RATHNAVEL SUBRAMANIAM COLLEGE OF ARTS & SCIENCE
(Autonomous)
Sulur, Coimbatore – 641 402

SCHEME OF EXAMINATIONS – CBCS PATTERN

PROGRAMME: B.Sc (Biochemistry)

Syllabus effective for the students admitted during the academic

Year 2018 Batch & onwards

(2018– 2021)

HOD **PRINCIPAL** **COE**

RATHNAVEL SUBRAMANIAM COLLEGE OF ARS AND SCIENCE

DEPARTMENT OF BIOCHEMISTRY

1. VISION AND MISSION OF THE DEPARTMENT

VISION
The vision of Biochemistry Department is to prepare the students as outstanding educators, scholars, and researchers. To inculcate a transformational force and digital knowledge among the students in the advancement of scientific research.
MISSION
To incorporate benchmarked teaching and learning pedagogies in the curriculum. To ensure all round development of students through judicious blend of curricular, co curricular and extra-curricular activities. To support and exchange knowledge between the industry and the Department. To utilize effectively the society's human and other resources through scientific research. To encourage youth to strive for individual and collective excellence.

PROGRAMME OUTCOMES (POs):

PO1	Graduates can have strong fundamentals in their specific discipline along with DIGITAL STRATEGIC knowledge.
PO2	To increase student's ability to communicate effectively with the community /society in verbal /written courage for such as to give or receive clear instruction.
PO3	To enhance their ability to understand and identify the professional and ethical responsibilities.

PO4	To enrich their personality and character development

PROGRAMME SPECIFIC OUTCOMES: (PSOs)

Upon completion of Bachelor of Biochemistry Degree, STUDENTS are able to achieve the following outcomes.

PSO1	Learners will have a complete focus in the areas of DNA & RNA Biochemistry, Genetic engineering, Phyto-regulation, Structural biology, RNA expression analysis, Clinical research and Data Analytics in life sciences fueling current advances in biosciences, medicine and pharmaceutics. This flexibility will allow a student in the major to consider and prepare for a multitude of career options.
PSO2	Depth understanding of selected aspects of Clinical Biochemistry and Analytical detection of volatiles through their practical lab sessions will help the learner to step into entrepreneurship
PSO3	Research projects that are exciting and inspiring, in the areas of nanotechnology, drug design, cancer, computational studies, skin modelling, lung diseases and toxicology contribute useful findings to the field
PSO4	Graduates will be able to work in a variety of positions in industry and health. These range from R&D in the chemical and pharmaceutical industries, to testing and research in government and hospital laboratories, to management.

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(Autonomous)
Affiliated to Bharathiar University, Coimbatore – 641 402

SCHEME OF EXAMINATION – CBCS PATTERN

PROGRAMME: B.Sc (Biochemistry)
(Effective from the academic year 2018-19)

Credits & Marks Distribution

Sl. No.	Course Type	Number of Courses	Credits	Marks	Total Credits
1	Multi Indian/ International Languages	2	4	200	8
2	Ability Enhancement Compulsory Courses – I & II : Group-I (English)	2	4	200	8
3	Ability Enhancement Compulsory Courses – II & IV: Group-II	2	1+3	200	4
4	Discipline Specific Courses	12	6	1200	72
5	Discipline Specific Elective Courses	4+1	6	500	30
6	Extra Disciplinary Course (EDC)	1	6	100	6
7	Skill Enhancement Courses	2 + 1	4	200	8
8	ALCTA– e Learning in MOOC platform	1	4*	Pass	4*
9	Non Credit Courses – Group I	2	-	Grade	-
10	Non Credit Courses – Group II	6	-	Pass	-
11	Non Credit Courses – Group III	4	-	Completed	-

Total	**2600**	**136 + 4***

Multi-Indian/ International Languages								
Course	**Course Name**	**L**	**T**	**P**	**CIA**	**SEE**	**Total**	**Credits**
Two courses - Any **one**group								
Group I								
MIL-I	Tamil I	6			25	75	100	4
MIL-II	Tamil II	6			25	75	100	4
Group II								
MIL-I	Hindi I	6			25	75	100	4
MIL-II	Hindi II	6			25	75	100	4
Group III								
MIL-I	Malayalam I	6			25	75	100	4
MIL-II	Malayalam II	6			25	75	100	4
Group IV								
MIL-I	French I	6			25	75	100	4
MIL-II	French II	6			25	75	100	4
Group V								
MIL-I	Arabic I	6			25	75	100	4
MIL-II	Arabic II	6			25	75	100	4
Total							**200**	**8**

Ability Enhancement Compulsory Courses - Group I : (I & II Sem)								
AECC – G1-I	English I	6			25	75	100	4
AECC – G1-II	English II	6			25	75	100	4
Total							**200**	**8**

Ability Enhancement Compulsory Courses - Group II (II &IVSem)								
AECC – G2-I	Environmental Studies	1			100	-	100	1
AECC – G2-II	Aptitude	3			100	-	100	3
Total							**200**	**4**

Discipline Specific Courses								
DSC – I	Biomolecules	4		4	25 40	75 60	100	6
DSC – II	Allied Chemistry	4		4	25 40	75 60	100	6
DSC – III	Instrumentation Techniques	4		4	25 40	75 60	100	6
DSC – IV	Office Automation and Multimedia	4		4	25 40	75 60	100	6
DSC – V	Cell and Molecular Biology	4		4	25 40	75 60	100	6
DSC – VI	Human Physiology and Clinical Biochemistry	4		4	25 40	75 60	100	6
DSC – VII	Intermediary Metabolism	4		4	25 40	75 60	100	6
DSC –VIII	Enzymology	4		4	25 40	75 60	100	6
DSC – IX	Biochemical Pharmacology	4		4	25 40	75 60	100	6
DSC – X	Immunology	4		4	25 40	75 60	100	6
DSC – XI	Plant Biochemistry	4		4	25 40	75 60	100	6
DSC – XII	Microbial Physiology	4		4	25 40	75 60	100	6
Total							**1200**	**72**

Discipline Specific Elective Courses I : (III Sem)								
Course	**Course Name**	**L**	**T**	**P**	**CIA**	**SEE**	**Total**	**Credits**
One course –From thegroup								
DSE –I	Stem cell and Cancer Biology	5	1		25	75	100	6
DSE –I	Bio – sensors	5	1		25	75	100	6
Total							**100**	**6**

Discipline Specific Elective Courses II : (IVSem)								
Course	**Course Name**	**L**	**T**	**P**	**CIA**	**SEE**	**Total**	**Credits**
One course–From thegroup								
DSE – II	Clinical Research	5	1		25	75	100	6
DSE –II	Recombinant DNA Technology	5	1		25	75	100	6
Total							**100**	**6**

Discipline Specific Elective Courses III : (V Sem)								
Course	**Course Name**	**L**	**T**	**P**	**CIA**	**SEE**	**Total**	**Credits**
One course –From the group								
DSE –III	Introduction to Data analytics	4		4	25 40	75 60	100	6
DSE –III	Endocrinology	4		4	25 40	75 60	100	6
Total							**100**	**6**

Discipline Specific Elective CoursesIV: (VI Sem)								
Course	**Course Name**	**L**	**T**	**P**	**CIA**	**SEE**	**Total**	**Credits**
One course –From thegroup								
DSE –IV	Decisions and interpretation of clinical data	4		4	25 40	75 60	100	6
DSE –IV	Environmental Biochemistry	4		4	25 40	75 60	100	6
Total							**100**	**6**
Discipline Specific Elective Courses V: (VISem)								
DSE – V	Elective V Project & Viva Voce	6			40	60	100	6
Total							**100**	**6**
Extra Disciplinary Course : (EDC) - V-Sem								
Any oneCourse from the following								
EDC	Commercial Correspondance	5	1		25	75	100	6
EDC	Entrepreneurship	5	1		25	75	100	6
EDC	Project Management	5	1		25	75	100	6
EDC	Insurance and Risk Management	5	1		25	75	100	6
EDC	Global Financial Markets	5	1		25	75	100	6
EDC	E-Commerce	5	1		25	75	100	6
EDC	Social Networking	5	1		25	75	100	6
EDC	Web Designing	5	1		25	75	100	6
EDC	LINUX Administration	5	1		25	75	100	6
EDC	Hospitality Management	5	1		25	75	100	6
EDC	Fundamentals of Digital Computers	5	1		25	75	100	6
EDC	Test for Reasoning & Quantitative Aptitude	5	1		25	75	100	6
EDC	Health Management	5	1		25	75	100	6
EDC	Forensic Science	5	1		25	75	100	6

