living systems
- To know the biological significance of lipids and fats in living systems
- To know the biological significance of carbohydrate metabolites in living systems
- To understand the functional role of nucleic acid in living systems
- To introduce the importance of vitamins in human body

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Recognize water as a universal solvent and elixir of life by knowing its importance
2. Identify the properties and classification of carbohydrates
3. Recall the role of various lipids in biomembrane including signal transduction
4. Categorize the amino acids and know their properties
5. Differentiate the structure, properties and functions of DNA and RNA
6. List the functions and deficiency disease of fat and water soluble vitamins

Unit 1

The foundations of biochemistry and water: Cellular and chemical foundations of life. Unique properties, weak interactions in aqueous systems, ionization of water, buffers, water as a reactant and fitness of the aqueous environment.

Unit 2

Carbohydrates and glycobiology: Monosaccharides - structure of aldoses and ketoses, ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers, structure of biologically important sugar derivatives, oxidation of sugars. Formation of disaccharides, reducing and non-reducing disaccharides. Polysaccharides – homo- and heteropolysaccharides, structural and storage polysaccharides. Structure and role of proteoglycans, glycoproteins and glycolipids (gangliosides and lipopolysaccharides). Carbohydrates as informational molecules, working with carbohydrates

Unit 3

Lipids : Building blocks of lipids - fatty acids, glycerol, ceramide. Storage lipids - triacyl glycerol and waxes. Structural lipids in membranes – glycerophospholipids, galactolipids and sulpholipids, sphingolipids and sterols, structure, distribution and role of membrane lipids. Plant steroids. Lipids as signals, cofactors and pigments

Unit 4

Amino acids and Nucleic acids : Structure and classification, physical, chemical and optical properties of amino acids. Nucleotides - structure and properties. Nucleic acid structure – Watson-Crick model of DNA. Structure of major species of RNA - mRNA, tRNA and rRNA. Nucleic acid chemistry - UV absorption, effect of acid and alkali on DNA. Other functions of nucleotides - source of energy, component of coenzymes, second messengers.

Unit 5

Vitamins: Structure and active forms of water soluble and fat soluble vitamins, deficiency diseases and symptoms, hypervitaminosis

TEXT BOOKS

Ambika, S, (2004). Fundamentals of Biochemistry for Medical Students, CIT Chennai.

Deb, C., (2011). Fundamentals of Biochemistry, 9th edition New Central Book Agency, Calcutta.

Jain, J.L., Jain, S and Jain, N., (2005). Fundamentals of Biochemistry, S. Chand and Company Ltd, New Delhi.

REFERENCE BOOKS

Nelson, D., and Cox, M. W.H. (2012) Lehninger Principles of Biochemistry (4th Ed.) New York, Freeman and Company.

Stryer, L., (2009). Biochemistry, W.H. Freeman and Company, New York.

Murray, R.K., Bender, D.A., Botham, K.M., and Kennelly, P.J., (2012). Harper's illustrated Biochemistry, 29th Edition. McGraw-Hill Medical. London.

16BCU102 **CELL BIOLOGY** **4H-4C**

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- To understand the structural organization of prokaryotic cells
- To understand the structural organization of eukaryotic cells
- To understand the technical basis of membrane biology
- On the structure and functions of various sub-cellular organelle
- To understand the cytoskeletal network and extracellular matrix
- To understand the cell cycle, cell division and cell death process

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Differentiate the prokaryotic and eukaryotic cell
2. Understand the principle behind studying the cell morphology using various microscope
3. Identify the structure and functions of each organelle in cell
4. Recognise the mechanism behind the protein sorting and transport to their destinations like lysosome, mitochondria and chloroplast
5. Maintenance of cytoskeleton structure and function of micro, macro and intermediary filaments
6. Enumerate the phases of cell cycle, events in cell division and mechanism of cell death

Unit 1

Introduction to cell biology: Prokaryotic (*archaea and eubacteria*) and eukaryotic cell (animal and plant cells), cells as experimental models.

Plasma membrane: Composition, Fluid mosaic model

Tools of cell biology: Light microscopy, phase contrast microscopy, fluorescence microscopy, confocal microscopy, electron microscopy, FACS. Centrifugation for sub-cellular fractionation.

Unit 2

Structure of different cell organelles

Structure of nuclear envelope, nuclear pore complex. Selective transport of proteins to and from the nucleus. Regulation of nuclear protein import and export.

ER structure. Targeting proteins to ER, smooth ER and lipid synthesis. Export of proteins and lipids from ER and into ER.

Structure and functions of mitochondria, chloroplasts and peroxisomes. Zellweger syndrome.

Unit 3

Protein trafficking

Organization of Golgi. Lipid and polysaccharide metabolism in Golgi. Protein sorting and export from Golgi. Mechanism of vesicular transport, cargo selection, coat proteins

and vesicle budding, vesicle fusion.
Lysosome. – Acid hydrolases, phagocytosis and autophagy**.**
import and mitochondrial assembly, protein export from mitochondrial matrix. Import and sorting of chloroplast proteins.

Unit 4

Cytoskeletal proteins : Structure and organization of actin filaments. Treadmilling and role of ATP in microfilament polymerization, organization of actin filaments. Non-muscle myosin. Intermediate filament proteins, assembly and intracellular organization. Assembly, organization and movement of cilia and flagella.

Unit 5

Cell wall and extracellular matrix :Prokaryotic and eukaryotic cell wall, cell matrix proteins. Cell-matrix interactions and cell-cell interactions. Adherence junctions, tight junctions, gap junctions, desmosomes, hemidesmosomes, focal adhesions and plasmodesmata.

Cell cycle, cell death and cell renewal : Eukaryotic cell cycle, restriction point, and checkpoints. Cell division. Apoptosis and necrosis - brief outline. Salient features of a transformed cell.

TEXT BOOKS

Paul, A., (2007). Text Book of Cell and Molecular Biology,1st edition. Books and Allied (P) Ltd, Kolkata.

Verma, P.S., and.Agarwal, V.K., (2005). Cell Biology Molecular Biology and Genetics, VII Edition, S.Chand and company Ltd, New Delhi.

Shukla, R.M., (2013). A textbook of Cell Biology, Dominant Publishers and Distributors.

Powar, C.B., (2001). Cell Biology, 3rd edition, Himalaya Publishing House, New Delhi

REFERENCES

Lodish, H., Berk, A., Kaiser, C.A., and Krieger, M., (2012). Molecular Cell Biology, 7th edition. W.H. Freeman & Company, London.

Garret, R. H. and Grisham, C.M., Biochemistry (2010) 4th ed., Cengage Learning (Boston), ISBN-13: 978-0-495-11464-2.

Cooper, G.M., and Hausman, R.E., (2013). Cell-A Molecular Approach, 6th Edition.. Sinauer Associates. USA

Karp, G., (2013). Cell and Molecular Biology, 7th edition. John Wiley and Sons, Inc, Hoboken, United States.

Alberts, B., Johnson,A., Lewis, J., and Enlarge, M., Molecular Biology of the Cell (2008) 5th ed., Garland Science (Princeton), ISBN:

Semester I

16BCU103 MEMBRANE BIOLOGY AND BIOENEGETICS 4H-4C

Instruction hours/week: L:3 T:1 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- The basis of membrane proteins (intrinsic and extrinsic)
- The basis of membrane lipids (phospholipids and glycolipids)
- The basis of membrane carbohydrates
- The basis of membrane model system for drug delivery
- On the transport of biomolecules across membranes
- To understand the role of membrane components on energy production

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Understand the basis of membrane proteins (intrinsic and extrinsic)
2. Understand the basis of membrane lipids (phospholipids and glycolipids)
3. Understand the basis of membrane carbohydrates
4. Understand the basis of membrane model system for drug delivery
5. Understand the transport of biomolecules across membranes
6. Understand the role of membrane components on energy production.

Unit 1

Biomembranes, membrane structures and membrane dynamics: Composition of biomembranes- prokaryotic, eukaryotic, neuronal and sub-cellular membranes. Study of membrane proteins. Fluid mosaic model with experimental proof. Monolayer, planer bilayer and liposomes as model membrane systems. Polymorphic structures of amphiphilic molecules in aqueous solutions- micelles and bilayers. CMC, critical packing parameter. Membrane asymmetry. Macro and micro domains in membranes. Membrane skeleton, lipid rafts, caveolae and tight junctions. RBC membrane architecture. Lateral, transverse and rotational motion of lipids and proteins. Techniques used to study membrane dynamics - FRAP, TNBS labeling etc. Transition studies of lipid bilayer, transition temperature. Membrane fluidity, factors affecting membrane fluidity.

Unit 2

Membrane transports: Thermodynamics of transport. Simple diffusion and facilitated diffusion. Passive transport- glucose transporter, anion transporter and porins**.** Primary active transporters- P type ATPases, V type ATPases, F type ATPases. Secondary active transporters- lactose permease, Na^+-glucose symporter. ABC family of transporters- MDR, CFTR. Group translocation. Ion channels- voltage-gated ion channels (Na^+/K^+ voltage-gated channel), ligand-gated ion channels (acetyl choline receptor), aquaporins, bacteriorhodopsin. Ionophores - valinomycin, gramicidin.

Unit 3

Vesicular transport, membrane fusion and bioenergetics: Types of vesicle transport and their function- clathrin, COP I and COP II coated vesicles. Molecular mechanism of vesicular transport. Membrane fusion. Receptor mediated endocytosis of transferrin. Laws

of thermodynamics, state functions, equilibrium constant, coupled reactions, energy charge, ATP cycle, phosphorylation potential, phosphoryl group transfers. Chemical basis of high standard energy of hydrolysis of ATP, other phosphorylated compounds and thioesters. Redox reactions, standard redox potentials and Nernst equation. Universal electron carriers.

Unit 4

Oxidative phosphorylation: Mitochondria. Electron transport chain- its organization and function. Inhibitors of ETC and uncouplers. Peter Mitchell's chemiosmotic hypothesis. Proton motive force. Fo F1ATP synthase, structure and mechanism of ATP synthesis. Metabolite transporters in mitochondria. Regulation of oxidative phosphorylation. ROS production and antioxidant mechanisms. Thermogenesis. Alternative respiratory pathways in plants.

Unit 5

Photophosphorylation : General features of photophosphorylation, historical background, Hills reaction, photosynthetic pigments, light harvesting systems of plants and microbes and resonance energy transfer. Bacterial photophosphorylation in purple bacteria, Green sulfur bacteria and *Halobacterium salinarum*. Photophosphorylation in plants - structure of chloroplast, molecular architecture of Photosystem I and Photosystem II, Z-scheme of photosynthetic electron flow, oxygen evolving complex and action of herbicides. Cyclic photophosphorylation and its significance. Photo inhibition. Evolution of oxygenic photosynthesis.

REFERENCES

Nelson, D.L. and Cox, M.M., W.H.Freeman., Lehninger: Principles of Biochemistry (2013) 6th ed., and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10:1-4641-0962-1.

Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M.P., Molecular Cell Biology (2013) 7th ed., W.H. Freeman & Company (New York), ISBN:13: 978-1-4641-0981-2.

Garret, R. H. and Grisham, C.M., Biochemistry (2010) 4th ed., Cengage Learning (Boston), ISBN-13: 978-0-495-11464-2.

Voet, D.J., Voet, J.G. and Pratt, C.W., (2008) Principles of Biochemistry 3rd ed., John Wiley & Sons, Inc. (New York), ISBN:13: 978

Semester I

16BCU111 MOLECULES OF LIFE 3H-2C

PRACTICAL -1

Instruction hours/week: L:0 T:0 P:3 **Marks:** Internal: **40**External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

To impart hands-on training:

- To know the safety measures to be followed in laboratory
- To prepare molar, normal and ppm solutions
- On buffer preparation
- To separate the biomolecules using chromatography techniques
- To identify the biomolecules qualitatively
- To quantify the biomolecules using colorimetry

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Gain knowledge on lab safety
2. Prepare reagents and solutions
3. Understand the basis of buffer preparation
4. Understand the principle and working procedure behind chromatographic separations
5. Understand the principle and working procedure behind staining techniques
6. Understand the principle and working procedure behind colorimetrictechniques

Experiments

1. Safety measures in laboratories.
2. Preparation of normal and molar solutions.
3. Preparation of buffers.
4. Determination of pKa of acetic acid and glycine.
5. Qualitative tests for carbohydrates, lipids, amino acids, proteins and nucleic acids.
6. Separation of amino acids/ sugars/ bases by thin layer chromatography.
7. Estimation of vitamin C.
8. Estimation of vitamin E.

REFERENCE BOOKS

Nelson, D.L. and Cox, M.M., W.H.Freeman., Lehninger: Principles of Biochemistry (2013) 6th ed., and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10:1-4641-0962-1.

Devlin, T.M., (2011) Textbook of Biochemistry with Clinical Correlations 7th ed., John Wiley & Sons, Inc. (New York), ISBN:978-0-470-28173-4.

Jayaraman, J. (2007). Laboratory Manual in Biochemistry, New Age International Publishers, New Delhi.

Sadasivam, S., and Manickam, A., (2009). Biochemical Methods, New Age International Publishers, New Delhi.

Semester I

16BCU112 **CELL BIOLOGY PRACTICAL -2** **3H-2C**

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

To impart hands-on training:

- On different parts of light microscopy
- On how to visualize the cells
- On phase contrast microscopy
- On how to identify different stages of mitosis and meiosis
- On staining techniques to identify the cell types
- On how to count the cells using hemocytometer

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Identify the spotters of light microscopy
2. Be able to visualize the cells
3. Use the phase contrast microscopy at appropriate magnifications
4. Identify the cells using staining techniques
5. Interpret various stages of cell division
6. Count the cells manually using hemocytometer

Experiments

1. Preparation of onion root squash and observation of cell
2. Visualization of animal and plant cell by methylene blue.
3. Identification of different stages of mitosis in onion root tip.
4. Identification of different stages of meiosis in grasshopper testis.
5. Cell size determination using ocular stage micrometer
6. Micrographs of different cell components (dry lab).
7. Sub-cellular fractionation.
8. Visualization of nuclear fraction by acetocarmine stain.
9. Staining and visualization of mitochondria by Janus green stain.

REFERENCE BOOKS

Cooper, G.M. and Hausman, R.E., (2009). The Cell: A Molecular Approach 5th ed., ASM Press & Sunderland (Washington DC), Sinauer Associates, MA, ISBN:978-0-87893-300-6.

Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell. J., (2012) Molecular Cell Biology 7th ed., W.H. Freeman & Company (New York), ISBN:13:978-1-4641-0981-2 / ISBN:10: 1-4641-0981-8.

Alberts, B., Johnson,A., Lewis, J., and Enlarge, M., (2008) Molecular Biology of the Cell 5th ed., Garland Science (Princeton), ISBN:

Semester I

16BCU113 MEMBRANE BIOLOGY AND BIOENEGETICS 4H-2C
PRACTICAL-3

Instruction hours/week: L:0 T:0 P:4 Marks: Internal: **40**External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

To impart hands-on training:

- To analyze the composition of lipids in animal cell (RBC)
- To analyze the composition of lipids in plant cell
- On CMC determination and its significance
- To separate the photosynthetic pigments using TLC
- On techniques related to isolation of membrane bound enzymes
- On techniques related to quantification of membrane bound enzymes

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Analyze the composition of lipids in animal cell (RBC)
2. Analyze the composition of lipids in plant cell
3. Determine CMC for the given sample
4. Separate the photosynthetic pigments using TLC
5. Isolate membrane bound enzymes
6. Perform quantification of membrane bound enzymes

Experiments

1. Effect of lipid composition on the permeability of a lipid monolayer.
2. Determination of CMC of detergents.
3. RBC ghost cell preparation and to study the effect of detergents on membranes.
4. Separation of photosynthetic pigments by TLC.
5. Isolation of mitochondria from liver and assay of marker enzyme SDH.
6. Study photosynthetic O2 evolution in hydrilla plant.
7. Isolation of chloroplast from spinach leaves, Estimation of chlorophyll.

REFERENCES

Nelson, D.L. and Cox, M.M., (2013) Lehninger: Principles of Biochemistry 6th ed., W.H.Freeman and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10:1-4641-0962-1.

Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M.P., (2013). Molecular Cell Biology 7th ed., W.H. Freeman & Company (New York), ISBN:13: 978-1-4641-0981-2.

Garret, R. H. and Grisham, (2010). Biochemistry 4th ed., C.M., Cengage Learning (Boston), ISBN-13: 978-0-495-11464-2.

Voet, D.J., Voet, J.G. and Pratt, C.W., (2008). Principles of Biochemistry 3rd ed., John Wiley & Sons, Inc. (New York), ISBN:13: 978

16LSU201 **TAMIL-2** **4H-4C**

Instruction hours/week: L:4 T:0 P:0 Marks: Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

பாடத்திட்டப்பொதுநோக்கம்

- கற்றல் வழி சிந்தனைத் திறனையும், கருத்து வெளிப்பாட்டுத் திறனையும், மேம்படுத்துதல்.
- ஆய்வுநோக்கைமேம்படுத்துதல்.
- இலக்கியங்கள் உணர்த்தும் வாழ்வின் நுட்பமான பகுதிகளை உணர்த்துதல்.
- மனித மனத்தினைப் பக்குவப்படுத்துதலில் இலக்கியம் தரும் பங்கினை உணர்த்துதல்.
- வளர்ந்து வரும் சமூகத்தில் அறஉணர்வு, பண்பாடு போன்றவை குறித்து அறிவூட்டல்.
- அரசுத் தேர்வுகளுக்கு மாணவர்களை ஆயத்தமாக்குதல்.

பாடத்திட்டப்பயன்விளைவு

7. இந்தியகுடியுரிமைப்பணிமுதலானபோட்டித்தேர்வுகளில், விருப்பப்பாடமாகஇந்தியகுடியுரிமைப்பணிமுதலானபோட்டித்தேர்வுகளில் , விருப்பப்பாடமாகஇடம்பெறுகின்ற, 'தமிழ்இலக்கியவரலாறு' குறித்தமுழுமையானஅறிமுகம்பெற்றிருத்தல்.
8. கல்வெட்டியல், ஓலைச்சுவடியியல்மற்றும்தொல்லியல்சார்ந்தஆவணத்தேடலுக்குரியஆய்வுமனப்பான்மையுடன், இலக்கியங்களைஅணுகுதல்.
9. தமிழின்வளர்ச்சித்துறையாகிய, 'அறிவியல்தமிழ்' ; 'இணையதமிழ்' குறித்தபன்நோக்குஅணுகுமுறையிலானஆய்வுச்சிந்தனைமேம்பாடு.
10. வேலைவாய்ப்புக்குரியசுயதிறன்மேம்பாட்டுடன், படைப்பாக்கத்திறன்மேம்பாடும்பெற்றிருத்தல் .
11. சமுதாயமற்றும்வாழ்வியல்மதிப்புகளைப்பேணுவதற்குக்கருவியாகஇலக்கியங்களைநாடுகின்றமனப்பான்மைவளர்ச்சி.
12. மொழிபெயப்புத்துறைசார்ந்தவேலைவாய்புத்திறன்பெற்றிருத்தல்

தாள்கள்வரிசையும்தேர்வுச்செயல்திட்டமும்பகுதி-I தமிழ்

பருவம்	தாள்	கற்பிக்கும் நேரம்/வாரம்	தேர்வு மணிகள்	மதிப்பெண் அக/எழுத்து	மொத்தம்	மதிப்பீடு
இரண்டு	II	4	3	40 / 60	100	4

பகுதி – I, **தமிழ்** **பருவம்** II

16LAU201 : **தமிழ்இரண்டாம்தாள்** 4-H,4-C

(இளநிலைஅறிவியல்பட்டவகுப்புகளுக்குரியது)

அலகு – I :பக்திஇலக்கியம் (10 மணிநேரம்)

சைவ, வைணவஇலக்கியங்கள் - தோற்றம் ,வளர்ச்சி, வரலாறு.

