BACHELOR OF SCIENCE (BIOCHEMISTRY)

VISION

To develop highly qualified competitive professionals required for both academics and industries with excellent leadership, communication and teamwork skills.

MISSION

- To provide basics and latest concepts in Biochemistry to the young minds.
- To offer excellent opportunities to acquire hands on experience in Research-oriented education.

PROGRAMME EDUCATIONAL OBJECTIVE (PEO)

PEO 1: To develop a sustained interest and enthusiasm among the students to learn and extend the concepts of Biochemistry in logical and stepwise manner.

PEO 2: To intend the students to be innovative and adaptable personalities in the field of Life Science with quality education.

PEO 3: To provide the skilled manpower required for Research and Development, Industries and Institutions of higher learning.

PROGRAMME OUTCOMES (PO)

After completion of the programme, the graduates will be able to

PO 1: Apply the knowledge of science in the domain of Biochemistry.

PO 2: Solve the complex problems in the field of Biochemistry with an understanding of the societal, legal and cultural impacts of the solution.

PO 3: Identify and solve problems and explore new areas of research in life science.

PO 4: Undertake higher studies in recognized Institutions of higher learning and engage in self-employment.

PO 5: Acquire the necessary theoretical and practical competencies in Biochemistry.

PROGRAMME SPECIFIC OUTCOMES (PSO)

After completion of the programme, the graduates will be able to

PSO 1: Implicate the concepts of biological components which are needed for optimum functioning of the cells and the entire system.

PSO 2: Demonstrate biological techniques to compile and evaluate the experimental results.

PSO 3: Appraise the changes in the structure and metabolism of the biomolecules leads to abnormalities.

PSO 4: Carry out basic research in Biochemistry including medical and diagnostic fields.

PSO 5: Form a part of member in a team with right attitude and find gainful employment in industry or government sectors.

REGULATIONS

ELIGIBILITY

Candidates for admission to the first year of the Degree of Bachelor of Science under B.Sc. Biochemistry course are required to have passed the Higher Secondary Examination (Academic stream) conducted by the Government of Tamil Nadu or an Examination as equivalent to 10+2 courses including CBSE, which have been recognized by the Periyar University.

DURATION OF THE COURSE

The course shall extend over a period of three years comprising of six semesters with two semesters in one academic year. There shall not be less than 90 working days for each semester. Examination shall be conducted at the end of every semester for the respective subjects.

MAXIMUM DURATION FOR THE COMPLETION OF THE UG PROGRAMME

The maximum duration for completion of the UG Programme shall not exceed 12 semesters.

Subject Code	Subject	Hours of Instruction	Exam Duration (Hours)	Maximum Marks			Credit Points
				CA	CE	Total	
First Semester							
			Part I				
18UTALA101/ 18UHILA101/ 18UFRLA101	Tamil I/ Hindi I/ French I	5	3	25	75	100	3
			Part II				
18UENLA101	Foundation English I	5	3	25	75	100	3
			Part III				
18UBCM101	Core I: Biomolecules	6	3	25	75	100	5
18UCHBCA101	Allied I: Chemistry I	4	3	25	75	100	2
18UBCMP101	Core Practical I: Biomolecules	5	6	40	60	100	3
18UCHBCAP101	Allied Practical I: Volumetric and Organic Analysis	3	3	40	60	100	2
			Part IV				
18UVE101	Value Education I: Yoga	2	3	25	75	100	2
	Total	**30**				**700**	**20**
Second Semester							
			Part I				
18UTALA201/ 18UHILA201/ 18UFRLA201	Tamil II/ Hindi II / French II	5	3	25	75	100	3
			Part II				
18UENLA201	Foundation English II	5	3	25	75	100	3
			Part III				
18UBCM201	Core II: Biochemical Techniques	6	3	25	75	100	5
18UMBBCA201	Allied II: Microbiology	4	3	25	75	100	2
18UBCMP201	Core Practical II: Biochemical Techniques	5	6	40	60	100	3
18UMBBCAP201	Allied Practical II: Microbiology	3	3	40	60	100	2

Part IV							
18UVE201	Value Education II: Environmental Studies	2	3	25	75	100	2
Total		**30**				**700**	**20**
Third Semester							
Part I							
18UTALA301/ 18UHILA301/ 18UFRLA301	Tamil III/ Hindi III/ French III	5	3	25	75	100	3
Part II							
18UENLA301	Foundation English III	5	3	25	75	100	3
Part III							
18UBCM301	Core III: Enzymology	4	3	25	75	100	4
18UCSBCA301	Allied III: Computer for Biology	4	3	25	75	100	2
18UBCMP301	Core Practical III: Enzymology	3	6	40	60	100	3
18UCSBCAP301	Allied Practical III: Computer for Biology	2	3	40	60	100	2
Part IV							
18UBCSB301	SBC I: Cell Biology	2	3	25	75	100	2
	NMEC I	2	3	25	75	100	2
Non Credit							
18ULS301	Career Competency Skills I	1	-	-	-	-	-
	Add on Course	2	3	-	-	100	-
Total		**30**				**900**	**21**
Fourth Semester							
Part I							
18UTALA401/ 18UHILA401/ 18UFRLA401	Tamil IV/ Hindi IV/ French IV	5	3	25	75	100	3
Part II							
18UENLA401	Foundation English IV	5	3	25	75	100	3
Part III							
18UBCM401	Core IV: Bioenergetics and Intermediary	5	3	25	75	100	5

	Metabolism						
18UMABCA401	Allied IV: Biostatistics	4	3	25	75	100	2
18UBCMP401	Core Practical IV: Intermediary Metabolism	3	6	40	60	100	3
18UMABCAP401	Allied Practical IV: Statistics (Using MS-Excel)	2	3	40	60	100	2
Part IV							
18UBCSB401	SBC II: Fundamentals of Biochemical Calculations (100 % Internal Evaluation)	2	3	100	-	100	2
	NMEC II	2	3	25	75	100	2
Non - Credit							
18ULS401	Career Competency Skills II	1	-	-	-	-	-
	Add on Course	1	3	-	-	100	-
Total		**30**				**900**	**22**
ALC*							
Fifth Semester							
Part III							
18UBCM501	Core V: Fundamentals of Immunology	5	3	25	75	100	4
18UBCM502	Core VI: Molecular Biology	5	3	25	75	100	5
18UBCM503	Core VII: Clinical Biochemistry	5	3	25	75	100	5
18UBCM504	Core VIII: Endocrinology	4	3	25	75	100	4
	Elective I	4	3	25	75	100	4
18UBCMP501	Core Practical V: Immunology and Clinical Biochemistry	4	6	40	60	100	3
Part IV							
18UBCSB501	SBC III : Pharmacognosy (100 % Internal	2	3	25	75	100	2

	Evaluation)						
Part V							
18UBCE501	Extension Activity	-	-	-	-		2
Non - Credit							
18ULS501	Career Competency Skills III	1	-	-	-	-	-
Total		**30**				**700**	**29**
ALC *							
Sixth Semester							
Part III							
18UBCM601	Core IX: Plant Biochemistry	5	3	25	75	100	5
18UBCM602	Core X: Pharmaceutical Biochemistry	5	3	25	75	100	5
18UBCM603	Core XI: Genetic Engineering	5	3	25	75	100	5
	Elective II	4	3	25	75	100	4
18UBCMP601	Core Practical VI: Plant Biochemistry and Genetic Engineering	4	6	40	60	100	3
18UBCPR601	Internship	4	-	40	60	100	4
Part IV							
18UBCSB601	SBC IV : Phytochemistry	2	3	25	75	100	2
Non - Credit							
18ULS601	Career Competency Skills IV	1	-	-	-	-	-
Total		**30**				**700**	**28**
Grand Total						**4400**	**140**

ELECTIVE SUBJECT

The students shall choose any one of the following elective subjects in fifth and sixth semester.

S.No.	Semester	Subject code	Subject
1.	V	18UBCEL501	Human Physiology
2.		18UBCEL502	Nutritional Biochemistry
3.	VI	18UBCEL601	Computational Biology
4.		18UBCEL602	Biomedical Instrumentation

NON MAJOR ELECTIVE COURSE (NMEC)

Non Major Elective Course is conducted for the Students of other Departments.

S.No.	Semester	Course Code	Subject
1.	III	18UBCNM301	Biochemistry in Health and Diseases
2.	IV	18UBCNM401	Functional Biology

ADD-ON COURSE

The students shall study the following Add-on Course during their Third and fourth semesters.

S.No.	Semester	Subject Code	Subject
1.	III	18UBCAC301	Clinical Laboratory Techniques
2.	IV	18UBCAC401	Medical Terminology (For Medical Coding/Medical Transcription)

ADVANCED LEARNER COURSE:

The students shall choose any one of the following Advanced Learner Course during their Fourth and Fifth semester.

S.No.	Semester	Subject Code	Subject
1.	IV	18UBCAL401	Food Biochemistry
2.		18UBCAL402	Bioprocess technology
3.	V	18UBCAL501	Soil Biochemistry
4.		18UBCAL502	Microbial Biochemistry

FOR COURSE COMPLETION

Student shall complete:

- Language subjects (Tamil/Hindi/French, English) in I, II, III and IV semester.
- Value Education: Yoga and Environmental Studies in I and II semester respectively.
- Allied subjects in I, II, III and IV semester.
- Two Add-on Course in III and IV semesters of their course of study.
- Two Non Major Elective Courses in III and IV semesters.
- Four Skill Based Courses in III, IV, V and VI semesters.
- Extension activity in V semester.
- Elective subjects in the V and VI semesters.
- Internship during the VI semester.
- Career Competency Skill in semester III, IV, V and VI.

TOTAL CREDIT DISTRIBUTION

S.No.	PART	Total Marks	Total Credits
1.	PART I: Language	400	12
2.	PART II: Foundation English	400	12
3.	PART III : Major, Allied, Elective, Internship	2800	98
4.	PART IV: Value Education, SBC, NMEC	800	16
5.	PART V: Extension Activity	-	2
TOTAL		**4400**	**140**

18UTALA101	**TAMIL – I: கவிதைகளும் கதைகளும்**	**பருவம் - I**

இப்பாடத்திட்டத்தின் நோக்கங்களாவன:

- தற்காலத்தமிழ் இலக்கியவகைகளை மாணவர்களுக்குக் கற்பித்தல்.
- காலந்தோறும் தமிழ்க் கவிதை வளர்ச்சி நிலைகளை அறிமுகப்படுத்துதல்.
- அடிப்படைத் தமிழ் இலக்கணத்தைக் கற்பித்து அரசுப்போட்டித் தேர்வுகளுக்கு ஆயத்தப்படுத்துதல்.

Credits: 3 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**மரபுக் கவிதைகள்** அ. பாரதியார் ஆ. பாரதிதாசன் - தமிழின் இனிமை இ. நாமக்கல் கவிஞர் - கவிதை என்றால் என்ன? ஈ. முடியரசன்	10	**CO1**
II	**புதுக்கவிதைகள்** அ. வைரமுத்து - ரத்ததானம் - தண்ணீர் பிச்சை ஆ. வெ.இறையன்பு - பூபாளத்திற்கொருபுல்லாங்குழல் - பனித்துளியில் பாற்கடல் இ. தீபா - மழைக்கு ஒரு மடல் - பாரதியார், வறுமை ஈ. சிற்பி - ஒரு கிராமத்து நதி - ஒரு கிராமத்து நதி	10	**CO2**
III	**சிறுகதைகள்** அ. அறிஞர் அண்ணா - செவ்வாழை ஆ. கிருத்திகா - உழவு மாடுகள் இ. வள்ளி.வ. - தணல் துண்டாய்...சில தருணங்கள் ஈ. தி.ஜானகிராமன் - முள்முடி	10	**CO3**
IV	**இலக்கியவரலாறு** அ. மரபுக்கவிதையின் தோற்றமும் வளர்ச்சியும் ஆ. புதுக்கவிதையின் தோற்றமும் வளர்ச்சியும் இ. சிறுகதையின் தோற்றமும் வளர்ச்சியும் ஈ. நாடகத்தின் தோற்றமும் வளர்ச்சியும்	10	**CO4**
V	**அடிப்படை இலக்கணம்** அ. முதலெழுத்துகள் மற்றும் சார்பெழுத்துகள் (நன்னூல் விதிப்படி விளக்கம்) ஆ. வல்லினம் மிகும் மிகா இடங்கள். இ. மரபுப் பெயர்கள் - இளமைப் பெயர்கள்	10	**CO5**

TEXT BOOK	
1.	தமிழ்த்துறைவெளியீடு, கே.எஸ்.ரங்கசாமி கலை அறிவியல் கல்லூரி (தன்னாட்சி), திருச்செங்கோடு.

COURSE OUTCOMES (CO)

இப்பாடத்தைக் கற்பதன் வாயிலாக மாணவர்கள் பெறும் பயன்களாவன

CO1	மரபுக்கவிதைகளின் வடிவங்களைஅறிதல்.
CO2	புதுக்கவிதைகளின் வடிவங்கள் மற்றும் பாடுபொருள் தன்மையை அறிதல்.
CO3	சிறுகதைகளின் உருவம்,உள்ளடக்கங்களை அறிதல்
CO4	காலந்தோறும் மாறும் இலக்கியவளர்ச்சியை அறிதல்
CO5	எழுத்துகளின் வகைகளை அறிதல்.

18UENLA101	**FOUNDATION ENGLISH I**	**SEMESTER – I**

COURSE OBJECTIVES

The course aims

- To enable the students to develop their comprehensive skill.
- To introduce the students to know about English poetry.
- To introduce the students to know about English short stories.

Credits: 3 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I & II	**POETRY** William Wordsworth - The Solitary Reaper Margaret Atwood - This Is a Photograph of Me **SHORT STORY** A. J. Cronin - Two Gentlemen of Verona **GRAMMAR** Parts Of Speech Articles **COMPOSITION** Letter Writing – Formal **COMMUNICATION SKILLS** Greeting and Introducing Inviting a Person	**20**	**CO1 & CO2**
III & IV	**POETRY** Robert Frost - The Road Not Taken **SHORT STORIES** Pearl S. Buck - The Refugees C. Rajagopalachary – Tree Speaks **GRAMMAR** Kinds of Sentences **COMPOSITION** Dialogue Writing	**20**	**CO3 & CO4**

	COMMUNICATION SKILLS Seeking Permission Offering a Suggestion and Giving an Advice		
V	**SHORT STORY** R. K. Narayan - The Axe **GRAMMAR** Question Tag **COMPOSITION** Reading Comprehension **COMMUNICATION SKILLS** Persuading	**10**	**CO5**

TEXT BOOKS

1. *G.Damodar, D.Venkateshwarlu, M.Narendra, M.SaratBabu, G.M.Sundaravalli.* 2009. **English For Empowerment**. Published by Orient Blackswan Private Limited. Hyderabad.
2. *M.M.Lukose*. 2010. **Images, A hand book of Stories.** Macmillan Publishers Indian Limited. Chennai.
3. *Dr.A.Shanmugakani,* M.A., Ph.d, **Prose for Communication**. Manimekala Publishing House, Madurai.
4. *SasiKumar V and Syamala V*. 2006. **Form and Function A Communicative Grammar for Colleges.** Emerald Publishers. Chennai.
5. *T.M.Farhathullah.* 2006. **Communication Skills For Undergraduates**. Publishers-RBA Publications. Chennai.

REFERENCE BOOK

1. *Thomas, A.J and Martinet, A.V*. 1994. **A Practical English Grammar.** Oxford University Press. Delhi.

COURSE OUTCOMES (CO)

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

CO1	Know the different parts of genres in English
CO2	Trace the famous authors of English
CO3	Enrich grammar knowledge
CO4	Stimulate their writing skills
CO5	Deserve appreciation for their communication

18UBCM101	**CORE I: BIOMOLECULES**	**SEMESTER – I**

COURSE OBJECTIVES

The Course aims

- To enable the students to learn the basic structures of macromolecules.
- To understand the biological importance of complex biomolecules such as polysaccharides, lipids, proteins and nucleic acids.

Credits: 5 **Total Hours: 60**

UNIT	CONTENTS	Hrs	CO
I	**Carbohydrates-I** Nomenclature - Classification. Structure (Fischer and Haworth structure), Stereo isomers and structural isomers. Structure and Properties of Monosaccharides – Glucose, fructose, Galactose. Mutarotation and chemical reactions related to functional groups - Enolisation, oxidation, reduction, glycoside formation, ester formation, cyanohydrin synthesis and osazone formation. Derivatives of carbohydrates – Structure of deoxy sugars, amino sugars and glycosides.	**12**	**CO1**
II	**Carbohydrates-II** Oligosaccharides – Disaccharides - Structure and importance of sucrose, lactose and maltose. Trisaccharide - Structure and importance of raffinose. Polysaccharides – Structure, properties and importance of homopolysaccharides (starch, glycogen, cellulose, pectin, chitin and inulin) and heteropolysaccharides - glycosaminoglycans (hyaluronic acid, chondroitin sulfate and heparin). Artificial Sweeteners – Elementary details of Aspartame, Sucralose and Saccharin.	**12**	**CO2**
III	**Amino acids**: Nomenclature. Classification (including newly identified amino acids) and structure with single letter codes. Properties - Physical and chemical. Essential and non essential amino acids – Definition and structure. Non protein amino acids - Definition, structure of Ornithine, Beta alanine, DOPA and GABA. Colour reactions of amino acids.	**14**	**CO3**

	Proteins – Classification, structural organization of Proteins – Primary (insulin), secondary (α helix and β pleated sheet), tertiary (Myoglobin) and quaternary structure (Hemoglobin). Contribution of Ramachandran to protein chemistry. Forces involved in stabilization of tertiary structure. Protein denaturation and renaturation.		
IV	**Lipids:** Classification, physical and chemical properties of fats and oils. Structure and importance of Phospholipids (Lecithin, Cephalins, Phosphatidyl serine) Glycolipids, Sphingolipids, Gangliosides. Nomenclature, Structure and functions of saturated, unsaturated fatty acid and sterols (cholesterol, stigmasterol and ergosterol). Essential fatty acids and PUFA - Definition, structure and importance. Lipoproteins - Types, composition and functions (Elementary details).	**12**	**CO4**
V	**Nucleic acids:** Chemistry of nitrogenous bases, nucleosides and nucleotides. Nucleic acids - DNA - Double helical structure - Watson and Crick model. Types of DNA - A, B, C and Z DNA. Properties of DNA – density, absorption maxima, Tm, denaturation and renaturation. RNA – Types - rRNA, mRNA, tRNA - Structure and functions.	**10**	**CO5**

TEXT BOOKS

1. *Jain, J. L.* 2005. **Fundamentals of Biochemistry.** [Sixth Edition]. S. Chand & Company Ltd., New Delhi

2. *Conn Erice, E.* and *Stumpf Paul, K.* 2007. **Outlines of Biochemistry**. [Fifth Edition]. John Wiley & Sons, New Delhi

REFERENCE BOOKS

1. *Nelson David, L.* and *Cox, M.M.* 2011. **Lehninger Principles of Biochemistry**. [Fifth Edition]. Macmillan/ Worth, New York.

2. *Lubert Stryer*, *Jermy M. Berg* and *John L. Tymoczko.* 2007. **Biochemistry.** [Sixth Edition]. W. H Freeman and Co, New York.

3. *Garrette Grisham*. 2005. **Principles of Biochemistry**. Thomson Brooks/Cole, Australia.

COURSE OUTCOMES (CO)

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

CO1	Illustrate the structure and chemical reactions of Monosaccharides.
CO2	Discriminate the complex structure of Oligosaccharides, Polysaccharides and their functions.
CO3	Describe about the nature of amino acids and their interactions in the formation of proteins.
CO4	Characterize the structure and properties of lipids.
CO5	Explain of the basics of nucleic acids and their significance.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	L	M	H	M
CO2	H	L	M	H	M
CO3	H	L	M	H	M
CO4	H	L	M	H	M
CO5	H	L	M	H	M

H-High; M-Medium; L-Low

18UCHBCA101	**ALLIED I: CHEMISTRY**	**SEMESTER-I**

COURSE OBJECTIVES

The course aims

- To understand the bonding in organic molecules and the factors affecting it
- To provide information about the mechanism of substitution reactions
- To acknowledge the basic ideas in Co-ordination compounds
- To evaluate the chemistry behind polymers
- To recognize the elementary ideas in Electrochemistry

Credits: 2 **Total hours: 40**

UNIT	**CONTENTS**	**Hrs**	**CO**
I	**Chemical Bonding:** Covalent bonds-Orbital overlap-Hybridisation-SP, SP^2, SP^3 -Electron displacement effect-Inductive effect – Resonance – Hyperconjugation-Steric effect-Their effects on the properties of compounds –Stereoisomerism-Optical isomerism-Elements of symmetry-Causes of optical activity-Tartaric acid-Geometrical isomerism of Maleic acid and Fumaric acid.	8	CO1
II	**Reaction and Mechanism:** Aliphatic Nucleophilic substitution reaction-Mechanism of SN^1 and SN^2 reaction-Aromatic compounds – Aromaticity-Huckel's rule-Electrophilic substitution reaction in Benzene-Mechanism of nitration, halogenation, sulphonation, Friedel-craft alkylation and Friedel-craft acylation	8	CO2
III	**Co-ordination Chemistry:** Definition-classification of ligands-Werner's theory-Sidgwick's theory-Effective atomic number-Pauling's theory (VB theory) – Chelation-Chelate effect – Haemoglobin-definition and biological role – Chlorophyll-definition and biological role – EDTA-its applications.	8	CO3
IV	**Polymer Chemistry:** Natural Polymer – Types of polymers –	8	CO4

	Homopolymer–Heteropolymer–Additional and Condensation polymers – polymerization reactions- Manufacture of film sheets – Rayon and Polyacrylicfibers – PVC – Uses of polymers.		
V	**Electrochemistry:** Kohlrausch's law-measurement of conductance – determination of pH-Conductometric titration-Hydrolysis of salts-Elementary ideas – Examples-Galvanic cell-**Galvanic cell –** EMF-Standard electrode potential-Electrochemical series-its applications – Principles of electroplating – Corrosion-Corrosion prevention.	8	CO5

TEXT BOOK

1. *Madan.R.L. and Tuli G. D.* 2005. **Simplified course in Physical chemistry.** [Sixth Edition]. S.Chand and company Ltd., New Delhi.