EDC	Microbes – Health & Disease	5	1		25	75	100	6
EDC	Health & Life Style Disorders	5	1		25	75	100	6
EDC	Indian Tax System	5	1		25	75	100	6
EDC	Digital Marketing	5	1		25	75	100	6
Total							**100**	**6**

Skill Enhancement Courses : Group I (III & IV Sem)								
SEC G1 – I	Communicative Skills I	2			50	-	50	2
SEC G1 – II	Communicative Skills II	2			50	-	50	2
Total							**100**	**4**

Skill Enhancement Courses : Group II (V Sem)								
Course	**Course Name**	**L**	**T**	**P**	**CIA**	**SEE**	**Total**	**Credits**
Any **one** group								
Group A								
SEC –G2-A-I	Placement - College to Corporate I	2			50	-	50	2
SEC –G2-A-II	Placement - College to Corporate II	2			50	-	50	2
Group B								
SEC –G2-B	Nanotechnology	4			100	-	100	4
Total							**100**	**4**

Non Credit Course – Group I (III & IV Sem)			
NCC-G1-I	Career Skills I	RVS Training Academy	Grade
NCC-G1-I	Career Skills II	RVS Training Academy	Grade

Extra Optional Credit Course (ALCTA-Advanced Learners Course in Trust Areas)			
Any 1 Course with 4 extra credits			
ALCTA	e-Learning in MOOC Platform	4 CREDITS	Completion

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SCHEME OF EXAMINATIONS

B.Sc (Biochemistry)

2018-2019 BATCH

Semester	Course Opted	Course Name	D	L	T	P	CIA	SEE	Marks	Credits
I	MIL-I	Tamil-I/Hindi-I/Malayalam –I/French-I/Arabic-I	3	6	-	-	25	75	100	4
	AECC-G1- I	English-I(Grammar and Usage)	3	6	-	-	25	75	100	4
	DSC-1	Biomolecules	3 3	4	-	4	25 40	75 60	100	6
	DSC-II	Allied Chemistry	3 3	4	-	4	25 40	75 60	100	6
	NCC-G3	NCC/NSS/ SPORTS/CULTURALS	-	1	-	-	-	-	-	-
	LIB	Library	-	1	-	-	-	-	-	-
		Total			**30**				**400**	**20**
II	MIL-II	Tamil-II/Hindi-II/Malayalam –II/French-I/Arabic-II	3	6	-	-	25	75	100	4
	AECC-G1-II	English-II(Communicative English)	3	6	-	-	25	75	100	4
	DSC – III	Instrumentation Techniques	3 6	4	-	4	25 40	75 60	100	6
	DSC – IV	Office Automation and Multimedia	3 3	4	-	4	25 40	75 60	100	6
	AECC – G2– I	Environmental Studies	3	1	-		100	-	100	1

	NCC-G3	NCC/NSS/ SPORTS/CULTURALS	-	1	-	-	-	-	-	-
	LIB	Library	-	1	-	-	-	-	-	-
		Total			**31**				**500**	**21**

Semester	Course Opted	Course Name	D	L	T	P	CIA	SEE	Marks	Credits
III										
	DSC –V	Cell and Molecular Biology	3 6	4	-	4	25 40	75 60	100	6
	DSC-VI	Human Physiology and Clinical Biochemistry	3 6	4	-	4	25 40	75 60	100	6
	DSE-I	Elective-I	3	5	1	-	25	75	100	6
	SEC - G1- I	Communicative Skills– I	3	2	-	-	50	-	50	2
	NCC - G1 – I	Career Skills – I	3	2						
	NCC- G3	NCC/NSS/ SPORTS/CULTURALS	-	1	-	-	-	-	-	-
		Total			**27**				**350**	**20**
IV										
	DSC – VII	Intermediary Metabolism	3 6	4	-	4	25 40	75 60	100	6
	DSC – VIII	Enzymology	3 6	4	-	4	25 40	75 60	100	6
	DSE-I I	Elective-II	3	5	1	-	25	75	100	6
	SEC -G1 – II	Communicative Skills– II	3	2	-	-	50	-	50	2

	NCC –G1-II	Career Skills – II	3	2						
	AECC -G2– II	Aptitude	3	3	-	-	100	-	100	3
	NCC-G3	NCC/NSS/ SPORTS/CULTURALS	-	1	-	-	-	-	-	-
		Total			**30**				**450**	**23**

Semester	Course Opted	Course Name	D	L	T	P	CIA	SEE	Marks	Credits
V										
	DSC – IX	Biochemical Pharmacology	3 6	4	-	4	25 40	75 60	100	6
	DSC – X	Immunology	3 6	4	-	4	25 40	75 60	100	6
	DSE-III	Elective-III	3 3	4	-	4	25 40	75 60	100	6
	EDC	Elective	3	5	1	-	25	75	100	6
		Any One Group								
		Group A								
	SEC –G2-A-I	Placement - College to Corporate I	3	2			50	-	50	2
	SEC –G2-A-II	Placement - College to Corporate II		2			50	-	50	2
		Group B								
	SEC – G2-B	Nanotechnology	3	4	-	-	100	-	100	4
	NCC-G3	NCC/NSS/ SPORTS/CULTURALS	-	-	-	-	Good/ Satisfactory			
		TOTAL		38					500	28
VI										
	DSC – XI	Plant Biochemistry	3 6	4	-	4	25 40	75 60	100	6
	DSC – XII	Microbial Physiology	3	4	-	4	25	75	100	6

			3				40	60		
	DSE-IV	Elective-IV	3	4	-	4	25	75	100	6
			3				40	60		
	DSE – V	Elective-V Project & Viva Voce	3	6	-	-	40	60	100	6
	ALCTA	e-Learning in MOOC Platform	-	-	-	-	-	-	-	4*
					30				**400**	**24**
	Total								**2600**	**140**

*Extra Optional Credit Course (ALCTA)

BIOLOGICAL DATABASES AND ANALYSIS

NonCredit Course – Group II (COP)

Semester	Course Opted	Course Name	D	L	T	P	CIA	SEE	Marks
I	NCC-G2-I	Introduction to Bioinformatics	3	1	-	-	25	75	100
II	NCC-G2-II	PRATICAL I – Introduction to Bioinformatics	3	-	-	1	25	75	100
III	NCC-G2-III	Biological Databases and Analysis	3	1	-	-	25	75	100
IV	NCC-G2-IV	PRATICAL II – Biological Databases and Analysis	3	-	-	1	25	75	100
V	NCC-G2- V	Molecular Modeling and Computer aided Drug Designing	3	1	-	-	25	75	100
VI	NCC-G2-VI	Project and Viva voce	3	-	-	1	25	75	100

DSE I -Discipline Specific Elective Courses I: (III Semester)

1. Stem cell and Cancer Biology 2. Bio - sensors

DSE II- Discipline Specific Elective Courses II: (IV Semester)

1. Clinical Research2. Recombinant DNA Technology

DSE III-Discipline Specific Elective Courses III: (V Semester)

1. Introduction to Data analytics 2. Endocrinology

DSE IV- Discipline Specific Elective Courses IV: (VI Semester)

1. Decisions and interpretation of clinical data

2. Environmental Biochemistry.

DSE V- Discipline Specific Elective Courses V: (VI Semester)

Project & Viva Voce

NCC - I (Non – Credit course) Group – I

The assessment will be done by RVS Training Academy and grade will be given based on internal evaluation in the respective semester

NCC – III (Non – Credit Course) Group – III

The students shall complete the activities in the concerned semester and completion status will be mentioned in their fifth semester mark statement. However, completing the activities listed in Group - III is mandatory to complete their degrees.

After due discussion, the following resolutions were unanimously passed.