1. சைவம் -பெரியபுராணம் - திருமூலநாயனார்புராணம்.

2.வைணவம் - பெரியாழ்வார்திருமொழி: 10 பாடல்கள்.

அலகு – II :சங்கஇலக்கியம் : (15 மணிநேரம்)

சங்கஇலக்கியங்கள்அறிமுகம்

அ).எட்டுத்தொகை

நற்றிணை : பிரசம்கலந்த – பாலை -110

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உலகம்ஒருநிறையாத்தான்-6, மாயோன்கொப்பூழ்-7, செய்யாட்குஇழைத்த-9,

கார்த்திகைகாதில்-10, ஈவாரைக்கொண்டாடி-11.

கலித்தொகை:சுடர்தொடீகேளாய்: குறிஞ்சிக்கலி- 36

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புறநானூறு :யாதும்ஊரேயாவருங்கேளிர் –பொதுவியல்- 192

ஆ). பத்துப்பாட்டு

திருமுருகாற்றுப்படை - பழமுதிர்ச்சோலையின்சிறப்பு

முருகன்இருப்பிடங்கள் – 'சிறுதினைமலரொடு' என்பதிலிருந்துதொடங்கி,

'அறிந்தவாறே' என்பதுவரையிலானதொடர்கள்: 218-249.

முருகன்அருள்புரிதல் – 'தெய்வம்சான்ற' என்பதிலிருந்துதொடங்கி, 'நல்குமதி'

என்பதுவரையிலானதொடர்கள்: 286-295.

அலகு - III :காப்பியம் (6 மணிநேரம்)

சிலப்பதிகாரம்:

மங்கலவாழ்த்துப்பாடல்: (21-29) – கண்ணகியின்சிறப்பு:

'நாகநீள்நகரொடு' என்பதிலிருந்துதொடங்கி,

'கண்ணகிஎன்பாண்மன்னோ' என்பதுவரையிலானதொடர்கள்.

நடுகற்காதை: (207-234)- சேரன்செங்குட்டுவன்கண்ணகிக்குக்கோயில்எடுத்தல்:

'அருந்திறலரசர்' என்பதிலிருந்துதொடங்கி, 'மன்னவரேறென்'

என்பதுவரையிலானதொடர்கள்.

16BCU201 **PROTEINS** **4H-4C**

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40**External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- To build their understanding on proteins
- On different molecular techniques used for separation of proteins
- On different molecular techniques used for characterization of proteins
- To study the three dimensional structure of proteins using computational tools
- To enrich the biological significance of proteins
- To identify appropriate technique to use during their project work

Course outcomes (CO's)

After successful completion of the course, the student will:

1. Build on their understanding of proteins
2. Use different molecular techniques used for separation of proteins
3. Use different molecular techniques used for characterization of proteins
4. Understand the three dimensional structure of proteins using computational tools
5. Identify the biological significance of proteins
6. Use appropriate technique during their project work

Unit 1

Introduction, Extraction and Separation of Proteins: Introduction - Amino acids and their properties - hydrophobic, polar and charged amino acids. Biologically important peptides - hormones, antibiotics and growth factors. Multimeric proteins, conjugated proteins and metallo proteins. Diversity of function. Extraction of proteins for downstream processing - Solubilization of proteins from their cellular and extracellular locations. Use of simple grinding methods, homogenization, ultrasonication, French press and centrifugation. Separation techniques - Ammonium sulphate fractionation, solvent fractionation, dialysis and lyophilization.

Unit 2

Purification and Characterization of proteins: Chromatographic Techniques - Ion-exchange chromatography, molecular sieve chromatography, hydrophobic interaction/reverse phase chromatography, affinity chromatography, HPLC (Normal and Reverse phase) and FPLC. Characterization of proteins - Determination of purity, molecular weight, extinction coefficient and sedimentation coefficient, IEF, SDS-PAGE and 2-D electrophoresis.

Unit 3

Structural Organization and Analysis of proteins : Organization of protein structure into primary, secondary, tertiary and quaternary structures. N-terminal and C-terminal amino acid analysis. Sequencing techniques - Edman degradation. Generation of overlap peptides using different enzymes and chemical reagents. Disulfide bonds and their location. Mass spectrometric analysis, tandem MS. Solid phase peptide synthesis

Unit 4

Three dimensional structures of protein and Protein Structure Database : Nature of stabilizing bonds - covalent and non covalent. Importance of primary structure in folding. The peptide bond - bond lengths and configuration. Dihedral angles psi and phi. Helices, sheets and turns. Ramachandran map. Techniques used in studying 3-D structures - X-ray diffraction and NMR. Motifs and domains. Tertiary and quaternary structures. Structures of myoglobin and haemoglobin. Denaturation and renaturation of Ribonuclease A. Introduction to thermodynamics of folding and molten globule. Assisted folding by molecular chaperones, chaperonins and PDI. Defects in protein folding. Diseases –Alzheimer's and Prion based. Protein sequence and structure databases (PDB). Use of sequence and domain information. Viewing protein structures using *in silico* tools.

Unit 5

Specialized Proteins and its Applications : Myoglobin and haemoglobin - Oxygen binding curves, influence of 2,3-BPG, CO2 and Cl^- Hill plot. Cooperativity between subunits and models to explain the phenomena –concerted and sequential models. Haemoglobin disorders. Antibodies - Antibody structure and binding to antigens. Actin-myosin motors - ATP activated actin - myosin contractions. Membrane Proteins - Integral and membrane associated proteins. Hydropathy plots to predict transmembrane domains. Significance of membrane proteins - bacteriorhodopsin.

REFERENCES

Nelson, D.L. and Cox, M.M., (2013). Lehninger: Principles of Biochemistry 6th ed., W.H. Freeman and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10:1-4292-3414-8.

Sheehan, D., (2009). Physical Biochemistry 2nd ed., Wiley-Blackwell (West Sussex), ISBN: 9780470856024 / ISBN: 9780470856031.

Cooper, T.G., (2011). The Tools of Biochemistry Wiley India Pvt. Ltd. (New Delhi), ISBN: 978-81-265-3016-8.

16BCU202 **ENZYMES** **4H-4C**

Instruction hours/ week: L:4 T:1 P:0 **Marks:** Internal: **40** External: **60 Total**: **100**
End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- To understand the basic concepts of enzymes
- To study the kinetics of enzyme catalysed reactions
- To learn the mechanism of action of enzymes and enzyme inhibition concepts
- To understand various modes of enzyme regulation
- To learn the application of enzymes in health
- To learn the application of enzymes in diseases

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Understand the basic concepts on enzymes
2. Relate the initial velocity and substrate concentration of enzymes and be able to understand the kinetics of inhibition reactions
3. Understand the basis of enzyme inhibitor drugs
4. Be able to understand the regulation pattern of various enzymes
5. Relate the regulation pattern of enzymes for its application in health and diseases
6. Understand the application of enzymes as marker in various disease conditions

Unit 1

Introduction to enzymes and enzyme catalysis

Introduction - Nature of enzymes - protein and non-protein (ribozyme). Cofactor and prosthetic group, apoenzyme, holoenzyme. IUBMB classification of enzymes. Features of enzyme catalysis- Factors affecting the rate of chemical reactions, collision theory, activation energy and transition state theory, catalysis, reaction rates and thermodynamics of reaction. Catalytic power and specificity of enzymes (concept of active site), Fischer's lock and key hypothesis, Koshland's induced fit hypothesis.

Unit 2

Enzyme kinetics

Relationship between initial velocity and substrate concentration, steady state kinetics, equilibrium constant - monosubstrate reactions. Michaelis-Menten equation, Lineweaver-Burk plot, Eadie-Hofstee and Hanes plot. Km and Vmax, Kcat and turnover number. Effect of pH, temperature and metal ions on the activity of enzyme. Bisubstrate reactions - Types of bi bi reactions (sequential – ordered and random, ping pong reactions). Differentiating bi substrate mechanisms (diagnostic plots, isotope exchange).

Unit 3

Mechanism of action of enzymes and Enzyme inhibition

Mechanism of action of enzymes - General features - proximity and orientation, strain and distortion, acid base and covalent catalysis (chymotrypsin, lysozyme). Metal

activated enzymes and metalloenzymes, transition state analogues. Enzyme Inhibition - Reversible inhibition (competitive, uncompetitive, non-competitive, mixed and substrate). Mechanism based inhibitors - antibiotics as inhibitors.

Unit 4

Regulation of enzyme activity

Control of activities of single enzymes (end product inhibition) and metabolic pathways, feedback inhibition (aspartate transcarbomoylase), reversible covalent modification phosphorylation (glycogen phosphorylase). Proteolytic cleavage-zymogen. Multienzyme complex as regulatory enzymes. Occurrence and isolation, phylogenetic distribution and properties (pyruvate dehydrogenase, fatty acyl synthase) Isoenzymes - properties and physiological significance (lactate dehydrogenase).

Unit 5

Coenzymes in enzyme catalysed reactions and Applications of enzymes. Structure and Functions of TPP, FAD, NAD, pyridoxal phosphate, biotin, coenzyme A, tetrahydrofolate, lipoic acid. Applications of enzymes - Application of enzymes in diagnostics (SGPT, SGOT, creatine kinase, alkaline and acid phosphatases), enzyme immunoassay (HRPO), enzyme therapy (Streptokinase). Immobilized enzymes – Preparation techniques and its applications.

REFERENCES

Nelson, D.L. and Cox, M.M., (2013). Lehninger: Principles of Biochemistry 6th ed., W.H. Freeman and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10:1-4292-3414-8.

Donald, V. and Judith G.V., (2011). Biochemistry 4th ed., John Wiley & Sons Asia Pvt. Ltd. (New Jersey), ISBN:978-1180-25024.

Nicholas C.P., and Lewis S., (1999). Fundamentals of Enzymology 3rd ed., Oxford University Press Inc. (New York), ISBN:0 19 850229 X.

Semester II

16BCU203 **HUMAN PHYSIOLOGY** **4H-4C**

Instruction hours/week: L:3 T:1 P:0 Marks: Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- On the concept of homeostasis
- On the physiological functioning of cardiovascular system
- On the physiological functioning of renal system
- On the physiological functioning of gastro-intestinal and hepatic system
- On the physiological functioning of muscular skeletal system
- On the physiological functioning of reproductive system

Course outcomes (CO's)

After successful completion of the course, the student will:

1. Understand the concept of homeostasis
2. Understand the physiological functioning of cardiovascular system
3. Understand the physiological functioning of renal system
4. Understand the physiological functioning of gastro-intestinal and hepatic system
5. Understand the physiological functioning of muscular skeletal system
6. Understand the physiological functioning of reproductive system

Unit 1

Homeostasis and the organization of body fluid compartments :

Intracellular, extracellular and interstitial fluid. Homeostasis, control system and their components. Plasma as an extracellular fluid, RBC, molecular mechanism of blood coagulation, role of vitamin K in coagulation, anticoagulant and fibrinolytic systems. Anemias, polycythemia, haemophilia and thrombosis.

Respiration : Organization of the pulmonary system. Mechanism of respiration, pulmonary ventilation and related volumes, pulmonary circulation. Principles of gas exchange and transport. Regulation of respiration. Pulmonary oedema and regulation of pleural fluid. Hypoxia, hypercapnea, pulmonary distress, emphesema, ARDS.

Unit 2

Cardiovascular physiology: Pressure, flow and resistance. Anatomy of heart. Physiology of the cardiac muscle, automacity of the cardiac muscle contraction, excitation contraction coupling, relationship between cardiac cycle, heart sound, ventricular volumes and the ECG, control of cardiac function and output. The arterial system, venous system, the microcirculation and mechanics of capillary fluid exchange. Control of blood flow to the tissues. Portal circulations. Arterial pressure and its regulation. Hypertension, congestive heart disease, atherosclerosis and myocardial infarction.

Unit 3

Renal physiology: Anatomy of the kidney and the nephron. Regulation of renal blood flow. Cell biology of the Bowmans' capsule. Physiology of glomerular filtration and GFR. Tubular processing of the glomerular filtrate. Micturition reflex and voluntary control of micturition. Regulation of ECF electrolyte and water content, blood volume and long term blood pressure. Blood buffer systems, renal and pulmonary control of blood pH, renal clearance. Assessment of kidney function. Acidosis and alkalosis. Glomerular nephritis, renal failure, dialysis and diuretics.

Unit 4

Gastrointestinal and hepatic physiology: Histology of the gastrointestinal tract. Propulsion and motility of food and digested material. Enteric reflexes, secretory functions of the gastrointestinal tract, digestion and absorption of macro and micronutrients. Peptic ulcer, Sprue, celiac disease, IBD, regurgitation, diarrhoea and constipation. Anatomy of the hepatic lobule and blood flow into the liver. Formation and secretion of bile. enterohepatic cycle, reticuloendothelial system, metabolic importance of liver. Liver function tests. Jaundice, liver cirrhosis and fatty liver.

Musculosketetal system :Bone structure and formation. Physiology of muscle contraction in striated and non-striated muscle.

Unit 5

Reproductive physiology : Sex determination and differentiation. Development of female and male genital tracts. Spermatogenesis, capacitation and transport of sperm, blood testis barrier. Ovarian function and its control. Uterine changes, fertilization and implantation. Placenta as a feto- maternal unit, gestation and parturition.

Neurochemistry and neurophysiology: Central Nervous system. Peripheral Nervous system. Blood brain barrier and CSF. Membrane potentials. Synaptic transmission. Neurotransmitters. Sensory receptors and neural pathways. Somatic sensation, EEG, sleep, coma, learning and memory**.**

TEXTBOOKS

Chatterjee, C.C., (2012). Human Physiology, 11th edition, Mical Alli Agency, Calcutta.

Saradha, S., (2004). Textbook of Human Physiology, S. Chand and Company, New Delhi.

REFERENCES

Guyton, C., and Hall, J.E., (2010). Textbook of Medical Physiology, 12th Editon. Prism Indian edition, W.B. Saunders Company, New Delhi.

Murray, R.K., Bender, D.A., Botham, K.M., and Kennelly, P.J., (2012).Harper's illustrated Biochemistry, 29th edition.. McGraw-Hill Medical. London.

Semester II

16BCU211 **PROTEINS** **3H-2C**

PRACTICAL - 4

Instruction hours/week: L:0 T:0 P:3 Marks: Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives:

To impart hands-on training:

- Qualitative analysis of proteins
- Quantitative analysis of proteins
- Determination of isoelectric point of proteins
- Separation of proteins using chemical methods
- Electrophoretic separation of proteins using SDS-PAGE
- Immune based separation of proteins

Course Outcomes (CO's):

After successful completion of the course, the student will:

1. Perform qualitative analysis of proteins
2. Quantify the amount of protein in the given sample
3. Determine isolectric point of given protein
4. Separate the protein using ammonium sulphate method
5. Perform SDS-PAGE for separation of proteins
6. Perform affinity chromatography

Experiments

1. Estimation of proteins using UV absorbance and Biuret method.
2. Microassay of proteins using Lowry/Bradford method.
3. Isoelectric pH of casein.
4. Ammonium sulphate fractionation of serum proteins.
5. Separation of albumin from serum using anion-exchange chromatography.
6. SDS-PAGE analysis of proteins.

REFERENCES

Nelson, D.L. and Cox, M.M., (2013). Lehninger: Principles of Biochemistry 6th ed., W.H. Freeman and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10:1-4292-3414-8.

Sheehan, D., (2009). Physical Biochemistry 2nd ed., Wiley-Blackwell (West Sussex), ISBN: 9780470856024 / ISBN: 9780470856031.

Cooper, T.G., (2011). The Tools of Biochemistry Wiley India Pvt. Ltd. (New Delhi), ISBN: 978-81-265-3016-8.

Semester II

16BCU212 **ENZYMES** **3H-2C**

PRACTICAL - 5

Instruction hours/ week: L:0 T:1 P:3 **Marks:** Internal: **40** External: **60 Total**: **100**

End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- To understand the basic concepts of enzymes
- To study the kinetics of enzyme catalysed reactions
- To learn the mechanism of action of enzymes and enzyme inhibition concepts
- To understand various modes of enzyme regulation
- To learn the application of enzymes in health
- To learn the application of enzymes in diseases

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Understand the basic concepts on enzymes
2. Relate the initial velocity and substrate concentration of enzymes and be able to understand the kinetics of inhibition reactions
3. Understand the basis of enzyme inhibitor drugs
4. Be able to understand the regulation pattern of various enzymes
5. Relate the regulation pattern of enzymes for its application in health and diseases
6. Understand the application of enzymes as marker in various disease conditions

Experiments

1. Partial purification of acid phosphatase from germinating mung bean.
2. Assay of enzyme activity and specific activity, e.g. acid phosphatase.
3. Effect of pH on enzyme activity
4. Determination of Km and Vmax using Lineweaver-Burk graph.
5. Enzyme inhibition - calculation of Ki for competitive inhibition.
6. Continuous assay of lactate dehydrogenase.
7. Assay of glucose-6-phosphate dehydrogenase.

REFERENCE

Nelson, D.L. and Cox, M.M., (2013). Lehninger: Principles of Biochemistry 6th ed., W.H. Freeman and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10:1-4292-3414-8.

Donald, V., and Judith G.V., (2011). Biochemistry 4th ed., John Wiley & Sons Asia Pvt. Ltd. (New Jersey), ISBN:978-1180-25024.

Nicholas C.P. and Lewis S., (1999). Fundamentals of Enzymology 3rd ed., Oxford University Press Inc. (New York), ISBN:0 19 850229 X.

Semester II

16BCU213 **HUMAN PHYSIOLOGY PRACTICAL-6** **4H-2C**

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

To impart hands-on training on:

- Counting of different cell types using microscopy
- Estimation of haemoglobin in the given blood sample
- Determination of the group of the given blood sample
- Separation of isoenzymes by electrophoresis
- Measurement of blood pressure using sphygmomanometer
- Fixing and staining of microtome sections of tissues for histopathology observations

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Count of different cell types (RBC, WBC) using microscopy
2. Perform the estimation of haemoglobin in the given blood sample
3. Perform and identify the grouping (ABO and Rh) of the given blood sample
4. Separate isoenzymes by electrophoresis
5. Perform blood pressure measurement using sphygmomanometer
6. Perform fixing and staining of microtome sections of tissues for histopathology observations

Experiments

1. Hematology.
   a. RBC and WBC counting
   b. Differential leucocyte count.
   c. Clotting time.
   d. Bleeding time
2. Estimation of haemoglobin.
3. Determination of blood groups
4. Separation of plasma proteins.
5. Determination of total iron binding capacity.
6. Pulmonary function tests, spirometry and measurement of blood pressure.
7. Separation of isoenzymes by electrophoresis.
8. Histology of connective tissue, liver and/ brain permanent slides.
9. Case studies (Renal clearance, GFR, ECG).