REFERENCE BOOKS

1. *Lee J.D*. 2008. **A New Concise Inorganic Chemistry**. [Fifth Edition]. Chapmann and Hall, London.
2. *Morrison R.T. and Boyd. R.N*. 2010. **Organic Chemistry**. [Seventh Edition]. Prentice-Hall of India (P) Ltd, New Delhi.
3. *Mukherjee. S. M. Singh .S. P. and Kapoor, R .P*. 1985. **Organic Chemistry.** [Fifth Edition]. New Age International (P) Ltd., New Delhi.

COURSE OUTCOMES (CO)

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

CO1	Analyze the bond formation in organic molecules
CO2	Recognize the mechanism of the reactions
CO3	Compute the chemistry of co-ordination compounds
CO4	Predict the chemistry behind polymers
CO5	Demonstrate the working principles of cells and batteries

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	H	L
CO2	M	M	H	H	H
CO3	H	M	H	M	M
CO4	H	M	H	M	M
CO5	L	H	L	M	H

H-High M-Medium L-Low

18UBCMP101	CORE PRACTICAL I: BIOMOLECULES	SEMESTER – I

COURSE OBJECTIVES

The Course aims

- To enable the students to know the basics of the chemical reactions by qualitative and quantitative analysis.
- To learn the simple biochemical separation methods.

Credits: 3 **Total Hours: 65**

S.No.	EXPERIMENT	Hrs	CO
I. Qualitative Analysis			
1.	Carbohydrates: Glucose, fructose, xylose, galactose, sucrose, lactose, maltose and starch.	15	CO1
2.	Amino acids: Tyrosine, tryptophan, histidine, methionine, arginine and cysteine.	10	CO1
3.	Proteins: Solubility test, coagulation test, ninhydrin test, biuret test, folin's phenol test, precipitation by metals.	5	CO1
4.	Lipids: Solubility, grease spot, Oil spot, emulsification, halogenations, colour reactions.	5	CO1
II. Biochemical Preparation			
5.	Starch from Potato.	5	CO2
6.	Casein from milk.	5	CO2
III. Quantitative Analysis			
7.	Estimation of Reducing Sugar (Glucose) - Benedict's method.	5	CO3
8.	Estimation of Amino acid (Glycine) - Formal titration.	5	CO3
9.	Determination of Saponification Number (Group Experiment).	5	CO3
10.	Determination of Acid Number (Group Experiment).	5	CO3

REFERENCE BOOKS

1. *Sadasivam, S.* and *Manickam, A*. 2010. **Biochemical Methods.** [Third Edition]. New Age International (P) Ltd., New Delhi.
2. *Jayaraman, J*. 2008. **Laboratory Manual in Biochemistry**. [First Edition Reprint]. New Age International (P) Ltd., New Delhi.

COURSE OUTCOMES (CO)

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

CO1	Perform qualitative analysis for identification of Biomolecules
CO2	Apply the techniques used for isolation of bio constituents from food samples
CO3	Do quantification of biomolecules by titrimetric methods

18UCHBCAP101	**ALLIED PRACTICAL I: VOLUMETRIC AND ORGANIC ANALYSIS**	**SEMESTER I**

COURSE OBJECTIVES

The course aims

- To enable the students to acquire the quantitative skills in volumetric analysis.
- To know the inorganic preparation

Credits: 2 **Total Hours: 30**

S.No.	**EXPERIMENT**	**CO**
Titrimetric Quantitative Analysis		
1.	Estimation of HCl using standard oxalic acid.	CO1
2.	Estimation of Ferrous sulphate using Mohr's salt.	CO1
Organic Qualitative Analysis		
3.	Monocarboxylic acid	CO2
4.	Monoamide	CO2
5.	Diamide	CO2
6.	Carbohydrate	CO2
7.	Aromatic aldehyde	CO2

REFERENCE BOOKS

1. *Kamboj.P.C.* 2013. **University Practical Chemistry.** [First Edition (reprint)]. Vishal publications, Jalandhar, Punjab.
2. *Venkateshwara, V., Veerasamy. R. Kulandaivel. R.,* 2012. **Basic Principles of Practical Chemistry.** [Second Edition]. S. Chand &sons,New Delhi.

COURSE OUTCOMES (CO)

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

CO1	Analyze quantitatively by titration techniques
CO2	Analyze systematically an organic compound by laboratory techniques

18UVE101	VALUE EDUCATION I: YOGA	SEMESTER - I

COURSE OBJECTIVES

The course aims

- To understand physical body and Health concepts
- To have the basic Knowledge on Simplified Physical Exercises and Asanas and Meditation
- To Introspect and improve the behaviors
- To inculcate cultural behavioral patterns

Credits: 2 **Total Hours: 30**

UNIT	CONTENTS	Hrs	CO
I	**Yoga and Physical Health:** Health - Meaning and Definition - Physical Structure - Three bodies - Five limitations - Simplified Physical Exercises - Hand, Leg, Breathing, Eye exercises - Kapalabathi, Makarasana 1, 2 , Massage, Acu pressure, Relaxation exercises - Yogasanas – Surya namaskar - Padmasana - Vajrasana - Ardha katti Chakrasana - Viruchasana - Yogamudra - Patchimothasana - Ustrasana - Vakkarasana – Salabasana	6	CO1
II	**Greatness of Life Force and Mind :** Maintaining youthfulness - Postponing the ageing process - Sex and spirituality - Significance of sexual vital fluid - Married life - Chastity - Development of mind in stages - Mental Frequencies - Methods for Concentration - Meditation and its Benefits	6	CO2
III	**Personality Development – Sublimation :** Purpose and Philosophy of Life - Introspection - Analysis of Thought - Moralization of Desire - Analysis and practice - Neutralization of Anger - Strengthening of will-power	6	CO3
IV	**Human Resources Development:** Eradication of Worries - Analysis and Eradication practice - Benefits of Blessings – Effect of good vibrations - Greatness of Friendship - Guidance for good	6	CO4

	Friendship – Individual Peace and world peace - Good cultural behavioral patterns		
V	**Law of Nature:** Unified force - Cause and effect system - Purity of thought deed and Genetic Centre – Love and Compassion - Gratitude - Cultural Education - Fivefold culture.	**6**	**CO5**

TEXT BOOK

1. Value Education - World Community Service centre, Vethathiri Publications, Erode

REFERENCE BOOKS

1. *Vethathiri Maharishi*, 2011, Journey of Consciousness, Erode, Vethathiri Publications.

2. *Vethathiri Maharishi*, 2014, Simplified Physical Exercises, Erode, Vethathiri Publications.

3. *Vethathiri Maharishi*, 2004, Unified force, Erode, Vethathiri Publications

4. Yoga for Modern age - Thathuvagnani Vethathiri Maharishi

5. Sound Health through yoga – Dr. K. Chandrasekaran, November 1999 Prem Kalyan Publications, Madurai

6. Light on yoga - BKS.lyenger

7. Thathuvagnani Vethathiri Maharishi – Kayakalpa yoga – First Edition 2009 – Vethathiri Publications, Erode.

8. Environmental Studies - Bharathidasan University Publication Division

COURSE OUTCOMES (CO)

After completion of the course, the student will be able to

CO1	Understand the physical structure and simplified physical exercises
CO2	Nurture the life force and mind
CO3	Introspect and improve the moral values
CO4	Realize the importance of human resources development
CO5	Enhance purity of thought and deed

18UTALA201	**Tamil – II: சமய இலக்கியங்கள்**	**பருவம் - II**

இப்பாடத்திட்டத்தின் நோக்கங்களாவன:

- சமய இலக்கியங்களை அறிமுகம் செய்தல்
- சமயச் சான்றோர் நிலைப்பாட்டை உணர்த்துதல்
- சமயங்கள் வளர்த்த தமிழை அறியச் செய்தல்

Credits: 3 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**சைவ, வைணவ இலக்கியங்கள்** அ. சம்பந்தர் தேவாரம் - திருக்கொடிமாடச்செங்குன்றூர்- (**முதல் ஐந்துபாடல்கள்**) ஆ. மாணிக்கவாசகர் - திருவம்மானை **(முதல் ஐந்துபாடல்கள்**) இ. பெரியாழ்வார் - திருப்பல்லாண்டு (**முதல் ஐந்துபாடல்கள்)** ஈ. ஆண்டாள் - திருமணக் கனவு **(முதல் ஐந்துபாடல்கள்**)	10	**CO1**
II	**கிறித்துவ, இசுலாமிய இலக்கியங்கள் (முதல் பத்துப்பாடல்கள்)**	10	**CO2**
III	**சமயச் சான்றோர் வரலாறு** அ. **சைவ சமயச் சான்றோர்கள்** 1. திருஞானசம்பந்தர், 2. திருநாவுக்கரசர், 3. சுந்தரர், 4. மாணிக்கவாசகர் 5. சேக்கிழார் ஆ. **வைணவ சமயச் சான்றோர்கள்** 1. முதலாழ்வார்கள் 2. திருமங்கையாழ்வார் 3.ஆண்டாள் 4. நாதமுனிகள்	12	**CO3**
IV	**சமய இலக்கிய வரலாறு** அ.பன்னிருதிருமுறைகள் ஆ. பதினெண்சித்தர்கள் இ. நாலாயிரதிவ்யபிரபந்தம் ஈ. சைவசித்தாந்தசாத்திரங்கள்	08	**CO4**
V	**இலக்கணமும் மொழித்திறனும்** அ. ஆகுபெயர் ஆ. தொகைச்சொற்கள் இ. மயங்கொலிச்சொற்கள் (ர,ற வேறுபாடுகள்) ஈ. நேர்காணல்	10	**CO5**

TEXT BOOK

1. தமிழ்த்துறை வெளியீடு, கே.எஸ்.ரங்கசாமி கலை அறிவியல் கல்லூரி (தன்னாட்சி), திருச்செங்கோடு– 637 215.

COURSE OUTCOMES (CO)

இப்பாடத்தைக் கற்பதன் வாயிலாக மாணவர்கள் பெறும் பயன்களாவன

CO1	தேவார,திவ்யபிரபந்தச் சிறப்பினைஉணர்தல்.
CO2	கிறித்துவ, இசுலாமிய காவியங்களின் சிறப்பினை உணர்தல்.
CO3	சைவசமய, வைணவசமயச் சான்றோர் சிறப்புக்களை உணர்தல்.
CO4	சமயவளர்ச்சி, இலக்கியவளர்ச்சி ஆகியவற்றை உணர்தல்
CO5	ஆகுபெயர் வகைகளை உணர்தல், மொழித்திறன் பெறுதல்.

18UENLA201	FOUNDATION ENGLISH II	SEMESTER – II

COURSE OBJECTIVES

The course aims

- To enable the students to develop their comprehensive skill.
- To introduce the students to know about English poetry and short stories.

Credits: 3 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I & II	**POETRY** Langston Hughes - I, Too **SHORT STORIES** Vsevolod M. Garshin - The Signal W. Somerset Maugham - The Man with the Scar **GRAMMAR** Tenses (Present, Past & Future) **COMPOSITION** E-mail SMS **COMMUNICATION SKILLS** Asking Questions	**20**	**CO1 & CO2**
III & IV	**POETRY** Chinua Achebe - Refugee Mother and Child Nissim Ezekiel - Goodbye Party for Miss Pushpa T. S **SHORT STORY** H. G. Wells - The Stolen Bacillus **GRAMMAR** Voices (Active and Passive) **COMPOSITION** Note Making, Note Taking **COMMUNICATION SKILLS** Praising and Complimenting Complaining and Apologizing	**20**	**CO3 & CO4**

V	**POETRY** Tripuraneni Srinivas - I Will Embrace only the Sun **SHORT STORY** O. Henry - One Thousand Dollars **COMPOSITION** Discourse Pattern **COMMUNICATION SKILLS** Expressing Sympathy Phoning	**10**	**CO5**

TEXT BOOKS

1. *G.Damodar, DVenkateshwarlu, M.Narendra, M.SaratBabu, G.M.Sundaravalli.* 2009. **English For Empowerment**. Published by Orient Blackswan Private Limited. Hyderabad –500 029.
2. *M.M.Lukose*. 2010. **Images, A hand book of Stories.** Macmillan Publishers Indian Limited. Chennai–600 041.
3. *SasiKumarV and SyamalaV*. 2006. **Form and Function A Communicative Grammar for Colleges.** Emerald Publishers. Chennai–600 008.
4. *T.M.Farhathullah.* 2006. **Communication Skills For Undergraduates**. Publishers-RBA Publications. Chennai–600 015.

REFERENCE BOOKS

1. *Thomas, A.J and Martinet, A.V.* 1994. **A Practical English Grammar.** Oxford University Press. Delhi.
2. *Martin Hewings.* 1999. **Advanced English Grammar.** Cambridge University Press. New Delhi.

COURSE OUTCOMES (CO)

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

CO1	Know the different parts of genres in English
CO2	Identify the famous authors of English
CO3	Enrich their grammar knowledge
CO4	Stimulate their writing skills
CO5	Deserve appreciation for their communication

18UBCM201	**CORE II: BIOCHEMICAL TECHNIQUES**	**SEMESTER – II**

COURSE OBJECTIVES

The Course aims

- To enable the students to have a deep knowledge on the techniques for measurement of biophysical factors in living organisms.
- To enable the students to get an insight on the usage of various techniques and their applications in industry and R&D.

Credits: 5 **Total Hours: 60**

UNIT	CONTENTS	Hrs	CO
I	**pH and buffers**: pH - Definition, H-H equation and its derivation. Measurement of pH - use of indicators and pH electrode- Reference electrodes – Standard hydrogen electrode, Calomel electrodes, Silver/Silver Chloride electrode and glass electrodes. pH meter. Buffers - Definition and importance of buffers in biological system. **Electrolytes-** Normal water and electrolyte balance and its regulation. Acid-base balance -respiratory and renal mechanism of acid - base balance. Acidosis and alkalosis. Osmosis, Viscosity, Diffusion, Surface Tension, Colloids – Definition and its biological significance.	**12**	**CO1**
II	**Centrifugation Techniques:** Cell disruption and homogenization - Media for homogenization, methods of cell disruption. Centrifugation - principle-sedimentation coefficient, RCF. Types of centrifuges and rotors. Preparative centrifugation-differential, density gradient centrifugation. Analytical ultracentrifugation –instrumentation and applications-Determination of molecular weight.	**12**	**CO2**
III	**Chromatographic Techniques:** Chromatography - Principle, choice of stationary and mobile phase, methodology and applications of paper, thin layer, ion exchange, affinity gel	**12**	**CO3**

	permeation and Gas liquid chromatography. HPLC – Principle and applications.		
IV	**Electrophoretic techniques:** Electrophoresis - Principles and applications of electrophoresis, Factors affecting electrophoretic mobility. Types of electrophoretic techniques – capillary, paper and agarose gel. PAGE- Native- PAGE and SDS-PAGE. Staining methods used in electrophoretic technique. Isoelectricfocusing.	**12**	**CO4**
V	**Colorimetry:** Beer Lambert's Law, Light absorption and its transmittance, Absorption Spectroscopy - Principle, instrumentation and applications of colorimeter and UV-Vis spectrophotometer. Emission Spectroscopy –Principle, instrumentation and applications of Spectrofluorimeter and Flame photometer.	**12**	**CO5**

TEXT BOOK

1. *Avinash Upadhyay*, *Kakoli Upadhyay* and *Nirmalendu Nath.* 2006**. Biophysical Chemistry: Principles and Techniques.** Himalaya Publishers, Mumbai.

REFERENCE BOOKS

1. *Keith Wilson* and *John Walker*. *2006.* **Principles and Techniques of Biochemistry and Molecular Biology.** [Sixth Edition]. Cambridge University Press, New York.

2. *Deb, A. C.* 2000. **Fundamentals of Biochemistry**. New Central Book Agency. Calcutta.

COURSE OUTCOMES (CO)

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

CO1	Sort out the procedure of electrochemical techniques for measurement of pH
CO2	Apply the principle of centrifuge for application in biomedical field
CO3	Explore the types and employ the applications of chromatographic techniques
CO4	Demonstrate the use of electrophoretic techniques in macromolecule separation
CO5	Validate the techniques for measuring the concentration of suspended particles

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	H	H	H	M
CO2	L	H	H	H	H
CO3	L	H	M	H	H
CO4	L	H	M	H	H
CO5	L	H	M	H	H

H-High; M-Medium; L-Low

18UMBBCA201	ALLIED II: MICROBIOLOGY	SEMESTER – II

COURSE OBJECTIVES

The Course aims

- To learn the early developments and basics of microbiology.
- To acquire the basic knowledge on microscopy, staining, sterilization and chemotherapeutic techniques.

Credits: 02 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	Definition of Microbiology– Scope and branches of microbiology– contributions–Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch and Alexander Fleming.	08	CO1
II	Microscopy– Simple and compound microscope, Darkfield microscope, Phase contrast microscope, Fluorescent microscope. Electron microscope. Principles and types of stain –Simple, differential and special staining (spore and capsule staining).	08	CO2
III	Media preparation– liquid media, solid media, selective media, enriched, enrichment and differential media. Isolation of pure culture– pour plate, spread plate and streak plate methods.	08	CO3
IV	Sterilization– Principle– dry heat, moist heat, radiation, UV rays and gamma rays. Filtration– depth, membrane and HEPA filters. Disinfection and disinfective agents. Chemical agents– alcohols, aldehydes and phenol.	08	CO4
V	Antimicrobial chemotherapy: Antibiotics– mode of action of cell wall, protein and nucleic acid synthesis inhibitors– antibiotic susceptibility test– Kirby Bauer and Stokes method.	08	CO5

TEXT BOOK

1. Pelczar Jr. M., Chan, E.C.S. and N.R. Kreig. 1995. **Microbiology**. Tata Mc Graw Hill, New Delhi

REFERENCE BOOKS
1. Lansing M Prescott, John P. Harley and Donald A. Klein. 2005. **Microbiology**. [Sixth Edition]. Mc Graw Hill. New York.
2. Sale, A.J. 1992. **Fundamental Principles of Bacteriology.** [Seventh Edition]. Mc Graw Hill Inc., New York.

COURSE OUTCOMES (CO)

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

CO1	Understand the scope and applications of microbiology the importance of bio instruments in research and industry
CO2	Apply microscopic techniques and perform staining in the laboratory for visualization of bacteria.
CO3	Analyse necessary parameters for the cultivation and preservation of microorganisms in the laboratory.
CO4	Apply aseptic condition for control of contamination.
CO5	Discuss proper usage of antibiotics to control pathogens and treatment for microbial diseases.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	L	H	H
CO2	M	H	L	H	H
CO3	M	H	L	H	H
CO4	M	H	L	H	H
CO5	M	H	L	H	H

H-High; M-Medium; L-Low

18UBCMP201	**CORE PRACTICAL II: BIOCHEMICAL TECHNIQUES**	**SEMESTER – II**

COURSE OBJECTIVES

The Course aims

- To enable the students to understand the basics in handling of instruments
- To foster the techniques of biomolecule separation

Credits: 3 **Total Hours: 55**

S.No.	EXPERIMENT	Hrs	CO
1.	Preparation of Buffers and Determination of pH using pH meter	5	CO2
2.	Principle and handling of Centrifuge.	5	CO1
3.	Separation of amino acid by ascending paper chromatography.	5	CO3
4.	Separation of amino acid by descending paper chromatography.	5	CO3
5.	Separation of amino acid by circular paper chromatography.	5	CO3
6.	Separation of Leaf pigments by Adsorption chromatography.	5	CO3
7.	Separation of lipids by Thin layer chromatography.	5	CO3
8.	Separation of DNA by agarose gel electrophoresis (Demonstration/Group Experiment).	5	CO3
9.	Separation of proteins by SDS PAGE (Demonstration/Group Experiment)	5	CO3
10.	Principle & handling of Colorimeter - Demonstration of Beer-Lambert's law using bromophenol blue.	5	CO1
11.	Preparation of Calibration curve-Colorimetric estimation of creatinine.	5	CO2

REFERENCE BOOKS

1. *David T. Plummer*. 1988. **Practical Biochemistry**. [Third Edition]. Tata McGraw Hill Publishers, New Delhi.

COURSE OUTCOMES (CO)

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

CO1	Operate and handle basic biochemical instruments
CO2	Apply the techniques in identification of Biomolecules
CO3	Perform separation procedure

18UMBBCAP201	ALLIED PRACTICAL II: MICROBIOLOGY	SEMESTER -II

COURSE OBJECTIVES

The Course aims

- To learn the basic techniques of microbiology.
- To understand the morphological structures of bacteria.
- To cultivate and maintain the microorganisms.