1. The candidate should earn a minimum of 136 credits for the completion of the UG program and the total marks will be 2600 for all UG programs, from 2017 -18 batch onwards.
2. The candidate must secure a minimum of 30 marks out of 75 in Semester End Examinations theory examinations in each course (MIL -Multi Indian Language,AECC-G1 -Ability Enhancement Compulsory Course-Group-1,DSC - Discipline Specific Course, DSE -Discipline Specific Elective, EDC-Extra Disciplinary Course).For the courses which have both theory as well as practical component, the minimum pass mark for theory and practical examinations will be 30 out of 75 and 24 out of 60 respectively. In the above mentioned courses theory marks will be 100 (25 CIA + 75 SEE) and practical marks will be 100 (40 CIA + 60 SEE). The sum of the above will be 200 which will be converted into

100. However after conversion, the candidate should secure a minimum of 40% (with the minimum pass mark conditions mentioned above for each component) to get a pass in that particular course. If the candidate fails in any one of the above two components, he/she has to reappear for both theory and practical examinations. For AECC-G2 (Environmental Studies & Aptitude*****) and SEC (Skill Enhancement Course) - II (Group B) the minimum marks for a pass in each course is 40 out of 100. However for SEC –I (Communicative Skills) and SEC-II (Group A) the minimum pass will be 20 marks out of 50. Grade will be provided for Non-credit course Group-I (Career Skills I & II).

3. The theory and practical marks will be separately mentioned in the mark statement for the subjects comprising both theory as well as practical component.
4. For non-credit courses (Group-III) viz. NCC/NSS/Sports/Cultural activities the activity opted by the candidate will be mentioned in the fourth semester marks statement as "completed /not completed". The aforesaid status will be based on the attendance/ progress report submitted by the concerned parent department.
5. It is compulsory for the candidates to secure the minimum Grade in Group I (Career Skills),a pass in Group II (COP- Career Oriented program) and the candidates should complete the non-credit course in Group III to become eligible for the award of the degree.

*****For B Sc Catering Science & Hotel Management in lieu of Aptitude course, Travel and tourism management is offered in the second semester under AECC G2.

2. Bloom's Taxonomy Action Verbs

Level	REMEMBER	UNDERSTAND	APPLY	ANALYZE	EVALUATE	CREATIVE
Bloom's Definition	Remember previously learned information.	Demonstrate an understanding of the facts.	Applyknowledge to actual Situations.	Breakdown objectsor ideas into simpler parts and findevidence to support generalizations.	Compile component ideas intoa new whole or propose alternative solutions.	Make and defend judgmentsbased oninternal evidenceor external criteria.

Verbs	Arrange Define Describe Duplicate Identify Label List Match Memorize Name Order Outline Recognize Relate Recall Repeat Reproduce Select State	Classify Convert Defend Describe Discuss Distinguish Estimate Explain Express Extend Generalized Give example(s) Identify Indicate Infer Locate Paraphrase Predict Recognize Rewrite Review Select Summarize Translate	Apply Change Choose Compute Demonstrate Discover Dramatize Employ Illustrate Interpret Manipulate Modify Operate Practice Predict Prepare Produce Relate Schedule Show Sketch Solve Use Write	Analyze Appraise Breakdown Calculate Categorize Compare Contrast Criticize Diagram Differentiate Discriminate Distinguish Examine Experiment Identify Illustrate Infer Model Outline Pointout Question Relate Select Separate Subdivide Test	Arrange Assemble Categorize Collect Combine Comply Compose Construct Create Design Develop Devise Explain Formulate Generate Plan Prepare Rearrange Reconstruct Relate Reorganize Revise Rewrite Set up Summarize Synthesize Tell	Appraise Argue Assess Attach Choose Compare Conclude Contrast Defend Describe Discriminate Estimate Evaluate Explain Judge Justify Interpret Relate Predict Rate Select Summarize Support Value

3. Types of Knowledge

General Categories

- Factual
- Conceptual
- Procedural
- Metacognitive

Factual Knowledge

- basic elements students must know if they are to be acquainted with the discipline or solve any of the problems in it
- exists at a relatively low level of abstraction

Subtypes of *Factual Knowledge*

- *Knowledge of terminology* (e.g., words, numerals, signs, pictures)
- *Knowledge of specific details (including descriptive and prescriptive data) and elements*

Conceptual Knowledge

- A concept denotes all of the entities, phenomena, and/or relations in a given category or class by using definitions.
- Concepts are abstract in that they omit the differences of the things in their extension
- Classical concepts are universal in that they apply equally to everything in their extension.
- Concepts are also the basic elements of propositions, much the same way a word is the basic semantic element of a sentence.

Procedural Knowledge

- is the "knowledge of how" to do something
- It often takes the form of a series or sequence of steps to be followed.
- includes knowledge of skills, algorithms, techniques, and methods, collectively known as procedures
- Also includes knowledge of the criteria used to determine when to use various procedures.
- is specific or germane to particular subject matters or academic disciplines

Metacognitive Knowledge

- Is knowledge about cognition in general as well as awareness of and knowledge about one's own cognition.

Categories of Metacognitive knowledge

- Assessing the task at hand
- Evaluating one's own strengths and weaknesses

- Planning an appropriate approach
- Applying strategies and monitoring performance
- Reflecting and adjusting one’s own approach
- Beliefs about intelligence and learning

4. INTERNAL MARKS ASSEESMENT TOOL

Modular Accessing Panels																
	Modules	Percentage of Componets for each course														
		Course Panels														
		Language - Concepts	Language - Usage	Theory - Concepts	Theory - Application	Theory - Skill based	Theory - Programming	Theory - Anlytics	Theory - Technology	Problem - Concepts	Problem - Analysis	Practical - Programming	Practical - Experiments	Practical - Application	Project	Training
	Code	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Test	60	20	60	40	40	40	40	40	60	60	40	40	40		
2	Quiz	10		10	10					10						
3	Class presentation	20	10		10	20		10	20						60	
4	Technical Presentation/Demonstration		10					10				10	10		20	60
5	Attendance											20	20	20		
6	Group Assignment			10		10										
7	Group - Mini Project				20			20								
8	Case Study					10					20					
9	Group Discussion		20					20								20
10	Writing skills	10	20	10			20									
11	Puzels/Games		10			20				20		10				
12	Simulation excercises						20			10	10		20			
13	Poster Presentation/Flow charts/Miniatures/Protocol		10	10			20		20		10	20	10	20	20	20
14	SSA ;Self -support assisgnments (Upcoming technicals)				20				20					20		
	CIA Marks	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Course Title :**BIOMOLECULES (T)**	Course Code : 13A
Semester : **I**	Course Group : **DSC-I**
Teaching Scheme in Hrs (L:T:P) : **4:0:0**	Credits : **4**
Map Code : **C(THEORY CONCEPTS)**	Total Contact Hours : **60**
CIA : **25 Marks**	SEE : **75 Marks**
Programme: **BSC-BC**	

Course outcome: (Cos)

No.	Course Outcome (Cos): After completion of this course, the students will be able to	POs & PSOs	Cl. Ses	CL
CO1	Understand the features including structure, function of Carbohydrates	PSO 1	10	U
CO2	Understand the various types and properties of lipids	PSO 2	10	U
CO3	Recognize the structure and function of amino acids	PSO 2	10	U & R
CO4	Derive the structure and the nature of the protein molecules	PSO 3	10	U & An
CO5	Explain the structure-function relationships for nucleic acids and chromatin	PSO3	10	U & An
CO6	Identify the components of nucleotide and study the structure and functions of two types of nucleic acids DNA and RNA	PSO 3	10	U & An

UNIT-I (LECTURE HOURS: 10)

Carbohydrates - Introduction (Definition & Classification),Types of Monosaccharides- (Introduction & Classification, Stereochemistry, Cyclic structure &Anomeric forms Haworth projection formula),Disaccharides- (Introduction & Classification, chemistry, structure & functions of Sucrose, maltose & lactose),Polysaccharides -(Introduction & Classification Storage polysaccharides), Starch & Glycogen - (Structure & Function), Structural polysaccharide - (Structure & Function).