REFERENCES

Rajan, S., (2012) Manual for Medical laboratory technology, First edition. Anjana Book House, Chennai.

Rao, B.S. and Deshpande, V., (2005). Experimental Biochemistry: A Student Companion IK International Pvt. Ltd. (New Delhi), ISBN:81-88237-41-8.

Semester II

16AEC201 **ENVIRONMENTAL STUDIES** **4H/4C**

Instruction hours/week: L: 3 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- To understand the concepts and components of ecosystem
- To understand the significance of eco components and measures to maintain ecosystem
- To teach the ethical and legal perspectives on ecosystem management
- To understand the undesired effects of environmental pollution
- To device a strategy to avoid environmental pollution
- To understand the concept of conservation

Course Outcomes (COs)

1. Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving.
2. Master core concepts and methods from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.
3. Understand the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
4. Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales.
5. Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
6. Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.

UNIT-1

Environment Definition, scope and importance, components, Ecosystem Definition, Concept, Scope, importance, Structure and functions of ecosystem. Energy flow, Ecological succession Food chains and food webs. Classification of ecosystem.

Unit 2

Natural Resources - Renewable and Non-renewable Resources: Natural resources and associated problems. Forest resources, Water resources, Mineral resources, Food resources, Energy resources, Land resources : Use and over-utilization, exploitation. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles. effects of fireworks.

Unit 3

Biodiversity and Its Conservation: Introduction, definition: genetic, species and ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. India as a mega-diversity nation. Hot-

spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

Unit 4

Environmental Pollution - Definition, Causes, effects and control measures of Air pollution, Water pollution, Soil pollution , Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards, Solid waste management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster management: Foods, earthquake, cyclone and landslides.

Unit 5

Social Issues and the Environment: From unsustainable to sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness. Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health.

REFERENCES

T1: Tripathy, S.N., and Panda, S., (2004). Fundamentals of Environmental Studies; 2nd Edition, Vrianda Publications Private Ltd., New Delhi.

T2: Kumar, A., (2004). A Textbook of Environmental Science; APH Publishing Corporation, New Delhi.

T3: Verma, P.S., Agarwal, V.K., (2001). Environmental Biology (Principles of Ecology); S.Chand and Company Ltd., New Delhi.

T4: Kaushik, A., Kaushik, C.P., (2004). Perspectives in Environmental Studies, New Age International Pvt. Ltd. Publications, New Delhi.

R1: Singh, M.P., Singh, B.S., and Dey, S.S., (2004). Conservation of Biodiversity and Natural Resources. Daya Publishing House, Delhi.

R2: Botkin, D.B., and Keller, E.A., (1995). Environmental Science, John Wiley and Sons, Inc., New York.

R3: Uberoi, N.K., (2005). Environmental Studies, Excel Books Publications, New Delhi, India.

Semester III

16BCU301 METABOLISM OF CARBOHYDRATES AND LIPIDS 4H-4C

Instruction hours/week: L: 4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objective

Equip the students:

- An overview on various metabolic pathways in human
- An overview on various metabolic pathways in plants
- To understand the pathways related with energy production through catabolism of carbohydrates and lipids
- To understand the pathways related with energy production through anabolism of carbohydrates and lipids
- To recognize the metabolic pathways that involve with the synthesis of macromolecule
- To know the biomolecules homeostasis mechanism

Course outcomes (CO's)

After successful completion of the course, the student will:

1. Students are able to understand the breakdown of macromolecules like carbohydrate and lipids
2. Recognise the energy production pathways like glycolysis, glycogeneolysis and TCA cycle
3. Interpret the central role of TCA cycle in energy metabolism
4. Relate the calvin cycle with the synthesis of starch and sucrose and integration of carbohydrate metabolism in plant
5. Understand the energy requirement and energy balance through glucose homeostasis
6. Relate the interdependence of metabolic pathways

Unit 1

Basic design of metabolism: Autotrophs, heterotrophs, metabolic pathways, catabolism, anabolism, ATP as energy currency, reducing power of the cell.

Glycolysis: Glycolysis - a universal pathway, reactions of glycolysis, fermentation, fates of pyruvate, feeder pathways for glycolysis, galactosemia.

Gluconeogenesis and pentose phosphate pathway: Synthesis of glucose from non-carbohydrate sources, reciprocal regulation of glycolysis and gluconeogenesis, pentose phosphate pathway and its importance.

Unit 2

Glycogen metabolism: Glycogenesis and glycogenolysis, regulation of glycogen metabolism, glycogen storage diseases.

Citric acid cycle: Production of acetyl CoA, reactions of citric acid cycle, anaplerotic reactions, amphibolic role, regulation of citric acid cycle, glyoxalate pathway, coordinated regulation of glyoxalate and citric acid pathways.

Unit 3

Synthesis of carbohydrates : Calvin cycle, regulation of calvin cycle, regulated synthesis of starch and sucrose, photorespiration, C4 and CAM pathways, synthesis of cell wall polysaccharides, integration of carbohydrate metabolism in plant cell.

Unit 4

Fatty acid oxidation: Digestion, mobilisation and transport of cholesterol and triacyl glycerols, fatty acid transport to mitochondria, β oxidation of saturated, unsaturated, odd and even numbered and branched chain fatty acids, regulation of fatty acid oxidation, peroxisomal oxidation, ω oxidation, ketone bodies metabolism, ketoacidosis.

Fatty acid synthesis: Fatty acid synthase complex. Synthesis of saturated, unsaturated, odd and even chain fatty acids and regulation.

Unit 5

Biosynthesis of eicosanoids, cholesterol, steroids and isoprenoids: Synthesis of prostagladins, leukotrienes and thromboxanes. Synthesis of cholesterol, regulation of cholesterol synthesis. Synthesis of steroids and isoprenoids.

Biosynthesis of membrane lipids:

Synthesis of membrane phospholipids in prokaryotes and eukaryotes, respiratory distress syndrome, biosynthesis of triacylglycerol, biosynthesis of plasmalogens, sphingolipids and glycolipids, lipid storage diseases.

Starve-feed cycle

Well-fed state, early fasting state, fasting state, early re-fed state, energy requirements, reserves and caloric homeostasis, five phases of glucose homeostasis.

REFERENCES:

Nelson, D.L. and Cox, M.M., (2013). Lehninger: Principles of Biochemistry 6th ed., W.H. Freeman and Company (New York), ISBN:13:978-1-4641-0962-1 / ISBN:10:1-4641-0962-1.

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Semester III

16BCU302 METABOLISM OF AMINOACID AND NUCLEIC ACIDS 4H-4C

Instruction hours/week: L: 4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- To understand the structure and functions of amino acids
- To understand the structure and functions of nucleic acids
- To understand the basis of diseases associated with amino acid catabolism
- To understand the basis of diseases associated with nucleic acid catabolism
- To understand the interconnection between amino acids and nucleic acids and central dogma concept
- To understand the biosynthesis of amino acids and nucleic acids

Course Outcomes (CO's)

After successful completion of the course, the student will:

1. Identify basic structures, names, and properties of nucleic acids
2. Demonstrate overview of amino acid metabolism and catabolism of amino acids
3. Understand the chemical logic of metabolic pathways
4. Recognize and understand basic mechanisms of pathway regulation
5. Understand the central dogma concept
6. Understand the basis of amino acid and nucleic acid disorders

Unit 1

Overview of amino acid metabolism : Nitrogen cycle, incorporation of ammonia into biomolecules. Metabolic fates of amino groups. Digestion and absorption of dietary proteins. Protein calorie malnutrition - Kwashiorkar and Marasmus. Nitrogen balance, transamination, role of pyridoxal phosphate, glucose-alanine cycle, Kreb's bicycle, urea cycle and inherited defects of urea cycle.

Catabolism of amino acids : Catabolic pathways of individual amino acids. Glucogenic and ketogenic amino acids. Metabolism of one carbon units.

Unit 2

Catabolism of amino acids

Disorders of amino acids metabolism, phenylketonuria, alkaptonuria, maple syrup urine disease, methylmalonic acidemia (MMA), homocystinuria and Hartnup's disease.

Biosynthesis of amino acids

Overview of amino acid synthesis. Biosynthesis of non-essential amino acids and its regulation.

Unit 3

Precursor functions of amino acids

Biosynthesis of creatine and creatinine, polyamines (putresine, spermine, spermidine), catecholamines (dopamine, epinephrine, norepinephrine) and neurotransmitters (serotonin, GABA). Porphyrin biosynthesis, catabolism and disorders of porphyrin metabolism.

Unit 4

Biosynthesis of purine and pyrimidine nucleotides

De novo synthesis of purine and pyrimidine nucleotides, regulation and salvage pathways.

Deoxyribonucleotides and synthesis of nucleotide triphosphate

Biosynthesis of deoxyribonucleotides and its regulation, conversion to triphosphates, biosynthesis of coenzyme nucleotides.

Unit 5

Degradation of purine and pyrimidine nucleotides

Digestion of nucleic acids, degradation of purine and pyrimidine nucleotides. Inhibitors of nucleotide metabolism. Disorders of purine and pyrimidine metabolism – Lesch-Nyhan syndrome, Gout, SCID, adenosine deaminase deficiency.

Integration of metabolism

Integration of metabolic pathways (carbohydrate, lipid and amino acid metabolic pathways), tissue specific metabolism (brain, muscle, and liver).

REFERENCES:

Nelson, D.L. and Cox, M.M., (2013). Lehninger: Principles of Biochemistry 6th ed., W.H. Freeman and Company (New York), ISBN:13:978-1-4641-0962-1 / ISBN:10:1-4641-0962.

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Semester III

16BCU303 HORMONES: BIOCHEMISTRY AND FUNCTION 4H-4C

Instruction hours/week: L:3 T:1 P:0 Marks: Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students on:

- The fundamentals of hormones and receptors
- Different mechanisms of hormonal actions
- Understanding of physiological and biochemical actions of hypothalamic, thyroid and pituitary hormones
- The role and applications of gastrointestinal hormones
- Understanding the clinical significance of adrenal and gonadal hormones
- Understanding of various endocrine disorders

Course outcomes (CO's)

After successful completion of the course, the student will:

1. Gain knowledge on functions, classification and transport of hormones
2. Understand the role of secondary messengers, effector systems and protein kinases, tyrosine kinases in hormonal action
3. Have knowledge on the biochemical action and regulation of various endocrine hormones
4. Understand the role and applications of gastrointestinal hormones
5. Have knowledge on the role and functions of adrenal and gonadal hormones
6. To be able to identify an endocrine disorder if symptoms are available

Unit 1

Introduction to hormones and receptors

Functions of hormones and their regulation. Chemical signaling - endocrine, paracrine, autocrine, intracrine and neuroendocrine mechanisms. Chemical classification of hormones, transport of hormones in the circulation and their half-lives. Hormone therapy. General introduction to Endocrine methodology. Hormone receptors - extracellular and intracellular. Receptor - hormone binding, Scatchard analysis. G protein coupled receptors, G proteins

Unit 2

Mechanisms of hormonal actions

Second messengers - cAMP, cGMP, IP3, DAG, Ca^{2+}, NO. Effector systems - adenylate cyclase, guanylate cyclase, PDE, PLC. Protein kinases (PKA, PKB, PKC, PKG). Growth factor signaling, PDGF, EGF, IGF-II, and erythropoietin. Receptor tyrosine kinases - EGF, insulin, erythropoietin receptor; ras - MAP kinase cascade, JAK - STAT pathway. Steroid hormone/ thyroid hormone receptor mediated gene regulation. Receptor regulation and cross talk.

Unit 3

Hypothalamic, pituitary and thyroid hormones

Hypothalamic - pituitary axis. Study the physiological and biochemical actions of hypothalamic hormones, pituitary hormones - GH, prolactin, TSH, LH, FSH, POMC peptide family, oxytocin and vasopressin, feedback regulation cycle. Endocrine disorders - gigantism, acromegaly, dwarfs, pigmies and diabetes insipidus. Thyroid gland.

Biosynthesis of thyroid hormone and its regulation; its physiological and biochemical action. Pathophysiology - Goiter, Graves disease, cretinism, myxedema, Hashimato's disease.

Unit 4

PTH, calcitonin and gastrointestinal hormones

PTH, Vitamin D and calcitonin. Mechanism of Ca^{2+} regulation and pathways involving bone, skin, liver, gut and kidneys. Pathophysiology - rickets, osteomalacia, osteoporosis. Regulation of release of insulin, glucagon, gastrin, secretin, CCK, GIP, adipolectin, leptin and ghrelin. Summary of hormone metabolite control of GI function. Physiological and biochemical action. Pathophysiology - diabetes type I and type II.

Unit 5

Adrenal and gonadal hormones

Aldosterone, renin angiotensin system, cortisol, epinephrine and norepinephrine. Fight or flight response, stress response. Pathophysiology – Addison's disease, Conn's syndrome, Cushing syndrome.Male and female sex hormones. Interplay of hormones during reproductive cycle, pregnancy, parturition and lactation. Hormone based contraception.

REFERENCES

Nelson, D.L. and Cox, M.M., (2013). Lehninger: Principles of Biochemistry 6th ed., W.H. Freeman & Company (NewYork), ISBN:13: 978-1-4641-0962-1 / ISBN:10-14641-0962-1.

Widmaier, E.P., Raff, H., and Strang, K.T., (2008). Vander's Human Physiology 11th ed.,. McGraw Hill International Publications, ISBN: 978-0-07-128366-3.

Hadley, M.C., and Levine, J.E., (2007). Endocrinology 6th ed., Pearson Education (New Delhi), Inc. ISBN: 978-81-317-2610-5.

Cooper, G.M., and Hausman, R.E., (2009). The Cell: A Molecular Approach 5th Ed. ASM Press & Sunderland, (Washington DC), Sinauer Associates. (MA). ISBN:978-0-87893-300-6.

16BCU311 METABOLISM OF CARBOHYDRATES AND LIPIDS Semester III

PRACTICAL- 7 4H-2C

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

To impart hands-on training:

- On different qualitative methods to estimate glucose
- On different quantitative methods to estimate glucose
- On fermentation techniques
- On isolation methods for lipids
- To understand the quantitative analysis of enzymes involved in carbohydrate metabolism
- To understand the quantitative analysis of enzymes involved in lipid metabolism

Course outcomes (CO's)

After successful completion of the course, the student will:

1. Use different qualitative methods to estimate glucose
2. Use different quantitative methods to estimate glucose
3. Perform fermentation techniques
4. Understand the quantitative analysis of enzymes involved in carbohydrate metabolism
5. Isolate lipid from the given sample
6. Estimate enzymes involved in lipid metabolism

Experiments

1. Estimation of blood glucose.
2. Sugar fermentation of microorganisms.
3. Assay of salivary amylase.
4. Isolation of lecithin, identification by TLC, and its estimation.
5. Isolation of cholesterol from egg yolk and its estimation.

REFERENCES:

Nelson, D.L. and Cox, M.M., (2013). Lehninger: Principles of Biochemistry 6th ed., W.H. Freeman and Company (New York), ISBN:13:978-1-4641-0962-1 / ISBN:10:1-4641-0962-1.

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16BCU312 METABOLISM OF AMINOACID AND NUCLEIC ACIDS Semester III
PRACTICAL-8 **4H-2C**

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objectives

To impart hands-on training:

- To assay clinically relevant transaminases
- To assess the levels of urea, uric acid and creatinine in urine sample using qualitative methods
- To assess the levels of urea, uric acid and creatinine in urine sample using quantitative methods
- To interpret the results on amino acids and nucleic acids in clinical cases
- To introduce case studies related to amino acid disorders
- To introduce case studies related to nucleic acid disorders

Course outcomes (CO's)

After successful completion of the course, the student will:

1. Assay clinically relevant transaminases
2. Assess the levels of urea, uric acid and creatinine in urine sample using qualitative methods
3. Assess the levels of urea, uric acid and creatinine in urine sample using quantitative methods
4. Interpret the results on amino acids and nucleic acids in clinical cases
5. Understand case studies related to amino acid disorders
6. Understand case studies related to nucleic acid disorders

Experiments

1. Assay of serum transaminases – SGOT and SGPT.
2. Estimation of serum urea.
3. Estimation of serum uric acid.
4. Estimation of serum creatinine.

REFERENCES

Nelson, D.L. and Cox, M.M., (2013). Lehninger: Principles of Biochemistry 6th ed., W.H. Freeman and Company (New York), ISBN:13:978-1-4641-0962-1 / ISBN:10:1-4641-0962-1.

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16BCU313 HORMONES: BIOCHEMISTRY AND FUNCTION PRACTICAL-9 **Semester III 4H-2C**

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objectives

To impart hands-on training on

- Qualitative and quantitative measurement of glucose
- Calcium assessment methods (inorganic)
- Assay of insulin using enzyme linked immunosorbent assay
- Basis of pregnancy detection kit
- Assessments of electrolytes to understand hormonal functioning
- Case studies related to hormonal imbalance

Course outcomes (CO's)

After successful completion, the students will understand

1. The different Qualitative and quantitative methods of glucose estimation
2. Titrimetric and colorimetric methods for Calcium assessment
3. Enzyme linked immunosorbent assay
4. The principle behind the making of hCG kit and working procedure
5. Assessments of electrolytes to understand hormonal functioning
6. The fundamental defects due to hormonal imbalance

Experiments

1. Glucose tolerance test.
2. Estimation of serum Ca^{2+}.
3. Estimation of serum T4.
4. HCG based pregnancy test.
5. Estimation of serum electrolytes.
6. Case studies.

REFERENCES

Nelson, D.L. and Cox, M.M., (2013). Lehninger: Principles of Biochemistry 6th ed., W.H. Freeman & Company (NewYork), ISBN:13: 978-1-4641-0962-1 / ISBN:10-14641-0962-1.

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16BCU304-A TOOLS AND TECHNIQUES IN BIOCHEMISTRY Semester III
3H-3C

Instruction hours/week: L: 3 T:0 P:0 Marks: Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objective

Equip the students:

- On maintenance of safety documents.
- On the preparation of SOPs
- On the detection of radioisotopes
- Interpretation of virtual lab experiment
- Different methods of centrifugation (differential/density gradient)
- Determination of pKa for biological buffers using Henderson-Hasselbach equation

Course outcomes (CO's)

After successful completion of the course, the student will:

1. Maintain safety documents.
2. Prepare SOPs
3. Detect radioisotopes
4. Interpret virtual lab experiments
5. Use different methods of centrifugation (differential/density gradient)
6. DeterminepKa for biological buffers using Henderson-Hasselbach equationin a given situation

Unit 1

Biochemical reagents and solutions

Good laboratory practices. Preparation and storage of solutions. Concepts of solution concentration and storing solutions.

- Preparation of a molar solutions
- Preparation of normal solutions
- Preparation of percentage and ppm solutions.

Unit 2

Serial dilution

Quantitative transfer of liquids.

- Preparation of dilute acids from concentrated acids
- Preparation of various dilute solutions

Unit 3

Buffers

Concept of a buffer, Henderson-Hasselbach equation, working of a pH meter.

- Preparation of a buffer of given pH and molarity.

Unit 4

Spectrophotometric techniques

Principle , instrumentation and applications of UV-visible and fluorescence spectroscopy.