Credit: 02 **Total Hours: 30**

Experiment	CONTENTS	Hrs	CO
1.	Handling and maintenance of bright field microscope	**3**	**CO1**
2.	Staining techniques– Simple staining	**3**	**CO1**
3.	Gram's staining	**3**	**CO1**
4.	Acid fast staining	**3**	**CO1**
5.	Spore staining	**3**	**CO1**
6.	Media preparation–Liquid and solid media	**3**	**CO2**
7.	Pure culture techniques– Streak plate method.	**3**	**CO2**
8.	Pour plate method.	**3**	**CO2**
9.	Spread plate method.	**3**	**CO2**
10.	Antibiotic susceptibility test–Kirby Bauer method.	**3**	**CO3**

REFERENCE BOOKS

1. *Thimmaiah, S.K.* **Standard Methods of Biochemical Analysis**. Kalyani Publishers

COURSE OUTCOMES (CO)

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

CO1	Recall the handling of microscope and morphological identification of microbes
CO2	Formulate the media for isolation and purification of microbial colonies
CO3	Evaluate the antimicrobial drug potency

18UVE201	VALUE EDUCATION II: ENVIRONMENTAL STUDIES	SEMESTER – II

COURSE OBJECTIVES

The course aims

- To enable the students acquire knowledge, values, attitudes, commitment and skills needed to protect and improve the environment.
- To implicate awareness among young minds for safeguarding environment from manmade disasters.

Credits: 2 **Total Hours: 30**

UNIT	CONTENTS	Hrs	CO
I	Environment – Definition – Scope – Structure and function of ecosystems - producers, consumers and decomposers - Energy flow in the ecosystem - Ecological succession– food chain, food webs and ecological pyramids – Concept of sustainabledevelopment.	06	CO1
II	Natural resources: Renewable - air, water, soil, land and wildlife resources. Non–renewable – Mineral coal, oil and gas. Environmental problems related to the extraction and use of natural resources.	06	CO2
III	Biodiversity – Definition – Values – Consumption use, productive social, ethical, aesthetic and option values threats to bio diversity – hotspots of bio diversity – conservation of bio- diversity: in – situ Ex – situ. Bio – wealth - National and Global level.	06	CO3
IV	Environmental Pollution: Definition – causes, effects and mitigation measures – Air pollution, Water pollution, Soil pollution, Noise pollution, Thermal pollution – Nuclear hazards – Solid wastes acid rain – Climate change and global warming environmental laws and regulations in India – Earth summit	06	CO4

V	Population and environment – Population explosion – Environment and human health – HIV/AIDS – Women and Child welfare – Disaster Management - Resettlement and Rehabilitation of people, Role of information technology in environmental health – Environmental awareness.	**06**	**CO5**

TEXT BOOK

1. Department of Biochemistry. Environmental Studies (Study Material). Published by K. S. Rangasamy College of Arts & Science (Autonomous). Tiruchengode.

REFERENCE BOOK

1. *Erach Bharucha*. 2005. **Textbook of Environmental studies**. Universities press. PVT. Ltd.

COURSE OUTCOMES (CO)

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

CO1	Describe the types of ecosystem and concepts in sustainable development
CO2	Explain the importance of natural resources and environmental problems
CO3	Recite about the biodiversity, hot spots of biodiversity and its conservation
CO4	Be conscious on the effects of pollution and population explosion
CO5	Implement the preventive measures for environmental issues

18UTALA301	**TAMIL – III: காப்பியம் - சிற்றிலக்கியம்**	**பருவம் - III**

இப்பாடத்திட்டத்தின் நோக்கங்களாவன:

- தமிழ்க் காப்பியங்கள் தோற்றத்தையும், காப்பிய இலக்கணத்தையும் காப்பிய வகைகளையும் அறிமுகம் செய்தல்.
- சிற்றிலக்கியங்கள் தோற்றம், வளர்ச்ச ிநிலைகளையும், சிற்றிலக்கியங்களையும் அறிமுகம் செய்தல்.
- பகுபத உறுப்புக்களைக் கற்பித்தல்.

Credits: 3 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	காப்பியங்கள் - சிலப்பதிகாரம் - வழக்குரைகாதை மணிமேகலை - மலர்வனம் புக்ககாதை.	10	**CO1**
II	பிறகாப்பியங்கள் - கம்பராமாயணம் - குகப் படலம் பெரியபுராணம் - இளையான்குடிமாறநாயனார் புராணம்.	10	**CO2**
III	சிற்றிலக்கியங்கள் - குற்றாலக் குறவஞ்சி– வசந்தவல்லியின் காதல் **(1-10 பாடல்)** கலிங்கத்துப் பரணி - பேய்களைப் பாடியது.	10	**CO3**
IV	இலக்கியவரலாறு - காப்பியங்கள் - ஐம்பெருங்காப்பியங்கள் - ஐஞ்சிறுகாப்பியங்கள் -புராணங்கள் - சிற்றிலக்கியங்கள்.	10	**CO4**
V	இலக்கணமும் மொழிப்பயிற்சியும் - பகுபத உறுப்பிலக்கணம் - சீர் வகைகள் - வழுஉச் சொற்கள் - கடிதம் எழுதுதல்.	10	**CO5**

TEXT BOOK

1. தமிழ்த்துறை வெளியீடு, கே.எஸ்.ரங்கசாமி கலை அறிவியல் கல்லூரி (தன்னாட்சி), திருச்செங்கோடு– 637 215.

COURSE OUTCOMES (CO)

இப்பாடத்தைக் கற்பதன் வாயிலாக மாணவர்கள் பெறும் பயன்களாவன

CO1	இரட்டைக் காப்பியங்களின் மேன்மைநிலையை உணர்தல்.
CO2	காப்பியக்காலகுடிகளின் நிலையை,உரிமையையுணர்தல்.
CO3	சிற்றிலக்கியங்களின் சிறப்பை உணர்தல்.
CO4	காப்பிய,சிற்றிலக்கியங்களின் வரலாறு குறித்த செய்திகளைஅறிதல்.
CO5	இலக்கணம் மற்றும் மொழிப்பயிற்சியின் அமைப்பை உணர்தல்.

18UENLA301	**FOUNDATION ENGLISH III**	**SEMESTER – III**

COURSE OBJECTIVES

The course aims

- To enable the students to develop their comprehensive skill.
- To promote language skills through literature.

Credits: 3 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I & II	**ONE ACT PLAY** A. Ball - The Seven Slaves **PROSE** Somerset Maugham - Mr. Know –All **GRAMMAR** Degrees of Comparison **COMPOSITION** Advertisement **COMMUNICATION SKILLS** Speaking About Oneself The Media	**20**	**CO1 & CO2**
III & IV	**ONE ACT PLAY** R.H. Wood - Post Early for Christmas **PROSE** Satyajit Ray - Film Making **GRAMMAR** Determiners **COMPOSITION** Resume Writing **COMMUNICATION SKILLS** Imagining Context specific expression - Master of Ceremonies	**20**	**CO3 & CO4**
V	**PROSE**	**10**	**CO5**

	Isai Tobolsky - Not Just Oranges **GRAMMAR** Reported Speech **COMPOSITION** Precise Writing **COMMUNICATION SKILLS** Inviting Personalities.		

TEXT BOOKS

1. *G.Damodar, D.Venkateshwarlu, M.Narendra, M.SaratBabu, G.M.Sundaravalli.* 2009. **English For Empowerment**. Published by Orient Blackswan Private Limited. Hyderabad –500 029.
2. *Ramamurthy.K.S. 1984.* **Seven-Act Plays**. Published in India by Oxford University. New Delhi–110 001.
3. *Sasi Kumar V and Syamala V*. 2006. **Form and Function - A Communicative Grammar for Colleges.** Emerald Publishers. Chennai–600 008.
4. *T.M.Farhathullah.* 2006. **Communication Skills For Undergraduates**. Publishers-RBA Publications. Chennai–600 015.

REFERENCE BOOKS

1. *Raymond Murphy*. 1994. **Intermediate English Grammar.** Cambridge University India Pvt. Ltd, Delhi.

COURSE OUTCOMES (CO)

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

CO1	Know the different parts of genres in English
CO2	Trace the famous authors of English
CO3	Enrich their grammar knowledge
CO4	Stimulate their writing skills
CO5	Deserve appreciation for their communication

18UBCM301	**CORE III: ENZYMOLOGY**	**SEMESTER – III**

Course Objectives:

The Course aims

- To understand the techniques of isolation & purification of the enzymes
- To acquire knowledge on Kinetics of the enzymes and enzyme regulation
- To gain information about application of enzymes in industry and medicine

Credits: 4 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Introduction:** IUB Classification and nomenclature of enzymes, Enzyme units -International units, Katal. Specific activity. The active site - General features. Theories of enzyme action - lock and key and induced fit hypothesis. Enzyme specificity- Definition and Types. Isoenzymes – LDH. Ribozymes, Abzymes, DNAzymes- definitions. Antioxidant enzymes – SOD, Catalase, Glutathione peroxidase (Elementary details).	10	CO1
II	**Purification of enzymes:** Isolation of Enzymes from natural resources. Need for enzyme purification, Steps in Enzyme purification – Gel filtration, ion exchange and Affinity chromatography. Criteria of purity. **Enzyme kinetics:** MM equation & MM plot – significance of Km and Vmax, reciprocal plots - LB plot. Factors affecting enzyme activity (pH, Temperature, Substrate concentration and enzyme concentration).	10	CO2
III	**Coenzymes:** Apoenzyme, holoenzyme. Structure and functions of TPP, NAD, NADP, FAD, FMN and Coenzyme A (Synthesis not required). Metal cofactors. Mechanism of enzyme Catalysis: General acid base catalysis, covalent catalysis -Mechanism of action of Chymotrypsin and Lysozyme.	10	CO3

IV	**Regulation of Enzymes:** Allosteric regulation - allosteric enzymes – allosteric site- modulators. Multisubunits - regulatory and catalytic subunits. Feedback inhibition. Allosteric regulation of aspartate transcarbamylase. Regulation by covalent modification (phosphorylation), Multienzyme Complex- Mechanism of action of Pyruvate dehydrogenase.	**10**	**CO4**
V	**Enzyme Inhibition:** Reversible - Competitive, non-competitive and un-competitive inhibition (kinetics not required). Irreversible inhibition - Inhibition by DFP and Iodoacetamide. **Immobilized enzymes:** Techniques of immobilization (entrapment, carrier binding and cross linking). Enzymes as Biosensors – Principle of Calorimetric, Potentiometric, Amperometric, Optical and immunosensors. Application of enzymes in industries - medicine, textile and food.	**10**	**CO5**

Text Book

1. *Avinash Upadhyay*, *Kakoli Upadhyay* and *Nirmalendu Nath.* 2006**. Biophysical Chemistry: Principles and Techniques.** Himalaya Publishers, Mumbai.

Reference Books

1. *Keith Wilson* and *John Walker*. *2006*. **Principles and Techniques of Biochemistry and Molecular Biology.** [Sixth Edition]. Cambridge University Press, New York.

2. *Deb, A. C.* 2000. **Fundamentals of Biochemistry**. New Central Book Agency. Calcutta.

COURSE OUTCOMES (CO)

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

CO1	Describe the various systems for classifying the enzymes
CO2	Apply appropriate methods for determination of catalytic parameters and activity of enzymes and resolve problems considering kinetics and thermodynamics of enzymatic reactions
CO3	Characterize the structure and functions of coenzymes, and the mechanism of enzyme catalysis
CO4	Explain the regulatory mechanisms of enzyme activity which involve in the maintenance of body's homeostatsis
CO5	Use appropriate enzymes for use in industries for recognizing their potential

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	L	L	M	L
CO2	H	H	M	H	H
CO3	H	M	M	M	L
CO4	H	L	M	H	M
CO5	H	M	L	H	H

H-High; M-Medium; L-Low

18UCSBCA301	ALLIED III:COMPUTER FOR BIOLOGY	SEMESTER–III

COURSE OBJECTIVES

The Course aims

- Basics terminologies of Computer.
- The importance of Office package in Biology.

Credits: 2 **Total Hours: 30**

UNIT	CONTENTS	Hrs	CO
I	**Introduction to Computers:** History and Generations of Computers - Characteristics of Computers - Applications of Computers - Classification of Computers - Organization of Computer System - Computer Hardware - Software Definition, Role and Categories. **The Processor:** The Central Processing Unit. **The Input - Output Media:** Inputs and Outputs:CRT Monitors - Flat Panel Monitors - Keyboards - Graphics and Graphical Terminals - Printers.	6	CO1
II	**Introduction to Microsoft Office Word 2007:** Working with Documents in Microsoft Word2007 - Saving the File - Formatting the Text - Alignment of Text - Applying Fonts - Spell Checking - Consulting Thesaurus - Assign a Character Style - Borders and Shading - Closing of the File - Save as Option - Printing your Document - Editing the Document - Editing Tools - AutoCorrect - AutoFormat - Find and Replace - Find - Replace Text - Page Numbering - Header and Footer - Foot Notes and End Notes.	6	CO2
III	**Introduction to Microsoft Office Word 2007:** Splitting Panes - Tiling of the Document - UsingMail Merge in Word 2007Opening Screen of Microsoft Word Screen. **Introduction to Microsoft Office Excel 2007:** Understanding Spreadsheets - Creating a Worksheet in Excel2007 - Copying Formula - Formulas that Make Decisions - Styles - Functions in Excel - Using Auto calculate -	6	CO3

	References - Sum Function - Average Function - Creating Charts in Excel - Auditing a Workbook - Comments Inserting - Outlines - Worksheet Fitting on a Page.		
IV	**Introduction to Microsoft Office Excel 2007:**FunctionWizard - Goal Seeking - Scenarios Manager - Creating a Pivot Table Report - Typing with AutoFill - Formatting Numbers and Labels - Changing the Size of Rows and Columns - Adding and Deleting Rows and Columns - Inserting (and Removing) Page Breaks - Applying Themes - Add or Remove a Sheet Background - Convert Text to Columns - Protect Worksheet or Workbook Elements - Functions in Excel.	**6**	**CO4**
V	**Working with Microsoft Office Power Point 2007:** Creating Presentation from Template - Creating a New Presentation - PowerPoint Views - Entering the Text - Moving the Text - Changing the Color - Adding Graphics to a Slide - Reordering Slides - Duplicating Slides - Deleting Slides - Adding a Animated Cartoon to a Slide - Adding Slide Transitions - Adding Text Transitions - Viewing a Presentation - Making Slide Shows - Hiding a Slide - Notes, Handouts and Masters for Presentation - Packing Presentation to Go - Add a Caption to a Picture in a Photo Album - Overview of Creating a Photo Album - Add a Picture to a Photo Album - Change the Appearance of a Picture in a Photo Album.	**6**	**CO5**

TEXT BOOKS

1. *Atul Kahate.* 2008**. Information Technology. [**Third Edition]. Tata McGraw - Hill Edition Ltd, New Delhi. (UNIT I)

2. *LawPoint.*2008. **Microsoft Office 2007**. [First Edition]. Ashok Lodha Publication, Kolkata. (UNIT II, III, IV and V)

REFERENCE BOOKS

1. *Anita Goel. 2010.* **Computer Fundamentals. [First Edition]. Pearson Publications 2007**. Dream tech Press, New Delhi.

2. *Pradeep K.Sinha, Priti Sinha*. 2016. [Fourth Edition]. **Computer Fundamentals**. BPB Publications

3. *J.B Dixit. 2011.* [Kindle Edition]. **Fundamentals of Computer Program and Information Technology. Laxmi Publishers.**

4. *Lisa A.Bucki, John Walkenbach, Faithe Wempen, Micheael Alexender, Dick Kusleika.* 2013. Reprint. **Microsoft Office 2013 Bible.** Wiley Publications.

5. *John Walkenbach*.2010. Reprint. **Microsoft Excel 2010 Bible**. Wiley India Pvt. Limited

6. *Tracy Syrstad*. 2015.[First Edition]. **Excel 2013 Absolute Beginners Guide.** Pearson Publications

WEB REFERENCES

1. https://www.tutorialspoint.com
2. https://www.free - computer - tutorials.net
3. https://www.edu.getglobal.org
4. https://www.w3schools.com

COURSE OUTCOMES (CO)

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

CO1	Explore the fundamental components of computer devices.
CO2	Create well defined documents with various tools in MS Word.
CO3	Interpret the various formulas, functions and chart preparations in MS Excel.
CO4	Generate various kinds of reports.
CO5	Create slides, overhead transparencies, Handouts and Speaker Notes.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	M	H	H
CO2	M	H	M	H	H
CO3	M	H	M	H	H
CO4	M	H	M	H	H
CO5	M	H	M	H	H

H-High; M-Medium; L-Low

18UBCMP301	CORE PRACTICAL III: ENZYMOLOGY	SEMESTER – III

COURSE OBJECTIVES

The Course aims

- To acquire knowledge about isolation and purification of enzymes
- To analyze the effect of Various factors that affect enzyme action

Credits: 3 **Total Hours: 33**

S.No.	EXPERIMENT	Hrs	CO
1.	Extraction of ALP from green gram.	3	CO1
2.	Partial purification of ALP by ammonium sulphate precipitation.	3	CO1
3.	Desalting of ammonium sulphate enzyme fraction by dialysis.	3	CO1
4.	Determination of specific activity of ALP.	3	CO1
5.	Effect of pH on the activity of ALP.	3	CO2
6.	Effect of temperature on the activity of ALP.	3	CO2
7.	Effect of substrate concentration on the activity of ALP.	3	CO2
8.	Determination of specific activity of salivary amylase.	3	CO2
9.	Effect of temperature on the activity of salivary amylase.	3	CO2
10.	Effect of substrate concentration on the activity of salivary amylase.	3	CO2
11.	Immobilization technique - Gel Entrapment.	3	CO3

REFERENCE BOOKS

1. *Sadasivam, S.* and*Manickam, A*. 2010. **Biochemical Methods.** [Third Edition]. New Age International (P) Ltd., New Delhi.

2. *Harold Varley*.1988. **Practical Clinical Biochemistry.** [Fourth Edition]. CBS Publishers. New Delhi.

COURSE OUTCOMES (CO)

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

CO1	Outline the general methods in enzyme extraction and purification process
CO2	Analyze the effect of various biological parameters on enzyme activity
CO3	Perform enzyme immobilization methods

<table>
<tr><td colspan="2">18UCSBCAP301</td><td colspan="2">ALLIEDPRACTICAL –III: COMPUTER FOR BIOLOGY</td><td>SEMESTER - III</td></tr>
<tr><td colspan="5">COURSE OBJECTIVES
The Course aims
• To acquire basic concepts of MS Word and its applications.
• To understand importance of MS Excel in real time applications.</td></tr>
<tr><td colspan="3">Credits: 2</td><td colspan="2">Total Hours: 24</td></tr>
<tr><td>S.NO</td><td colspan="2">PROGRAMS</td><td>Hrs</td><td>CO</td></tr>
<tr><td colspan="5">MS – Word</td></tr>
<tr><td>1</td><td colspan="2">Creating a Personal Profile.</td><td>2</td><td>CO1</td></tr>
<tr><td>2</td><td colspan="2">Designing a Document for Lab Requirements using following options
• Font styles.
• Page layout, Page Setup (Setting Margins, Changing Page Size, Changing Page Orientation and Applying Page Background).
• Table.</td><td>2</td><td>CO1</td></tr>
<tr><td>3</td><td colspan="2">Creating a Document for topic presentation with following options
• Single and Double Column.
• Page numbers.
• Headers and Footers.
• Date and time, Pictures and Shapes.</td><td>2</td><td>CO1</td></tr>
<tr><td>4</td><td colspan="2">Mail Merge–Invitation to Multiple Recipients for Conducting Seminar in the Department.</td><td>2</td><td>CO2</td></tr>
<tr><td colspan="5">MS - Excel</td></tr>
<tr><td>5</td><td colspan="2">Entering Data for Stock Analysis and Formatting the Cells.</td><td>2</td><td>CO3</td></tr>
<tr><td>6</td><td colspan="2">Working with Sorting and Filtering.</td><td>2</td><td>CO3</td></tr>
<tr><td>7</td><td colspan="2">Creating a Chart for an Experiment with sample data.</td><td>2</td><td>CO3</td></tr>
</table>

8	Stock Maintenance for Lab Equipment.	**2**	**CO3**
9	Creating a Presentation for the given topic.	**2**	**CO4**
10	Creating a Presentation for the Department Profile.	**2**	**CO4**
11	Creating a Presentation with Animation effects.	**2**	**CO5**
12	Creating a photo album for the Department event.	**2**	**CO5**

WEB REFERENCE:

1. https://www.tutorialspoint.com
2. https://www.free - computer - tutorials.net
3. https://www.edu.getglobal.org
4. https://www.w3schools.com

COURSE OUTCOMES (CO)

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

CO1	Create professional and academic documents by applying different formats and styles.
CO2	Effectively utilize the table and Mail Merge concepts.
CO3	Create, edit and enhance basic Excel spreadsheet using formula and charts.
CO4	Understand basic power point using templates, animations and slide transitions.
CO5	Create and manipulate slides with text and graphics.