UNIT-II (LECTURE HOURS: 10)

Lipids –Introduction(Definition & Classification),Simple lipids-(Fats, oils & waxes. Physical properties - Solubility, specific gravity, melting point, color & odor),Chemical properties of fats - (Hydrolysis, Saponification Number, Iodine Number, RM value, Acid Number and Rancidity of fats),Compound lipids - (Structure & functions of Phospholipids, Glycolipids and Lipoproteins),Derived lipids- (Saturated, Unsaturated & Essential fatty acids)Sterols and Steroids - (Cholesterol and its structure)

UNIT-III(LECTURE HOURS: 10)

Aminoacid- Introduction(Definition& structure),Classification (Based on functional groups, amino acids as ampholytes),Aliphatic Aminoacids (Structure and properties),Aromatic aminoacids -(Structure and properties),Peptide bond - (Structure & properties),Identification - (N&C terminal residues)

UNIT-IV(LECTURE HOURS: 8)

Protein - Introduction (Classification & properties),Structure of proteins (Primary, secondary, tertiary & Quaternary structures),Denaturation & Renaturation of proteins (Physical & chemical agents, coagulation, refolding)

UNIT-V(LECTURE HOURS: 10)

Nucleic acids - Introduction (Definition & Types),Purines - (Structure of Adenine, Guanine, Xanthine & Hypoxanthine),Pyrimidines - (Structure of Thymine, Uracil & Cytosine),Nucleosides & nucleotides- (Structures & Modified Nitrogenous bases),DNA - (DNA double helix - Watson & Crick model, Chargaff's rule),Types(A, B & Z forms),Denaturation & Renaturation - (Hyperchromism, Effect of pH & temperature on DNA. Nucleation & zippering reaction),RNA - Types -(mRNA, rRNA, tRNA,miRNA, Si RNA -Structures and their biological roles)

Text Books :

T1: Biochemistry | Edition:5 | W.H.Freeman& Company,New York | LUBERT STRYER(2015)

T2:Essentials of Biochemistry | Edition:2 | Books and Allied (P) Ltd | U.CHAKRAPANI AND U.SATHYANARAYANA (2016)

T3:Fundamentals of Biochemistry | Edition:II | S.Chand& Company | JAIN.J.L(2015)

T4:Introduction to Practical Biochemistry | Edition:3 | Tata McGraw-Hill Education | David.T. Plummer AND Plummer.(2017)

Reference Books :

R1: BIOCHEMICAL METHODS | Edition:2 | New Age International | SADASIVAM.S(2017)

R2:Fundamentals of Biochemistry | Edition:1 | John Wiley & Sons Inc USA | DONALD VOET AND JUDITH G. VOET(2014)

R3:LABORATORY MANUAL IN BIOCHEMISTRY | Edition:2 | NEW AGE INTERNATIONAL PUBLISHER | JAYARAMAN.J(2016)

R4:Lehninger Principles of Biochemistry | Edition:3 | Mac millan Worth Publishers USA | DAVID.L NELSON ANDMICHAEL.M.COX(2015)

Course Title :**BIOMOLECULES (P)**	Course Code : 13P
Semester : **I**	Course Group : **DSC-II**
Teaching Scheme in Hrs (L:T:P) : **0:0:4**	Credits : **2**
Map Code : H (PRACTICAL - EXPERIMENTS)	Total Contact Hours: **60**
CIA : **40 Marks**	SEE : **60 Marks**
Programme: **BSC-BC**	

List of Experiments:

1. Qualitative Analysis of Monosaccharides - Glucose and Fructose

2. Qualitative Analysis of Disaccharides - Sucrose and Maltose
3. Qualitative Analysis of Polysaccharides - Starch and Dextrin
4. Determination of Acid number of edible oil. -
5. Determination of saponification number of edible oil -
6. Estimation of unsaturated fat by iodine value of oil. -
7. Qualitative Analysis of Non-polar, Aliphatic Aminoacids- Methionine, Leucine
8. Qualitative Analysis of Aromatic Aminoacids- Tyrosine, Tryptophan
9. Qualitative Analysis of Polar, Uncharged Aminoacid- Serine
10. Qualitative Analysis of Charged Aminoacid- Histidine
11. Identification of protein by Biuret method -
12. Denaturation of protein using Egg -
13. Alkali hydrolysis on RNA and effect of denaturation of DNA

Course Title :**ALLIED CHEMISTRY (T)**	Course Code : 13Q
Semester : **I**	Course Group : **DSC-II**
Teaching Scheme in Hrs (L:T:P) : **4:0:0**	Credits : **4**
Map Code : **C(THEORY CONCEPTS)**	Total Contact Hours : **60**
CIA : **25 Marks**	SEE : **75 Marks**
Programme: **BSC-BC**	

No	Course Outcome (Cos): After completion of this course, the students will be able to	Pos& PSOs	Cl. Ses	BLOOM'S TAXONOMY LEVEL
CO1	Understand the basics of thermodynamic laws and principle	PO1& PS01	10	U
CO2	Demonstrate the different aspects of chemical bonding	PO1& PS01	10	An

CO3	Describe the basic rules of organic nomenclature	PO1& PS01	10	Ap
CO4	Demonstrate titrimetry experiments and assessments of important factors that could affect the analytical result.	PO1& PS01	10	Ap
CO5	Analyse the concepts of physical chemistry	PO1& PS01	10	An
CO6	Acquire knowledge on Green chemistry	PO1& PS01	10	U

UNIT-1 (LECTURE HOURS: 10)

Thermodynamics– Introduction - (Definition, Energy changes and Importance of Thermodynamics), Types of system - (Open, Closed and Isolated), Types of process - (Reversible, Irreversible and isothermal),Properties- (Extensive and intensive),Laws of thermodynamics - (First law and Second law, Enthalpy and Entropy), Free energy - (Definition, Spontaneity, Gibbs free energy)

UNIT-2 (LECTURE HOURS:10)

Chemical bonding theory: Structure of atoms and molecules - (Introduction), Types of chemical bonds - (Ionic, Covalent, and Coordinate), Hybridization - (Introduction, Salient Features of Hybridization, Shapes of hybrid orbital),Structure and polarity of water - (Hydrogen Bond in Water, Buffer Solutions and Preparations)

UNIT-3 (LECTURE HOURS: 10)

Organic chemistry theory: Organic chemistry - (Introduction, Classification, Nomenclature),Isomers and Isomerism - (Types and Molecular Formula),Stereoisomerism- (Definition and Classification - Optical and Geometric isomerism),Cyclic, Acyclic and Heterocyclic compounds - (Introduction, Classification, Structure of Monocyclic, Acyclic and Heterocyclic compounds)

UNIT-4 (LECTURE HOURS: 10)

Volumetric methods theory : Solution - (Definition of Ideal and Non-ideal Solutions, Units of Concentration, Molecular Weight, Equivalent Weight, Molarity, Molality, Normality, PPM and Percentage solution), Concepts of volumetric analysis - (Introduction, Analysis and Titrant),Principles of acid base titration –(Introduction - Acids, Alkalies, Indicators and Buffers),Titration - (Strong acid vs strong base, weak acid vs strong base, weak base vs strong acid), EDTA titration - (Introduction , indicators for EDTA titration)

UNIT-5 (LECTURE HOURS: 8)

Physical chemistry theory :Electrochemistry - (Definition, Electrolytes, Conductance, Equivalent Conductance, Specific Conductance, Molar conductance),Surface chemistry- (Adsorption, Adsorbents, Physisorption and

Chemisorption, Colloids, Gels, Emulsions, Electro Osmosis, Inhibition),Environmental chemistry - (Concept and Scope of Environmental Biochemistry)

TEXTBOOK

T1:B.R.Puri,L.R.Sharma and MadhanS.Pathania,Principles of physical chemistry,(2017),Vishal Publishing Co.

T2: S. Bahl and ArunBahl (2014) A textbook of organic chemistry ,S.Chand and Co.Ltd.

T3: Principles of Inorganic chemistry | Edition:25 | Shobinlalnagin Chand & Co | Puri&Sharma(2014)

T4: Text book of Organic Chemistry | Edition:28 | Sultan chand& sons | H.M. CHAWLA AND P.L. SONI (2014)

Reference Books:

R1. Industrial chemistry | Edition:10 | Goel Publishing House Meerut, India | 2.B.K. SHARMA (2007) Chemistry | Edition:4 | Houghton miftin company new york

R2. M.Satake,Y.Hayashi(2003),Colloidal and Surface chemistry,Discovery publishing house

Course Title :**ALLIED CHEMISTRY (P)**	Course Code : 13Q
Semester : **I**	Course Group : **DSC-II**
Teaching Scheme in Hrs (L:T:P) : **0:0:4**	Credits : **2**
Map Code : H (PRACTICAL - EXPERIMENTS)	Total Contact Hours: **60**
CIA : **40 Marks**	SEE : **60 Marks**
Programme: **BSC-BC**	

List of Experiments:

1. Demonstration of Thermodynamics - Enthalpy and Entropy

2. Preparation of buffer solutions – phosphate buffer and citrate buffer at different pH
3. Estimation of hardness of water
4. Qualitative Analysis of Aromatic compounds - Toluene and Naphthalene
5. Qualitative Analysis of Aliphatic compounds – Glucose, Fructose
6. Qualitative Analysis of Functional group-Carboxylic acid and tryptophan
7. Titration for Acid-Base - Strong Acid vs Strong Base, HCl Vs NaOH

   Strong base Vs weak acid,NaOH Vs CH3COOH(acetic acid)

   Weak base Vs strong acid,Ammonia (NH3) Vs H2SO4

8.Determination of alkalinity in water

9.COD (chemical oxygen demand)-Measure of wastewater quality.