- Determination of the absorption maxima and molar extinction coefficient (of a relevant organic molecule).
- Measurement of fluorescence spectrum.
- Determination of concentration of a protein solution by Lowry/BCA method.
- Determination of nucleic acid concentration and purity

Unit 5

Introduction and importance of virtual labs in Biochemistry

REFERENCES

Sheehan, D., (2010). Physical Biochemistry: Principles and Applications 2nd ed., Wiley Blackwell (West Sussex), ISBN:978-0-470-85602-4 / ISBN:978-0-470-85603-1.

Freifelder, D., (1982). Physical Biochemistry: Applications to Biochemistry and Molecular Biology 2nd ed., W.H. Freeman and Company (New York), ISBN:0-7167-1315-2 / ISBN:0-7167-1444-2.

Plummer D. T., (1998). An Introduction to Practical Biochemistry 3rd ed., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10: 0-07-099487-0.

Semester III

16BCU304-B **CONCEPTS IN GENETICS** **3H-3C**

Instruction hours/week: L: 3 T:0 P:0 Marks: Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students:

- On understanding of the principles and concepts of genetics
- On the concepts of genetic disorders
- On the concepts of different types of mutations (inversions, deletions, duplications and translocations)
- On understanding the structure-function relationship of a specific gene
- On different model systems to study hereditary concepts
- On pedigree analysis

Course outcomes (CO's)

After successful completion of the course, the student will:

1. Understand the principles and concepts of genetics
2. Understand the basis of genetic disorders
3. Comprehend different types of mutations (inversions, deletions, duplications and translocations)
4. Understand the structure-function relationship of a specific gene
5. Use appropriate model systems to study hereditary concepts
6. Perform pedigree analysis

Unit 1

Model organisms, Mendelism and chromosomal basis of heredity

Model organisms: *Escherichia coli*, *Saccharomyces cerevisiae*, *Drosophila melanogaster*, *Caenorhabditis elegans*, *Danio rerio* and *Arabidopsis thaliana*, Basic principles of heredity. Laws of probability & binomial expansion, formulating and testing genetic hypothesis, chromosomal basis of Mendelism -Sutton and Boveri hypothesis with experimental evidences.

Unit 2

Extensions of Mendelism, genetics of a gene, bacteria and viruses

Allelic variation and gene function- dominance relationships, multiple alleles, lethal alleles and null alleles. Pleiotropy gene interaction- epistatic and non-epistatic, interaction between gene(s) and environment. Penetrance and expressivity, norm of reaction and phenocopy. Complementation test, limitations of *cis-trans* test, intragenic complementation, rII locus of phage T4 and concept of cistron. Mechanism of genetic exchange - conjugation, transformation and transduction. Gene mapping in bacteria.

Unit 3

Genetics of eukaryotes and Human pedigree analysis

Linkage and crossing over, genetic mapping in eukaryotes, centromere mapping with ordered tetrads, cytogenetic mapping with deletions and duplications in *Drosophila*, detection of linked loci by pedigree analysis in humans and somatic cell hybridization for positioning genes on chromosomes. Pedigree conventions, characteristics of dominant and recessive inheritance. Applications of pedigree analysis.

Unit 4

Developmental genetics, epigenetics and chromosomal aberrations

Model organism for genetic analysis, *Drosophila* development, maternal effect genes, morphogens and zygotic gene activity in development, sex chromosomes and sex determination, dosage compensation of X-linked genes. Extra nuclear inheritance, tests for organelle heredity and maternal effect, epigenetic mechanisms of transcriptional regulation & genomic imprinting. Variations in chromosome number- monosomy and trisomy of sex and autosomes. Variations in chromosome structure- inversions, deletions, duplications and translocations.

Unit 5

Complex traits inheritance, population & evolutionary genetics

Inheritance of complex trait, analysis of quantitative traits, narrow and broad sense heritability, quantitative trait loci (QTL) and their identification. Hardy- Weinberg law, predicting allele and genotype frequencies and exceptions to Hardy-Weinberg principle. Molecular evolution - analysis of nucleotide and amino acid sequences, molecular phylogenies, homologous sequences, phenotypic evolution and speciation.

REFERENCES

Snustad, D.P., and Simmons, M.J., (2012). Genetics 6th ed., John Wiley & Sons. (Singapore), ISBN: 978-1-118-09242-2.

Pierce, B.A., (2012). Genetics - A Conceptual Approach 4th ed., W.H. Freeman & Co. (New York), ISBN:13:978-1-4292-7606-1 / ISBN:10:1-4292-7606-1.

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16BCU314-A TOOLS AND TECHNIQUES IN BIOCHEMISTRY PRACTICAL-A

Semester III **3H-1C**

Instruction hours/week: L:0 T:0 P:3 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

To impart hands-on training:

- On the strength of concentrated acids
- On serial dilution of concentrated solutions
- How to determine the molar extension coefficient?
- How to obtain UV spectrum for a given compound?
- How to quantify nucleic acids using spectrophotometer?
- How to estimate the purity of nucleic acids

Course outcomes (CO's)

After successful completion of the course, the student will:

1. Know the strength of laboratory acids and bases
2. Prepare serial dilution of concentrated solutions
3. Determine the molar extension coefficient
4. Obtain UV spectrum for a given compound
5. Quantify nucleic acids using spectrophotometer
6. Assess the purity of nucleic acids

Experiments

1. Preparation of a molar solutions
2. Preparation of normal solutions
3. Preparation of percentage and ppm solutions.
4. Preparation of dilute acids from concentrated acids
5. Preparation of various dilute solutions
6. Preparation of a buffer of given pH and molarity.
7. Determination of the absorption maxima and molar extinction coefficient (of a relevant organic molecule).
8. Measurement of UV spectrum of compounds .
9. Determination of concentration of a protein solution by Lowry/BCA method.
10. Determination of nucleic acid concentration and purity

REFERENCES

Sheehan, D., (2010). Physical Biochemistry: Principles and Applications 2nd ed., Wiley Blackwell (West Sussex), ISBN:978-0-470-85602-4 / ISBN:978-0-470-85603-1.

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16BCU314-B **CONCEPTS IN GENETICS PRACTICAL-B** **Semester III 3H-1C**

Instruction hours/week: L:0 T:0 P:3 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objectives

To impart hands-on training:

- Sex determination
- On the method of induction of polyploidy
- On utility of buccal epithelial cells for genetic assessments
- On verification of Monohybrid crosses.
- On calculation of allele and genotype frequencies
- On plasmid conjugation in bacteria (transformation)

Course outcomes (CO's)

After successful completion of the course, the student will:

1. Execute sex determination
2. Understand induction methods of polyploidy
3. Use buccal epithelial cellsfor genetic assessments
4. Understand monohybrid crosses.
5. Calculate allele and genotype frequencies
6. Understand bacterial transformation

Experiments

1. Squash preparation of salivary glands of Dipteran larva to observe polytene chromosomes.
2. Induction of polyploidy in onion roots.
3. Smear technique to demonstrate sex chromatin in buccal epithelial cells.
4. Monohybrid crosses in *Drosophila* for studying autosomal and sex-linked inheritance.
5. PTC testing in a population and calculation of allele and genotype frequencies.
6. Study of abnormal human karyotype and pedigrees (dry lab).
7. Conjugation in bacteria.

REFERENCES

Snustad, D.P., and Simmons, M.J., (2012). Genetics 6th ed., John Wiley & Sons. (Singapore), ISBN: 978-1-118-09242-2.

Pierce, B.A., (2012). Genetics - A Conceptual Approach 4th ed., W.H. Freeman & Co. (New York), ISBN:13:978-1-4292-7606-1 / ISBN:10:1-4292-7606-1.

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16BCU401 GENE ORGANISATION, REPLICATION AND REPAIR Semester IV 4H-4C

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objectives

Equip the students:

- On the genome organization
- To study the mechanism of replication DNA in prokaryotes
- To study the mechanism of replication DNA in eukaryotes
- To study the mechanism of transcription in bothprokaryotes and eukaryotes
- To understand the mechanism of recombination and transposition of DNA
- To understand DNA damage, mutation and DNA repair process

Course outcomes (CO's)

After successful completion of the course, the student will:

1. Understand the genome organization
2. Understand the mechanism of replication DNA in prokaryotes
3. Understand the mechanism of replication DNA in eukaryotes
4. Understand the mechanism of transcription in both prokaryotes and eukaryotes
5. Understand the basis of recombination and transposition of DNA
6. Understand DNA damage, mutation and DNA repair process

Unit 1

Structure, Genes and genomic organization of DNA

DNA structure, features of the double helix, various forms of DNA, denaturation and reassociation of DNA. **Genes and genomic organization** - Genome sequence and chromosome diversity, definition of a gene, organization of genes in viruses, bacteria, animals and plants. Nucleosome structure and packaging of DNA into higher order structures.

Unit 2

Replication of DNA in Prokaryotes

The chemistry of DNA synthesis, DNA polymerase, the replication fork, origin of replication, enzymes and proteins in DNA replication, various modes of replication, stages of replication of *E. coli* chromosome, relationship between replication and cell division,

Unit3

Replication of DNA in Eukaryotes

Replication in eukaryotes. Comparison of replication in prokaryotes and eukaryotes. Inhibitors of DNA replication and applications in medicine. Supercoiling of DNA and its importance, topoisomerases, critical role of topoisomerases in cell, topoisomerase inhibitors and their application in medicine.

Unit 4

Recombination and transposition of DNA

Homologous recombination, proteins and enzymes in recombination, site-specific recombination, serine and tyrosine recombinases, biological roles of site-specific recombination, transposition, three classes of transposable elements, importance of transposable elements in horizontal transfer of genes and evolution.

Unit 5

Molecular basis of mutations and DNA repair

Importance of mutations in evolution of species. Types of mutations - transition, transversions, frame shift mutations, mutations induced by chemicals, radiation, transposable elements, Ames test. Various modes of DNA repair - Replication errors and mismatch repair system, repair of DNA damage, direct repair, base excision repair, nucleotide excision repair, recombination repair, translesion DNA synthesis.

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Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., (2008). Molecular Biology of the Gene 6th ed., Cold Spring Harbor Laboratory Press, Cold spring Harbor (New York), ISBN:0-321-50781 / ISBN:978-0-321-50781-5.

Nelson, D.L. and Cox, M.M., (2013). Lehninger: Principles of Biochemistry 6th ed., W. H. Freeman & Company (New York), ISBN:13: 978-1-4292-3414-6 / ISBN:10-14641-0962-1.

Snustad, D.P., and Simmons, M.J., (2010). Principles of Genetics 5th ed., John Wiley & Sons Asia, ISBN:978-0-470-39842-5.

Semester IV

16BCU402 GENE EXPRESSION AND REGULATION 4H-4C

Instruction hours/week: L:4 T:0 P:0Marks: Internal: **40**External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objectives

Equip the students:

- To utilize stages of transcription for drug development
- To understand the stages of RNA biosynthesis
- To understand the antibiotics mechanism of action and applications in medicine
- To understand the specialized system for protein degradation
- To gain knowledge on RNA interference in the treatment of HIV and Cancer
- To gain knowledge on DNA repair mechanisms

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Course outcomes (CO's)

After successful completion of the course, the student will:

1. Understand the mechanism of action of drugs
2. Understand the stages of RNA biosynthesis
3. Understand the mechanism of action of broad spectrum and specific antibiotics
4. Utilize the specialized system for protein degradation
5. Gain knowledge on RNA interference in the treatment of HIV and Cancer
6. Gain knowledge on DNA repair mechanisms.

Unit 1

Biosynthesis of RNA in prokaryotes

RNA polymerases, transcription cycle in bacteria, sigma factor, bacterial promoters, identification of DNA binding sites by DNA footprinting, the three stages of RNA synthesis, initiation, elongation and termination, rho-dependent and rho-independent termination. Inhibitors of transcription and applications as anti-microbial drugs.

Unit 2

Biosynthesis of RNA in eukaryotes

Comparison between prokaryotic and eukaryotic transcription. Transcription by RNA polymerase II, RNA polymerase II core promoters, general transcription factors, various types of RNA processing, transcription by RNA polymerase I and III. Inhibitors of eukaryotic transcription and their applications. Comparison of fidelity of transcription and replication.**RNA splicing-** Chemistry of RNA splicing, the spliceosome machinery, splicing pathways, group I and group II introns, alternative splicing, exon shuffling, RNA editing.

Unit 3

Biosynthesis of proteins

The genetic code-Degeneracy of the genetic code, wobble in the anticodon, features of the genetic code, nearly universal code. **Biosynthesis of proteins-** Messenger RNA, transfer RNA, attachment of amino acids to tRNA, the ribosome - initiation, elongation and termination of translation, regulation of translation. Comparison of prokaryotic and

eukaryotic protein synthesis. Use of antibiotics in understanding protein synthesis and applications in medicine.**Protein targeting and degradation -** Post translational modifications, glycosylation, signal sequences for nuclear transport, bacterial signal sequences, import of proteins by receptor mediated endocytosis, specialized systems for protein degradation.

Unit 4

Regulation of gene expression in prokaryotes

Principles of gene regulation, negative and positive regulation, concept of operons, regulatory proteins, activators, repressors, DNA binding domains, regulation of lac operon and trp operon, induction of SOS response, synthesis of ribosomal proteins, regulation by genetic recombination, transcriptional regulation in λ bacteriophage.

Unit 5

Regulation of gene expression in eukaryotes

Heterochromatin, euchromatin, chromatin remodeling, regulation of galactose metabolism in yeast, regulation by phosphorylation of nuclear transcription factors, regulatory RNAs, riboswitches, RNA interference, synthesis and function of miRNA molecules, phosphorylation of nuclear transcription factors.

REFERENCES

Nelson, D.L. and Cox, M.M., (2013). Lehninger: Principles of Biochemistry 6th ed., W.H. Freeman & Company (New York), ISBN:13: 978-1-4292-3414-6 / ISBN:10-14641-0962-1.

Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., (2008). Molecular Biology of the Gene 6th ed., Cold Spring Harbor Laboratory Press, Cold Spring Harbor (New York), ISBN:0-321-50781 / ISBN: 978-0-321-50781-5.

Semester IV

16BCU403 **IMMUNOLOGY** **4H-4C**

Instruction hours/week: L:3 T:1 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objectives

Equip the students with:

- Organs involved in immunity
- Acquired and innate arms of immune system
- The significance of humoral and cell mediated immunity during infection
- Various immunodeficiency diseases and hypersensitive reactions
- Structure and function of various immune cells and their role to combat infection
- Principles of vaccination

Course outcomes (CO's)

After successful completion, the students will understand

1. Organs involved in immunity
2. Acquired and innate arms of immune system
3. The significance of humoral and cell mediated immunity during infection
4. Various immunodeficiency diseases and hypersensitive reactions
5. Structure and function of various immune cells and their role to combat infection
6. Principles of vaccination

Unit 1

Cells and organs of the immune system and immunity

Hematopoiesis, cells of the immune system, primary and secondary lymphoid organs and tissues (MALT). Anatomical barriers, cell types of innate immunity, soluble molecules and membrane associated receptors (PRR), connections between innate and adaptive immunity, cell adhesion molecules, chemokines, leukocyte extravasation, localized and systemic response.

Unit 2

Antigens, Antibodies and receptor diversity

Antigens and haptens, factors that dictate immunogenicity, B and T cell epitopes. Structure and distribution of classes and subclasses of immunoglobulins (Ig), Ig fold, effector functions of antibody, antigenic determinants on Ig and Ig super family**.** Dreyer-Bennett hypothesis, multigene organization of Ig locus, mechanism of V region DNA rearrangement, ways of antibody diversification.

Unit 3

Biology of the B and T lymphocyte and complement system

Antigen independent phase of B cell maturation and selection, humoral response – T-dependent and T-independent response, anatomical distribution of B cell populations. Structure and role of T cell receptor, and co-receptor, T cell development, generation of

receptor diversity, selection and differentiation. Complement activation by classical, alternate and MB lectin pathway, biological consequences of complement activation, regulation and complement deficiencies.

Unit 4

Cell mediated cytotoxic responses and hypersensitivity

General properties of effector T cells, cytotoxic T cells (Tc), natural killer cells; NKT cells and antibody dependent cellular cytotoxicity (ADCC). Organ specific and systemic autoimmune diseases, possible mechanisms of induction of autoimmunity, Gell and Coombs classification, IgE mediated (Type I) hypersensitivity antibody mediated cytotoxic (Type II) hypersensitivity, immune complex mediated (type III) hypersensitivity and cell mediated (Type IV) hypersensitivity.

Unit 5

Antigen presentation, MHC complex and transplantation

General organization and inheritance of MHC, structure, distribution and role of MHC class I and class II proteins, linkage disequilibrium, pathways of antigen processing and presentation. Immunological basis of graft rejection, clinical manifestations, immunosuppressive therapy and privileged sites. Vaccines - active and passive immunization, types of vaccines.

REFERENCES:

Kuby., (2007) Immunology ; 6th ed., Kindt, T.L., Goldsby, R.A. and Osborne, B.A., W.H Freeman and Company (New York), ISBN:13: 978-0-7167-8590-3 / ISBN: 10:0-7617-8590-0.

Coico, R., and Sunshine, G., (2009) Immunology: A Short Course 6th ed., John Wiley& sons, Inc (New Jersey), ISBN: 978-0-470-08158-7.

Murphy, K., Mowat, A., and Weaver, C.T., (2012). Janeway's Immunobiology 8th ed., Garland Science (London & New York), ISBN: 978-0-8153-4243-4.

Semester IV

16BCU411 GENE ORGANISATION, REPLICATION AND REPAIR 4H-2C PRACTICAL -10

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objectives

To impart hands-on training on:

- The isolation of prokaryotic chromosomal DNA
- The isolation of eukaryotic chromosomal DNA
- Determination of melting temperature for the given nucleotide sequence
- Concepts of hyper and hypo chromicity
- Determination of viscosity
- Verification of Chargaffs rule (purine=pyrimidine)

Course outcomes (CO's)

After successful completion of the course, the student will:

1. Isolate prokaryotic chromosomal DNA
2. Isolate eukaryotic chromosomal DNA
3. Determine the melting temperature for the given nucleotide sequence
4. Know the concepts of hyper and hypo chromicity
5. Determine the viscosity of DNA
6. Verify Chargaffs rule (purine=pyrimidine)

Experiments

1. Verification of Chargaff's rule by paper chromatography.
2. Ultraviolet absorption spectrum of DNA and RNA.
3. Determination of DNA and RNA concentration by A260nm.
4. Determination of the melting temperature and GC content of DNA.
5. A study on the viscosity of DNA solutions.
6. Isolation of chromosomal DNA from *E. coli* cells.

REFERENCES:

Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., (2008). Molecular Biology of the Gene 6th ed., Cold Spring Harbor Laboratory Press, Cold spring Harbor (New York), ISBN:0-321-50781 / ISBN:978-0-321-50781-5.

Nelson, D.L., and Cox, M.M., (2013). Lehninger: Principles of Biochemistry 6th ed., W. H. Freeman & Company (New York), ISBN:13: 978-1-4292-3414-6 / ISBN:10-14641-0962-1.

Snustad, D.P., and Simmons, M.J., (2010). Principles of Genetics 5th ed., John Wiley & Sons Asia, ISBN:978-0-470-39842-5.