18UBCSB301	SBC I: CELL BIOLOGY	SEMESTER – III

COURSE OBJECTIVES

The Course aims

- To understand the relationship between organization and functions of cell and subcellular organelles.

Credits: 2 **Total Hours: 25**

UNIT	CONTENTS	Hrs	CO
I	**Cell and Cell Cycle:** Origin and evolution of cell. Cell classification- Prokaryotic and Eukaryotic cell. Mitotic and meiotic cell division. Overview of Cell Cycle.	5	CO1
II	**Nucleus, Mitochondria & Cytoskeleton:** Nucleus and Mitochondria – Structure and functions. Cytoskeleton: Microfilaments (Actin and Myosin), Intermediate Filaments (Keratin and Desmin), Microtubules (Cilia and flagella)	5	CO2
III	Golgi apparatus – Structure and functions. Endoplasmic reticulum and Ribosomes – Types, structure and functions. Lysosome, Peroxisomes and Glyoxisomes– Structure and functions.	5	CO3
IV	**Plasma membrane & Membrane transport:** Structure, composition and functions of the plasma membrane - Fluid mosaic model, Membrane lipids and proteins. Cell permeability: Passive diffusion - Transport of small molecules across biomembranes. Active transport by ATP-Powered Pumps: Na^+/K^+ ATPase.	5	CO4
V	**Cellular interactions:** Tight junctions, desmosomes, gap junctions - organization and functions (Elementary details). **Cancer Biology** - Properties of cancer cell. Difference between normal and cancer cell. Carcinogenic agents - physical, chemical and biological agents.	5	CO5

TEXT BOOK	
1.	*Ajoy Paul*. 2009. **Text book of Cell and Molecular Biology.** [Second Edition]. Books and Allied (P) Ltd., Kolkata.
2.	*Robert K. Murray.* 2002. **Harper's Biochemistry**. [Twenty Fifth Edition]. McGraw-Hill Publishers, New York **(Cancer Biology).**

COURSE OUTCOMES (CO)

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

CO1	Explain the purposes of basic components of prokaryotic and eukaryotic cells and their involvement in cell cycle
CO2	Recognize the use of cellular components in generating and utilizing energy in cells
CO3	Identify the cellular components that are involved in protein synthesis
CO4	Describe the basic mechanisms involved in transport of biomolecules through biological membranes
CO5	Apply their knowledge of cancer biology to selected examples of changes or losses in cell function especially during responses to environmental or physiological changes, or alterations of cell function

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	L	L	M	L
CO2	H	L	L	M	L
CO3	H	L	L	M	L
CO4	H	L	L	H	M
CO5	H	L	H	H	H

H-High; M-Medium; L-Low

18ULS301	CAREER COMPETENCY SKILLS I	SEMESTER – III

COURSE OBJECTIVES

The course aims

- To understand the basic needs of Communication
- To utilize the communication skills for achieving at the time of Interview

Total Hours: 15

UNIT	CONTENTS	Hrs	CO
I	Basic Grammar – Usage of English – Listening and Speaking (Level-1) Tenses and Voices (Present, Past and Future)	3	CO1
II	Sentence Correction – Sentence Pattern - Reading Comprehension (Level -1)	3	CO2
III	Expansion of Proverbs – Closet Test (Level -1)	3	CO3
IV	Sentence Improvement (Essay Writing, Now- a –Days Vocabulary), Story Writing	3	CO4
V	E-Mail Building (Sending call letters), Letters (Formal and Informal)	3	CO5

TEXT BOOKS

1. *Anne Seaton, Mew Y. H.* **Basic English Grammar for English-Book 1.** Learners Saddle point Publishers.

2. *Mark Newson.* **Basic English Syntax with Exercises.** (E-Copy)

REFERENCE BOOK

1. *Chand S, Agarwal R. S.* **Objective General English.** Arihant Publications (India) Limited.

COURSE OUTCOMES (CO)

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

CO1	Recall the basic grammar in English
CO2	Concentrate on Sentence Correction
CO3	Understand Paragraph Writing
CO4	Improve the ability of Sentence Construction and Story Writing
CO5	Format Web Writing and Formal Writing of letters.

18UTALA401	**TAMIL – IV: சங்க இலக்கியம் - நீதி இலக்கியம்**	**பருவம் - IV**

இப்பாடத்திட்டத்தின் நோக்கங்களாவன :

- சங்க இலக்கியம், அற இலக்கியங்களின் சிறப்பை உணர்த்துதல்.
- இலக்கண நூல்களை காலவரிசைப்படி அறியச் செய்தல்.
- அணி இலக்கணத்தின் சிறப்பை உணரச் செய்தல்.

Credits: 3 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**எட்டுத்தொகை** அ. நற்றிணை – அன்னாய் வாழிப்பத்து (பாடல் எண். 208, 209, 210) ஆ. குறுந்தொகை – யாயும் ஞாயும் (பாடல் எண்.40) இ. கலித்தொகை – ஆற்றுதல் என்பதொன். (பாடல் எண்.103) ஈ. புறநானூறு – பல்சான்றீரே பல்சான்றீரே (பாடல் எண்.195)	**10**	**CO1**
II	**பத்துப் பாட்டு** அ. குறிஞ்சிப்பாட்டு (1 முதல் 106 அடிகள் வரை) -கபிலர்	**12**	**CO2**
III	**அற இலக்கியங்கள்** அ. நாலடியார் - பாடல் எண் (35,59,94,141,333) ஆ. நான்மணிக்கடிகை - பாடல் எண் (04,09,59,69,80) இ. புழமொழி - பாடல் எண் (05,21,120,149,361) ஈ. சிறுபஞ்சமூலம் - பாடல் எண் (05,17,48,83,99)	**10**	**CO3**
IV	**இலக்கியவரலாறு** அ. சங்க இலக்கிய நூல்கள் அறிமுகம் ஆ. முச்சங்கவரலாறு இ. தமிழ் இலக்கண நூல்கள் அறிமுகம் ஈ. அற இலக்கியங்கள் அறிமுகம்	**10**	**CO4**
V	**இலக்கணம்** அ. அணி இலக்கணம் 1. உவமைஅணி 2. உருவகஅணி 3. வேற்றுமைஅணி 4. வஞ்சப்புகழ்ச்சிஅணி ஆ. அகத்திணைகள்,புறத்திணைகள் - விளக்கம்	**08**	**CO5**

TEXT BOOK

1. தமிழ்த்துறை வெளியீடு, கே.எஸ்.ரங்கசாமி கலை அறிவியல் கல்லூரி (தன்னாட்சி), திருச்செங்கோடு– 637 215.

COURSE OUTCOMES (CO)

இப்பாடத்தைக் கற்பதன் வாயிலாக மாணவர்கள் பெறும் பயன்களாவன

CO1	எட்டுத்தொகை நூல்களின் சிறப்பை அறிதல்
CO2	பத்துப்பாட்டு நூல்களின் சுவை அறிதல்
CO3	அற இலக்கியங்கள் பற்றிஅறிதல்
CO4	இலக்கியங்கள் தோற்றமுறையை அறிதல்
CO5	அணி இலக்கணத்தின் பயன் பற்றிஅறிதல்.

18UENLA401	**FOUNDATION ENGLISH IV**	**SEMESTER – IV**

COURSE OBJECTIVES

The course aims

- To promote communication skills through literature.
- To enhance the language learning through activities.

Credits: 3 **Total Hours: 50**

UNIT	**CONTENTS**	**Hrs**	**CO**
I & II	**ONE ACT PLAY** Monica Thorne - The King Who Limped **PROSE** A.G.Gardiner - On Shaking Hands **GRAMMAR** Punctuation **COMPOSITION** Hints Development **COMMUNICATION SKILLS** Breaking the Law Honoring the Person	**20**	**CO1 & CO2**
III & IV	**ONE ACT PLAY** Ella Adkins – The Unexpected **PROSE** Minoo Masani - No Man is an Island **GRAMMAR** Conditional Clause **COMPOSITION** Report Writing **COMMUNICATION SKILLS** Brain Storming	**20**	**CO3 & CO4**

V	**PROSE** Arnold Toynbee - India's Contribution to World Unity **GRAMMAR** Simple, Compound and Complex Sentences **COMPOSITION** Jumbled Sentences **COMMUNICATION SKILLS** Role-Play	**10**	**CO5**

TEXT BOOKS

1. *Ramamurthy*.K.S. 1984. **Seven-Act Plays**. Published in India by Oxford University. New Delhi–110 001.
2. *Damodar.G, D.Venkateshwarlu, M.Narendra, M.SaratBabu, G.M.Sundaravalli. 2009*. **English For Empowerment**. Published by Orient Blackswan Private Limited. Hyderabad –500 029.
3. *SasiKumar V and Syamala V*. 2006. **Form and Function - A Communicative Grammar for Colleges.** Emerald Publishers. Chennai–600 008.
4. *Farhathullah.T.M.* 2006. **Communication Skills for Undergraduates**. RBA Publications. Chennai–600 015.

REFERENCE BOOKS

1. *Raymond Murphy.* 1994. **Intermediate English Grammar.** Cambridge University India Pvt. New Delhi.

COURSE OUTCOMES (CO)

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

CO1	Understand the text on the basis of close reading analytically and critical views.
CO2	Ability to construct a sustained sophisticated and original argument on a specific topic.
CO3	Acquire language skills through composition.
CO4	Acquire both composition and communication skills.
CO5	Apply basic communication skills.

18UBCM401	CORE IV: BIOENERGETICS AND INTERMEDIARY METABOLISM	SEMESTER – IV

COURSE OBJECTIVES

The Course aims

- Understand the metabolic pathways and their physiological significance.
- Learn the energetic of the metabolic pathways.

Credits: 5 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	Thermodynamics: Laws of Thermodynamics, Enthalpy, Entropy, Exothermic and Endothermic reactions. Free energy. Biological oxidation - Redox potential. Role of high energy compounds in biological system. ATP as energy currency of cell. Electron Transport Chain, Oxidative Phosphorylation – Mechanism of Oxidative Phosphorylation - Chemiosmotic hypothesis. ATP synthase. Inhibitors of ETC. Uncouplers.	10	CO1
II	**Carbohydrate metabolism: Glycolysis**: Reactions and energetics. Pasteur Effect. TCA cycle- reactions & energetics, Anaplerotic reactions. Pentose Phosphate Pathway – reactions and its significance. Gluconeogenesis and Glycogen metabolism. Mitochondrial Shuttle systems. (Malate-Aspartate and Glycerol-3- phosphate).	10	CO2
III	**Lipid Metabolism:** Fatty acid oxidation – α, β, ω oxidation. Oxidation of odd chain fatty acids. *De novo* synthesis of saturated fatty acids - Transfer of Mitochondrial acetyl Co-A to cytosol, Fatty acid synthase complex. Biosynthesis of unsaturated fatty acids. Ketone bodies - formation and utilization. Biosynthesis and degradation of cholesterol. Synthesis and degradation of phospholids (Lecithin).	10	CO3

IV	**Amino acid metabolism:** Biosynthesis of aminoacids - Serine and Tyrosine. Catabolism of amino acids - Transamination, Deamination, Decarboxylation. Ammonia transport and urea formation. Catabolism of carbon skeleton of aminoacids - Ketogenic (Phenyalanine) and glucogenic (Methionine) amino acids. Integration of carbohydrate, protein and fat metabolism.	**10**	**CO4**
V	**Nucleotide metabolism:** Biosynthesis of purine nucleotides- *De novo* and salvage pathways. Catabolism of purine nucleotides. Biosynthesis of pyrimidine nucleotides – *De novo* and salvage pathways. Catabolism of pyrimidine nucleotides. Inhibitors of nucleotide biosynthesis.	**10**	**CO5**

TEXT BOOK

1. *Jain, J. L.* 2002. **Fundamentals of Biochemistry.** [Fifth Edition]. S.Chand& Company Ltd., New Delhi.

REFERENCE BOOKS

1. *Nelson David, L.* and *Cox, M.M*. 2011.**Lehninger Principles of Biochemistry**. [Fifth Edition]. W.H. Freemen & Co. New York.

2. *Robert K. Murray, Daryl K. Granner, Peter A. Mayer* and *Victor W. Rodwell*. 2006. **Harper's Biochemistry.** [Twenty Fifth Edition]. Lange book Publishers, New York.

3. *Stryer, L.* and*Berg, J. M.* 2003. **Biochemistry.** [FifthEdition]. W. H. Freemen & Co. New York.

COURSE OUTCOMES (CO)

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

CO1	Demonstrate the principle and mechanism of working of various energy transfer reactions in living system.
CO2	Correlate the pathways of carbohydrate metabolism.
CO3	Explain the synthesis and utilization of lipids in living organisms.
CO4	Appraise the anabolic and catabolic reactions of amino acids.
CO5	Discriminate the synthesis and degradation of the nucleic acids.

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	L	H	H	H
CO2	L	L	H	H	H
CO3	L	L	H	H	H
CO4	L	L	H	H	H
CO5	L	L	H	H	H

H-High; M-Medium; L-Low

18UMABCA401	ALLIED IV: BIOSTATISTICS	SEMESTER – IV

COURSE OBJECTIVES

The Course aims

- To learn the strategies of research field and also to provide knowledge to understand the role of statistics in research.

Credits: 2 **Total Hours: 40**

UNIT	CONTENTS	Hrs.	CO
I	**Introduction:** Definition – Function of Statistics – Limitations of Statistics – Collection of data – Classification and Tabulation. **(Chapter 1 Sections: 1.3, 1.7, 1.8) (Chapter 2 Sections: 2.1, 2.3)**	8	CO 1
II	**Measures of Central Tendency:** Arithmetic Mean – Median – Mode – Geometric mean – Harmonic mean. **(Chapter 3 Sections: 3.1.1, 3.2 - 3.5)**	8	CO 2
III	**Measures of Dispersion and Variability:** Range – Inter Quartile Range and Quartile Deviation – Mean Deviation – Standard deviation – Coefficient of variation. **(Chapter 4 Sections: 4.1 – 4.4)**	8	CO 3
IV	**Correlation Analysis:** Types of correlation – Methods of studying Correlation (Excluding Correlation of grouped data). **Regression Analysis:** Regression line – Regression equations (Excluding Method of Least Sqaure). **(Chapter 6 Sections: 6.1 – 6.2) (Chapter 7 Sections: 7.1 – 7.2)**	8	CO 4
V	**Sampling and Test of Significance:** Steps in test of hypothesis – Test of significance of small samples (t and F) – Chi-square test (Problems only). **(Chapter 10 Sections: 10.1, 10.5) (Chapter 11)**	8	CO 5

TEXT BOOK

1. *Palanichamy. S and Manoharan. M,* 2001. **Statistical methods for Biologists.** [Third Edition]. Palani Paramount Publications, Palani.

REFERENCE BOOKS

1. *Daniel W.W.* 1987. **Biostatistics.** John Wiley and Sons, Newyork.
2. *Arora, P.N. and Malhan, P.K.* 2006. **Biostatistics.** Himalaya Publishing House, Mumbai.

COURSE OUTCOMES (CO)

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

CO 1	Learn the importance of statistics
CO 2	Understand the concepts of measures of central tendency
CO 3	Know the concepts of measures of dispersion
CO 4	Gain knowledge on correlation and regression analyses
CO 5	Test the samples using testing of hypothesis

MAPPING

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	L	H	L	H	H
CO 2	L	H	L	H	H
CO 3	L	H	L	H	H
CO 4	L	H	L	H	H
CO 5	L	H	L	H	H

H-High; M-Medium; L-Low

18UBCMP401	CORE PRACTICAL IV: INTERMEDIARY METABOLISM	SEMESTER – IV

COURSE OBJECTIVES

The Course aims

- To enable the students to acquire knowledge about quantification of major metabolites

Credits: 3 **Total Hours: 27**

S.No.	EXPERIMENT	Hrs	CO
1.	Estimation of glucose - Nelson Somogyi method.	3	**CO1**
2.	Estimation of Urea - DAM method.	3	**CO1**
3.	Estimation of Iron – Bipyridyl method.	3	**CO1**
4.	Estimation of cholesterol – Zak's method.	3	**CO1**
5.	Estimation of Total protein – Lowry's method.	3	**CO1**
6.	Estimation of Pentose - Bial's method.	3	**CO1**
7.	Estimation of RNA - Orcinol method.	3	**CO1**
8.	Estimation DNA – Diphenylamine method.	3	**CO1**
9.	Estimation of Pyruvate - DNPH method.	3	**CO1**

REFERENCE BOOKS

1. *Harold Varley*. 1988. **Practical Biochemistry,** Volume I & II. [Fourth Edition]. CBS Publishers, New Delhi.

COURSE OUTCOMES (CO)

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

CO1	Demonstrate the basic principles in estimation of intermediary metabolites produced in metabolic pathways

18UMABCAP401	ALLIED PRACTICAL: STATISTICS (USING MS-EXCEL)	SEMESTER – IV

COURSE OBJECTIVES

The Course aims

- To give a good grip on concepts in analyzing the data using statistical software

Credits: 2 **Total Hours: 21**

PROGRAM	CONTENTS	Hrs.	CO
1	Diagrams and graphs	**03**	**CO 1**
2	Measures of Locations	**03**	**CO 2**
3	Measures of Dispersion	**03**	**CO 2**
4	Correlation coefficient (Karl Pearson and Rank method)	**03**	**CO 3**
5	Regression lines	**03**	**CO 3**
6	Small sample test (t and F)	**03**	**CO 4**
7	Chi-square test for independence of attributes.	**03**	**CO 4**

REFERENCE BOOKS

1. *Bhattacharjee Dibyojyoti.* **Practical Statistics Using Microsoft Excel.** Asian Books Private Ltd.

2. *Apte D.P.* 2008. **Statistical Tools for Mangers using MS EXCEL.** Excel Books.

COURSE OUTCOMES (CO)

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

CO 1	Demonstrate the data in diagrammatic and graphical representation
CO 2	Find the averages and measures of dispersion
CO 3	Calculate correlation and regression for huge amount of data
CO 4	Gain knowledge about test of significance

18UBCSB401	SBC II: FUNDAMENTALS OF BIOCHEMICAL CALCULATIONS (100% INTERNAL EVALUATION)	SEMESTER–IV

COURSE OBJECTIVES

The Course aims

- To make the students to understand the basic calculations in biochemistry

Credits: 2 **Total Hours: 25**

UNIT	CONTENTS	Hrs	CO
I	Unit of Measurements: SI Units. Strength of the solutions - Percentage solutions, part dilutions, molar solutions and normal solutions.	5	CO1
II	pH and pKa calculations, preparation of buffers	5	CO2
III	Half life and disintegration time – simple problems. Percentage transmittance and absorbance conversion.	5	CO3
IV	Enzyme kinetics - Km, Turn over, Vmax	5	CO4
V	Dilutions and graphing	5	CO5

TEXT BOOK

1. *Jain, J. L.* 2002. **Fundamentals of Biochemistry.** [Fifth Edition]. S.Chand& Company Ltd., New Delhi.
2. *Nelson David, L.* and *Cox, M.M*. 2011.**Lehninger Principles of Biochemistry**. [Fifth Edition]. Macmillan/ Worth, New York.

COURSE OUTCOMES (CO)

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

CO1	Prepare solutions and buffers for performing laboratory experiments
CO2	Calculate and find out the optimum concentrations of solutes to be mixed for preparing a solution
CO3	Explain the concept of absorbance and half-life of solutes in a living system
CO4	Interpret the calculated results
CO5	Perform laboratory experiments and research works with high accuracy

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	M	L	H	H
CO2	L	M	L	H	H
CO3	L	M	L	H	H
CO4	L	M	M	H	H
CO5	L	M	M	H	H

H-High; M-Medium; L-Low

18ULS401	CAREER COMPETENCY SKILLS II	SEMESTER – IV

COURSE OBJECTIVES

The course aims

- To impart knowledge on the aptitude skills.
- To enhance employability skills and to develop career competency.

Total Hours: 15

UNIT	CONTENTS	Hrs	CO
I	Aptitude: Speed Maths - Multiplication of Numbers - Simplification - Squaring of numbers - Square roots and cube roots – HCF & LCM –Decimals - Averages, Powers and Roots.	3	CO1
II	Aptitude: Problems on Numbers – Problems on Ages – Surds & Indices – Percentage – Profit & Loss – Ratio & Proportion – Partnership – Chain Rule.	3	CO2
III	Aptitude: Simple & Compound Interest – Alligation or Mixture - Permutation and Combination.	3	CO3
IV	Aptitude: Probability – Missing Number series – Wrong Number Series – Races & Games of Skill.	3	CO4
V	Aptitude: Time & Work – Pipes & Cistern – Time & Distance – Problems on Trains – Boats and Streams.	3	CO5

TEXT BOOK

1. *R.S. Aggarwal.* 2017. **Quantitative Aptitude**, *S Chand and Company Limited, New Delhi.*

REFERENCE BOOK

1. *Abhijith Guha.* 2015. **Quantitative Aptitude for Competitive Examinations**, *5th Edition, Tata McGraw Hill, New Delhi.*

COURSE OUTCOMES (CO)

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

CO1	Carry out mathematical calculations using shortcuts.
CO2	Calculate problems on age, surds and indices with shortcuts
CO3	Understand the core concepts of SI and CI, Permutation and Combination.
CO4	Obtain knowledge on shortcuts to calculate number series.
CO5	Perform new methods for aptitude calculations.