Course Title :**INSTRUMENTATION TECHNIQUES (T)**	Course Code : 23A
Semester : **II**	Course Group : **DSC-III**
Teaching Scheme in Hrs (L:T:P) : **4:0:0**	Credits : **4**
Map Code : **C(THEORY CONCEPTS)**	Total Contact Hours : **60**
CIA : **25 Marks**	SEE : **75 Marks**
Programme: **BSC-BC**	

No.	Course Outcome	POs & PSOs	Cl. Ses	CL
CO1	Understand the terms like pH, pOH, acidic, basic, neutral solutions and universal indicator and acquire the practical skill.	PSO 1	12	U
CO2	Explore the use of suitable chromatographic or electrophoretic techniques for actual analytical problems.	PSO 2	12	Ap
CO3	Motivating the students in handling the basic apparatus and instruments.	PSO 2	12	Ap
CO4	Identifying the separation of proteins/peptides by selecting appropriate separation techniques .	PSO 2	12	R
CO5	Understand the theoretical principles of radioactivity and appreciate the uses of radioisotopes.	PSO 1	12	R

UNIT – I (LECTURE HOURS: 12)

pH Buffer: Introduction - (Definition and applications), Determination of pH - (using indicators and pH meter),Electrode -

Types-(calomel electrode, silver-silver chloride electrode and standard hydrogen electrode),Henderson's Hasselbach equation- (Relationship between pKa& pH)Buffer : Acids & Bases- (Buffer system, Bicarbonate Buffer system, Hb Buffer system)

UNIT – II (LECTURE HOURS: 12)

Chromatography: Definition and its types, Paper Chromatography- (Principle, Technique & applications),ThinLayer chromatography(Principle, Technique & applications),Gas Liquid chromatography- (Principle, Technique & applications),Ion exchange chromatography- (Principle, Technique & applications),HPLC- (Principle, Technique & applications), Affinity Chromatography- (Principle, Technique & applications), Molecular sieve Chromatography- (Principle, Technique & applications)

UNIT – III(LECTURE HOURS: 12)

Electrophoresis: Introduction- (Types and Factors affecting electrophoretic mobility),Agarose Gel Electrophoresis- (Principle, technique and applications),SDS – PAGE- (Principle, technique and applications),Immunoelectrophoresis - (Principle, technique and applications),Centrifugation- (Introduction, types of centrifugation and Rotor types),Ultra centrifugation- (Working, applications and its types.)

UNIT – IV(LECTURE HOURS: 12)

Colorimetry : Introduction - (colour and absorption),Beer - Lambert's law- (Principle & Laws),Working of a single cell photoelectric colorimeter- (Principle instrumentation & applications), Spectrophotometry(Principle, Instrumentation and applications),Flourimetry- (Principle, Instrumentation and applications)

UNIT – V(LECTURE HOURS: 12)

Isotopesand Radioactivity – Introduction - (Tracer techniques),Radioactive decay and units of radio activity(Curie, Bequerel, specific activity),Detection and measurement of radio activity- (GM counter, Scintillation counting, Autoradiography),Applications of radioisotopes- (Biological and Medical sciences)

Text Books :

T1: Biophysical Chemistry | Edition:4 | Himalaya Pub. House | UpadhyayNath(2009)

T2:Practical Biochemistry | Edition:3 | Tata McGraw-Hill Education | David Plummer(1988)

Reference Books :

R1: Analytical Biochemistry | Edition:4 | Longman | David James Holme(1997)

RATHNAVEL SUBRAMANIAM COLLEGE OF ARTS & SCIENCE (AUTONOMOUS)

SULUR, COIMBATORE
DEPARTMENT OF BIOCHEMISTRY – UG
ACADEMIC YEAR 2017-18

COURSE CONTENT

Course Title	:INSTRUMENTATION TECHNIQUES (P)	Course Code	: 23P
Semester	: II	Course Group	: DSC-III
Teaching Scheme in Hrs (L:T:P) : 0:0:4		Credits	: 2

Map Code : H (PRACTICAL - EXPERIMENTS)	Total Contact Hours: **60**
CIA : **40 Marks**	SEE : **60 Marks**
Programme: **BSC-BC**	

List of Experiments:

1. Determination of pH
2. Preparation of Buffers
3. Paper Chromatography – Circular
4. Thin Layer Chromatography.
5. Separation of compounds using centrifuge.
6. SDS-gel Electrophoresis – Demonstration
7. Estimation of Protein by FOLIN - CIOCALTEAU method
8. Estimation of Urea by DAM-TSC method
9. Industrial visit to learn techniques in radioactivity

RATHNAVEL SUBRAMANIAM COLLEGE OF ARTS & SCIENCE (AUTONOMOUS)
SULUR, COIMBATORE
DEPARTMENT OF BIOCHEMISTRY
ACADEMIC YEAR 2017-18

1. COURSE CONTENT

Course Title :**OFFICE AUTOMATION AND MULTIMEDIA(T)**	Course Code : 23B
Semester : **II**	Course Group : **DSC-IV**
Teaching Scheme in Hrs (L:T:P) : **4:0:0**	Credits : **6**
Map Code :	Total Contact Hours :60

CIA : **25 Marks**	SEE : **75 Marks**
Programme: **BSC-BC**	

No.	Course Outcome	POs & PSOs	Cl. Ses	CL
CO1	Understand the Fundamentals of Computer.	**PSO 1**	**10**	**U& R**
CO2	Learning History of Computer	**PSO 2**	**10**	**U & R**
CO3	Understanding use of Computer.	**PSO 2**	**10**	**U & R**
CO4	Learning of MS-Word.	**PSO 2**	**10**	**U & R**
CO5	Learning of MS-Excel.	**PSO 1**	**10**	**U & R**
CO6	Learning of MS-Power Point	**PSO 1**	**10**	**U & R**

UNIT-I(LECTURE HOURS: 12)

Introduction to Computers –

Introduction - Compute, Input-Output and characteristics.Digital and analog Computer - Digital and Analog Computer Characteristics of computer - Speed, Accuracy, Diligence, Storage capacity, Versatility.History of computer - Calculate Machine, ABACUS.**Generation of computer**First Generation - Vacuum tube Second Generation - Using Transistors Third Generation - Using Integrated Circuits Fourth Generation - Using Micro ProcessFifth Generation - Using artificial Intelligence **Classification of computer** Micro computers - Low-cost and single-user Digital Computer, notebook computers, tablet, handled computer, smart phoneMini Computers - Real time application, research centersMainframe Computers - Multi programming and high performance, Large storage capacity, facility of main frame computersSuper

Computers - Floating point Operation per second, C-DAC, PARAM **The Computer System**Hardware , software - Hardware ,software and dataThe Input Process-Output concept - Access data, Process data , generates output, store data Components of Computer hardware - I/O unit, CPU, Memory unit, the computer system interactionMemory unit - Primary memory ,Secondary memory (RAM/ROM)Application of computer - Education ,Entertainment ,sports, Advertising ,Medicine ,Home

UNIT : II (LECTURE HOURS: 12)

MS-Word- Introduction

Starting MS-Word - Text based document ,GUI, pointer, Click, Double Click, Select, Quick menu, Starting Ms-word, Ms-word IconMs-word Screen and its Components - New, Open, Save, Office logo button, Quick Access tool bar, The ribbon, tabs, Ruler bar, Status bar, Scroll bar, working areaOffice button Commands - New, open ,save, saves as, Print, prepare, send, publish, close**Working with MS- Word** The Home tab - Clipboard, Font, paragraph, style and editing , Move text, Copy text, Find and replaceThe Insert tab - Pages, tables , Illustrate , Link , Header & Footer and text, Symbols, chart, shapes,PictureThe Page layout tab - Themes, Page setup, page background, Paragraph, Arrange
The reference Tab - Table of content, Footnotes, Citation, Bibliography, Caption, Index, table AuthoritiesThe mailing Tab - Create, Start mail merge, Write & Insert fields, Preview Result and finishThe review tab - Proofing, Comments, Tracking, Changes, Compare and ProtectThe View tab - Documents View, Show/hidden, Zoom, Window and macros