Semester IV

16BCU412 GENE EXPRESSION AND REGULATION 4H-2C

PRACTICAL - 11

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40**External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

To impart hands-on training:

- To analyze total nucleic acids from planttissue
- To analyze total nucleic acids from animal tissue
- To isolate mRNA using affinity chromatography
- On the synthesis of cDNA
- On the gene expression using RT-PCR
- To study Lac Operon

Course outcomes (CO's)

After successful completion of the course, the student will:

1. Estimate total nucleic acids from plant tissue
2. Estimate total nucleic acids from animal tissue
3. Isolate mRNA using affinity chromatography
4. Synthesize cDNA
5. Perform RT-PCR
6. Test Lac Operon in E. coli cells

Experiments

1. Extraction of total nucleic acids from plant tissue.
2. Isolation of mRNA from yeast by affinity chromatography.
3. cDNA synthesis
4. Assessment of gene expression using RT-PCR.
5. Induction of Lac Operon.

REFERENCES

Nelson, D.L., and Cox, M.M., (2013). Lehninger: Principles of Biochemistry 6th ed., W.H. Freeman & Company (New York), ISBN:13: 978-1-4292-3414-6 / ISBN:10-14641-0962-1.

Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., (2008). Molecular Biology of the Gene 6th ed., Cold Spring Harbor Laboratory Press, Cold Spring Harbor (New York), ISBN:0-321-50781 / ISBN: 978-0-321-50781-5.

16BCU413 **IMMUNOLOGY PRACTICAL - 12** **Semester IV** **4H-2C**

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

To impart hands-on training on:

- Isolation of lymphocytes
- Purification of immunoglobulins using protein A
- Immunodiffusion techniques (Single and Double)
- Agglutination techniques
- Blood grouping
- ELISA

Course outcomes (CO's)

1. Will perform isolation of lymphocytes
2. Purify of immunoglobulins using protein A
3. Perfom Immunodiffusion techniques (Single and Double)
4. Agglutination techniques
5. Blood grouping
6. ELISA

Experiments

1. Isolation of lymphocytes from blood and macrophages from peritoneal cavity or spleen.
2. Purification of immunoglobulins.
3. Assays based on precipitation reactions - Ouchterlony double diffusion (ODD) and Mancini radial immunodiffusion.
4. Assays based on agglutination reactions - Blood typing (active) & passive agglutination.
5. Enzyme linked immune-sorbent assay (ELISA).

REFERENCES

Kuby, J., (2007) Immunology;6th ed., Kindt, T.L., Goldsby, R.A. and Osborne, B.A., W.H Freeman and Company (New York), ISBN:13: 978-0-7167-8590-3 / ISBN: 10:0-7617-8590-0.

Coico, R., and Sunshine, G., (2009). Immunology: A Short Course 6th ed., John Wiley& sons, Inc (New Jersey), ISBN: 978-0-470-08158-7.

Murphy, K., Mowat, A., and Weaver, C.T., (2012). Janeway's Immunobiology 8th ed., Garland Science (London & New York), ISBN: 978-0-8153-4243-4.

Semester IV

16BCU404-A **BIOINFORMATICS** **3H-3C**

Instruction hours/week: L:3 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives

Equip the students:

- To understand basis and importance of bioinformatics and computer aided drug design
- To get exposed to different types of biological databases
- To look at a biological problem from a computational point of view
- To find out the methods for analyzing the expression, structure and function of proteins, and understanding the relationships between species
- To get knowledge on different methods for construction of a phylogenetic tree
- About the basics and importance of Proteomics and Genomics

Course outcomes (CO's)

After successful completion of the course, the student will:

1. Understand the basics of computer aided drug design
2. Perform experiment pair wise and multiple sequence alignment and will analyze the secondary and tertiary structures of protein sequences
3. Understand the data structure (databases) used in bioinformatics and interpret the information
4. Perform search on protein and metabolic pathway databases
5. Perform BLAST to identify the sequence of amino acids
6. Construct a phylogenetic tree using bioinformatics

Unit 1

Introduction to bioinformatics

Computer fundamentals - programming languages in bioinformatics, role of supercomputers in biology. Historical background. Scope of bioinformatics - genomics, proteomics, computer aided drug design (structure based and ligand based approaches) and Systems Biology. Applications of bioinformatics.

Unit 2

Biological databases and data retrieval

Introduction to biological databases - primary, secondary and composite databases, NCBI, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), protein databases (PIR, Swiss-Prot, TrEMBL, PDB), metabolic pathway database (KEGG, EcoCyc, and MetaCyc), small molecule databases (PubChem, Drug Bank, ZINC, CSD). Structure viewers (RasMol, J mol), file formats.

Unit 3

Sequence alignment

Similarity, identity and homology. Alignment – local and global alignment, pairwise and multiple sequence alignments, alignment algorithms, amino acid substitution matrices (PAM and BLOSUM), BLAST and CLUSTALW.

Unit 4

Phylogenetic analysis

Construction of phylogenetic tree, dendrograms, methods of construction of phylogenetic trees - maximum parsimony, maximum likelihood and distance methods.

Unit 5

Protein structure prediction analysis and gene prediction

Levels of protein structure. Protein tertiary structure prediction methods –homology modeling, fold recognition and *ab-initio* methods. Significance of Ramachandran map. Introduction to genomics, comparative and functional genomics, gene structure in prokaryotes and eukaryotes, gene prediction methods and tools.

REFERENCES

Mount, D.W., (2001). Bioinformatics: Sequence and Genome Analysis 1st ed., Cold Spring Harbor Laborator Press (New York), ISBN: 0-87969-608-7.

Pevsner, J., (2003). Bioinformatics and Functional Genomics (2003), 1st ed., John Wiley & Sons, Inc. (New Jersey), ISBN: 0-47121004-8.

Baxevanis, A.D., and Ouellette, B.F., (2005). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd ed., John Wiley & Sons, Inc. (New Jersey), ISBN: 0-47147878-4.

Ghosh, Z., and Mallick, B., (2008). Bioinformatics – Principles and Applications (2008), 1st ed. Oxford University Press (India), ISBN: 9780195692303.

Semester IV

16BCU404-B PROTEIN PURIFICATION TECHNIQUES 3H-3C

Instruction hours/week: L:3 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students on:

- The basic principles involved in protein purification
- The basic chemical methods used for protein separation
- The principle, working and applications of different chromatographic techniques for protein characterization
- The principle, working and applications of different electrophoretic techniques for protein purification.
- The principle and applications of dialysis
- Advanced protein purification techniques

Course outcomes (CO's)

After successful completion of the course, the student will:

1. Understand the basic principles pertaining to protein purification
2. Perform gel exclusion, affinity and ion exchange chromatography for protein purification
3. Perform SDS PAGE and identify the molecular weight of the protein
4. Understand the principle, instrumentation and applications of HPLC
5. Perform dialysis technique
6. Identify and apply appropriate techniques for purification of the given protein sample

Unit 1

Salting in and salting out- Principle, Debye-Huckel theory, Hofmeister series,Ionic strength, Ammonium sulfate precipitation, applications

Unit 2

Gel exclusion Chromatography- Principle, instrumentation and applications of gel exclusion chromatography, data analysis Advantages and disadvantages.

Unit 3

Polyacrylamide gel electrophoresis- Principle, instrumentation and applications of PAGE. Gel polymerization- APS, TEMED. Separation and determination of molecular weight of proteins SDS, running gel, stacking gel, electrophoresis buffer,

Unit 4

HPLC -Principle, instrumentation and applications of HPLC. Preparation of column, adsorbent materials, void volume, efficiency factor. Van Deemter equation Applications- Manufacturing, legal, research, medical

Unit 5

Dialysis- Principle and types- Hemodialysis, pediatric, intestinal and peritoneal dialysis. Dialyzable substances. Medical applications.

REFERENCES

Sheehan, D., (2010). Physical Biochemistry: Principles and Applications 2nd ed., Wiley Blackwell (West Sussex), ISBN: 978-0-470-85602-4 / ISBN: 978-0-470-85603-1.

Freifelder, D., (1982). Physical Biochemistry: Applications to Biochemistry and Molecular Biology 2nd ed., W.H. Freeman and Company (New York), ISBN:0-7167-1315-2 / ISBN:0-7167-1444-2.

Plummer D. T., (1998). An Introduction to Practical Biochemistry 3rd ed., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10: 0-07-099487-0

16BCU414-A **BIOINFORMATICS PRACTICAL-A** **Semester IV** **3H-1C**

Instruction hours/week: L:0 T:0 P:3 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objectives

To impart hands-on training on:

- Sequence retrieval from NCBI database
- Searching Protein and DNA structure from PDB
- Different molecular file formats for saving a protein/DNA sequence
- Different sequence alignment databases.
- Applying the statistical approaches and models for phylogenetic analysis and tree reconstruction.
- Different protein structure prediction databases

Course outcomes (CO's)

After successful completion of the course, the student will:

1. Be able to retrieve a sequence from NCBI database
2. Be able to search a protein from PDB
3. Understand the different molecular file formats for saving a protein/DNA sequence
4. Apply different sequence alignment databases such as BLAST and CLUSTALW.
5. Apply the statistical approaches and models for phylogenetic analysis and tree reconstruction.
6. Analyze and predict the protein structure using structure prediction databases

Experiments

1. Biological databases and data retrieval

Sequence retrieval (protein and gene) from NCBI.
Structure download (protein and DNA) from PDB.
Molecular file formats - FASTA, GenBank, Genpept, GCG, CLUSTAL, Swiss-Prot, FIR. Molecular viewer by visualization software.

2. Sequence alignment

BLAST suite of tools for pairwise alignment.
Multiple sequence alignment using CLUSTALW.

3. Phylogenetic analysis

Generating phylogenetic tree using PHYLIP.

4. Protein structure prediction and analysis

Primary sequence analyses (Protparam).
Secondary structure prediction (GOR, nnPredict, SOPMA).
Tertiary structure prediction (SWISSMODEL).
Protein structure evaluation - Ramachandran map (PROCHECK).

5. Gene structure prediction and analysis

Gene prediction using GENSCAN and GLIMMER.

REFERENCE

Mount, D.W., (2001). Bioinformatics: Sequence and Genome Analysis 1st ed., Cold Spring Harbor Laborator Press (New York), ISBN: 0-87969-608-7.

Pevsner, J., (2003). Bioinformatics and Functional Genomics 1st ed., John Wiley & Sons, Inc. (New Jersey), ISBN: 0-47121004-8.

Baxevanis, A.D., and Ouellette, B.F., (2005). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins 3rd ed., John Wiley & Sons, Inc. (New Jersey), ISBN: 0-47147878-4.

Ghosh, Z., and Mallick, B., (2008). Bioinformatics – Principles and Applications 1st ed. Oxford University Press (India), ISBN: 9780195692303.

16BCU414-B PROTEIN PURIFICATION TECHNIQUES Semester IV
PRACTICAL -B 3H-1C

Instruction hours/week: L:0 T:0 P:3 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objectives

To impart hands-on training on:

- Instrumentation of different protein purification methods
- The basic chemical methods used for protein separation
- The principle, working and applications of different chromatographic techniques for protein characterization
- The principle, working and applications of different electrophoretic techniques for protein purification.
- The principle and applications of dialysis
- Advanced protein purification techniques

Course outcomes (CO's)

After successful completion of the course, the student will:

1. Gain knowledge on the basic principles pertaining to protein purification
2. Perform gel exclusion, affinity and ion exchange chromatography for protein purification
3. Perform SDS PAGE and identify the molecular weight of the protein
4. Understand the principle, instrumentation and applications of HPLC
5. Perform dialysis techniques for protein separation
6. Identify and apply appropriate techniques for purification of the given protein sample

Experiments

1. Preparation of the sample.
2. Ion-exchange chromatography.
3. Gel filtration chromatography.
4. Paper chromatography /TLC.
5. Electrophoresis.

REFERENCES

Sheehan, D., (2010). Physical Biochemistry: Principles and Applications 2nd ed., Wiley Blackwell (West Sussex), ISBN: 978-0-470-85602-4 / ISBN: 978-0-470-85603-1.

Freifelder, D., (1982). Physical Biochemistry: Applications to Biochemistry and Molecular Biology 2nd ed., W.H. Freeman and Company (New York), ISBN:0-7167-1315-2 / ISBN:0-7167-1444-2.

Plummer D. T., (1998). An Introduction to Practical Biochemistry 3rd ed., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10: 0-07-099487-0

16BCU501-A **CLINICAL BIOCHEMISTRY** **Semester V**
3H-3C

Instruction hours/week: L:3 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objectives

Equip the students on:

- Organization of clinical laboratory
- Specimen collection
- Precision, accuracy
- Quality control
- Automated systems
- Assessment of organ functions

Course outcomes (CO's)

After successful completion of the course, the student will

1. Know about organization of clinical laboratory
2. Specimen collection
3. Precision, accuracy calculations
4. Quality control
5. Automated systems
6. Know to use the diagnosis to assess organ functioning

Unit 1

Introduction

Organization of clinical laboratory, Introduction to instrumentation and automation in clinical biochemistry laboratories safety regulations and first aid. General comments on specimen collection, types of specimen for biochemical analysis. Precision, accuracy, quality control, precautions and limitations.

Unit 2

Evaluation of biochemical changes in diseases

Basic hepatic, renal and cardiovascular physiology. Biochemical symptoms associated with disease and their evaluation. Diagnostic biochemical profile.

Unit 3

Assessment of glucose metabolism in blood

Clinical significance of variations in blood glucose. Diabetes mellitus.

Lipid profile

Composition and functions of lipoproteins. Clinical significance of elevated lipoprotein.

Unit 4

Liver function tests

Renal function tests and urine analysis

Use of urine strip / dipstick method for urine analysis.

Unit 5 Tests for cardiovascular diseases

Involvement of enzymes in diagnostics of heart disease including aspartate transaminase, isoenzymes of creatine kinase and lactate dehydrogenase and troponin.

REFERENCES

Mukherjee, K.L., (2010). Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests Vol. I (2010), Tata Mc Graw–Hill Publishing Company Limited (New Delhi). ISBN:9780070076594 / ISBN:9780070076631

Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests VoI. II (2010), Mukherjee, K.L., Tata Mc Graw – Hill Publishing Company Ltd. (New Delhi), ISBN: 9780070076648.

Baynes, J.W. and Dominiczak, M.H., (2005). Medical Biochemistry 2nd ed., Elsevier Mosby Ltd. (Philadelphia), ISBN:0-7234-3341-0.

Rao, B.S. and Deshpande, V., (2005). Experimental Biochemistry: A Student Companion IK International Pvt. Ltd. (New Delhi), ISBN:81-88237-41-8.

Semester V

16BCU501-B BIOCHEMICAL CORRELATION OF DISEASE 3H-3C

Instruction hours/week: L:3 T:0 P:0 **Marks:** Internal: **40**External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students with:

- Inborn errors of metabolism
- Nutritional disorders
- Life style disorders
- Autoimmune diseases
- Contagious diseases
- Vaccine strategies

Course outcomes (CO's)

After successful completion, the students will understand:

1. Inborn errors of metabolism
2. Nutritional disorders
3. Life style disorders
4. Autoimmune diseases
5. Contagious diseases
6. Vaccine strategies

Unit 1

Inborn errors of metabolism

Alkaptonuria, Phenylketonuria, Glycogen and Lipid storage diseases, SCID, Clotting disorders.

Unit 2

Nutritional deficiency based diseases

Kwashiorkar, Marasmus, Beri-beri, Scurvy, Pellagra, Anaemia, Night blindedness, Rickets, Osteomalacia, Osteoporosis, Wilson's disease.

Unit 3

Life style diseases

Obesity, Cardiovascular diseases, Atherosclerosis, Diabetes mellitus-II. Inflammatory Bowel Disease (IBD).

Hormonal Imbalances

Outline of hormone action and imbalances leading to disease - precocious puberty, hyper and hypopituitarism. Hyper and hypothyroidism.

Unit4

Autoimmune diseases

Concepts in immune recognition - self and non self discrimination, organ specific autoimmune diseases – Hashimoto's thyroiditis, Grave's disease, myasthenia gravis;. Systemic diseases - SLE, rheumatoid arthritis; Diabetes Mellitus-I.

Diseases caused due to misfolded proteins

Alzheimer's, Huntington's disease, Kuru, Creutzfeldt-Jakob disease, Sickle cell

anaemia, Thalessemia.

Unit 5

Infectious diseases

Viral infection (polio, measles, mumps, influenza, HIV); Bacterial infections (tetanus, diphtheria, tuberculosis, typhoid, cholera); Protozoan (*Plasmodium* and *Trypanosoma*) and parasitic infections. Vaccines against diseases. General strategies in the design and development of vaccines.

REFERENCES

Devlin, T.M., (2011). Textbook of Biochemistry with Clinical Correlations. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.

Coico, R., and Sunshine, G., (2009). Immunology: A Short Course. 6th ed., John Wiley& sons, Inc (New Jersey), ISBN: 978-0-470-08158-7.

Berg, J.M., Tymoczko, J.L. and Stryer, L., (2012). Biochemistry. 7th ed., W.H Freeman and Company (New York), ISBN: 13:978-1-4292-7635-1.

Snustad, D.P. and Simmons, M.J., (2012). Genetics. 6th ed., John Wiley & Sons. (Singapore), ISBN: 978-1-118-09242-2.

16BCU511-A **CLINCAL BIOCHEMISTRY PRACTICAL-A** **Semester IV 3H-1C**

Instruction hours/week: L:0 T:0 P:3 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objectives

To impart hands-on training on

- Collection and processing of serum
- Collection and processing of urine sample
- Assessment of liver function
- Assessment of renal function
- Assessment of cardiac function
- Principles behind Dipstick method for fast diagnosis

Course outcomes (CO's)

After successful completion, the students will understand

1. How to Collectand process serum/plasma samples
2. How to Collect and process urine samples
3. Assessment of liver function
4. Assessment of renal function
5. Assessment of cardiac function
6. Principles behind Dipstick method for fast diagnosis

Experiments

1. Collection of blood and storage
2. Separation and storage of serum
3. Estimation of blood glucose by glucose oxidase peroxidase method.
4. Estimation of triglycerides.
5. Estimation of bilirubin (direct and indirect).
6. Quantitative determination of serum creatinine and urea.
7. Estimation of creatine kinase.

REFERENCES

Mukherjee, K.L., (2010). Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests Vol. I Tata Mc Graw–Hill Publishing Company Limited (New Delhi). ISBN:9780070076594 / ISBN:9780070076631

Mukherjee, K.L., (2010). Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests VoI. II, Tata Mc Graw – Hill Publishing Company Ltd. (New Delhi), ISBN: 9780070076648.

Baynes, J.W., and Dominiczak, M.H., (2005). Medical Biochemistry, 2nd ed., Elsevier Mosby Ltd. (Philadelphia), ISBN:0-7234-3341-0.

Rao, B.S., and Deshpande, V., (2005). Experimental Biochemistry: A Student Companion IK International Pvt. Ltd. (New Delhi), ISBN:81-88237-41-8.