18UBCNM301	NMEC I: BIOCHEMISTRY IN HEALTH AND DISEASES	SEMESTER – III

COURSE OBJECTIVES

The Course aims

- Learn the functions of biomolecules.
- Understand the physiological changes of various diseases.
- Know about the nutritional requirements and dietary management of the diseases.

Credits: 2 **Total Hours: 25**

UNIT	CONTENTS	Hrs	CO
I	**Carbohydrates**: Definition. Dietary sources and energy content. Classification (structure not necessary) and functions. Dietary fiber – Definition. Fiber content of foods and its importance. Disorder of carbohydrate metabolism - Diabetes mellitus - Definition, types (type I, type II and gestational) - Etiology, complications, diagnosis, prevention and treatment (elementary details). Obesity – Etiology with special reference to junk foods, complications and dietary management.	5	CO1
II	**Amino acids:** Definition. Essential and non-essential aminoacids. Protein – Definition. Classification based on shape and functions. Importance of proteins. Dietary sources and energy content. Difference between plant and animal proteins. Protein deficiency diseases - Kwashiorkar, Marasmus and Marasmic kwashiorkar. Overview of inborn errors of aminoacid metabolism with reference to albinism (Metabolic pathway not needed).	5	CO2
III	**Lipids:** Classification, Composition and functions. Dietary sources and energy content. Essential fatty acids and PUFA -	5	CO3

	Dietary sources and deficiency of essential fatty acids. Lipoproteins – Types, composition and functions – Good and bad cholesterol. Atherosclerosis and Ischaemic heart disease - Role of dietary lipids (Elementary details).		
IV	**Mineral nutrition:** Macro and micro elements – Definition. Macro (calcium, phosphorous, sodium and potassium, sulphur and chlorine) and micro (iron, copper, chromium, iodine and fluorine) mineral nutrients - Dietary sources, functions and abnormalities. Over consumption and toxicity (Elementary details).	**5**	**CO4**
V	**Vitamins:** Definition, classification. Fat soluble vitamins (A, D, E, K) and Water soluble vitamins (B and C) – Dietary sources, functions and abnormalities (Elementary details).	**5**	**CO5**

TEXT BOOK

1. *Swaminathan, M.* 2004. **Essentials of Food and Nutrition**. The Bangalore Printing and Publishing Co. Ltd., Bangalore

REFERENCE BOOKS

1. *Jain, J. L.* 2002. **Fundamentals of Biochemistry.** [Fifth Edition]. S. Chand & Company Ltd., New Delhi.

2. *Garrow, J. S.* and *James, W. P. T.* 2000. **Human Nutrition and Dietetics**. [Tenth Edition]. Churchill Livingstone Publishers, UK.

3. *Wong, D. W. S.* 1996. **Mechanism and Theory in Food Chemistry.** CBS, New Delhi.

COURSE OUTCOMES (CO)

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

CO1	Explain about the sources, function of carbohydrates and disorders of carbohydrate metabolism
CO2	Elucidate the classification and functions of proteins and their deficiency diseases
CO3	Explicate the structure and biological importance of lipids
CO4	Expound the dietary sources, recommended daily allowance and over consumption of minerals
CO5	Illustrate the classification, sources, functions and deficiency of vitamins

18UBCNM401	**NMEC II : FUNCTIONAL BIOLOGY**	**SEMESTER – IV**

COURSE OBJECTIVES

The Course aims

- To enable the students to understand the structure, function and disorders of functional system of human body

Credits: 2 **Total Hours: 25**

UNIT	CONTENTS	Hrs	CO
I	**Biology, Cell, tissues, organs and body fluids:** Biology- Definition. Different branches of Biology. Characteristic of living things. Cells - Definition and types of cells (Prokaryotes, Eukaryotes and Viruses -Structural details not needed). Tissues and organs – Introduction, types and functions. Internal environment and Homeostasis. Protection against the external environment -Skin and mucous membrane.	5	CO1
II	**Circulatory system-Internal transport system:** General plan of human circulation. Structure of heart. Heart as a pump. Blood and plasma - composition. Blood cells - RBC, WBC and platelets. Blood vessels - Arterial and Venous system (Elementary details). Blood pressure (diastolic and systolic), stroke. Blood groups - ABO, Rh blood group systems. Artificial pacemaker.	4	CO2
III	**Respiratory system-Intake of oxygen and elimination of CO_2:** Breathing - Definition. Human breathing system - lungs, diaphragm, nose, throat, trachea, bronchi and alveoli. Gaseous exchange and control of breathing. Smoking and health.	5	CO3
IV	**Digestive system- Intake of food and elimination of faeces:** Gut- main parts of the gut. Digestion of food in mouth, throat, stomach, small intestine, large intestine, caecum and appendix. Role of liver in digestion. Digestive disorders - Constipation, Diarrhoea, vomitting, piles and appendicitis-etiology,	5	CO4

	complications and management (Elementary details).		
V	**Excretory system- Elimination of waste material:** Overview of the structure of urinary system. Nephron - Cleaning of blood and formation of urine. Kidney failure - Dialysis and kidney transplantation (elementary details). **Nervous system** (Communication with outside world) - Organization of nervous system, nerve cell, conduction of nerve impulse, reflex arc, reflex action and Coordination.	**6**	**CO5**
TEXT BOOK			
1. *Michael Roberts*. 1995. **Biology.** Thomas Nelson and Sons (P) Ltd., Canada.			
REFERENCE BOOK			
1. *Kathleen J. W. Wilson* and *Anne Waugh.* 1998. **Ross and Wilson Anatomy and Physiology in health and illness**. [Eighth Edition]. Churchill Livingstone, London.			

COURSE OUTCOMES (CO)

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

CO1	Describe the organization of cells, tissues, organs and body fluids
CO2	Explain the respiratory process in living system
CO3	Discriminate the types of blood cells, blood vessels and blood groups
CO4	Illustrate the digestion process and digestive disorders
CO5	Describe the structure of renal system and nervous system

18UBCAC301	ADD ON COURSE I: CLINICAL LABORATORY TECHNIQUES	SEMESTER – III

COURSE OBJECTIVES

The Course aims

- To enable the students to gain knowledge about the routine clinical techniques in medical laboratories

Total Hours: 25

UNIT	CONTENTS	Hrs	CO
I	Clinical laboratory standards and Basic laboratory safety, hazards in the clinical laboratory. Automation: Introduction - Classification of automated system, steps of automation in biochemical analysis. Autoanalyzer - Components and operation. Specimen processing: blood – Phlebotomy, Methods of collection, Anticoagulants – EDTA, Double oxalate, Sodium citrate, Sodium fluoride, Potassium oxalate, Heparin. Preparation of serum and protein free filtrate. Urine – Methods of collection. Storage - Preservatives.	5	CO1
II	**Blood:** Difference between serum and plasma. Development of Blood cells - Erythropoiesis, Leucopoiesis, Thrombopoiesis. Blood cell count: TC - Haemocytometry, DC, Platelet count. Estimation of Hemoglobin - Sahli's Method, PCV - Microhaematocrit method. ESR - Westergren's method, bleeding time – Duke's method. Clotting time - Capillary tube method. Clinical interpretation of haematological tests – Anemia, polycythemia and leukemia. Apheresis.	5	CO2
III	**Human blood group system**: ABO, sub groups of ABO, variants of ABO and Rh blood group system. **Blood transfusion:** Definition and clinical significance. Complications	4	CO3

	Blood banking: Blood collection - Screening of donor. Criteria for rejecting donor. Blood collection procedure. Transportation of blood. Storage of blood and changes in the stored blood.		
IV	**Urine analysis**: Gross examination of urine, chemical examination of urine. Reducing sugar – Benedict's test, Protein - Heat and acetic acid test, ketone bodies - Rothera's test, bile salts - Hay's test, bile pigments - Fouchet or Harrison test. **Stool examination** – Specimen collection, Physical & chemical examination, Test for Occult blood - Benzidine method, Microscopic examination of stool. **Sputum Analysis:** Specimen collection, macroscopic examination - Color, Volume, Odour. Microscopic examination**.** **Semen Analysis:** Collection**,** Gross examination, Microscopic examination, Chemical examination of semen.	**6**	**CO4**
V	**Pathology:** Preparation of tissues**-** Fixation and decalcification. Processing of tissues. Preparation of sections. Routine staining procedures – Haematoxylin and Eosin. Special stains for connective tissues. Stains for carbohydrate and amyloids. Cytology: Preparation and fixation of specimen. Stains and staining techniques. Differentiation of normal and malignant cells.	**5**	**CO5**

TEXT BOOK

1. *Kanai.L. Mukherjee.* 2005. **Medical Laboratory Technology, Volume III.** Tata McGraw- Hill Publishing Co. New Delhi. **(UNIT - I & IV).**
2. *Ramnik Sood*. 2006. **Medical Laboratory Technology**. Jaypee Brothers Medical Publishers Ltd., New Delhi. **(UNIT - II & III).**
3. *Kanai.L. Mukherjee.* 2005. **Medical Laboratory Technology, Volume I.** Tata McGraw- Hill Publishing Co. New Delhi. **(UNIT - V).**

COURSE OUTCOMES (CO)

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

CO1	Explain about the automated systems in clinical laboratories
CO2	Describe the components of blood and the methods of analysis
CO3	Illustrate the various blood grouping systems, complications in blood transfusion, methods in collection and storage of blood in blood banks
CO4	Handle and examine biological samples using appropriate methods
CO5	Engage themselves in tissue preparations, staining and destaining processes

18UBCAC401	**ADD ON COURSE II: MEDICAL TERMINOLOGY (For Medical Coding/Medical Transcription)**	**SEMESTER – III**

COURSE OBJECTIVES

The Course aims

- To enable the students to understand the standard medical abbreviations and the relationship between medical terms and their synonyms

Total Hours: 25

UNIT	CONTENTS	Hrs	CO
I	**Introduction to Medical Terminology** Definition and Origin of Medical Terms. Components of Medical Terms, Prefixes, Suffixes, Roots and Combining forms. External Anatomy and Internal Anatomy. Body Fluids, Body Substances, Chemicals, Colours, phobias	5	CO1
II	**Terms Relating to the Body as a Whole** Basic Structures, Cells, Tissues, Organs, Systems, Directions, Anatomic Planes and Position	5	CO2
III	**The Skeletal and Muscular System** Pathologic conditions (Inflammations and Infections), Hereditary, Congenital and Developmental Disorders, Fractures, Metabolic and Deficiency Diseases, Symptomatic Terms, Diagnostic Terms, Standard Abbreviations.	5	CO3
IV	**Cardiovascular System and Respiratory System** Pathologic conditions (Inflammations and Infections), Hereditary, Congenital and Developmental Disorders, Fractures, Metabolic and Deficiency Diseases, Symptomatic Terms, Diagnostic Terms, Standard Abbreviations.	5	CO4
V	**Gastro-Intestinal System and Genito-Urinary System** Pathologic conditions (Inflammations and Infections), Hereditary, Congenital and Developmental Disorders, Fractures,	5	CO5

	Metabolic and Deficiency Diseases, Symptomatic Terms, Diagnostic Terms, Standard Abbreviations.		

REFERENCES

1. https://www.online-medical-dictionary.org/
2. https://www.merriam-webster.com/medical
3. https://www.medicinenet.com/medterms-medical-dictionary/article.html

COURSE OUTCOMES (CO)

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

CO1	Define the basics, components and importance of medical terms
CO2	Spell correctly the common medical terms associated with human anatomy
CO3	Describe the terms associated with skeletal and muscular system
CO4	Explain the terminology of cardiovascular and respiratory system
CO5	Interpret the conditions of gastrointestinal and urinary system

18UBCAL401	ADVANCED LEARNER COURSE: FOOD BIOCHEMISTRY	SEMESTER – IV

COURSE OBJECTIVES

The Course aims

- To make the students to understand the biochemical processes of food and the role of Food additives and colors in food.
- On successful completion of the paper the students will get an insight to become an entrepreneur.

UNIT	CONTENTS	CO
I	**Water –** Dietary sources, physical properties, water activity and food spoilage, control of water activity in foods. **Carbohydrates –** flavor and color production by carbohydrates, texturing characteristics of carbohydrates. **Lipids** - emulsifying properties of fats, rancidity and reversion of oils. **Proteins –** proteins of milk, meat, fish, eggs, cereals	**CO1**
II	**Microorganism in Food spoilage–** Mold, yeast, bacteria. Factors responsible for spoilage, Spoilage of vegetable, Fruit, Meat, Poultry, Beverage and Other food products. Food poisoning, types of food poisoning – chemicals, microorganism (*Clostridium, Staphylococcus, Aspergillus*).	**CO2**
III	**Food additives**: Definition, Functional characteristics of chemical additives; Intentional food additives – Acids, Bases and their salts; Antioxidants; Desirable and undesirable aspects of additives	**CO3**
IV	**Food colors** - chlorophyll, carotenoids, anthocyanins, betalaines, melanins. Natural and artificial food colorants. Flavour – sweetness, saltiness, sourness, bitterness, astringence, pungency, meatiness and fruity flavors, synthetic flavors. Natural flavor development in foods	**CO4**
V	**Food adulterants:** Definition, types of adulterants, methods of detection (milk, meat, chilli powder, oil, turmeric powder, coffee, pepper, salt, sugar)	**CO5**

	Food Preservation: Importance, principle, methods. Preservation by heat, cold, chemicals	

TEXT BOOK

1. *Sivasankar, B*. 2005. **Food Processing and Preservation.** Prentice Hall of India Pvt. Ltd., New Delhi

REFERENCE BOOKS

1. *ManoranjanKalia* and *Sangeetha Sood*. 1999. **Food Preservation and Processing.** Kalyani Publishers, New Delhi

2. *Sreelakshmi, B*. 1997. **Food Science.** New Age International Pvt. Ltd., New Delhi

COURSE OUTCOMES (CO)

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

CO1	Explain the properties and activity of water in foods
CO2	Describe the characteristics and properties of biomolecules
CO3	Elucidate the microorganisms in food spoilage and food poisoning
CO4	Illustrate the functional characteristics of food additives
CO5	Recite about food colours, preservatives and adulterants

18UBCAL402	BIOPROCESS TECHNOLOGY	SEMESTER – IV

COURSE OBJECTIVES

The Course aims

- To enable the students to gain knowledge about the exploitation of microbes for industrial purpose

UNIT	CONTENTS	CO
I	**Fermentation:** Fermentation – Definition. Isolation of microorganism, strain development and screening of industrially important microbes. Basic design and construction of fermentor – conventional fermentor. Operation of conventional fementor. Types of fermentor- Stirred tank, Air lift, Bubble column, Packed beds.	**CO1**
II	**Fermentation Processes** - Batch, fed batch and continuous fermentation. Types – Solid substrate (SSF) and submerged fermentation. Fermentation process- Inoculum preservation, inoculum build up, prefermentor culture and production fermentation. Measurement and control of bioprocess parameters	**CO2**
III	**Downstream processing**- Introduction, stages in downstream processing: solid-liquid separation, release of intracellular process, concentration, purification, formulation	**CO3**
IV	**Industrial Bioprocessing I**: Commercial production of enzymes- amylase and protease. Production of organic solvents- alcohol. Alcoholic beverages, wine and beer. Production of organic acids- citric acid and acetic acid	**CO4**
V	**Industrial Bioprocessing II**: Production of antibiotic-Penicillin and tetracycline. Production of amino acids- glutamic acid. Production of Vitamins – Vitamin B12. Production of Polysaccharides - Xanthan	**CO5**

TEXT BOOK

1.	*Satyanarayana, U.* 2008. **Biotechnology.** Books and Allied Pvt. Ltd., Kolkata.
2.	*Patel, A.H.* 2005. **Industrial Microbiology.** [Fifth Edition]. Mac Millan India Ltd., New Delhi
3.	*Wulf Crueger* and *Anneliese Crueger.* 2004. **A Text Book of Industrial Microbiolog** Panima Publishing Corporation, New Delhi
4.	*Casida, L. S.* 2007. **Industrial Microbiology.** New Age International, New Delhi

COURSE OUTCOMES (CO)

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

CO1	Recall the types and working of fermentors
CO2	Perform isolation and culturing of microorganism for industrial use
CO3	Illustrate the stages in downstream processing
CO4	Discriminate the commercial production of enzymes, organic acids and organic solvents
CO5	Demonstrate the production of vitamins, antibiotics and polysaccharides

GUIDELINES

1. SUBMISSION OF RECORD NOTE BOOKS AND PROJECT DISSERTATION:

Candidates appearing for Practical Examinations and Project & Viva-Voce shall submit Bonafide Record Note Books/ Dissertation prescribed for Practical/ Project Viva-Voce Examinations, otherwise the candidates will not be permitted to appear for the Practical/ Project & Viva-Voce Examinations.

2. PASSING MINIMUM AND INTERNAL MARK DISTRIBUTION (Theory, Practical and Project)

I. (i) THEORY

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 40 marks put together out of 100 in the Comprehensive Examination in each theory paper with a passing minimum of 30 marks in External out of 75.

MARK DISTRIBUTION

Internal Marks Distribution [CA- Total Marks: 25]

Attendance	: 5 Marks
Assignment	: 5 Marks
Internal Examinations	: 15 Marks
Total	**: 25 Marks**

(ii) THEORY (If Internal Evaluation is for 100 Marks)

ASSESSMENT OF SBC II: BIOCHEMICAL CALCULATIONS (Internal Evaluation only)

The candidate shall be declared to have passed the Examination, if the candidate secures not less than 40 marks out of 100 in the internal evaluation.

Biochemical Calculations

Assignment (3)	: 30 Marks
Test (2)	: 50 Marks
Workbook Submission	: 10 Marks
Attendance	: 10 Marks
Total	**: 100 Marks**

II. PRACTICAL

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 40 marks put together out of 100 in the Comprehensive Examination in each Practical paper with a passing minimum of 24 marks in External out of 60.

Internal Marks Distribution [CA- Total Marks: 40]

Experiment	: 10 Marks
Attendance	: 5 Marks
Record	: 5 Marks
Internal Examinations	: 20 Marks
Total	**: 40 Marks**

III. PROJECT WORK

The project work shall be carried out by students in groups during the VI semester and has to complete the work at the end of that Semester.

- The Student has to attend 2 reviews before completing his/her Project and it will be evaluated by an internal examiner.
- The assessment of student performance in a semester is calculated by Continuous Internal Assessment (CA) for 40 marks and External Assessment for 60 marks.
- Upon completion of the project work the candidate shall be required to appear for a Viva-Voce conducted by an external examiner.
- The candidate shall be declared to have passed the Examination, if the candidate secure not less than 40 marks put together out of 100 in the Comprehensive Examination in Project with a passing minimum of 24 marks in External out of 60.

Mark Distribution Pattern

Internal Mark Distribution **Continuous Assessment (CA) Total Marks: 40**

1.	Attendance	:	10 Marks
2.	Review (2)	:	20 Marks
3.	Presentation	:	10 Marks
	Total	**:**	**40 Marks**

External Mark Distribution **Comprehensive Examination (CE) Total Marks: 60**

1.	Research work done	:	20 Marks
2.	Project report	:	20 Marks
3.	Presentation	:	10 Marks
4.	Viva-Voce	:	10 Marks
	Total	**:**	**60 Marks**

IV. CAREER COMPETENCY SKILLS

Semester III - Viva voce

- The student has to come in proper dress code for the Viva Voce
- Questions will be asked to evaluate the reading, speaking and listening skills of the students.
- E-mail and Letter drafting exercises will be given.

Semester IV - On Line Objective Examination (Multiple Choice questions)

- 100 questions-100 minutes
- Twenty questions from each UNIT.
- Online examination will be conducted at the end of the IV Semester.

3. QUESTION PAPER PATTERN AND MARK DISTRIBUTION FOR THEORY

Question Paper Pattern and Mark Distribution **(For 75 marks)**

1. **PART – A (10 x 2 = 20 Marks)**
   Answer ALL questions
   Two questions from each UNIT
2. **PART – B (5 x 5 = 25 Marks)**
   Answer ALL questions
   One question from each UNIT with Internal Choice
3. **PART – C (3 x 10 = 30 Marks)**

Answer ANY THREE questions
One question from each UNIT
Open Choice – 3 out of 5 questions

Question Paper Pattern and Mark Distribution **(For 100 marks)**

1. **PART – A (10 x 2 = 20 Marks)**
   Answer ALL questions
   Two questions from each UNIT
2. **PART – B (5 x 7 = 35 Marks)**

Answer ALL questions
One question from each UNIT with Internal Choice

3. **PART – C (3 x 15 = 45 Marks)**

Answer ANY THREE questions
One question from each UNIT
Open Choice – 3 out of 5 questions

QUESTION PAPER PATTERN FOR CORE PRACTICAL EXAMINATIONS
(MAXIMUM MARKS: 60) TIME: 6 HOURS

1.	Two experiments (2x25)	:50
2.	Spotters (5x2)	:10
	Total	**: 60 Marks**

KEY FOR EVALUATION OF PRACTICAL EXAMINATION

1. **Qualitative analysis (25 Marks)**
   - Procedure : 15
   - Result : 10
2. **Quantitative analysis (25 Marks)**
   - Principle : 05
   - Procedure : 05
   - Tabular Column : 03
   - Graph : 02
   - Result : 10
3. **For Separation technique (25 Marks)**
   - Principle : 05
   - Procedure : 05
   - Observation : 05
   - Result : 10

ALLIED PRACTICAL

Comprehensive Examination (CE) : 60 marks
Continuous Assessment (CA) : 40 marks

Question paper pattern for Allied practical (Maximum marks: 60) Time: 3 Hours

1. One experiment (1x40) : 40
2. Spotters (10x2) : 20

Total : 60 Marks

KEY FOR EVALUATION OF ALLIED PRACTICAL EXAMINATION

1. **Qualitative analysis (40 Marks)**
   - Procedure : 20
   - Result : 20
2. **Quantitative analysis (40 Marks)**
   - Principle : 05
   - Procedure : 05
   - Tabular Column : 05
   - Graph : 05
   - Result : 20

ALLIED COURSE OFFERED BY THE DEPARTMENT

S. No.	Course Code	Subject	Offered for the students of	Instruction Hours
SEMESTER – III				
1	18UBCMBA301/ 18UBCBTA301	Allied III: Biochemistry (Biomolecules)	B.Sc Microbiology/ Biotechnology	3
2	18UBCMBAP301/ 18UBCBTAP301	Allied Practical III: Biochemistry (Biomolecules)		3

18UBCMBA301 / 18UBCBTA301	**ALLIED III : BIOCHEMISTRY (BIOMOLECULES)**	**SEMESTER - III**

COURSE OBJECTIVES

The Course aims

- To enable the learners to have a strong foundation in the structural and metabolic aspects of biomolecules which is the basic requirement of all life sciences.