UNIT : III (LECTURE HOURS: 12)

MS-Excel- Introduction Introduction- Spread sheet - Rows and column, Flexibility, Speed, Accuracy, Calculations **Basics of spreadsheet** MS-Excel Icon - Menu Driven, Icons in various Tabs, Groups, Short KeysElectronic Document - Numbers(Constants), Formulas, Text (Labels)**MS-Excel screen and its Components**The Office Logo button - The commands of Document as New, Open, save, Save as, Print, CloseThe Quick Access Toolbar - The Tabs (Home, Insert etc.), Groups, icons, Status Bar, Scroll Bar, Worksheet Tab, Row, Column Headings, Active Cell, Formula Bar, Name Box,Ways to select a command**Working with MS-Excel 2007**The Home Tab - The Clipboard group contains the cut, copy Font, Alignment, Number group, Cells allow the user to insert, Editing groupThe Insert Tab - Tables, Chart, Illustrations, The Links, The Text group, Insert tab commands description, Pivot table tools options tab, Table tools design tab, Picture tools format tab, Drawing tools format tab, Header and footer tools design tabThe page layout tab - Themes, Page Setup, Scale to Fit, Sheet Options and Arrange.The Formulas Tab - The Function Library, LOOKUP, Defined Names, Formula Auditing, Formula, Calculation, Formula addressing, Absolute addressThe Data Tab - Get External Data, Connections, Sort & Filter, Data Tools and Outline.

UNIT : IV (LECTURE HOURS: 12)

MS-PowerPoint-Introduction Introduction of power point**Basics of PowerPoint**PowerPoint BasicsPowerPoint Terminology**Start MS-PowerPoint**MS-PowerPoint icon - Shortcut key, double-click the IconMS-PowerPoint screen and its Components - Office Logo Button, The Quick Access Toolbar, The Ribbon, Tabs/Group, Icon, View Buttons, Outline/Slides Tab, Slide Pane, Ruler Bar, Status Bar, Scroll Bar, **Working with MS-PowerPoint 2007**The Home Tab - The Clipboard group contains the cut, copy Font, Alignment, Number group, Cells allow the user to insert, Editing group The Insert Tab - Tables, Chart, Illustrations, The Links, The Text group, Insert tab commands description, Pivot table tools options tab, Table tools design tab, Picture tools format tab, Drawing tools format tab, Header and footer tools design tabThe page layout tab - Themes, Page Setup, Scale to Fit, Sheet Options and Arrange.The Formulas Tab - The Function Library, LOOKUP, Defined Names, Formula Auditing, Formula, Calculation, Formula addressing, Absolute addressThe Data Tab - Get External Data, Connections, Sort & Filter, Data Tools and Outline.

UNIT : V (LECTURE HOURS: 12)

MS-Access- Introduction - Database stores, DBMS, creation, insertion, deletion, updating and retrieval of data, Oracle, IBM's DB2, Microsoft's SQL Server, Microsoft Access, Microsoft FoxPro and Borland dBase. MySQL is a popular open source DBMS, Tables, Forms, Queries, Reports.Database Terminology - Data elements or data, Table, Field, Record, Primary key, Relational database.Start MS-Access - Menu-driven software, commands, Tabs and Groups, mouse makes workingMS-Access screen and its Components - Office Logo Button, The Quick Access Toolbar, The Ribbon, Tabs, Icon, Navigation Pane, Navigation Buttons, Object Tabs, View Buttons**Working with MS-Access 2007**The Home Tab - The Clipboard group contains the cut, copy Font, Alignment, Number group, Cells allow the user to insert, Editing group The Insert Tab - Tables, Chart, Illustrations, The Links, The Text group, Insert tab commands description, Pivot table tools options tab, Table tools design tab, Picture tools format tab, Drawing tools format tab, Header and footer tools design tabThe page layout tab - Themes, Page Setup, Scale to Fit, Sheet Options and Arrange.The Formulas Tab - The Function Library, LOOKUP, Defined Names, Formula Auditing, Formula, Calculation, Formula addressing, Absolute addressThe Data Tab - Get External Data, Connections, Sort & Filter, Data Tools and Outline.

TEXT BOOKS:

T1. Computer Fundamentals: Anita Goel 2007.
T2. Computer Fundamentals: Pearson 1st Edition Anita Goel 2010(April 13, 2010)

Course Title :**OFFICE AUTOMATION AND MULTIMEDIA**	Course Code : 23Q
Semester : **II**	Course Group : **DSC-IV**
Teaching Scheme in Hrs (L:T:P) : **4:0:4**	Credits : **4**
Map Code :	Total Contact Hours : **60**
CIA : **40 Marks**	SEE : **60 Marks**
Programme: **BSC-BC**	

List of Experiments:

1. Introduction
2. How to operate OS
3. How to use DOS commands
4. Creation of mail , Sending & Receiving
5. Word Processing using MS Word: Starting Up
6. Saving – Opening your document
7. Using various fonts
8. Mail merge
9. Worksheets, Performing mathematical calculations
10. Creating a formula-printing
11. Employee salary list preparation
12. Chart creation
13. Draw graphs to illustrate the class performance
14. Organization chart creation
15. Draw a flow chart using power point to find the sum of 50.
16. demonstration of a product
17. a product of your choice
18. Making slide show
19. Creating table
20. Adding fields
21. Entering values
22. storing tables

Course Title :**CELL AND MOLECULAR BIOLOGY (T)**	Course Code : 33A
Semester : III	Course Group : **DSC-V**
Teaching Scheme in Hrs (L:T:P) : **4:0:0**	Credits : **4**
Map Code : **C(THEORY CONCEPTS)**	Total Contact Hours : **60**
CIA : **25 Marks**	SEE : **75 Marks**

Programme: **BSC-BC**

No.	Course Outcome	POs & PSOs	Cl. Ses	CL
CO1	Understand the features including structure, function of cells and cell organelles	**PSO 1**	**10**	**U**
CO2	Understand the various types cell cycles and cell motility	**PSO 2**	**10**	**Ap**
CO3	Recognize the structure and function of Nucleic acids	**PSO 2**	**10**	**Ap**
CO4	Describe the Mechanism of central dogma	**PSO 2**	**10**	**R**
CO5	Explain the replication, Transcription and translation.	**PSO 1**	**10**	**R**
CO6	Identify the translational inhibitors and the factors involving in the central dogma	**PSO 1**	**10**	**U**

UNIT : I (LECTURE HOURS: 10)

Structure and function of cells-:Prokaryotes- (Structure and Organization of membrane), Eukaryotes- (Structure and Organization of membrane),Comparisons of karyons- (Difference between Prokaryotes and Eukaryotes)
Plasma membrane(Structure & function),Cell organelles : Structure & function- (Nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast),Cytoskeleton and its role in motility

UNIT : II (LECTURE HOURS: 10)

Mechanism of cell division: Mitosis- (Regulation of cell cycle),Meiosis- (Regulation of cell cycle),Genetic recombination- (Factors and genes regulating cell cycle),Models and cell-cell communication : Fluid mosaic mode-

l(Structure and functions),Active transport - (Antiport and symport pumps),Passive Transport - (Diffusion , Facilitated Diffusion , Filtration , Osmosis),Cell-Cell communication, Endocytosis and exocytosis

UNIT : III (LECTURE HOURS: 10)

An Introduction to Molecular biology :Central dogma- (Conversion of Nucleic acid to protein), Replication- (Introduction ,enzymes involved and mechanism), Repair mechanism- (Replication origin and replication fork),Fidelity of replication- (extra chromosomal replicons, and DNA damage and repair mechanisms)

UNIT : IV (LECTURE HOURS: 10)

Transcription :Introduction,Enzymology of Transcription- (RNA polymerases, Regulatory sequences in protein-coding genes)Gene regulation – (Transcription factors and machinery) Formation of initiation complex-(transcription activators and repressors), regulation of transcription - (factor activity, capping, elongation and termination), Processing of Pre-mRNA- (splicing, polyadenylation; RNA transport, Cytoplasmic mechanisms of Post-transcriptional control, Processing of rRNA and tRNA),Operon models- (lac and trp operon)