Semester V

16BCU511-B BIOCHEMICAL CORRELATION OF DISEASE PRACTICAL- B **3H-1C**

Instruction hours/week: L:0 T:0 P:3 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objectives

To impart hands-on training on

- The execution of glucose challenge and tolerance test
- Measurement of cholesterol
- Basis of cell counting using hemocytometer
- Principles behind automated cell counters
- Assessment of bone mineral density
- Measurement of thyroid hormones using ELISA

Course outcomes (CO's)

After successful completion, the students will understand

1. the execution of glucose challenge and tolerance test
2. Measurement of cholesterol
3. Basis of cell counting using hemocytometer
4. Principles behind automated cell counters
5. Assessment of bone mineral density
6. Measurement of thyroid hormones using ELISA

Experiments

1. Glucose tolerance test.
2. Lipid profile: triglycerides and total cholesterol.
3. Obesity parameters.
4. RBC counting and haemoglobin estimation.
5. Blood pressure measurements.
6. Bone density measurements (visit to a nearby clinic).
7. T4/TSH assays.

REFERENCES

Devlin, T.M., (2011). Textbook of Biochemistry with Clinical Correlations, John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.

Coico, R., and Sunshine, G., (2009). Immunology: A Short Course, 6th ed., John Wiley& sons, Inc (New Jersey), ISBN: 978-0-470-08158-7.

Berg, J.M., Tymoczko, J.L., and Stryer, L., (2012). Biochemistry, 7th ed., W.H Freeman and Company (New York), ISBN: 13:978-1-4292-7635-1.

Snustad, D.P., and Simmons, M.J., (2012). Genetics, 6th ed., John Wiley & Sons. (Singapore), ISBN: 978-1-118-09242-2.

Semester V

16BCU502-A **BASIC MICROBIOLOGY** **4H-4C**

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students with:

- Origin of microbiology field and theories
- Diverse nature of microbial organisms
- Life cycle of viruses
- Life cycle of bacteria
- Life cycle of algae, fungi and protozoa

Course outcomes (CO's)

After successful completion, the students will understand:

1. Origin of microbiology field and theories
2. Diverse nature of microbial organisms
3. Life cycle of viruses
4. Life cycle of bacteria
5. Life cycle of algae, fungi and protozoa
6. Emerging microbial threats

Unit 1

History of Development of Microbiology

Development of microbiology as a discipline, Spontaneous generation vs. biogenesis. Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming. Role of microorganisms in fermentation, Germ theory of disease, Development of various microbiological techniques and golden era of microbiology, Establishment of fields of medical microbiology and immunology through the work of Paul Ehrlich, Elie Metchnikoff, Edward Jenner

Unit 2

Diversity of Microbial world

Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. Difference between prokaryotic and eukaryotic microorganisms. General characteristics of different groups: acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance.

Unit 3

Viruses, viroids and prions

An introduction to viruses with special reference to the structure and replication of the following: Poxvirus, Poliovirus, HIV, T4 and λ phage, lytic and lysogenic cycles.

Unit 4

Bacteria

An account of typical eubacteria, chlamydiae & rickettsiae (obligate intracellular parasites), mycoplasma, and archaebacteria (extremophiles). Applications of bacteria in industry, environment and food.

Unit 5

Algae, Fungi and Protozoa

History of phycology; General characteristics of algae including occurrence, thallus organization, algae cell ultra structure, pigments, flagella, eyespot food reserves and vegetative, asexual and sexual reproduction. Applications of Algae in agriculture, industry, environment and food. Historical developments in the field of Mycology, significant contributions of eminent mycologists. General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra- structure, thallus organization and aggregation, fungal wall structure and synthesis, asexual reproduction, sexual reproduction, heterokaryosis, heterothallism and parasexual mechanism. Economic Importance of Fungi in Agriculture, environment, Industry, medicine, food, biodeterioration, mycotoxins. General characteristics with special reference to Amoeba.

TEXTBOOK

Powar, C.B., and Dahinwala, H.F., (2007). General Microbiology, Himalaya Publishing house, Mumbai.

REFERENCES

Prescott, L.J., and Klein, D., (2007). Microbiology, 7th edition McGraw Hill Publishers, London.

Pelzar, A., (2004). Microbiology, McGraw Hill Publishers, London

Atlas, R.M., (1997). Principles of Microbiology. 2nd edition. W M.T.Brown Publishers

Semester V

16BCU502-B NUTRITIONAL BIOCHEMISTRY 4H-4C

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40**External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objectives

Equip the students with

- Concepts of nutrition
- Calorific value of carbohydrates, fats and proteins
- Recommended dietary allowances
- Nutrition as a strategy to prevent diseases
- Nutrition deficiency disorders
- Food drug interactions

Course outcomes (CO's)

After successful completion, the students will understand

1. Concepts of nutrition
2. Calorific value of carbohydrates, fats and proteins
3. Recommended dietary allowances
4. Nutrition as a strategy to prevent diseases
5. Nutrition deficiency disorders
6. Food drug interactions

Unit 1

Introduction to Nutrition and Energy Metabolism

Defining Nutrition, role of nutrients. Unit of energy, Biological oxidation of foodstuff. measurement of energy content of food, Physiological energy value of foods, SDA. Measurement of energy expenditure. Direct and Indirect Calorimetry, factors affecting thermogenesis, energy utilization by cells, energy output – Basal and Resting metabolism, physical activity, factors affecting energy input - hunger, appetite, energy balance Energy expenditure in man. Estimating energy requirements, BMR factors Recommended Nutrient Intakes (RNI) and Recommended Dietary Allowances for different age groups.

Unit 2

Dietary carbohydrates, lipid and health

Review functions of carbohydrates. Digestion, absorption ,utilization and storage, hormonal regulation of blood glucose. Dietary requirements and source of carbohydrates, Dietary fiber, role of fibre in lipid metabolism, colon function, blood glucose level and GI tract functions.

Review of classification, sources, functions, digestion, absorption, utilization and storage. Essential Fatty Acids; Functions of EFA, RDA, – excess and deficiency of EFA. Lipotropic factors, role of saturated fat, cholesterol, lipoprotein and triglycerides. Importance of the following: a) Omega – fatty acids. Omega 3/ omega 6 ratio b) Phospholipids c) Cholesterol in the body d) Mono, Polyunsaturated and Saturated Fatty Acids. Dietary implications of fats and oils, Combination ratios of n6 and n3, MUFA, PUFA and SFA.

Unit 3

Dietary Proteins and health

Review of functions of proteins in the body, Digestion and absorption. Essential and Non-essential amino acids. Amino Acid Availability Antagonism, Toxicity and Imbalance, Amino acid Supplementation. Effects of deficiency. Food source and Recommended Dietary Allowances for different age group. Amino acid pool. NPU, Biological Value , Nitrogen balance. PEM and Kwashiorkor.

Unit 4

Fat and water soluble Vitamins, Minerals

Vitamin A, C, E,K and D Dietary sources, RDA, Adsorption, Distribution, Metabolism and excretion(ADME), Deficiency. Role of Vitamin A as an antioxidant, in Visual cycle, dermatology and immunity. Role of Vitamin K in Gamma carboxylation. Role of Vitamin E as an antioxidant. Extra-skeletal role of Vitamin D and its effect on bone physiology. Hypervitaminosis. Vitamin C role as cofactor in amino acid modifications. Niacin-Metabolic interrelation between tryptophan, Niacin and NAD/ NADP. Vitamin B6-Dietary source, RDA, conversion to Pyridoxal Phosphate. Role in metabolism, Biochemical basis for deficiency symptoms. Vitamin B12 and folate; Dietary source, RDA, absorption, metabolic role Biochemical basis for deficiency symptoms. Calcium, Phosphorus and Iron - Distribution in the body digestion, Absorption, Utilization , Transport, Excretion, Balance, Deficiency, Toxicity, Sources, RDA. Calcium: Phosphorus ratio, Role of iron in prevention of anemia. Iodine and iodine cycle. Iodine, Fluoride, Mg, Cu, Zn, Se, Manganese, Chromium, Molybdenum Distribution in the human body, Physiology, Function, deficiency, Toxicity and Sources

Unit 5

Assessment of Nutritional status, Food and drug interactions and Nutriceuticals

Anthropometric measurements; Z scores, BMI, skinfold, circumference ratios. Biochemical assessment; Basal metabolic panel, Comprehensive metabolic panel, CBC, Urine Analysis, Assessment of Anemia, ROS assessment, GTT and glycosylated Hb, Differential diagnosis of B12 and folate.Nutrient interactions affecting ADME of drugs, Alcohol and nutrient deficiency, Anti-depressants, psychoactive drugs and nutrient interactions, Appetite changes with drug intakes and malnutrition. Food as medicine.

REFERENCES

Devlin, T.M., (2011). Textbook of Biochemistry with Clinical Correlations, John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.

Williams, M.H., Anderson, D.E, and Rawson, E.S., (2013). Nutrition for health, fitness and sport. McGraw Hill international edition. ISBN-978-0-07-131816-7.

Mahan, L.K. Strings, S.E., and Raymond, J., (2012). Krause's Food and Nutrition Care process. Elsevier's Publications. ISBN- 978-1-4377-2233-8.

Coombs, G.F., (2008). The vitamins, Fundamental aspects in Nutrition and Health. Elsevier's Publications. ISBN-13- 978-0-12- 183493-7.

Gibson R., (2005). Principles of Nutritional Assessment. Oxford University Press.

Semester V

15BCU503-A **PLANT BIOCHEMISTRY** **4H-4C**

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students with

- Plant cell structure
- Synthesis of proteins by plants
- Metabolism in plants
- Microenvironment for plant growth
- Nitrogen fixation
- Biosynthesis of secondary metabolites by plants

Course outcomes (CO's)

After successful completion, the students will understand

1. The difference between Animal and Plant cell structure
2. Significance of plant proteins
3. Metabolism in plants
4. Various microenvironment required for plant growth
5. The process of nitrogen fixation
6. Biosynthesis of secondary metabolites by plants

Unit 1

Plant cell structure and Photosynthesis

Structure of Plasma membrane, Vacuole and tonoplast membrane, cell wall, plastids and peroxisomes. Photosynthesis - Structure of PSI and PSII complexes, Light reaction, Cyclic and non cyclic photophosphorylation.

Unit 2

Carbon assimilation and Plant Respiration

Carbon assimilation - Calvin cycle and regulation; C4 cycle and Crassulacean acid metabolism (CAM). Respiration - Overview of glycolysis, Alternative reactions of glycolysis, Regulation of plant glycolysis, Translocation of metabolites across mitochondrial membrane, TCA cycle, Alternative NAD(P)H oxidative pathways; Cyanide resistant respiration and Photorespiration.

Unit 3

Nitrogen metabolism

Biological Nitrogen fixation by free living and in symbiotic association, structure and function of enzyme Nitrogenase. Nitrate assimilation: Nitrate and Nitrite reductase. Primary and secondary ammonia assimilation in plants; ammonia assimilation by Glutamine synthetase- glutamine oxoglutarate amino transferase (GS-GOGAT) pathway. Seed storage proteins in legumes and cereals.

Unit 4

Regulation of plant growth and Plant tissue culture

Introduction to plant hormones and their effect on plant growth and development,

Regulation of plant morphogenetic processes by light. Plant tissue culture - Cell and tissue culture techniques, types of cultures: organ and explants culture, callus culture, cell suspension culture and protoplast culture. Plant regeneration pathways: organogenesis and somatic embryogenesis. Applications of cell and tissue culture and somoclonal variation.

Unit 5

Plant Secondary metabolites

Representatives alkaloid group and their amino acid precursors, function of alkaloids, Examples of major phenolic groups; simple phenylpropanoids, Coumarins, Benzoic acid derivatives, flavonoids, tannins and lignin, biological role of plant phenolics, Classification of terpenoids and representative examples from each class, biological functions of terpenoids.

REFERENCES

Bowsher, C., Steer, M., Tobin, A., (2008). Plant Biochemistry. Garland science ISBN 978-0-8153-4121-5.

Biochemistry and molecular Biology of plant-Buchanan. (2005) 1st edition. Publisher: I K International. ISBN-10: 8188237116, ISBN-13: 978-8188237111.

Dey, P.M., and Harborne, J.B., (1997). Plant Biochemistry. Academic Press ISBN-10:0122146743, ISBN-13:978-0122146749

Semester V

16BCU503-B **ADVANCED CELL BIOLOGY** **4H-4C**

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students:

- To understand the organization of plasma membrane
- To understand the cell- cell interactions
- To understand the cell cycle and cell division
- On the structure and functions of various sub-cellular organelle
- To understand the cancer biology
- To grow and characterize the cancer cell

Course outcomes (CO's)

After successful completion of the course, the student will:

1. Composition of plasma membrane and transport in nucleus
2. Understand the methods of cell-cell interactions
3. Know the stages in cell cycle and cell division
4. Recognise the mechanism behind the protein sorting and transport to their destinations
5. Ensure the stages of cancer
6. Cell culture studies and instrumentation analysis.

Unit 1

Plasma Membrane and Nuclear Transport

Properties and Composition of Cell Membrane; Structure of Nuclear Envelope; Nuclear Pore Complex; Transport Across Nuclear Envelope; Regulation of Nuclear Protein Import and Export. **Transport across plasma membrane**

Unit 2

Cell-Cell Interaction

Cell-Cell Interactions and Cell-Matrix Interactions; Components of Extracellular Matrix: Collagen and Non-Collagen Components; Tight Junctions; Gap Junctions; Desmosomes; Hemidesmosomes: Focal adhesions and plasma desmata; Cell wall; Role of cell interaction in development

Unit 3

Cell Cycle and Programmed Cell Death

Overview of The Cell Cycle; Eukaryotic Cell Cycle; Events Of Mitotic Phase; Cytokinesis; Events Of Meiosis And Fertilization; Regulation Of Cell Division And Cell Growth; Apoptosis And Necrosis, Stem Cells And Maintenance of Adult Tissues, Hematopoiesis,
Embryonic Stem Cells and Therapeutic Cloning.

Unit 4

Cancer Biology

Development and causes Of Cancer; Genetic Basis of Cancer; Oncogenes, Tumor Viruses; Molecular Approach to Cancer Treatment.

Unit 5

Advanced Methods in Cell Biology

Ultracentrifugation, Fluorescence Microscopy- FACS, Confocal Microscopy, Electron Microscopy, Plant and Animal Cell Culture, Immunohistochemistry.

REFERENCES

Cooper, G.M., and Hausman, R.E., (2009) The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

Karp, G., (2010) Cell and Molecular Biology: Concepts and Experiments. 6 edition. John Wiley & Sons. Inc.

Alberts, B., Johnson,A., Lewis, J., and Enlarge, M., (2008) Molecular Biology of the Cell. 5th ed., Garland Science (Princeton).

Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D., and Darnell. J., (2012). Molecular Cell Biology. 7th ed., W.H. Freeman & Company (New York).

Becker, W.M., Kleinsmith, L.J., Hardin, J., and Bertoni, G.P., (2009). The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing , San Francisco.

Semester V

16BCU504-A MOLECULAR BASIS OF NON- INFECTIOUS HUMAN DISEASE 4H-4C

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objectives

Equip the students with

- Concept of infection
- Classification of infectious pathogens
- Steps involved in the infection of a pathogenic bacteria
- Steps involved in the infection of a pathogenic viruses
- Steps involved in the infection of a pathogenic parasites
- Methods to prevent/treat infections

Course outcomes (CO's)

After successful completion, the students will understand

1. Concept of infection
2. Variety of infectious pathogens
3. The process of infection by pathogenic bacteria
4. The process of infection by pathogenic viruses
5. The process of infection by pathogenic parasites
6. How to prevent/treat infections

Unit 1

Nutritional disorders

Overview of major and minor nutrient components in the diet. Balanced diet and the concept of RDA. Nutrient deficiencies; Kwashiorkor and Marasmus, Scurvy, beri beri, pellagra and B12 deficiency, Xerophthalmia and Night blindness, Vitamin D deficiency, Vitamin K deficiency. Discuss with relation to biochemical basis for symptoms. Obesity and eating disorders like Anorexia nervosa and Bullemia.

Unit 2

Metabolic and Lifestyle disorders

Diabetes mellitus A metabolic syndrome and the relationship with hypertension, obesity, hypothyroidism and stress. Cardio vascular disorders and Atherosclerosis- defining the broad spectrum of ailments that fall in this category, understanding the factors that contribute to the syndrome, stages of disorder and the management of the condition. Irritable bowel syndrome- biochemistry behind the disorder and the influence of diet, stress and environment on the condition.

Unit 3

Cancer: Initiation and stages of progression

Cancer: characteristics of a transformed cell, causes and stages of Cancer, molecular basis for neoplastic growth and metastasis, Proto-oncogenes and tumor suppressor genes; Cancer causing mutations; Tumor viruses; Biochemical analysis of cancer; Molecular approaches to cancer treatment.

Unit 4

Diseases due associated with misfolded proteins and multifactorial complex disorders

Introduction to protein folding and proteosome removal of misfolded proteins; etiology and molecular basis for Alzheimer's, Prion diseases, Huntington's Chorea, sickle cell anemia, Thalassemia. Understanding the definition of multifactorial diseases. Polygenic diseases and the relationship of environmental factors and genetic makeup in the onset of diseases.

Disorders of mood : Schizophrenia, dementia and anxiety disorders. Polycystic ovarian syndrome, Parkinson's disease, ALS

Unit 5

Monogenic diseases

In born errors in metabolism: PKU, Alkaptonuria, Maple syrup urine disease; Receptor and transport defects: Cystic fibrosis, Long QT syndrome, familial hypercholesterolemia, Achondroplasia. Hemoglobinopathies and clotting disorders.

REFERENCES

Willey, J.M., Sherwood, L.M., Woolverton, C.J. (2008). Prescott, Harley, Klein's Microbiology, 7th Ed., Mc Graw Hill International Edition (New York) ISBN: 978-007-126727.

Mandell, Douglas and Bennett. S., (2008). Principles and practices of Infectious diseases, 7th edition, Volume, 2. Churchill Livingstone Elsevier.

Kenneth, J.R., Ray, C.G., (2010). Sherris Medical Microbiology: An Introduction to Infectious Diseases by Publisher: McGraw-Hill.

Patrick, R., Murray, K.S., Michael A.R., and Pfaller, (2011). Medical Microbiology, Elsevier Health Sciences

Semester V

16BCU504-B MOLECULAR BASIS OF INFECTIOUS DISEASES 4H-4C

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objectives

Equip the students with

- Concept of infection
- Classification of infectious pathogens
- Steps involved in the infection of a pathogenic bacteria
- Steps involved in the infection of a pathogenic viruses
- Steps involved in the infection of a pathogenic parasites
- Methods to prevent/treat infections

Course outcomes (CO's)

After successful completion, the students will understand

1. Concept of infection
2. Variety of infectious pathogens
3. The process of infection by pathogenic bacteria
4. The process of infection by pathogenic viruses
5. The process of infection by pathogenic parasites
6. How to prevent/treat infections

Unit 1

Classification of infectious agents

Bacteria, Viruses, protozoa and fungi. Past and present emerging and re-emerging infectious diseases and pathogens. Source, reservoir and transmission of pathogens, Antigenic shift and antigenic drift. Host parasite relationship, types of infections associated with parasitic organisms. Overview of viral and bacterial pathogenesis. Infection and evasion.