Credits: 2 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Carbohydrates:** Introduction, classification. Monosaccharide – Structure and importance of glucose and fructose. Isomers: stereo and structural isomers. Mutarotation and chemical reactions- reduction, oxidation and osazone formation. Oligosaccharides – Disaccharides - Structure and importance of sucrose, lactose. Polysaccharides - Structure and importance of homopolysaccharides – Starch and Glycogen. Heteropolysaccharides - Hyaluronic acid and Heparin.	8	CO1
II	**Amino acids:** Classification, Structure and properties. Essential, Non- essential and Non-protein amino acids. **Protein:** Classifications and Functions: Structural organization of Proteins - Primary, secondary, tertiary and quaternary structure. Forces involved in stabilization of tertiary structure of proteins.	8	CO2
III	**Lipids:** Classification. Triacylglycerol – Structure, physical & chemical properties. Phospholipids - Structure of lecithin. Phospholipids in cell membrane – Fluid Mosaic model. Derived lipids. Essential fatty acids, Saturated and unsaturated fatty	8	CO3

	acids: - Structure. Sterol – Structure of Cholesterol.		
IV	**Enzymes –** Definition, IUB classification with examples. Active site - Definition, Mechanism of enzyme action - Lock & key model and induced fit hypothesis. Enzyme units - IU, katal. Factors affecting enzyme activity (pH, Temperature and substrate concentration).	**8**	**CO4**
V	**Vitamins** - Classification, Sources, daily requirements, physiological functions and deficiency of fat and water soluble vitamins. **Minerals and Trace elements**: Macro and micro minerals. Sources, daily requirements, physiological functions and deficiency diseases of calcium, phosphorous, sodium, potassium, iron.	**8**	**CO5**

TEXT BOOK

1. *Jain, J. L.* 2002. **Fundamentals of Biochemistry.** [Fifth Edition]. S. Chand & Company Ltd., New Delhi.

REFERENCE BOOKS

1. *Deb, A. C.* 2000**. Fundamentals of Biochemistry.** Books and Allied (P) Ltd., Calcutta.

COURSE OUTCOMES (CO)

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

CO1	Explain the structure of carbohydrates and their functions
CO2	Describe the nature of Nature of amino acids, functions and structural organization of proteins
CO3	Illustrate on characterization of lipids and their functions
CO4	Interpret the classification, characteristics and basic concepts of enzyme action
CO5	Elucidate the classification and clinical significance of micronutrients

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H,M	M,M	M,H	H,H	H,L
CO2	H,M	M,M	M,H	H,H	H,L
CO3	H,M	M,M	M,H	H,H	H,L
CO4	H,M	M,M	M,H	H,H	H,L
CO5	H,M	M,M	M,H	H,H	H,L

H-High; M-Medium; L-Low

18UBCMBAP301 / 18UBCBTAP301	**ALLIED PRACTICAL III: BIOCHEMISTRY (BIOMOLECULES)**	**SEMESTER – III**

COURSE OBJECTIVES

The Course aims

- To enable the learners to have a strong foundation in understanding chemical nature of biomolecules.

Credits: 2 **Total Hours: 27**

S.No.	**EXPERIMENT**	**Hrs**	**CO**
I. Qualitative Analysis			
1.	Carbohydrates: Glucose, fructose, xylose, sucrose, lactose, and starch.	9	1
2.	Amino acids: Tyrosine, tryptophan, histidine, methionine and cysteine.	6	1
3.	Proteins: Solubility test, coagulation test, ninhydrin test, biuret test, folin's phenol test, precipitation by metals.	3	1
4.	Lipids: Solubility, grease spot, Oil spot, emulsification, halogenations, colour reactions.	3	1
II. Quantitative Analysis			
5.	Estimation of Glycine by Formal titration method.	3	2
6.	Determination of Saponification Value	3	2

REFERENCE BOOKS

1. *Sadasivam, S.* and *Manickam, A*. 2010. **Biochemical Methods.** [Third Edition]. New Age International (P) Ltd., New Delhi.
2. *Jayaraman, J*. 2008. **Laboratory Manual in Biochemistry**. [First Edition Reprint]. New Age International (P) Ltd., New Delhi.

COURSE OUTCOMES (CO)

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

CO1	Perform qualitative analysis for identification of Biomolecules
CO2	Do quantification of biomolecules by titrimetric methods

18UBCM501	CORE V: FUNDAMENTALS OF IMMUNOLOGY	SEMESTER – V

Course Objectives:

The Course aims

- To make the learners to study in detail about the organization and function of human immune system in health and disease.
- To understand the principle of molecular interactions of immune cells with an antigen.

Credits: 4 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Immunobiology:** Immunity- Innate and acquired immunity, Primary and secondary lymphoid organs. Cells of Immune system: Structure of T, B, NK and Killer cells. Macrophages – Phagocytosis and inflammation. Structure and functions of neutrophils, eosinophils and basophils. Cytokines and their functions. Immune response – Cell mediated and humoral.	10	CO 1
II	**Antigen**: Properties, specificity and cross reactivity, antigenicity, immunogenicity, haptens, adjuvants, epitopes, mitogens, self-antigens and MHC (elementary details). **Antibody:** Structure, classes, sub types and functions of IgG, IgM, IgA, IgE and IgD. Hybridoma technology and applications of monoclonal antibodies.	10	CO 2
III	**Antigen - Antibody interactions:** Antibody affinity, antibody avidity; Precipitation – immunodiffusion - Radial and double immuno diffusion, Immunoprecipitation, Immunoelectrophoresis - Principle and applications. Agglutination: slide and tube agglutination. Principle and applications – IF, RIA, ELISA.	10	CO 3

IV	**Complement system and Hypersensitivity reactions:** Complement cascade – Classical, alternative and lectin pathways of complement activation. Complement fixation test. Allergy and hypersensitivity reactions - types- I, II, III & IV and their clinical manifestations.	**10**	**CO 4**
V	**Immune system and diseases:** Transplantation immunology- Mechanism of graft acceptance and rejection, immuno suppressive therapy. Auto immunity - Elementary nature, myasthenia gravis. Immuno deficiency diseases- immune system in AIDS. Vaccines – Active and passive immunization. Benefits and adverse effects of vaccination.	**10**	**CO 5**

Text Book

1. *Nandhini Shetty.* 2005. **Immunology: Introductory Text Book**. [Second Edition]. New Age International. New Delhi.

Reference Books

1. *Roitt, I. M.* 1988. **Essential Immunology**. Blackwell Scientific Publishers, New York.
2. *Ian R. Tizard.* 1995. **Immunology: An Introduction**. Saunders College Publishing. New York.
3. *Charles A. Janeway*. 2005. **Immunobiology - The Immune Systems in Health and Disease.** [Sixth Edition]. Garlands Science Publishing, New York.

COURSE OUTCOMES (CO)

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

CO1	Describe the structure and functions of cells of immune system
CO2	Illustrate the properties and types of antigen and antibodies
CO3	Interpret the basics in antigen and antibody reaction
CO4	Explain about the complement system and hypersensitivity reactions
CO5	Clarify about the immune diseases and vaccination

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	H	M
CO2	H	H	M	H	H
CO3	H	H	M	H	H
CO4	H	H	H	H	H
CO5	H	H	H	H	H

H-High; M-Medium; L-Low

18UBCM502	**CORE VI: MOLECULAR BIOLOGY**	**SEMESTER - V**

Course Objectives:

The Course aims

- To enable the students to learn about the synthesis and functions of molecules that make up the living processes, mutations and DNA repair mechanism.

Credits: 5 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Genetic Material**: Central dogma of Molecular Biology. DNA as genetic information carriers- Experimental evidences – Griffith, Avery and McCarty and Hershey and Chase experiment. Basic concept of genetic information – Definition of gene. Differentiation of genes and genome. Structural Organization of Eukaryotic genome – Nucleosomes and chromatin structure. Organization of genes in the genome (protein coding and protein non- coding genes, introns, exons) and special base sequences of DNA – Satellite DNA, SINEs, LINEs and transposons. Structural organization of Prokaryotic genome. Plasmids (Elementary details).	**10**	**CO 1**
II	**Replication:** Mechanism of replication in Prokaryotes – Conservative, semi conservative and dispersive types. Experimental evidence for semi conservative replication; Enzymes and protein factors involved in replication; Initiation, elongation and termination. Replication in eukaryotes (Elementary details). Recombination – Holliday model. Inhibitors of replication.	**10**	**CO 2**
III	**Transcription:** Prokaryotic transcription – RNA polymerase, promoters, initiation, elongation and termination of RNA synthesis. Eukaryotic transcription (Elementary details). Post	**10**	**CO 3**

	transcriptional modifications of mRNA, tRNA and rRNA. Splicing of RNA. Inhibitors of Prokaryotic & Eukaryotic transcription. Reverse transcription. Enzymes involved in Transcription.		
IV	**Translation:** Genetic code – Decipherment. Salient features of genetic code. Biological significance of degeneracy – Wobble hypothesis. Composition of Prokaryotic and Eukaryotic ribosomes. Role of tRNA in translation. Mechanism of translation in prokaryotes – Activation, initiation, elongation & termination. Translation in Eukaryotes (Elementary details). Post translational modification. Inhibitors of translation. **Regulation of Gene expression in Prokaryotes** – Basic concepts of gene Regulation. Operon concept. Lac operon – Enzyme induction and repression.	**10**	**CO 4**
V	**Mutation:** Molecular basis of mutation, types of mutation (point mutation – transition, transversion, suppressor, backward and forward mutations), Nutritional, lethal and conditional mutation, spontaneous and induced mutations. Frame shift mutation – (insertion, deletion). Identification of mutants – Lederberg's replica plating experiment. **DNA repair mechanisms** – Direct reversal, excision repair and SOS repair.	**10**	**CO 5**

Text Books

1. *Nelson David, L.* and *Cox, M.M.* 2011. **Lehninger Principles of Biochemistry** Macmillan Worth, New York.
2. *William S. Klug* and *Michael R. Cummings.* 2000. **Concept of Genetics**. [Sixth Edition]. Prentice Hall, London.

Reference Books

1. *Lewin, B.* 2010. **Genes IX**. Pearson Prentice Hall, London.
2. *Weaver, R. F.* 1999**. Molecular Biology.** McGraw Hill, Boston.

COURSE OUTCOMES (CO)

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

CO1	Illustrate the structural organization of genome
CO2	Demonstrate the mechanism of replication process
CO3	Describe the transcription process and their inhibitors
CO4	Explain about the synthesis of proteins and regulatory mechanism
CO5	Elucidate the molecular basis of mutation and repair mechanism

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	M	H	M	H
CO2	H	M	H	H	H
CO3	M	H	M	H	H
CO4	H	H	M	H	H
CO5	H	H	H	H	H

H-High; M-Medium; L-Low

18UBCM503	CORE VII: CLINICAL BIOCHEMISTRY	SEMESTER – V

Course Objectives:

The Course aims

- To enable the students to learn the mechanism behind the disorder of metabolic pathways and the various diagnostic methodologies available for diseases and disorders.

Credits: 5 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Disorders of Carbohydrate Metabolism**: Sugar levels in blood and Homeostasis, Renal threshold for glucose, Factors influencing blood glucose level. Diabetes mellitus - Classification, Complications and Diagnosis- glucose tolerance tests. Inborn errors of Carbohydrate metabolism- glycogen, galactose, fructose, pentose metabolism.	**10**	**CO 1**
II	**Amino acid and Protein metabolism**: Inborn errors of amino acid metabolism - Aromatic aminoacids - phenylketonuria, tyrosinemia, albinism, alkaptonuria, S - containing aminoacids - cystinuria and homocystinuria, Branched chain aminoacids - Maple Syrup urine disease. Proteinuria. Plasma proteins - albumin, globulin (α_1 antitrypsin and ceruloplasmin) - their significance and variation in health and diseases.	**10**	**CO 2**
III	**Lipid metabolism**- Hyperlipidemia, hypercholesterolemia, atherosclerosis, hypertriglycerdemia, fatty liver, Gaucher's disease, Tay-Sach's and Niemann-Pick disease. Obesity-causes, types and metabolic changes. Steatorrhoea. **Nucleic acid metabolism**-Gout and Lesch Nyhan syndrome.	**10**	**CO 3**
IV	**Gastric function tests**: Introduction, Collection and examination	**10**	**CO 4**

	of gastric contents, tests of gastric function –stimulation test. **Liver disease**: Introduction, bilirubin metabolism and jaundice - classification. **Liver function tests** – tests based on abnormalities of bile pigments (Estimation of conjugated and total bilirubin in serum - Diazo method), based on changes in plasma proteins (Estimation of total plasma proteins, albumin and globulin and determination of A:G ratio, plasma fibrinogen, various flocculation tests, prothrombin time), based on carbohydrate metabolism (galactose and fructose tolerance test), based on abnormalities of lipids (determination of serum cholesterol and faecal fat). Serum enzymes in liver disease – Serum transaminases (SGOT & SGPT).		
V	**Kidney function tests**: Kidney disorder -Overview of acute and chronic renal failure. Urinary calculi. Kidney function tests – Based on GFR (Clearance test-Creatinine, Urea and Inulin), based on renal plasma flow (Para amino hippurate and Filtration fraction), based on tubular function (Concentration and Dilution tests). Artificial kidney - Dialysis.	**10**	**CO 5**

Text Book

1. *Chatterjee, M. N.* and *Rana Shindae.* 2007. **Text Book of Medical Biochemistry**. Jaypee Brothers Medical Publishers. Pvt. Ltd., New Delhi.

Reference Books

1. *Carl A. Burtis.* 2011. **Tietz Text Book of Clinical Chemistry and Molecular Diagnostics** [Fifth Edition]. Elsevier Health Sciences. New York.
2. *Vasudevan, D.*M. and *Srikumari, S.* 2007. **Text Book of Biochemistry for Medical Students.** [Fifth Edition]. Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi.

3. *Thomas M. Devlin*. 1997. **Textbook of Biochemistry. [**Fourth Edition]. John Wiley, Inc. Publication, New York**.**

COURSE OUTCOMES (CO)

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

CO1	Set up a clinical laboratory and explain the disorders of carbohydrate metabolism
CO2	Infer the inborn errors of amino acid metabolism
CO3	Interpret the disorders of lipid and nucleic acid metabolism
CO4	Perform the collection & analysis of gastric contents and liver function tests
CO5	Elucidate the disorders of kidney and kidney function tests

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	H	H	H
CO2	M	M	M	H	M
CO3	M	M	H	H	H
CO4	M	H	H	H	H
CO5	M	H	H	H	H

H-High; M-Medium; L-Low

18UBCM504	CORE VIII: ENDOCRINOLOGY	SEMESTER – V

Course Objectives:

The Course aims

- To learn about the chemistry, physiological roles and control of secretion of various classes of hormones.
- To understand the mechanism of regulation of various physiological processes and the role of hormones in maintaining the homeostasis of the cellular systems.

Credits: 4 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Hormones:** Introduction: Hormones and Hormone receptors – Definition; classification of Hormones. Mechanism of action of Group I and Group II hormones. **Hypothalamic and Hypophysial hormones:** Hypothalamic hormones; Chemistry, metabolic role, control of secretion and pathophysiology of Anterior pituitary (ACTH, TSH, FSH, LH, MSH, Growth hormone) and posterior pituitary hormones (Vasopressin and Oxytocin). Controlling action of hypothalamus over Anterior pituitary hormones.	8	CO 1
II	**Thyroid Hormones and Parathormone:** Chemistry, synthesis, physiological role, control of secretion and pathophysiology of Thyroid hormones and Parathormone. Vitamin D and its role in calcium homeostasis. **Stress Releasing Hormones:** Endorphins	8	CO 2
III	**Pancreatic Hormones:** Chemistry, Synthesis, physiological role, control of secretion and pathophysiology of Insulin, Glucagon. **GI Tract Hormones:** Chemistry, synthesis, physiological role, control of secretion and pathophysiology of Gastrin, Secretin, Cholecystokinin.	8	CO 3

IV	**Adrenal medullary hormones:** Chemistry, synthesis, physiological role, regulation of secretion and pathophysiology of Adrenocorticol hormones (Glucocorticoid and Mineralocorticoid). **Catecholamine:** Chemistry, synthesis, physiological role, control of secretion and pathophysiology of Adrenal medullary hormones.	**8**	**CO 4**
V	**Male reproductive hormones:** Chemistry, synthesis, physiological role and regulation of secretion of Androgen. Disorders of Male reproductive system. **Female reproductive hormones:** Chemistry, synthesis, physiological role and control of secretion of Estrogen and Progesterone. Role of Hormones in Menstrual cycle. Disorders of Female reproductive system. **(*Self-Study*)**	**8**	**CO 5**

Text Book

1. *Robert, K. Murray, Peter A. Mayes* and *Victor W. Rodwell*. 2003. **Harper's Biochemistry.** [Twenty Fifth Edition]. Mc Graw Hill, New York.

Reference Books

1. *Rana Shinde*and *Chatterjee M. N.* 2000. **Text Book of Medical Biochemistry.** [Sixth Edition]. Jaypee Publishers. New Delhi.
2. *Mac E. Hadley*. 2008**. Endocrinology.** [Fifth Edition]. Pearson Education, Inc. &Dorling Kindersley Publishing, Inc.

COURSE OUTCOMES (CO)

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

CO1	Illustrate the mechanism of action of hormones of hypothalamus and pituitary gland
CO2	Point out the physiological role and pathophysiology of thyroid hormones
CO3	Elucidate the chemistry, secretion & biological function of pancreatic hormones
CO4	Enumerate the chemistry & synthesis of medullary hormones and catecholamine
CO5	Detail the role of reproductive hormones and their disorders

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	L	H	H	M
CO2	H	L	H	H	M
CO3	H	L	H	H	M
CO4	H	L	H	H	M
CO5	H	L	H	H	M

H-High; M-Medium; L-Low

18UBCEL501	ELECTIVE I: HUMAN PHYSIOLOGY	SEMESTER – V

Course Objectives:

The Course aims

- To study about the organization and function of human immune system in health and disease.
- To understand the principle of molecular interactions of immune cells with an antigen.

Credits: 4 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Blood:** Composition and functions of blood, blood coagulation-intrinsic and extrinsic pathways. **Cardio Vascular system:** Anatomy of heart. Cardiac conduction system and cardiac cycle. Blood pressure and control of blood pressure.	8	CO 1
II	**Respiratory system:** Anatomy of lungs. Diffusion of gases in lungs, transport of oxygen from lungs to tissues through blood, Transport of CO_2 from tissues to lungs through blood. **Muscles**: Classification of muscles. Contractile elements of muscle – myosin, actin, tropomyosin and troponin. Physiology of muscle contraction.	8	CO 2
III	**Digestive system:** Structure and functions of different components of digestive system-stomach, pancreas, liver, gall bladder and intestine. Absorption of carbohydrates, lipids and proteins. Mechanism of HCl formation in stomach. **Excretory system:** Anatomy and histology of the kidneys, renal physiology – Mechanism of urine formation. Micturition.	8	CO 3
IV	**Nervous system:** Classification of nervous system. Classification	8	CO 4

	and structure of neuron. Properties – excitability, conductivity, refractory period. Synapse – classification and function. Neurotransmitters – Excitatory and inhibitory neurotransmitters with special reference to acetylcholine and GABA. **Special senses**: Eye – Structure of eyeball, Visual process – structure and functions of rods and cones, Wald's visual cycle.		
V	**Reproductive System: Male Reproductive System:** Functional anatomy of Testes and other accessory organs. Spermatogenesis. **Female Reproductive System:** Functional anatomy of primary (ovary) and accessory (uterus, cervix and vagina) organs**.** Menstrual cycle. Process of ovulation	**8**	**CO 5**

Text Books

1. *Gerald J. Tortora* and *Sandra Reynolds.* 2003. **Principles of Anatomy and Physiology.** [Tenth Edition]. John Wiley and Sons. Inc. Pub., New York. **(UNIT – I, II).**
2. *Sembulingam, K.* and *Prema Sembulingam*.2000. **Essentials of Medical Physiology.** [Second Edition]. Jaypee Brothers Medical Publishers (P) Ltd., New Delhi. **(UNIT – III, IV & V).**

Reference Book

1. *Kathleen, J. W., Wilson, O.B.E.* and *Anne Waugh.* 1998. **Ross and Wilson Anatomy and Physiology in Health and Illness.** [Eighth Edition]. Churchill Livingston, New York.