UNIT : V (LECTURE HOURS: 10)

Translation : Introduction and factors involved- (Initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNAsynthetase, translational proof-reading),Post- translational modification- (Translational inhibitors, post- translational modification of proteins),Ribosome- (Function & formation of initiation complex),Genetic codes(functions and importance in genetic engineering)

Text Books :

T1: Cell Biology | Edition:3rd edition | Himalaya Publishing House Pvt. Ltd | POWAR C B(2017)

Reference Books :

R1: Cell Biology | Edition: 6 | John Wiley and Sons, Inc., Hoboken, NJ GERALD KARP (2010)

R2: Cell Biology | Edition: 5 | Universities Press (India) Pvt. Ltd. CHANNARAYAPPA (2014)

Course Title	:**CELL AND MOLECULAR BIOLOGY (P)**	Course Code	: 33P
Semester	: III	Course Group	: **DSC-V**

Teaching Scheme in Hrs (L:T:P) : **0:0:4**	Credits : **2**
Map Code : H (PRACTICAL - EXPERIMENTS)	Total Contact Hours: **60**
CIA : **40 Marks**	SEE : **60 Marks**
Programme: **BSC-BC**	

List of Experiments:

1. Determination of fluid movements by osmotic pressure in potato
2. Determination of electrical impulses by using bell jar experiment
3. Estimation of chlorophyll from plant leaves.
4. Karyotyping of any plant
5. Isolation of DNA from blood
6. Isolation of DNA from plant leaves
7. Estimation of chlorophyll from plant leaves.
8. Mitotic division in onion root tip.
9. Estimation of RNA by Orcinol method.
10. Estimation of Amino acid by Ninhydrin method

Course Title :**HUMAN PHYSIOLOGY AND CLINICAL BIOCHEMISTRY (T)**	Course Code : 33B

Semester : III	Course Group : **DSC-VI**
Teaching Scheme in Hrs (L:T:P) : **4:0:0**	Credits : **4**
Map Code : **C(THEORY CONCEPTS)**	Total Contact Hours : **60**
CIA : **25 Marks**	SEE : **75 Marks**
Programme: **BSC-BC**	

No.	Course Outcome	POs & PSOs	Cl. Ses	CL
CO1	Discuss the internal structure of Digestive system and the Physiological action of digestion and absorption process along with its clinical disorders.	**PSO 1**	**10**	**U**
CO2	Describe the extracellular fluid and its composition and functions and its disease state.	**PSO 2**	**10**	**Ap**
CO3	Illustrate the anatomy and Physiological aspects of circulatory and respiratory system and its clinical disorders	**PSO 2**	**10**	**Ap**
CO4	Describe the mechanisms involved in the central nervous system and neurotransmitter action and its clinical disorders.	**PSO 2**	**10**	**R**
CO5	Discuss the structure and function of Nephrons	**PSO 1**	**10**	**R**
CO6	Describe the mechanism of Urine formation and its clinical disorders.	**PSO 1**	**10**	**U**

UNIT – I (LECTURE HOURS: 10)

DIGESTIVE SYSTEM

ANATOMY OF THE DIGESTIVE SYSTEM: Structural features of intestinal Organs. Salivary, gastric, biliary, pancreatic secretion- (Introduction and functions) secretions- (composition and functions). Mechanism of HCl. Secretions.-(Carbonic acid and Bicarbonate formation**)**Digestion and absorption in the small intestine. Digestion and absorption of carbohydrates, lipids and proteins.**Clinical Disorders :**Gastric Ulcer, Gastritis's, Liver Function test (LFT)-Bilirubin Test, Diabetes Metillus.(Introduction and functions)

UNIT – II (LECTURE HOURS: 9)

BODY FLUIDS: Extracellular fluid-plasma- Definition- (composition and function). Blood: Definition-(composition and function). Blood cells – WBC, RBC,-. Hemoglobin- (Introduction, types and function),Platelets –(Introduction and functions)Blood coagulation and Blood groups –(ABO & Rh factor- Mechanism of Blood coagulation) Clinical Disorders- Anemia, Polycythemia, Leukemia, Leucopenia and Thrombocytosis- (Introduction and mechanism)

.

UNIT – III (LECTURE HOURS: 10)

CIRCULATORY & RESPIRATORY SYSTEM

Circulation- (Structure and Functions of Heart), cardiac cycles-(Introduction and Mechanism) Electrocardiogram-(Introduction and application).Respiration:Anatomy, and physiology of Respiration - (Introduction and Mechanism) Exchange of gases between lung and blood and between blood and tissues- (Mechanism of action) Transport of respiratory gases..(Mechanism of action)Clinical Disorders**-** Arteriosclerosis, Myocardial Infarction, Asthma and Pulmonary infection- pneumonia**- (** Introduction, Etiology and disease mechanism)

UNIT – IV (LECTURE HOURS: 10)

NERVOUS SYSTEM

Central nervous system**-** General Organization. Neuron- (structure and its function). Resting and action potential-conduction of nerve impulses- (Introduction and mechanism) Synaptic transmission- (Introduction and Mechanism) Neurotransmitters –(Introduction, types and functions)Clinical Disorders**-** Paralysis, Parkinson's and Alzhmiers Disease-(Introduction, etiology and mechanism of disease)

UNIT – V (LECTURE HOURS: 10)

EXCRETORY SYSTEM

Kidney-Structure and functions of kidney - (Introduction and structure)Nephron- Structure & composition-(Introduction). Mechanism of urine formation-(Glomerular filteration, Tubular reabsorption and Tubular secretions).Micturition.**-**(Introduction and Mechanism).Clinical Disorders-Glomerular Nephritis, Nephrotic syndrome Renal Calculi.- (Introduction and mechanism)

Text Books

T1.: Human Physiology: Vol I & II C.C. Chatterjee, 2016.
T2: Dr,Sembulingam&PremaSembulingam, Medical Physiology, 2012, 5th Edition,JP Publications
T3: Guyton, Textbook of Medical Physiology, 1991, 8th ed., W.B. Saunders Company.

Reference Books

R1. Human Physiology-Systemic & applied-Sahalya, 2009.
R2. Human Nutrition and Dietetics – Swaminathan, Bangalore printing and Pulv. Co. Ltd, 1996.
R3. Review of Medical Physiology – Ganong, Appleton and Lange, 2003.

Course Title :HUMAN PHYSIOLOGY AND CLINICAL BIOCHEMISTRY**(P)**	Course Code : 33P
Semester : **III**	Course Group : **DSC-VI**
Teaching Scheme in Hrs (L:T:P) : **0:0:4**	Credits : **2**
Map Code : H (PRACTICAL - EXPERIMENTS)	Total Contact Hours: **60**
CIA : **40 Marks**	SEE : **60 Marks**
Programme: **BSC-BC**	

List of Experiments:

1.Estimation of Bilirubin by KIT method.

2. Estimation of Glucose by OT method.

3. Estimation of Protein by Lowry's method.

4. Collection of Blood – Separation of Serum and Plasma

5. Determination of Bleeding Time.

6. Determination of Clotting Time.

7. Preparation of Bicarbonate Buffer.

8. Estimation of Cholesterol by Zak's Method.

9. Estimation of Hemoglobin by Darbkin's/ Sahil's Method.

10. Determination of Sodium by Tritimetry Method.

11. Estimation of Potassium by Flame Photometry.

12. Estimation of Phospholipids by Colorimetric method.

13. Collection of Urine and its Preservation.

14. Qualitative analysis of Sugar by Benedict's Method.

15. Qualitative analysis of Abnormal Constituents

Course Title : **STEM CELLS AND CANCER BIOLOGY**	Course Code : 33E
Semester : **III**	Course Group : **DSE-I**
Teaching Scheme in Hrs (L:T:P) : **6:0:0**	Credits : **2**
Map Code :D	Total Contact Hours: **90**
CIA : **25**	SEE : **60**
Programme: **BSC-BC**	

CO1- Understand the key features of the origin the basics, properties and types with their derivatives of stem cells
CO2- Remember the causes of cancer cells, neurodegenerative disease and the fate mapping of stem cells.
CO3- Select the future challenges associated with stem cell usage
CO4- State the interruption of carcinogens and mutagens in the normal cell cycle.
CO5- Analyze the new drugs and its application through stem cell therapy
CO6- Understand the different forms of cancer therapy.