Unit 2

Overview of diseases caused by bacteria

Detailed study of tuberculosis: History, causative agent, molecular basis of host specificity, infection and pathogenicity, Diagnostics, Therapeutics, inhibitors and vaccines. Drug resistance and implications on public health. Other bacterial diseases including Typhoid, Diphtheria, Pertussis, Tetanus, Typhoid and Pneumonia.

Unit 3

Overview of diseases caused by Viruses

Detailed study of AIDS, history, causative agent, pathogenesis, Diagnostics, Drugs and inhibitors. Other viral diseases including hepatitis, influenza, rabies, chikungunya and polio.

Unit 4

Overview of diseases caused by Parasites

Detailed study of Malaria, history, causative agents, Vectors, life cycle, Host parasite interactions, Diagnostics, Drugs and Inhibitors, Resistance, Vaccine development.

Other diseases including leishmaniasis, amoebiasis.

Unit 5

Overview of diseases caused by other organisms

Fungal diseases, General characteristics. Medical importance of major groups, pathogenesis, treatment.

REFERENCES

Willey, J.M., Sherwood, L.M., Woolverton, C.J. Prescott, Harley, (2008) Klein's Microbiology 7th Ed., Mc Graw Hill International Edition (New York)
ISBN: 978-007-126727.

Mandell, Douglas and Bennett, S., (2010). Principles and practices of Infectious diseases, 7th edition, Volume, 2. Churchill Livingstone Elsevier.

Kenneth, J., Ryan, C., Ray, G., (2010). Sherris Medical Microbiology: An Introduction to Infectious Diseases by Publisher: McGraw-Hill

Patrick R. Murray, Ken S. Rosenthal, Michael A., (2010).Medical Microbiology Elsevier Health Sciences

16BCU512-A **BASIC MICROBIOLOGY PRACTICAL-A** **Semester V 4H-2C**

Course objectives

To impart hands-on training on

- Sterilization methods
- Autoclave, filtration techniques
- Preparation of microbial culture media
- Assessment of bacterial strains
- Pure cultures using streaking methods
- Colony counting

Course outcomes (CO's)

After successful completion, the students will understand

1. Sterilization methods
2. Autoclave, filtration techniques
3. Preparation of microbial culture media
4. Assessment of bacterial strains
5. Pure cultures using streaking methods
6. Colony counting

Experiments

1. Microbiology Laboratory Practices and Biosafety.
2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter).
3. Preparation and sterilization of culture media for bacterial cultivation.
4. Study of different shapes of bacteria, fungi, algae, protozoa using permanent slides/pictographs.
5. Staining of bacteria using Gram stain.
6. Isolation of pure cultures of bacteria by streaking method.
7. Estimation of CFU count.

REFERENCES

Atlas, R.M., (1997). Principles of Microbiology. 2nd edition. W M.T.Brown Publishers.

Pelczar, M.J, Chan, E.C.S., and Krieg, N.R., (1993). Microbiology. 5th edition. McGraw Hill Book Company .

Kannan, N., (2003). Laboratory Manual in Microbiology, Panima Publishing Corporation, Bangalore.

Semester V

16BCU512-B NUTRITIONAL BIOCHEMISTRY 4H-2C
PRACTICAL-B

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objectives

To impart hands-on training on

- Estimation of vitamin
- Homocysteine measurements
- Assessment of protein energy malnutrition
- Obesity assessments
- Oxidative stress measurements
- BMD assessments

Course outcomes (CO's)

After successful completion, the students will understand

1. Estimation of vitamin
2. Homocysteine measurements
3. Assessment of protein energy malnutrition
4. Obesity assessments
5. Oxidative stress measurements
6. BMD assessments

Experiments

1. Bioassay for vitamin (Any one).
2. Homocystiene estimation by colorimetric method.
3. Serum/ urine MMA estimation.
4. Anthropometric identifications for Kwashiorkor, Marasmus and Obesity.
5. Determination of oxidative stress: TBARS, antioxidant enzymes in hemolysate.
6. Vitamin A/E estimation in food item.
7. Bone densitometry /bone ultrasound test demonstration (visit to a nearby clinic)

REFERENCES

Devlin, T.M., (2011). Textbook of Biochemistry with Clinical Correlations. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.

Williams, M.H., Anderson, D.E., Rawson, E.S., (2013). Nutrition for health, fitness and sport. McGraw Hill international edition. ISBN-978-0-07-131816-7.

Mahan, L.K, Strings, S.E., Raymond, J., (2012). Krause's Food and Nutrition Care process. Elsevier's Publications. ISBN- 978-1-4377-2233-8.

Coombs, G.F., (2008). The vitamins, Fundamental aspects in Nutrition and Health. Elsevier's Publications. ISBN-13- 978-0-12- 183493-7.

Gibson R., (2005). Principles of Nutritional Assessment. Oxford University Press.

Semester V

16BCU513-A **PLANT BIOCHEMISTRY PRACTICAL-A** **4H-2C**

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives:

To impart hands-on training on

1. Preparation of plant tissue lysates
2. Estimation of enzymes during germination
3. Extraction of enzymes from plant source
4. Separation of plant metabolites using TLC
5. PTC media preparation, culturing techniques
6. Vitamin assessments.

Course outcomes (CO's)s:

After successful completion, the students will understand

1. Preparation of plant tissue lysates
2. Estimation of enzymes during germination
3. Extraction of enzymes from plant source
4. Separation of plant metabolites using TLC
5. PTC media preparation, culturing techniques
6. Vitamin assessments

Experiments

1. Induction of hydrolytic enzymes proteinases /amylases/lipase during germination
2. Extraction and assay of Urease from Jack bean
3. Estimation of carotene/ascorbic acid/phenols/tannins in fruits and vegetables
4. Separation of plant pigments by TLC
5. Culture of plants (explants).

REFERENCES

Bowsher, C., Steer, M., and Tobin, A., (2008). Plant Biochemistry, Garland science ISBN 978-0-8153-4121-5.

Biochemistry and molecular Biology of plant-Buchanan. (2005) 1 edition. Publisher: I K International. ISBN-10: 8188237116, ISBN-13: 978-8188237111.

Dey P.M and Harborne J.B. (1997). Plant Biochemistry (Editors) Publisher: Academic Press ISBN-10:0122146743, ISBN-13:978-0122146749

Semester V

16BCU513-B **ADVANCED CELL BIOLOGY PRACTICAL-B** **4H-2C**

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40**External: **60** Total: **100**
End Semester Exam: 3 Hours

Course Objectives

To impart hands-on training:

- Sterilization analysis and good culture pracice
- On how to visualize the cells
- On phase contrast microscopy
- On how to identify different stages of mitosis and meiosis
- On staining techniques to identify the cell types
- On how to count the cells using hemocytometer

Course outcomes (CO's)

After successful completion of the course, the student will:

1. Follow the good practice in lab
2. Be able to visualize the cells
3. Use the phase contrast microscopy at appropriate magnifications
4. Identify the cells using staining techniques
5. Interpret various stages of cell division
6. Count the cells manually using hemocytometer

Experiments

1. Aseptic technique and good culture practice
2. Measurement of the size of the cells in light microscope
3. Isolation of organelles by sub-cellular fractionation.
4. Study of cell viability /death assay by use of trypan blue and MTT assay.
5. Study of apoptosis through analysis of DNA fragmentation patterns in mitochondria.
6. Identification and study of cancerous cells using permanent slides and photomicrographs.
7. Histopathology procedure (Demo)

REFERENCES

Cooper, G.M., and Hausman, R.E., (2009). The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

Karp, G., (2010). Cell and Molecular Biology: Concepts and Experiments. 6 edition. John Wiley & Sons. Inc.

Alberts, B., Johnson,A., Lewis, J., and Enlarge, M., (2008). Molecular Biology of the Cell. 5th ed., Garland Science (Princeton).

Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell. J., (2012). Molecular Cell Biology. 7th ed., W.H. Freeman & Company (New York).

Becker, W.M., Kleinsmith, L.J., Hardin. J., and Bertoni, G.P., (2009). The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

16BCU514-A MOLECULAR BASIS OF NON INFECTIOUS HUMAN DISEASE PRACTICAL-A **Semester V 4H-2C**

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40**External: **60** Total:100
End Semester Exam: 3 Hours

Course objectives

To impart hands-on training on

- Preparation of slides for infectious pathogens
- the principle behind WIDAL test
- the basis of Gram staining
- the detection of pathogens using PCR
- Dot Blot principles
- differential diagnosis

Course outcomes (CO's)

After successful completion, the students will understand

1. Preparation of slides for infectious pathognes
2. the principle behing WIDAL test
3. the basis of Gram staining
4. the detection of pathogens using PCR
5. Dot Blot principles
6. differential diagnosis

Experiments

1. Anthropometric measurements for normal and high risk individual and identifications for Kwashiorkor, Marasmus and Obesity
2. Estimation of homocysteine levels in serum
3. Estimation of glycosylated hemoglobin
4. Permanent slides for different types of cancer
5. Diagnostic profile for assessment of CVS and Diabetes mellitus using case studies.
6. Bone densitometry test demonstration (visit to a nearby clinic)

REFERENCES

Prescott, Harley, (2008). Klein's Microbiology 7th Ed., Willey, J.M., Sherwood, L.M., Woolverton, C.J. Mc Graw Hill International Edition (New York) ISBN: 978-007-126727.

Mandell, Douglas and Bennett.S, (2009). Principles and practices of Infectious diseases, 7th edition, Volume, 2. Churchill Livingstone Elsevier.

Kenneth, J., Ryan, C., and Ray, G., (2008). Sherris Medical Microbiology: An Introduction to Infectious Diseases, Publisher: McGraw-Hill

Patrick R., Ken, S., and Pfaller, M.A., (2008). Medical Microbiology by Elsevier Health Sciences

Semester V

16BCU514-B MOLECULAR BASIS OF INFECTIOUS DISEASES PRACTICAL-B **4H-2C**

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objectives

To impart hands-on training on

- Preparation of slides for infectious pathogens
- The principle behind WIDAL test
- The basis of Gram staining
- The detection of pathogens using PCR
- Dot Blot principles
- Differential diagnosis

Course outcomes (CO's)

After successful completion, the students will understand

1. Preparation of slides for infectious pathognes
2. The principle WIDAL test
3. The basis of Gram staining
4. The detection of pathogens using PCR
5. Dot Blot principles
6. Differential diagnosis

Experiments

1. Permanent slides of pathogens. *Mycobacterium tuberculosis, Leishmania, Plasmodium falciparum*
2. WIDAL test
3. Gram staining
4. Acid fast staining
4. PCR based diagnosis (Demo)
5. Dot Blot ELISA

REFERENCES

Willey, J.M., Sherwood, L.M., and Woolverton, C.J., (2008). Prescott, Harley, Klein's Microbiology, 7th Ed., Mc Graw Hill International Edition (New York) ISBN: 978-007-126727.

Mandell, Douglas and Bennett.S, Principles and practices of Infectious diseases, 7th edition, Volume, 2. Churchill Livingstone Elsevier.

Ryan, K.J., and Ray, C.G., (2008). Sherris Medical Microbiology: An Introduction to Infectious Diseases by Publisher: McGraw-Hill

Murray, P.R., Rosenthal, K.S., and Pfaller, M.A., (2008). Medical Microbiology by Elsevier Health Sciences

Semester VI

16BCU601-A GENETIC ENGINEERING AND BIOTECHNOLOGY 3H-3C

Instruction hours/week: L:3 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objective

Equip the students on:

- Principles behind recombinant DNA technology
- Tools required for recombinant DNA technology
- Cloning and expression vectors
- Production of industrial relevant proteins
- Production of drugs for clinical applications
- Application of rDNA technology in crop improvement

Course outcomes (CO's)

After successful completion, the students will understand

1. The principles behind recombinant DNA technology
2. Various tools required for recombinant DNA technology
3. Cloning and expression vectors
4. Production of industrial relevant proteins
5. Production of drugs for clinical applications like insulin
6. Application of rDNA technology in crop improvement

Unit 1

Introduction to recombinant DNA technology : Overview of recombinant DNA technology. Restriction and modification systems, restriction endonucleases and other enzymes used in manipulating DNA molecules, separation of DNA by gel electrophoresis. Extraction and purification of plasmid and bacteriophage DNA.

Joining of DNA fragments : Ligation of DNA molecules. DNA ligase, sticky ends, blunt ends, linkers and adapters. Synthetic oligonucleotides, synthesis and use.

Unit 2

Cloning vectors for prokaryotes and eukaryotes : Plasmids and bacteriophages as vectors for gene cloning. Cloning vectors based on *E. coli* plasmids, pBR322, pUC8, pGEM3Z. Cloning vectors based on M13 and λ bacteriophage. Vectors for yeast, higher plants and animals.

DNA sequencing : DNA sequencing by Sanger's method, modifications based on Sanger's method. Automated DNA sequencing. Pyrosequencing.

Unit 3

Introduction of DNA into cells and selection for recombinants : Uptake of DNA by cells, preparation of competent cells. Selection for transformed cells. Identification for recombinants - insertional inactivation, blue-white selection. Introduction of phage DNA into bacterial cells. Identification of recombinant phages. Introduction of DNA into animal cells, electroporation.

Methods for clone identification

The problem of selection, direct selection, marker rescue. Gene libraries, identification of a clone from gene library, colony and plaque hybridization probing, methods based on detection of the translation product of the cloned gene.

Unit4

Polymerase chain reaction: Fundamentals of polymerase chain reaction, designing primers for PCR. Studying PCR products. Cloning PCR products. Real time PCR.

Expression of cloned genes : Vectors for expression of foreign genes in *E. coli*, cassettes and gene fusions. Challenges in producing recombinant protein in *E. coli*. Production of recombinant protein by eukaryotic cells. Fusion tags and their role in purification of recombinant proteins.

Unit 5

Applications of genetic engineering in Biotechnology: Site–directed mutagenesis and protein engineering. Applications in medicine, production of recombinant pharmaceuticals such as insulin, human growth hormone, factor VIII.

Recombinant vaccines. Gene therapy. Applications in agriculture - plant genetic engineering, herbicide resistant crops, problems with genetically modified plants, safety concerns.

REFERENCES

Brown, T.A., (2010). Gene Cloning and DNA Analysis 6th ed., Wiley-Blackwell publishing (Oxford, UK), ISBN: 978-1-4051-8173-0.

Primrose, S.B., and Twyman, R. M., (2006). Principles of Gene Manipulation and Genomics 7th ed., Blackwell publishing (Oxford, UK) ISBN:13: 978-1-4051-3544-3.

Glick, B.R., Pasternak, J.J. and Patten, C.L., (2010). Molecular Biotechnology: Principles and Applications of Recombinant DNA 4th ed., ASM Press (Washington DC), ISBN: 978-1-55581-498-4 (HC).

Semester VI

16BCU601-B RECOMBINANT DNA TECHNOLOGY 4H-4C

Instruction hours/week: L:3 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students with:

- Handling of *Escherichia coli*
- Isolation of plasmid DNA from *Escherichia coli*
- Restriction digestion using enzymes
- Amplification using PCR
- Transformation of plasmid into *Escherichia coli*
- Western blotting demonstration

Course outcomes (CO's)

After successful completion, the students will

1. Know the precautions of handling *Escherichia coli*
2. Isolate the plasmid DNA from *Escherichia coli*
3. Restriction digestion using enzymes such as ECoRI, Hind III
4. Amplify the rDNA using PCR
5. Understand the techniques related to transformation of plasmid into *Escherichia coli*
6. Understand the steps involved in Western blot analysis

Unit 1

Work flow for *in silico* cloning

Unit 2

Preparation of media, antibiotic solution, culturing of *E. coli*, isolation of single Colonies

- Preparation of LB broth and agar.
- Inoculation of medium.
- Preparation of glycerol stocks of bacterial strains.
- Obtaining isolated colonies by streak plate method.
- Preparation of stock solutions.

Unit 3

Overview of plasmid vectors and methods of isolation Isolation of plasmid by alkaline lysis method.

- Isolation of plasmid DNA using column chromatography (kit).

Unit 4

Characterization of plasmid by gel electrophoresis

- Digestion of plasmid DNA with restriction enzymes and analysis of the fragments.

Unit 5

Cloning of a gene in a vector and functional analysis No. of Hours : 12

Polymerases chain reaction (parametric optimization, primer designing), ligation, introduction of DNA construct into host cells, selection of recombinants.

- Amplification of DNA segment/gene of interest by PCR.
- Purification of PCR product, digestion of insert and vector by restriction enzymes for directional cloning, purification of insert and digested vector by gel extraction.
- Ligation of vector and insert.
- Preparation of competent cells of *E. coli* DH5α and transformation with the ligation mixture.
- Functional selection of recombinants (blue/white selection and eGFP fluorescence).

REFERENCES

Green, M.R., and Sambrook, J., (2012). Molecular Cloning: A laboratory Manual Vol. 1-3, 4th ed., Cold Spring Harbour Laboratory Press (New York). ISBN: 978-1-936113-41-5 / ISBN: 978-1-936113-42-2.

Semester VI

16BCU611-A GENETIC ENGINEERING AND BIOTECHNOLOGY 3H-1C PRACTICAL-A

Instruction hours/week: L:0 T:0 P:3 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students with:

- Handling of *Escherichia coli*
- Isolation of plasmid DNA from *Escherichia coli*
- Restriction digestion using enzymes
- Amplification using PCR
- Transformation of plasmid into *Escherichia coli*
- Western blotting demonstration

Course outcomes (CO's)

After successful completion, the students will

1. Know the precautions of handling *Escherichia coli*
2. Isolate the plasmid DNA from *Escherichia coli*
3. Restriction digestion using enzymes such as ECoRI, Hind III
4. Amplify the rDNA using PCR
5. Understand the techniques related to transformation of plasmid into *Escherichia coli*
6. Understand the steps involved in Western blot analysis

Experiments

1. Isolation and estimation of DNA, RNA and protein from animal source
2. Isolation of plasmid DNA from *E. coli* cells.
3. Agarose gel electrophoresis of DNA
4. Digestion of plasmid DNA with restriction enzymes.
5. Amplification of a DNA fragment by PCR.
6. Transformation of *E. coli* cells with plasmid DNA.
7. Western Blotting(Demo)

REFERENCE

Brown, T.A., (2010). Gene Cloning and DNA Analysis 6th ed., Wiley-Blackwell publishing (Oxford, UK), ISBN: 978-1-4051-8173-0.

Primrose, S.B., and Twyman, R.M., (2006). Principles of Gene Manipulation and Genomics 7th ed., Blackwell publishing (Oxford, UK) ISBN:13: 978-1-4051-3544-3.

Glick, B.R., Pasternak, J.J. and Patten, C.L., (2010). Molecular Biotechnology: Principles and Applications of Recombinant DNA 4th ed., ASM Press (Washington DC), ISBN: 978-1-55581-498-4 (HC).