COURSE OUTCOMES (CO)

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

CO1	Clarify the physiological functions of blood and organization of cardiac system
CO2	Explain the physiology of respiratory and muscular system
CO3	Interpret the structure and functions of digestive & excretory systems
CO4	Infer organization of nervous system & the functioning of special senses
CO5	Elucidate the Functional anatomy of the human reproductive system

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	L	H	H	M
CO2	H	L	H	H	M
CO3	H	L	H	H	M
CO4	H	L	H	H	M
CO5	H	L	H	H	M

H-High; M-Medium; L-Low

18UBCEL502	ELECTIVE I: NUTRITIONAL BIOCHEMISTRY	SEMESTER – V

Course Objectives

The Course aims

- To enable the learners to understand the major role in the Nutrition and Diet for the maintenance of normal health.

Credits: 4 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Nutrition**- Concepts, Role of nutrition in maintaining health. Nutritional problems in India. Food Safety and Standards. **Energy** -Unit of Energy -kcal, Measurements of energy- Direct and Indirect calorimetry. Definition and factors affecting- Specific Dynamic action (SDA), Respiratory quotient (RQ), Basal metabolic rate (BMR), Body mass index (BMI).	8	CO 1
II	**Carbohydrates, Fats, Proteins** - Classification, calorific value, recommended daily allowances, Dietary sources. Functions, digestion, absorption, storage and metabolism. Malnutrition: Deficiencies and Over consumption. **Obesity**- Definition, etiology, complications, prevention and treatment.	8	CO 2
III	**Vitamins**: Classification. Recommended daily allowances, dietary sources, functions and deficiencies of water and fat soluble vitamins. **Minerals**: Macro elements - recommended daily allowances, dietary sources, functions and deficiencies of Ca, Mg, Na, P, K, S and Cl. Microelements - recommended daily allowances, dietary sources, functions and deficiencies of Cu, Zn, I, Fe, Mn, Co, Mo, Se, Cr and F. Over consumption and toxicity.	8	CO 3
IV	**Diet and Physiological Status**: Protein energy malnutrition (PEM) (Kwashiorkor and Marasmus). Human milk and its	8	CO 4

	viruses, Breast vs formulated milk feeding. Nutritional requirements in pregnancy and lactation. Sports Nutrition (Elementary details).		
V	**Food allergy –** Definition of Food allergy. Effect of drugs on food. Drug nutrient interactions. Nutritional therapy. Role of diet and nutrition in the prevention and treatment of diseases and various ailments – Diabetes mellitus, cardiovascular diseases, kidney disorders.	**8**	**CO 5**

Text Book

1. *Swaminathan,* M. 2004. **Essentials of Food and Nutrition**. The Bangalore Printing and Publishing Co. Ltd., Bangalore.

Reference Books

1. *Garrow, J. S.* and *James, W. P. T.* 2000. **Human Nutrition and Dietetics**. [Tenth Edition]. Churchill Livingstone Publishers, UK.
2. *Wong, D. W. S*. 1996. **Mechanism and Theory in Food Chemistry.** CBS, New Delhi.

COURSE OUTCOMES (CO)

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

CO1	Simplify the role of nutrition in maintaining proper health and energy measurements
CO2	Deduce the classification, functions, deficiencies and over consumption of carbohydrates, lipids and proteins
CO3	Infer the classification, dietary sources and deficiencies of vitamins
CO4	Describe the nutritional disorders and the importance of human milk
CO5	Elaborate on the effects of drug on food and the role of diet in prevention and treatment of diseases

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	L	M	M	H
CO2	H	M	H	M	H
CO3	H	M	H	M	H
CO4	H	M	H	M	H
CO5	H	M	H	H	H

H-High; M-Medium; L-Low

18UBCMP501	**CORE PRACTICAL V: IMMUNOLOGY AND CLINICAL BIOCHEMISTRY**	**SEMESTER – V**

Course Objectives:

The Course aims

- To enable the students to understand the different estimation procedures in diagnosis of diseases

Credits: 3 **Total Hours: 36**

S.No.	EXPERIMENT	Hrs	CO
I. Immunology			
1.	Radial immunodiffusion.	2	1
2.	Double immunodiffusion – Ouchterlony.	2	1
3.	VDRL – Slide test.	1	1
II. Clinical Biochemistry			
A. Analysis of blood			
4.	Separation of serum and plasma from blood.	1	2
5.	Estimation of glucose - Nelson -Somogyi method.	4	3
6.	Estimation of Urea - DAM method.	2	3
7.	Estimation of Creatinine-Jaffe's method.	2	3
8.	Estimation of Bilirubin (total, conjugated and unconjugated) - Diazo method.	4	3
9.	Estimation of cholesterol – Zak's method.	4	3
10.	Estimation of Total protein – Lowry's method.	4	3
11.	Determination of SGOT - Mohun and Cook method.	2	3
12.	Determination of SGPT - Mohun and Cook method.	2	3
B. Analysis of urine			
13.	Estimation of Urea.	2	3
14.	Estimation of Creatinine - Jaffe's method.	2	3

15.	Qualitative analysis of urine- Analysis of normal and abnormal constituents in urine.	2	3
Reference Book			
1.	*Harold Varley.*1988. **Practical Clinical Biochemistry.** [Fourth Edition]. CBS Publishers. New Delhi.		

COURSE OUTCOMES (CO)

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

CO1	Execute the immunological techniques
CO2	Handle the blood and urine samples
CO3	Perform the quantification experiments of metabolites and determine the enzyme activity for diagnosis of diseases

18UBCSB501	SBC III: PHARMACOGNOSY (100% INTERNAL EVALUATION)	SEMESTER – V

Course Objectives

The Course aims

- To enable the students to learn about the therapeutic applications of plants and their phytoconstituents.

Credits: 2 **Total Hours: 25**

UNIT	CONTENTS	Hrs	CO
I	History, Definition and Scope of pharmacognosy.	5	CO 1
II	Traditional and Alternative Systems of medicines - Ayurveda, siddha and Unani.	5	CO 2
III	Collection, cultivation, utilization and preservation of medicinal plants	5	CO 3
IV	Preparation of plant extracts (Aqueous and methanol) - maceration, infusion, decoction and percolation (soxhlet method).	5	CO 4
V	Analytical pharmacognosy: Drug adulteration, Drug evaluation, physical and chemical evaluation.	5	CO 5

Text Book

1. *Kokate, C. K., Purohit, A. P.* and *Gokhale, S. B.* 2008. **Pharmacognosy.** Nirali Prakashan, Pune.

COURSE OUTCOMES (CO)

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

CO1	Describe the history and scope of pharmacognosy
CO2	Correlate the general concepts in ancient and modern medicine
CO3	Collect, identify and utilize the medicinal plants
CO4	Extract the crude extracts from plants using various extraction procedures
CO5	Analyze and use the methods of drug evaluation processes

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	M	M	H	H
CO2	M	M	M	H	H
CO3	L	H	M	H	H
CO4	L	H	M	H	H
CO5	L	H	M	H	H

H-High; M-Medium; L-Low

18ULS501	CAREER COMPETENCY SKILLS-III	SEMESTER – V

Course Objectives:

The course aims

- To impart knowledge on the logical reasoning.
- To enhance employability skills and to develop career competency.

Total Hours: 15

UNIT	CONTENTS	Hrs	CO
I	Verbal Reasoning: Number Series Completion- Alpha Series Completion- Blood Relation- Distance and Direction- Analogy- Inequality- Classification.	**3**	**CO 1**
II	Non-Verbal Reasoning: Series Completion - Analogy and Classification - Completion of Incompletion Pattern.	**3**	**CO 2**
III	Non-Verbal Reasoning: Mirror Image and Water Image – Statement and Arguments - Cubes and Dices.	**3**	**CO 3**
IV	Reasoning: Puzzle Arrangement - Syllogism - Input and Output.	**3**	**CO 4**
V	Verbal Reasoning: Linear Arrangement - Circular Arrangement – Matrix Arrangement.	**3**	**CO 5**

Text Book

1. Test of Reasoning – *RS Aggarwal*, S Chand and Company Limited, 2017 Edition, New Delhi.

Reference Book

1. Verbal & Non-Verbal Reasoning For Competitive Exams - *Gajendra Kumar, Abhishek Banerjee*, Disha publication, New Delhi.

COURSE OUTCOMES (CO)

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

CO1	Understand the core concepts of Verbal Reasoning
CO2	Formulate Non Verbal Reasoning with shortcuts
CO3	Find Mirror Image, Cubes and Dices
CO4	Obtain the knowledge on shortcuts to solve Puzzles.
CO5	Solve Linear Arrangement and Matrices with shortcuts.

18UBCM601	CORE IX: PLANT BIOCHEMISTRY	SEMESTER – VI

Course Objectives

The Course aims

- To strengthen the base in fundamental aspects of biochemical basis of physiological processes in plants and their response to environment stress.

Credits: 5 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Plant - water relations:** Structure and functions of plant cell wall. Transport mechanism-diffusion, osmosis and imbibitions. Absorption-active, passive, factors affecting absorption. Transpiration - types, mechanism of stomatal opening and factors affecting transpiration. Guttation.	10	CO 1
II	**Photosynthesis:** Photosynthetic pigments-chlorophyll, carotenoid and phycobilin. Ultrastructure and organization of chloroplast. Light reactions - Photo system I and II. Evidences in support of light reaction-Hill's reaction. Factors affecting photosynthesis. Cyclic and non-cyclic phosphorylation. Dark reaction (C_3 plants). Hatch-slack cycle (C_4 plants) and CAM plants. Photorespiration.	10	CO 2
III	**Biogeochemical cycle**- Sulphur, nitrogen, hydrogen, carbon, oxygen, phosphorus **Nitrogen assimilation:** Nitrogen cycle – ammonification, nitrification and denitrification. Biological nitrogen fixation – Symbiotic and Non-symbiotic nitrogen fixation. Export of nitrogen in the form of asparagine and ureides.	10	CO 3
IV	**Plant growth regulators:** Chemistry, biosynthesis and physiological effects of Auxins, Gibberllins, Cytokinins, ABA	10	CO 4

	and Ethylene. Seed germination: Physiology, factors affecting seed germination, glyoxalate cycle, biochemistry of seed dormancy, fruit ripening and senescence.		
V	**Plant and Environment:** Plant stress - definition. Types of stress - Abiotic and biotic. Abiotic – Deficit and responses of plants to water, temperature and salt stress. Biotic stress – Bacteria, fungi, virus, parasites and insects. Oxidative stress-oxidative stress caused by ozone. Role of Defense system in plants - enzymatic and non-enzymatic antioxidants in oxidative tolerance of plants.	**10**	**CO 5**

Text Books

1. *William G. Hopkins.* 1999. **Introduction to Plant Physiology**. [Second Edition]. John Wiley & Sons. New York.
2. *Bob B. Buchanan, Wilhelm Gruissem* and *Russell L. Jones.* 2001. **Biochemistry and Molecular Biology of Plants.** American Society of Plant Biologists. New Delhi. **(Oxidative stress).**

Reference Books

1. *Robert M. Devlin* and *Fracis H. Witham.* 1986. **Plant Physiology**. [Fourth Edition]. CBS Publishers, New Delhi.
2. *Pandey, S. N.* and *Sinha, B. K.* 1999. **Plant Physiology**. [Third Edition]. Vikas Publishing House Pvt. Ltd., Pune.
3. *Chawla, H. S.* 2002. **Introduction to Plant Biotechnology**. [Second Edition]. Science Publishers, USA.

COURSE OUTCOMES (CO)

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

CO1	Explain the structure of photosynthetic pigments and their role in photosynthesis
CO2	Deduce the transport mechanism, absorption and transpiration process
CO3	Figure out the biochemistry of nitrogen fixation
CO4	Presume the synthesis and physiological effects of plant growth regulators
CO5	Discuss the types of plant stress and the role of defense system in plants

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	L	H	M	L
CO2	M	H	H	M	L
CO3	M	H	H	M	L
CO4	M	L	H	H	H
CO5	M	L	H	H	H

H-High; M-Medium; L-Low

18UBCM602	CORE X: PHARMACEUTICAL BIOCHEMISTRY	SEMESTER – VI

Course Objectives

The Course aims

- To enable the students to learn about the pharmacokinetics and pharmacodynamics and toxicological aspects of drugs.
- To make them to get job opportunity in pharmaceutical companies in both production and R&D.

Credits: 5 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Pharmacodynamics and Kinetics:** History of Drugs, Classification of drugs, routes of drug administration, absorption and distribution of drugs, factors influencing drug absorption and elimination of drugs. Toxicity assessment: acute, subchronic, chronic exposure, determination of ED_{50} and LD_{50} values.	10	CO 1
II	**Drug-Receptor interactions:** Receptor- definition, Agonist and antagonist. Types of receptor - G-protein coupled receptor, Receptors with intrinsic ion channel, Enzymatic receptors, receptors regulating gene expression, involvements of binding forces in drug receptor interaction, drug action not mediated by receptors.	10	CO 2
III	**Drug metabolism:** Phase I reactions - role of Cytochrome P_{450}. Microsomal and Non microsomal reactions. Phase II reactions-Conjugation reactions. Physiological importance of xenobiotic metabolism.	10	CO 3
IV	**Chemotherapy:** Basic concept. Mode of action of antimicrobial drugs- antibacterial, antifungal and antiviral drugs.	10	CO 4

	Cancer chemotherapy: Cancer and principles of cancer chemotherapy. Mode of action of anti-cancer drugs- antimetabolites, alkylating agents and other agents.		
V	**Drugs acting on various systems:** CNS-sedative- hypnotic, GI tract- drugs for peptic ulcer, diarrhoea and constipation. Miscellaneous drugs - antiseptic, disinfectant, chelating agents. Adverse drug reactions and drug induced side effects, biological effects of drug abuse, drug dependence, drug tolerance and intolerance.	**10**	**CO 5**

Text Books

1. *Jayashree Ghosh***.** 2010. **A Textbook of Pharmaceutical Chemistry.** [Third RevisedEdition]. S.Chand & Company Ltd., New Delhi (**UNIT I, II, IV & V**).
2. *Gordan Gibson,G.* and *Paul Skett.* 1999. **Introduction to Drug Metabolism.** [Third Edition]. Nelson Thornes. UK. (**UNIT - III).**

Reference Books

1. *Satoskar, R. S.* and *Bhandarkar, S. D.* 1993. **Pharmacology and Pharmacotherapeutics**. Vol I & II. Popular Prakasam Pvt. Ltd., New Delhi.
2. *Robert K. Murray, Daryl K. Granner, Peter A. Mayer* and *Victor W. Rodwell*. 2006. **Harper's Biochemistry.** [Twenty Fifth Edition]. Mc Graw Hill, New York.

COURSE OUTCOMES (CO)

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

CO1	Describe the pharmacokinetics and dynamics of drug molecule
CO2	Explain the basic concepts in drug receptor reaction
CO3	Categorize the biotransformation reactions of drug molecule
CO4	Exemplify the fundamental concept, mode of action of chemotherapeutics
CO5	Illustrate the biological effects of drug dependence and drug abuse

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	L	M	H	H
CO2	M	L	M	H	H
CO3	M	L	M	H	H
CO4	M	L	M	H	H
CO5	M	L	M	H	H

H-High; M-Medium; L-Low

18UBCM603	CORE XI: GENETIC ENGINEERING	SEMESTER – VI

Course Objectives

The Course aims

- To understand the basic techniques in Genetic Engineering.
- To learn the applications of Genetic Manipulation.

Credits: 5 **Total Hours: 50**

UNIT	CONTENTS	Hrs	CO
I	**Basic techniques** - Isolation and purification of genomic and plasmid DNA. Agarose gel electrophoresis, southern, northern and western blotting. Labeling of Nucleic acid probes- radioactive, non-radioactive labels. PCR - Technique and applications. DNA Sequencing – chemical degradation method- Maxam and Gilbert, Dideoxynucleotide sequencing- Sanger's method.	**10**	**CO 1**
II	**Basic principles of gene cloning:** Enzymes used in genetic engineering - Restriction enzymes - Nomenclature, Target sites and types. Isochizomers. Nuclease, Ligases, DNA polymerases, RNA polymerase, terminal deoxy nucleotidyl transferase, alkaline phosphatase, polynucleotide kinase, Reverse transcriptase. Linkers and adapters. Basic principle and steps of gene cloning.	**10**	**CO 2**
III	**Cloning Vectors**: Plasmids - Basic features. Plasmid vectors- pBR 322 and pUC vectors. Phages- Basic features, Insertion vector, Replacement vectors, cosmids, phagemids. **Methods of gene transfer**: Physical methods (Microinjection, Biolistic transformation, Electroporation, Electrofusion, Protoplast fusion) and chemical methods (calcium phosphate, polyethylene glycol (PEG), DEAE-Dextran, use of liposomes).	**10**	**CO 3**

IV	**Gene cloning & expression strategies:** Construction of Genomic library. Screening and identification of recombinants. Selectable markers and reporter gene. Expression Vectors: Promoters, cassettes. Viral expression vectors for animals – Retro virus.	**10**	**CO 4**
V	**Gene Transformation**: Micro propagation, Callus formation. Somatic embryogenesis, protoplast culture, somatic hybridization. Transgenic plants - Production – Agro bacterium mediated transformation-Ti plasmid -T- DNA. Applications of transgenic plants - Production of pest and herbicide resistant plants. Plants as bioreactors - Production of edible vaccines. Transgenic animals - Methods of production (microinjection) and applications - Animal bioreactors- Transgenic animals in xenotransplantation, transgenic organisms to interrupt disease cycle- transgenic snails, transgenic mosquitoes.	**10**	**CO 5**

Text Books

1. *Smita Rastogi* and *Neelam Pathak.* 2010. **Genetic Engineering**. Oxford University Press. New Delhi.

Reference Books

1. *Glick R. Bernard* and *Pasternak J. Jack.* 1994. **Molecular Biotechnology**. ASM press, Washington D.C.
2. *Old, R. W.* and *Primrose, S. B.* 1994. **Principles of Gene Manipulation**. Black Well Scientific Publications. USA.

COURSE OUTCOMES (CO)

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

CO1	Isolate and purify of DNA
CO2	Recognize the general principles in gene cloning
CO3	Characterize the gene cloning vectors and different methods in gene transfer
CO4	Portray the gene cloning and expression strategies
CO5	Compute the methods in production of genetically modified organisms

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	L	H	H
CO2	M	H	L	H	H
CO3	M	H	L	H	H
CO4	M	H	L	H	H
CO5	M	H	L	H	H

H-High; M-Medium; L-Low

18UBCEL601	ELECTIVE II: COMPUTATIONAL BIOLOGY	SEMESTER – VI

Course Objectives

The Course aims

- To enable the learners to understand the basic concept in Bioinformatics

Credits: 4 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Genomics** – Definition. Hierarchical view of genome analysis. Subfields – Definition (structural, functional and comparative genomics). Genome mapping- Definition. Physical mapping. Expressed sequence tags (EST). Gene expression analysis - DNA microarray. DNA polymorphism – Definition. Single nucleotide polymorphism. RFLP and its applications.	8	CO 1
II	**Proteomics** - Definition. Protein sequencing – Steps - End group analysis (Edman degradation), cleavage of disulfide bonds, separation, purification and characterization polypeptide chains, amino acid composition, specific peptide cleavage reactions, separation and purification of peptide fragments, sequence determination, ordering the peptide fragments, assignment of disulfide bond positions, peptide sequencing by MS, peptide mapping. Protein expression analysis - 2D PAGE and isoelectric focusing.	8	CO 2
III	**Nucleic acid database:** Bioinformatics - Introduction, History and Applications. Internet concepts. Biological Database – types, classification and properties. Sequence Formats – FASTA. Nucleic acid Sequence Database – NCBI – Features and tools. GENBANK – format, divisions and retrieval system. Retrieving Human BRCA1 gene sequence. EMBL and DDBJ.	8	CO 3

IV	**Protein Database:** Protein sequence database – SWISSPROT-format, features and sequence retrieval system. Molecular visualization tools: RasMol, MolMol. Retrieving Human myosin protein sequence. Features of PIR. Protein Structure database – SCOP, CATH and PDB. PDB - Database submission & retrieving tools. Retrieving Human insulin protein structure. Secondary structure prediction - Neural network and Chou-fasman method. Analysis of casein secondary structural features by Chou- fasman method.	**8**	**CO 4**
V	**Comparative genomics and proteomics:** Sequence alignment – Types. Local and Global alignment. Pair wise alignment - BLAST: principle & types. BRCA1 sequence analysis - Principle, methods, applications and similarity search with BLAST. Multiple sequence alignment- CLUSTAL W. Study of similarities - BLOSUM, PAM and Gap (Elementary details).	**8**	**CO 5**

Text Books

1. *Attwood, T. K.* and *Parry Smith, D. J.* 2005. **Introduction to Bioinformatics**. [First Edition]. Pearson Education. New Delhi. **(UNIT - I, III, IV & V).**
2. *Donald Voet and Judith G.Voet*. 1995. **Biochemistry.** [Second Edition]. John Wiley &Sons, Inc. New York. **(UNIT - II).**

Reference Book

1. *David W. Mount.* 2004. **Bioinformatics: Sequence and Genome Analysis**. CSHL.

COURSE OUTCOMES (CO)

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

CO1	Describe the basic concepts and subfields in genomics
CO2	Portray the wide-ranging conceptions in proteomics
CO3	Depict the nature, classification and properties of biological databases
CO4	Predict the protein structure and use the sequence database
CO5	Illustrate the methods in similarity sequences searching

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	H	H	H	H
CO2	M	H	H	H	H
CO3	M	H	H	H	H
CO4	M	H	H	H	H
CO5	M	H	H	H	H

H-High; M-Medium; L-Low

18UBCEL602	**ELECTIVE II: BIOMEDICAL INSTRUMENTATION**	**SEMESTER – VI**

Course Objectives

The Course aims

- To enable the learners to understand the basic concept in Biomedical Instrumentation.

Credits: 4 **Total Hours: 40**

UNIT	CONTENTS	Hrs	CO
I	**Biomedical Instrumentation**: Definition, Classification of Biomedical instrumentation, sources of biomedical signals, components, design factors and characteristics. Difficulties in measuring living system.	8	CO 1
II	**Electrodes**- theory, types-biopotential, microelectrodes, metal plate and needle electrodes. Transducers – types - magnetic induction, piezoelectric, photovoltaic, thermoelectric, strain guage. Sensors.	8	CO 2
III	**Biopotential Recorders**: Resting and action potential, propagation of action potential, wave forms- ECG, EMG, EEG, EOG, EGG & ERG. **Specialized Medical Equipments:** X- ray machine, Angiography.	8	CO 3
IV	**Physiological assist devices**- pace makers, artificial heart valves, defibrillators, nerve and muscle stimulator (Galvanic and interrupted Galvanic current), heart-lung machine-mechanical functions, oxygenators- bubble, film. Kidney machine-hemo and peritoneal dialysis.	8	CO 4
V	**Advances in biomedical instrumentation**- Lasers, endoscopes-types. Cryogenic surgery. Gamma ray camera,	8	CO 5

	computerized tomography, infrared thermography, ultrasonic imaging, magnetic resonance imaging.		

Text Books

1. *Anandanatarajan*, R. 2013. **Biomedical Instrumentation and measurements**. PHI Learning Pvt., Ltd. New Delhi.
2. *Arumugam*, M. 2011. **Biomedical Instrumentation**. Anuradha publications, Chennai.

Reference Book

1. *Khandpur, R. S.* 1995. **Hand book of Biomedical instrumentation.** Tata Mc.Graw-Hill publishing company Ltd., New Delhi.

COURSE OUTCOMES (CO)

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

CO1	Explain the classification of biomedical instruments
CO2	Analyze the working of electrodes and transducers
CO3	Relate the principle & working of biopotential recorders
CO4	Tailor on the principles and working physiological assist devices
CO5	Narrate the recent advancements in biomedical instruments

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	H	M	H	H
CO2	L	H	M	H	H
CO3	L	H	M	H	H
CO4	L	H	M	H	H
CO5	L	H	M	H	H

H-High; M-Medium; L-Low

18UBCMP601	CORE PRACTICAL VI : PLANT BIOCHEMISTRY & GENETIC ENGINEERING	SEMESTER – VI

Course Objectives:

The Course aims

- To enable the students to understand the basic concepts in extraction, screening, quantification process of secondary metabolites and plant tissue culture.

Credits: 3 **Total Hours: 36**

S.No.	EXPERIMENT	Hrs	CO
I. PLANT BIOCHEMISTRY			
1.	Estimation of chlorophyll.	3	1
2.	Preparation of water and methanol extract from Neem - soxhlet method.	1	1
3.	Screening of secondary metabolites – Phenols, Flavonoids, Tannins, Steroids and alkaloids.	4	1
4.	Quantitative analysis of secondary metabolites – flavonoids and phenols.	4	1
5.	Isolation and estimation of starch – Anthrone method.	4	1
6.	Estimation of Vitamin C in plant source.	4	1
7.	Media preparation for plant tissue culture.	4	2
8.	Sterilization techniques for plant tissue culture.	4	2
9.	Callus induction.	4	2
II. GENETIC ENGINEERING			
10.	Isolation of plant DNA and identification by agarose gel electrophoresis.	4	3

Reference Books

1. *Jayaraman, J.* 2008. **Laboratory Manual in Biochemistry**. [First Edition Reprint]. New Age International (P) Ltd., New Delhi.

2. *James Cappuccino* and *Matalie Sherman*. 2004. **Microbiology A laboratory Manual.** [Ninth Edition]. Pearson Education, New Delhi.

COURSE OUTCOMES (CO)

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

CO1	Perform the extraction and screening procedure in identification of plant metabolites
CO2	Execute the plant tissue culture techniques
CO 3	Demonstrate the DNA isolation procedure

18UBCSB601	SBC IV: PHYTOCHEMISTRY	SEMESTER – VI

Course Objectives

The Course aims

- To enable the students to learn about the biochemistry and therapeutic value of Phytoconstituents.

Credits: 2 **Total Hours: 25**

UNIT	CONTENTS	Hrs	CO
I	**Phytochemistry**: Definition, history, scope and importance. Drugs- Definition, sources of drugs: Biological and mineral sources. Role of medicinal and aromatic plants in national economy. Medicinal value of Amla, Stevia, Aswagandha and Turmeric.	5	CO 1
II	**Secondary metabolites**: Definition and classification. Screening of Phytoconstituents –Extraction of secondary metabolites from plant source (Aqueous, methanol and acetone). Screening of carbohydrates, phenols, tannins, flavonoids, alkaloids, terpenoids, steroids and amino acids in plant extracts.	5	CO 2
III	**Carbohydrates and derived products:** Source, structure, functions and commercial applications of agar, guargum, gum acacia. Chemical constituents and uses of honey. Functions of Lipid derived products- Bees wax, Castor oil, Cocoa butter.	5	CO 3
IV	**Tannins and Flavonoids:** Source, structure, functions and commercial applications of tannin and tannin derived products (Gambier, black catechu, and myrobalan). Source, structure and functions of flavonoids (silymarin, gingko and buck-wheat).	5	CO 4
V	**Terpenoids and Alkaloids:** Source, structure, functions and commercial applications of terpenoids and terpenoid containing drugs (Eucalyptus oil, turpentine oil and	5	CO 5

	peppermint oil). Structure and functions of alkaloids and alkaloid containing drugs (atropine, quinine, morphine, ephedrine).		

Text Books

1. *Kokate, C. K., Purohit, A. P. and Gokhale, S. B*. 2008. **Pharmacognosy.** Nirali Prakashan, Pune.
2. *Roseline, A*. 2011. **Pharmacognosy**. MJP Publishers, Chennai.

Reference Book

1. *Parthasarathy,* V. A., *John Zachariah*, T. and *Chempakam*, B. 2008. **Chemistry of Spices**. CABI Publications, London.

COURSE OUTCOMES (CO)

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

CO1	Explain the history of phytomedicine and sources of drugs
CO2	Classify the secondary metabolites and use the extraction & screening methods
CO3	Discriminate the chemistry and functions of carbohydrate derived products
CO4	Categorize the sources and biological significance of tannin and flavonoid derived compounds
CO5	Explicate the structure and importance of alkaloid & terpenoid containing drugs

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	L	L	H	H
CO2	H	H	L	H	H
CO3	H	M	L	H	H
CO4	H	L	L	H	H
CO5	H	L	L	H	H

H-High; M-Medium; L-Low

18ULS601	**CAREER COMPETENCY SKILLS-IV**	**SEMESTER – VI**

Course Objectives:

The course aims

- To understand the basic needs of Communication
- To utilize the communication skills for achieving at the time of Interview

Total Hours: 15

UNIT	**CONTENTS**	**Hrs**	**CO**
I	Basic Grammar- English usage- Reading and Writing (Level-2) Direct and Indirect Speech	3	CO1
II	Spotting Errors – Parts of speech and Punctuation	3	CO2
III	Role Play – Just a Minute (JAM) -Group Discussion	3	CO3
IV	Interview Presentation (Self-Introduction)-Critical thinking, problem solving.	3	CO4
V	Dress Code and Body Language-Leadership	3	CO5

Text Books

1. Basic English Grammar for English-Book 1, Learners, *Anne Seaton, Y.H.Mew*, Saddlepoint Publishers(E-Copy)
2. Basic English Syntax with Exercises, *Mark Newson* (E-Copy)

Reference Book

1. Objective General English, S.Chand, *Dr.R.S.Agarwal*

COURSE OUTCOMES (CO)

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

CO1	Recall the basic grammar in language
CO2	Concentrate on sentence correction
CO3	Recognize the differences among facts, opinions and judgements
CO4	Develop their personal skills through interview
CO5	Appropriately apply their learning and leadership style and strength

18UBCAL501	ADVANCED LEARNER COURSE II: SOIL BIOCHEMISTRY	SEMESTER – V

Course Objectives

The Course aims

- To enable the learners to understand the concepts of biofertilizers and its role in soil fertility.

UNIT	CONTENTS	CO
I	**Soil:** Soil properties, composition. Factors influencing soil microbial population. Decomposition of organic matter in soil. Elements required in plant nutrition, functions of nutrients in plants- nitrogen, phosphorus, potassium, iron. Soil fertility evaluation: Nutrient deficiency symptoms of plants- hidden hunger, seasonal effects. Plant analysis-tissue test, total analysis.	**CO 1**
II	**Fertilizers-**Definition, method of placement- pre planting, at planting, after planting, movement of fertilizer, benefits and hazards. Biofertilizers- Definition and benefits. Biopesticides –Types and advantages. Composting-types, advantages, decomposition stages in composting.	**CO 2**
III	**Biomass and Bioenergy**- sources and utilization of biomass, production of alcohol from biomass. Biofuel- Biohydrogen production. Bioleaching- mechanism, advantages. Biosorption, by fungi, algae, moss, bacteria. Mechanism, limitations and factors affecting biosorption.	**CO 3**
IV	**Biogeochemical cycle**- Sulphur, nitrogen, hydrogen cycle, carbon cycle, oxygen, phosphorus. Biodegradation – Definition, properties affecting biodegradation, degradation of hydrocarbons. Bioremediation -Definition, types – *In situ* and *Ex situ* bioremediation, types of reactions in bioremediation. Bioremediation of contaminated	**CO 4**

	soils and waste lands.	
V	**Environmental Monitoring -** Biosensors. Methods of management **-** carbondioxide reduction by photosynthesis, calcification. Sewage treatment by bacteria and algae, eutrophication and removal of phosphorus. Metal pollution management, Bioscavengers, role of immobilized cells in pollution management.	**CO 5**

Text Books

1. Tisdale, S. L. 1997. **Soil fertility and fertilizers** [Fifth Edition] Prentice-Hall of India, New Delhi **(Unit I, II)**
2. *Indu Shekhar Thakur*. 2011. **Environmental Biotechnology: Basic Concepts and Applications**. [Second Edition]. I.K. International Publishing House Pvt. Ltd., New Delhi. **(Unit II, III)**
3. *Satyanarayana, U.* 2008. **Biotechnology.** Books and Allied Pvt. Ltd., Kolkata. **(UNIT – III, IV& V).**

COURSE OUTCOMES (CO)

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

CO1	Analyze the composition and properties of soil
CO2	Appraise the usage and benefits of biofertilizers and biopesticides
CO3	Adapt the concept of biomass, biofuel and bioleaching
CO4	Apply the concept of biogeochemical cycle and illustrate its importance
CO5	Assess the methods of remedial measures in conservation of natural resources

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L	H	L	H	H
CO2	L	H	L	H	H
CO3	L	H	L	H	H
CO4	M	H	L	H	H
CO5	M	H	L	H	H

H-High; M-Medium; L-Low

18UBCAL502	ADVANCED LEARNER COURSE II: MICROBIAL BIOCHEMISTRY	SEMESTER – V

Course Objectives:

The Course aims

- To gain knowledge about the biochemical basis of the physiological processes in microbes and exploitation of microbes for industrial purpose

UNIT	CONTENTS	CO
I	**Cell wall biosynthesis:** Organisation of prokaryotic cell surface, structure and synthesis of bacterial peptidoglycan, teichoic acids and lipoteichoicacids, lipopolysaccharides.	**CO 1**
II	**Energy production:** Nutritional classification of microorganisms based on source of energy, carbon and electrons. Characteristics and metabolism of autotrophs - photosynthetic bacteria and cyanobacteria. Autotrophic CO2 fixation and photosynthesis - Photosynthetic pigments, photosynthetic apparatus and mechanism of photosynthesis. Electron transport chain, oxidative phosporylation and energy yield in bacteria.	**CO 2**
III	**Carbohydrate metabolism:** Central pathway - EMP pathway, Alternate pathway -Entner-Doudoroff (ED) pathway, Phosphoketolase pathway. Metabolism of lactose, mannitol, fucose and rhamnose. Degradation of pectin, cellulose and lignin.	**CO 3**
IV	**Fermentation technology:** Fermentation – Definition – (Stickland reaction). Isolation of microorganism, strain development and screening of industrially important microbes. Methods - Batch, fed batch and continuous fermentation. Types – Solid substrate (SSF) and submerged fermentation. Fermentation process- Inoculum preservation, inoculum build up, prefermentor culture and production fermentation, Brief account on downstream processing.	**CO 4**

V	**Bioprocessing:** Commercial production of enzymes- amylase, organic solvents - alcohol, alcoholic beverages-wine, organic acids- citric acid, antibiotics-penicillin, amino acids- glutamic acid, vitamins – vitamin B12 and polysaccharides –dextran.	**CO 5**

Text Books

1. Albert. G. Moat and John. W. Foster. 1995. **Microbial Physiology**. [Third Edition]. John Wiley and Sons Publications, New York. (UNIT – I, II & III).
2. Satyanarayana, U. 2008. **Biotechnology**. Books and Allied Pvt. Ltd., Kolkata. (UNIT - IV & V).

Reference Books

1. Doelle, H. W. 2005. **Bacterial Metabolism**. [Second Edition]. Academic Press. New Delhi.
2. Wulf Crueger and Anneliese Crueger. 2004. **A Text Book of Industrial Microbiology**. Panima Publishing Corporation, New Delhi.
3. Casida, L. S. 2007. **Industrial Microbiology**. New Age International, New Delhi.

COURSE OUTCOMES (CO)

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

CO1	Describe the structural organization of microbes
CO2	Explain the ways by which microbes involve in energy production
CO3	Illustrate the mechanisms of microbial carbohydrate metabolism
CO4	Demonstrate the methods involved in fermentation process
CO5	Depict the process of industrial production of enzymes and antibiotics

MAPPING

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	H	H	H	H	M
CO2	H	H	L	H	M
CO3	H	H	L	H	M
CO4	H	H	L	H	H
CO5	H	H	L	H	H

H-High; M-Medium; L-Low

GUIDELINES

1. SUBMISSION OF RECORD NOTE BOOKS AND PROJECT DISSERTATION:

Candidates appearing for Practical Examinations and Project & Viva-Voce shall submit Bonafide Record Note Books/ Dissertation prescribed for Practical/ Project Viva-Voce Examinations, otherwise the candidates will not be permitted to appear for the Practical/ Project & Viva-Voce Examinations.

2. PASSING MINIMUM AND INTERNAL MARK DISTRIBUTION (Theory, Practical and Project)

I. (i) THEORY

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 40 marks put together out of 100 in the Comprehensive Examination in each theory paper with a passing minimum of 30 marks in External out of 75.

MARK DISTRIBUTION

Internal Marks Distribution [CA- Total Marks: 25]

Attendance	: 5 Marks
Assignment	: 5 Marks
Internal Examinations	: 15 Marks
Total	**: 25 Marks**

B. (i) THEORY (If Internal Evaluation is for 100 Marks)

The candidate shall be declared to have passed the Examination, if the candidate secures not less than 40 marks out of 100 in the Comprehensive Examination (Internal Evaluation only).

Internal Marks Distribution [CA- Total Marks: 100]

Attendance	: 10 Marks
Assignment	: 30 Marks (3 Assignments compulsory)
Internal Examinations	: 60 Marks
Total	**: 100 Marks**

ASSESSMENT OF SBC II: FUNDAMENTALS Of BIOCHEMICAL CALCULATIONS AND SBC III: PHARMACOGNOSY (Internal Evaluation only)

The candidate shall be declared to have passed the Examination, if the candidate secures not less than 40 marks out of 100 in the internal evaluation.

SBC II: Biochemical Calculations

Assignment (3)	: 30 Marks
Test (2)	: 50 Marks
Workbook Submission	: 10 Marks
Attendance	: 10 Marks
Total	**: 100 Marks**

SBC III: Pharmacognosy

Assignment (3)	: 30 Marks
Test (3)	: 60 Marks
Attendance	: 10 Marks
Total	**: 100 Marks**

II. PRACTICAL

The candidate shall be declared to have passed the Examination, if the candidate secure not less than 40 marks put together out of 100 in the Comprehensive Examination in each Practical paper with a passing minimum of 24 marks in External out of 60.

Internal Marks Distribution [CA- Total Marks: 40]

Experiment	: 10 Marks (10-12 Experiments)
Attendance	: 5 Marks
Record	: 5 Marks
Internal Examinations	: 20 Marks
Total	**: 40 Marks**

III. INTERNSHIP

The Internship shall be carried out by students individually during the VI semester by attending a minimum of 15 days training at any institute.

- The Student has to attend 2 reviews before completing his/her internship and it will be evaluated by an internal examiner.
- The assessment of student performance in a semester is calculated by Continuous Internal Assessment (CA) for 40 marks and External Assessment for 60 marks.
- Upon completion of the internship work the candidate shall be required to appear for a Viva-Voce conducted by an external examiner.
- The candidate shall be declared to have passed the Examination, if the candidate secure not less than 40 marks put together out of 100 in the Comprehensive Examination in Internship with a passing minimum of 24 marks in External out of 60.

Mark Distribution Pattern

Internal Mark Distribution **Continuous Assessment (CA) Total Marks: 40**

1.	Attendance	:	10 Marks
2.	Review (2)	:	20 Marks
3.	Presentation	:	10 Marks
	Total	**:**	**40 Marks**

External Mark Distribution **Comprehensive Examination (CE) Total Marks: 60**

1.	Internship work done	:	20 Marks
2.	Internship report	:	20 Marks
3.	Presentation	:	10 Marks
4.	Viva-Voce	:	10 Marks
	Total	**:**	**60 Marks**

IV. CAREER COMPETENCY SKILLS

Semester III and VI - Viva voce

- The student has to come in proper dress code for the Viva Voce
- Questions will be asked to evaluate the reading, speaking and listening skills of the students.
- E-mail and Letter drafting exercises will be given.

Semester IV and V - On Line Objective Examination (Multiple Choice questions)

- 100 questions-100 minutes
- Twenty questions from each UNIT.
- Online examination will be conducted at the end of the IV and V Semester.

3. QUESTION PAPER PATTERN AND MARK DISTRIBUTION THEORY

Question Paper Pattern and Mark Distribution **(For 75 marks)**

1. PART – A (10 x 2 = 20 Marks)

Answer ALL questions

Two questions from each UNIT

2. PART – B (5 x 5 = 25 Marks)

Answer ALL questions

One question from each UNIT with Internal Choice

3. PART – C (3 x 10 = 30 Marks)

Answer ANY THREE questions

One question from each UNIT

Open Choice – 3 out of 5 questions

Question Paper Pattern and Mark Distribution **(For 100 marks)**

1. PART – A (10 x 2 = 20 Marks)

Answer ALL questions

Two questions from each UNIT

2. PART – B (5 x 7 = 35 Marks)

Answer ALL questions

One question from each UNIT with Internal Choice

3. PART – C (3 x 15 = 45 Marks)

Answer ANY THREE questions

One question from each UNIT

Open Choice – 3 out of 5 questions

QUESTION PAPER PATTERN FOR CORE PRACTICAL EXAMINATIONS

(MAXIMUM MARKS: 60) TIME: 6 HOURS

1. Two experiments (2x25) :50
2. Spotters (5x2) :10

Total : 60 Marks

KEY FOR EVALUATION OF PRACTICAL EXAMINATION

1. **Qualitative analysis (25 Marks)**
   - Procedure : 15
   - Result : 10
2. **Quantitative analysis (25 Marks)**
   - Principle : 05
   - Procedure : 05
   - Tabular Column : 03
   - Graph : 02
   - Result : 10
3. **For Separation technique (25 Marks)**
   - Principle : 05
   - Procedure : 05
   - Observation : 05
   - Result : 10

ALLIED PRACTICAL

Comprehensive Examination (CE) : 60 marks

Continuous Assessment (CA) : 40 marks

Question paper pattern for Allied practical (Maximum marks: 60) Time: 3 Hours

1. One experiment (1x40) : 40
2. Spotters (10x2) : 20

Total : 60 Marks

KEY FOR EVALUATION OF ALLIED PRACTICAL EXAMINATION

1. **Qualitative analysis (40 Marks)**

   Procedure : 20

   Result : 20

2. **Quantitative analysis (40 Marks)**

   Principle : 05

   Procedure : 05

   Tabular Column : 03

   Graph : 02

   Result : 25