Semester VI

16BCU611-B RECOMBINANT DNA TECHNOLOGY PRACTICAL-B **3H-1C**

Instruction hours/week: L:0 T:0 P:3 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objectives

Equip the students with:

- Handling of streak plate method
- Isolation of plasmid DNA from *Escherichia coli*
- Restriction digestion using enzymes
- Amplification using PCR
- Transformation of plasmid into *Escherichia coli*
- Western blotting demonstration

Course outcomes (CO's)

After successful completion, the students will

1.Know the handling of streak plate method
2.Isolate the plasmid DNA from *Escherichia coli*
3.Restriction digestion using enzymes such as ECoRI, Hind III
4.Amplify the rDNA using PCR
5.Understand the techniques related to transformation of plasmid into *Escherichia coli*
6.Understand the steps involved in Western blot analysis

Experiments

1. Obtaining isolated colonies by streak plate method.
2. Isolation of plasmid by alkaline lysis method.
3. Isolation of plasmid DNA using column chromatography (kit).
4. Digestion of plasmid DNA with restriction enzymes and analysis of the fragments(Demo).
5. Amplification of DNA segment/gene of interest by PCR.
6. Preparation of competent cells of *E. coli* DH5α and transformation with the ligation mixture.
7. Functional selection of recombinants (blue/white selection and eGFP fluorescence).

REFERENCES

Green, M.R., and Sambrook, J., (2012). Molecular Cloning: A laboratory Manual Vol. 1-3, 4th ed., Cold Spring Harbour Laboratory Press (New York). ISBN: 978-1-936113-41-5 / ISBN: 978-1-936113-42-2.

Semester VI

16BCU602-A **BIOSTATISTICS** **4H-4C**

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students with:

- Definition and representation styles of data
- Analysis of data using correlation to understand the interdependence
- Analysis of data using regression to understand the interdependence
- To learn various measures of central values and standard deviation.
- To understand the relationship between two variables.
- To test the significance of a particular data by various parameters.

Course outcomes (CO's)

After successful completion, the students will:

1. Use appropriate representation styles to present the data
2. Perform correlation analysis
3. Perform regression analysis
4. Calculate mean, median, mode and standard deviation.
5. Calculate the relationship between two variables.
6. Test the significance of a particular data by various parameters.

Unit 1

Definitions-Scope of Biostatistics- Variables in biology, collection, classification and tabulation of data- Graphical and diagrammatic representation.

Unit 2

Measures of central tendency – Arithmetic mean, median and mode. Measures of dispersion-Range, standard deviation, Coefficient of variation.

Unit 3

Correlation – Meaning and definition - Scatter diagram –Karl Pearson's correlation coefficient. Rank correlation.

Unit 4

Regression: Regression in two variables – Regression coefficient problems – uses of regression.

Unit 5

Test of significance: Tests based on Means only-Both Large sample and Small sample tests - Chi square test - goodness of fit.

TEXT BOOK

Pillai R.S.N., and Bagavathi V., 2002.,Statistics , S. Chand & Company Ltd, New Delhi.

REFERENCES

Jerrold H.Z., (2003). Biostatistical Analysis, Fourth Edition, Pearson Education (Pvt., Ltd.,) New Delhi.

Arora, P.N., (1997). A foundation course statistics, S.Chand & Company Ltd, New Delhi.

Navnitham, P.A., (2004). Business Mathematics and Statistics, Jai Publications, Trichy,

Gupta S.P., (2001). Statistical methods, Sultan Chand & Sons, New Delhi.

Semester VI

16BCU602-B FUNDAMENTALS OF NANO TECHNOLOGY 4H-4C

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students with

- Structure and modeling of Nanoparticles
- Interactions between atoms and molecules
- Building block of nanostructures
- Synthesis and formation of nanotubes
- Nanomachine and devices
- Characteristic feature of nanomachine

Course outcomes (CO's)

After successful completion, the students will understand

1. Structure and properties of nanoparticles
2. Types of forces formed between atoms and molecules
3. Biological building blocks and nanostructures
4. Synthesis and application of nanomaterial
5. Types of nanomachines and nanodevices
6. Applications of nanodevices

Unit 1

Nanostructre and Properties: Structure- size Dependence of properties, Localized particles- Donors, Acceptors and Deep Traps, Mobility, Excitons Properties of nanoparticles-Metal nanoclusters –theoretical modeling of nanoparticles, geometric structure, electronic structure, Semiconducting nanoparticles-optical properties, photofragmentation, coulombic explosion.

Unit 2

Forces Between Atoms and Molecules: Thermodynamic aspects of intermolecular forces – Strong intermolecular forces – Covalent and coulomb interactions – Interactions involving polar molecules – Interactions involving thepolarization of molecules – Van der Waals forces – Repulsive forces, total intermolecular pairpotentials, and liquid structure – Special Interactions – Hydrogen bonding, Hydrophobic, and Hydrophilic interactions.

Unit 3

Biological Materials: Biological building blocks-sizes of building blocks and nanostructures, polypeptide Nanowire and protein nanoparticles. Nucleic acids-DNA Double nanowire, biological nanostructures-examples of proteins, miscelles and vesicles, multilayer films.

Unit 4

Synthesis of Nanomaterials: Top down – ball milerling; Bottom up – co-precipitaion – sol-gel – electrodeposition – using natural nanoparticles – chemical vapor deposition. The

Carbon Nanotube – New Forms of Cabon – Types of Nanotubes – Formation of Nanotubes – Uses for nanotubes – Biological Applications

Unit 5

Applications of nanotechnology: Nanomachines and nanodevices-Microelectromechanical systems (MEMSs), Nanoelectrochemical systems (NEMSs)-fabrication, nanodevices and nanomachines, molecular and supramolecular switches-photochemical switching, current-voltage characteristics

TEXT BOOKS

Poole, C.P., and Owens J.F., (2003). Introduction to Nanotechnology" Wiley- Interscience.

REFERENCES

Israelachvili, J.N., (2008). Intermolecular and surface forces. Academic Press.

Ratner, M.A., and Ratner, D., (2002). Nanotechnology: A Gentle Introduction to the Next Big Idea" **,**First Edition,Prentice Hall PTR.

Wilson, M., Kannangara, K., Smith, G., Simmons, M., and Raguse, B., (2005). Nanotechnology: basic science and emerging technologies, Overseas Press.

Semester VI

16BCU603-A **DRUG BIOCHEMISTRY** **4H-4C**

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40**External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students with:

- Definition and classification of drugs
- Basics of Pharmacokinetics of a drug
- Basics of Pharmacodynamics in living system
- Mechanism of action of drugs
- Toxicity assessment
- Drug abuse

Course outcomes (CO's)

After successful completion, the students will understand

1. Definition and classification of drugs
2. Basics of Pharmacokinetics of a drug
3. Basics of Pharmacodynamics in living system
4. Mechanism of action of drugs
5. Toxicity assessment
6. Drug abuse

Unit 1

Introduction to drug Biochemistry: Classification, routes of administration – factors influencing dosage and drug action, Absorption and distribution of drugs, binding of drugs to plasma proteins, Drug Dose relationship (LD_{50}, ED_{50}, therapeutic index), Drug – Receptor interaction, Drug binding forces, Receptor theories, Drug – Receptor interaction. Bioavailability; Pharmaco kinetics.

Unit 2

Drug metabolism: Drug Biotransformation pathways - phase I – oxidation, reduction and hydroxylation. Phase II- Conjugation, Elimination of drugs from body system. Storage of drugs in adipose tissue.

Unit 3

Drug abuse; drug dependence; drug resistance- Biological mechanism, ways to overcome.

Chemotherapy: Antibacterials – Mode of action of sulfonamides, penicillin, streptomycin, tetracycline, chloramphenicol, antiviral drugs, antifungal drugs; Antimetabolites of folate, purines & pyrimidines, Anti tubercular drugs.

Unit 4

Mechanism of action drugs used in the treatment of diabetes mellitus (Acarbose, Biguanides), AIDS (Azidophymidine, Didanosine), cancer(Mechlorethamine, Busulfan), heart (Amrinone, Digoxin) and kidney disorder (Benzophiadiazines, furosemide); antiepileptic drug(Lamictal, Tapclob), drugs for cough (Dextromethorphane Hydrobromide, Noscapine) and bronchial asthma (Salbutamol, Aminophylline), diuretics

(Manitol, Xanthine), anti ulcer drugs (Cimetidine, Ranitidine) and drugs for fever (Paracetamol, Ibuprofen).

Unit 5

Toxicology- Introduction, definition and disciplines of toxicology, classification of toxicity and toxicants, Mechanisms of toxic effect, treatment of intoxication, methods in toxicology testing, heavy metal toxicity and chelation therpy. Environmental pollution, mycotoxins, mushroom poisons

TEXTBOOKS

Satoskar, R.S., Bhandarkar, S.P., and Ainapuri, S.S., (2003). Pharmacology and Pharmacotherapeutic, 18th edition,Popular Prakashan, Mumbai.

REFERENCE BOOKS

Hamilton, D., Philips, R.J., and Scott, D., (2004). Occupational, Industrial and Environmental Toxicology, Moshy Inc Publishers.

Berg, G., Hendrickson, R.G., and Morocco, A., (2005). Medical Toxicology Review. McGraw Hill Mical Publishing Company**.**

Foye, W., (2012). Principles of Medicinal Chemistry, 7th edition, B.I. Wanerly Pvt. Ltd, New Delhi.

Grahame-Smith, D.G., and Aronson, J.K., (2002). Oxford textbook of ClinicalPharmacology and Drug Therapy: 3rd edition. Oxford University Press.

Tripathy, K.D., (2009). Essentials of Medical Pharmacology, Jaypee brothers medical publishers, New Delhi.

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Semester VI

16BCU603-B FOOD PRESERVATION TECHNOLOGY 4H-4C

Instruction hours/week: L:4 T:0 P:0 **Marks:** Internal: **40**External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

Equip the students with

- Microorganisms in food
- Methods of food preservation
- Types and applications of Preservation Technology
- Principle and processing of packaging
- Importance and functions of quality control
- Methods of quality and processed the food products.

Course outcomes (CO's)

After successful completion, the students will understand

1. Microorganism in natural food and control mechanism
2. Principles and food preservative methods
3. Types and applications of Preservation Technology
4. Introduction and development of Packaging
5. Objectives of food quality
6. Assessment of food quality and integrated food law

Unit 1

Microbiology of Food: History of microbiology of food. Types of micro-organism normally associated with food -mold, yeast, and bacteria, Microbial growth pattern, physical and chemical factors influencing destruction of micro-organisms. Micro-organisms in natural food products and their control mechanisms. Food chemistry-definition and importance

Unit 2

Principles of Food Processing: Principles of Preservation methods. Dehydration: Novel evaporation /dehydration techniques, spray drying. Vacuum drying- osmotic dehydration - efficient drying systems, High salt and high sugar preservations, infrared heating Freezing of foods, freeze concentration and drying, methods of freeze concentration. High Temperature operations, sterilization and Pasteurization.

Unit 3

Types of Preservation Technology: Microwave Processing: Microwave, properties, heating mechanism. Applications of microwave in food processing, effect of microwave on food nutrient. Food Irradiation Technology: General aspects of irradiation, ionizing radiation, irradiation process, units, mechanism, advantages and disadvantages of irradiation process. Ultrasound in food processing and preservation: Introduction and its application in food processing.

Unit 4

Food Packaging: Introduction to packaging. Packaging operation, package-functions and design. Principle in the development of protective packaging. Deteriorative changes in foodstuff and packaging methods for prevention, shelf life of packaged foodstuff, methods to extend Shelf-life. Evaluation of packaging, and package performance, packaging equipment, package standards and regulation, bar coding material. Biodegradable packaging.

Unit 5

Food Quality and Food Laws: Objectives, Importance and functions of quality control. Methods of quality, assessment of food materials-fruits, vegetables, cereals, dairy products, meat, poultry, egg and processed food products. Sanitation and hygiene - Integrated Food Laws

TEXT BOOKS:

Barbosa-Canovas, G.V., and Gould, G.W., (2000). Innovation in Food Processing. Technomic Publication, Lancaster, UK:

Frazier, W.C., and Dennis, C., Westhoff, C., (2008). Food Microbiology. Fourth Edition, Tata McGraw-Hill Education Publication, India.

REFERENCES:

Ray, B., (2003). Fundamental Food Microbiology, 3rd edition. CRC Press LLC, N.W. Corporate Blvd., Boca Raton, Florida 33431.

Precott, Harley, (2004). Microbiology, Sixth edition, McGraw-Hill Science, NewYork
Michael J. Waites, Neil L. Morgan, John S. Rockey, Gary Higton. 2001. "Industrial Microbiology: An Introduction", Blackwell Science, oxford,UK

Vijaya, R.K., (2007). Food microbiology. First Edition MJP Publishers, 2007.

16BCU612-A **BIOSTATISTICS PRACTICAL-A** **Semester VI 4H-2C**

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objectives

To impart hands-on training in the usage of software's to perform:

- Measures of central tendency
- Coefficient of variation
- Correlation analysis
- RANK Correlation test
- Regression analysis
- T-test

Course outcomes (CO's)

After successful completion, the student will:

1. Measure mean, median and mode
2. Perform Coefficient of variation
3. Execute Correlation analysis
4. Perform Regression analysis
5. Perform RANK correlation test
6. Analysis the difference between means using T-test

Experiments

1. Mean for individual, discrete series using SPSS Package.
2. Mean for continuous series using SPSS Package.
3. Median for individual and discrete series using SPSS Package..
4. Median for continuous series using SPSS Package..
5. Mode for individual and discrete series using SPSS Package..
6. Standard deviation for individual and discrete series using SPSS Package.
7. Coefficient of variation for individual and discrete series using SPSS Package.
8. Karl Pearson's Correlation using SPSS Package.
9. Rank Correlation Coefficient for Untied Rank using SPSS Package.
10. Rank Correlation Coefficient for Tied Rank using SPSS Package.

REFERENCES

Jerrold, H.Z., (2003). Biostatistical Analysis, Fourth Edition, Pearson Education (Pvt., Ltd, New Delhi.

Arora, P.N., (1997). A foundation course statistics, S.Chand & Company Ltd, New Delhi.

Navnitham, P.A., (2004). Business Mathematics And Statistics, Jai Publications, Trichy,

Gupta, S.P., (2001). Statistical methods, Sultan Chand & Sons, New Delhi.

Semester VI

16BCU612-B FUNDAMENTALS OF NANO TECHNOLOGY PRACTICAL-B 4H-2C

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objectives

Equip the students with:

- Synthesis of silver nanoparticles
- Synthesis of nanoparticles using leaf extract
- Synthesis of nanoparticles using fungal part
- Synthesis of Nanoparticles using *Actinomyces*
- Characterization of nanoparticles by UV spectroscopy
- Synthesis and Characterization of nanoparticles using FTIR

Course outcomes (CO's)

After successful completion, the students will

1. Know the synthesis of nanoparticles
2. Synthesis of nanoparticles from plant extract
3. Synthesis of nanoparticles from fungi
4. Synthesis of nanoparticles from Actinomycete
5. Characterization of nanoparticles by UV spectroscopy
6. Analysis of chemical composition by FTIR

Experiments

1. Nanoparticles synthesis using chemical methods
2. Synthesis of nanoparticles using plant extracts
3. Nanoparticles synthesis using fungal species
4. Nanoparticles synthesis using *Actinomyces*
5. UV-Visible spectra analysis of nanoparticles (Demo)
6. FT-IR spectra analysis of nanoparticles (Demo)

References

Edward, L.W., (2006). Nanophysics & Nanotechnology: An Introduction to Modern Concepts in Nanoscience, WILEY-VCH.

Fahrner, W.R., (2005). Nanotechnology and Nanoelectronics Materials, Devices, Measurement Techniques, Springer.

Semester VI

16BCU613-A **DRUG BIOCHEMISTRY PRACTICAL-A** **4H-2C**

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**
End Semester Exam: 3 Hours

Course objectives

To impart hands-on training in:

- Handling of small experimental animals
- Enteral and parenteral route of drug administration
- Assessment of behavioual changes
- Assessment of drug toxicity
- Calculation of LD_{50}
- Monitoring for adverse effects of drugs

Course outcomes (CO's)

After successful completion, the student will:

1. Handle small experimental animals such as rats, mice and rabbits
2. Learn Enteral and parenteral route of drug administration
3. Learn to assess behavioual changes
4. Learn to assess drug toxicity
5. Learn the basis of LD_{50}
6. Monitor adverse effects of drugs

Experiments

1. Behavioural Changes upon drug Adminstration
2. Liver toxicity Studies
   - SGOT
   - SGPT
   - GGT
3. Renal toxicity studies
   - Urea
   - Uric acid
   - Creatinine
4. LD_{50} Determination

REFERENCE BOOKS

Hamilton, D., Philips, R.J., and Scott, D., (2004). Occupational, Industrial and Environmental Toxicology, Moshy Inc Publishers.

Berg, G.M.I., Hendrickson R.G., and Morocco, A., (2005). Medical Toxicology Review. McGraw Hill Mical Publishing Company**.**

Foye, W., (2012). Principles of Medicinal Chemistry, 7th edition, B.I. Wanerly Pvt. Ltd, New Delhi.

Grahame-Smith, D.G., and Aronson, J.K., (2002). Oxford textbook of ClinicalPharmacology and Drug Therapy: 3rd edition. Oxford University Press.

Tripathy, K.D., (2009). Essentials of Medical Pharmacology, Jaypee brothers medical publishers, New Delhi.

Semester VI

16BCU613-B FOOD PRESERVATION TECHNOLOGY PRACTICAL-B **4H-2C**

Instruction hours/week: L:0 T:0 P:4 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course objectives

To impart hands-on training on

- Preparation of syrups with fruits
- Assessment of product quality and shelf-life
- Measurement of carrier gas movement
- Determine the presence of coliform in food
- Determine the heterotrophic plate count of bacteria.
- Identification of microflora in food.

Course outcomes (CO's)

After successful completion, the students will understand

1. Preparation of syrups with fruits
2. Measurement of water vapour in carrier gas
3. Determine the types of chemicals migrate from packaging into food.
4. Heterotrophic plate count of bacteria in packed food
5. Determine the counts of staphylococcus aureus in bread.
6. Identification of the microflora behavior and physicochemical changes undertaken in a food

Experiments

1. Preparation of syrups, Grape squash and orange squash.
2. Water vapor transmission rate of different packaging materials
3. Determination of migration characteristics of packaging materials
4. Determination of migration characteristics of packaging materials using different simulants
5. Determination of bacterial counts of polymer – packed foods during storage
6. Determination of tensile strength of given packaging material
7. Determination of bursting strength of given packaging material
8. Determination of coliforms and fungal counts of polymer – packed foods during storage
9. Microwave and radiation preservation of meat, poultry and fish
10. Identification and chemical resistance of plastic films.
11. Estimation of shelf-life of packaged food stuff.
12. Detection of adulteration in foods.

REFERENCES

Coles, R., Dowell, D.M., and Kirwan, J., (2003). Food Packaging Technology. Black Well Publishing Ltd., 2003.

Plummer, D.T., (1971). An Introduction to Practical Biochemistry. Mc-Graw Hill Pub.Co., New York.

Raghuramulu, N., Nair, K.M., and Kalyanasundaram, S., (1983). A Manual of Laboratory Techniques. National Institute of Nutrition, ICMR, Hyderabad.

Rahman, M.S., (2006). Handbook of Food Preservation. Marcel Dekker Publisher, Inc.NY.

Stanburry, P.P., and Whitaker, A., (1984). Principles of Fermentation Technology.Pergamon Press, Oxford UK.

Semester VI

16BCU691 **RESEARCH PROJECT** **8H-6C**

Instruction hours/week: L:2 T:0 P:6 **Marks:** Internal: **40** External: **60** Total: **100**