UNIT I -(LECTURE HOURS:15)

Stem cells–(Introduction, Definition and history)Types (Oligopotent, Totipotent, Pluripotent)Properties - Specialized, unspecialized (differentiation)Embryonic stem cells–(Introduction, Generation and culturingAdult) stem cells - Introduction, Generation and culturingHematopoietic stem cells–(Introduction, Generation and culturing)Stem cell in aging – (potency and future of stem cells)

UNIT II --(LECTURE HOURS:15)

Leukemia and cancer stem cells. Leukemia –(Introduction, history and causes)Cancer stem cells–(Origin, Metastasis, implications)Neural stem cells–(Differentiation, implications)Neurodegenerative diseases–(Introduction, Alzheimer's disease, Parkinson's disease)Derived stem cellsDifferentiation–(Early and later development)Types–(Ectoderm, Endoderm and mesoderm derived stem cell)Fate mapping of stem cellsIntroduction –(experimental system)

UNIT III--(LECTURE HOURS:15)

Stem cell therapies

Applications of stem cell- (In the treatment for major diseases in reparative medicine), **Hematopoietic Stem Cell** –(transplantation). **Skin replacement therapy**–(Introduction and treatment using stem cells) **Brain cell Transplantation**–(Introduction and therapy using stem cells)**Autoimmune diseases, Grave's disease, Diabetes**–(Introduction and therapy using stem cells)**Heart failure**–(Introduction and therapy using stem cells)**Future challenges and Ethical issues in stem cellsChallenges in stem cell usage**–(Introduction and its applications)**Issues related to stem cells**–(Ethical and legal issues)

UNIT IV--(LECTURE HOURS -18)
FUNDAMENTALS OF CANCER BIOLOGY
Cell cycle and cancer: Introduction of cell phases-(Mitotic phase, interphase, centromere, chromatids).**Cancer biology and carcinogenic agents**: Introduction, - (neoplasia, anaplasia, metaplasia and hyperplasia). **Cancer cells:** Cancer stem cells-(Introduction and its nature).**Cancer symptoms**- (Early symptoms, APC, Tumor suppressor cells).**Characteristics of cancer cells**–(changes in cell membrane structure and functions, tumor angiogenesis). **Carcinogenic agents** – (Physical, chemical and biological agents in carcinogenesis). Historical highlights, **Chemical carcinogens**-(types of chemical carcinogens; direct acting, pro-carcinogens, co-carcinogens, mechanism of their action). **Viral carcinogenesis** – Role of viruses in causation of human cancer; (Tobacco and diet related cancers).

UNIT V--(LECTURE HOURS -18)
Causes of cancer- Physical and Biological factors, (raditionexposure,Tumor promoters)**types of cancer**- (benign, malignant, metastatic cancers. Carcinomas, sarcomas, adenomas, haemopoetic cancers). Cancer screening and early detection-(Detection using biochemical assays, Tumor markers, Molecular tools for early diagnosis of cancer) **Detection ,Treatment and Therapies of cancer:**Detection of cancers- (Prediction of aggressiveness of cancer).Different forms of therapy- (Chemotherapy, Radiation therapy, targeted cancer therapy and Immunotherapy).Advances in cancer detection-(Use of signal targets towards therapy of cancer, Gene therapy).
Text Books :
T1: Molecular Cell Biology| Edition:5 | Freeman and company | Lodish et al.,(2004)
T2: Regerative medicine | Edition:1 | NIH | Bethesda(2006)
T3: Understanding Stem cells | Edition:1 | National Academy of Science | Thomas P Zwaka(2010)

Course Title :**INTERMEDIARY METABOLISM (T)**	Course Code : 43A
Semester : **IV**	Course Group : **DSC-VII**
Teaching Scheme in Hrs (L:T:P) : **4:0:0**	Credits : **4**
Map Code : **C(THEORY CONCEPTS)**	Total Contact Hours : **60**
CIA : **25 Marks**	SEE : **75 Marks**
Programme: **BSC-BC**	

No.	Course Outcome	POs & PSOs	Cl. Ses	CL
CO1	Discuss the general design of metabolic pathways based on bioenergetic principle.	PSO 1	10	U

CO2	Describe the process involved in carbohydrate metabolism, Glycolysis, Glycogenesis &Glycogenolysis.	PSO 2	10	U& An
CO3	Understanding the mechanisms involved in Electron Transport Chain.	PSO 2	10	R & U
CO4	Illustrate the process of Biosynthesis of fatty acid oxidation in lipid metabolism	PSO 2	10	U & An
CO5	Describe the process involved in the metabolism of protein.	PSO 3	10	U & An
CO6	Describe the Synthesis & Degradation of Purine and Pyrimidine nucleotides.	PSO 2	10	U & An

UNIT-I- (LECTURE HOURS: 10)

Metabolism –(Metabolism- Concepts of anabolism and catabolism) Carbohydrate metabolism -Glycolysis (Pathway and Energetics). TCA cycle – (Pathway and Energetics).Glycogenolysis-(Reactions of Glycogen phosphorylase, Glucan transferase and Glucose phosphatase).Glycogenesis –(Reactions of Glucokinase, Formation of UDPG glucose, Glycogen synthase). Gluconeogenesis- (Reactions of Transamination, Deamination, Propionate metabolism).HMP shunt –(Oxidative and non oxidative phase reactions).

UNIT-II-(LECTURE HOURS: 10)

Biological Oxidation –(Biological oxidation(Reactions, Redox potential, High energy compounds).Electron Transport Chain – (Electron carrier, sites of ATP production, inhibitors of ETC).Oxidative phosphorylation –(Structure of ATPase complex, Chemiosmotic theory, inhibitors).

UNIT-III- (LECTURE HOURS: 10)

Lipid Metabolism - (Oxidation of fatty acids – alpha, beta and omega oxidation).Biosynthesis of Saturated and Unsaturated fatty acids – (Reactions of Acetyl ACP, Fatty acid synthase)Biosynthesis of Phospholipids – (Phosphotidyl choline, ethanolamine and serine). Metabolism of Cholesterol–(Conversion of acetate to mevalonate to isoprene to squalene to cholesterol).

UNIT-IV(LECTURE HOURS: 10)

Protein Metabolism –(General reactions of amino acid - Deamination, Transamination, Decarboxylation).Urea cycle –(Reactions and intermediates of urea cycle).Catabolism of carbon skeleton of aminoacids- (Glycogenic and

ketogenic).Integration of metabolism – (Interrelation between Carbohydrate, Fat and Protein metabolism).

UNIT-V (LECTURE HOURS: 10)

Nucleic acids- (Introduction - Nucleosides & Nucleotides).Metabolism of Purines-(Biosynthesis of purine nucleotides Denovo synthesis - Synthesis of purines AMP & GMP from ribose 5 phosphate).Biosynthesis of purine nucleotides salvage pathways – (Conversion of purines their nucleosides & their deoxyribonucleotides into mononucleotides).Metabolism of pyrimidines –(Biosynthesis of pyrimidine nucleotides- Denovo synthesis).Biosynthesis of pyrimidine nucleotides-(salvage pathways - Deoxyribonucleosides of uracil & cytosine are salvaged).

Text books:

T1: Fundamentals of Biochemistry, 2017 J.L.Jain, S.Chand publications.

T2: Principles of Biochemistry, 2011 Nelson, David.I and Cox, M.M.Macmillian worth, NY.

T3:Textbook of Biochemistry, 1995 LubertStryer, 4th Edition, W.H.Freeman& Co. (New edition)

T4:Biochemical Methods 2014, Sadasivam and A. Manickam, Second Edition. (New edition)

T5:Laboratory Manual in Biochemistry 2013, J.Jayaraman

Reference books

R1: Textbook of Biochemistry, Harper, Robert K.Murray, Daryl k.Graner, Peter A.Mayes Rodwell,2018, Rev edition.

R2:Principles of Biochemistry, Zubay Geoffrey, McGraw publishers, 2017, 5th edition.

R3:Textbook of Biochemistry, 2016 LubertStryer, 4thEdition, W.H.Freeman& co.

Course Title :**INTERMEDIARY METABOLISM (P)**	Course Code : 43P
Semester : **IV**	Course Group : **DSC-VIII**
Teaching Scheme in Hrs (L:T:P) : **0:0:4**	Credits : **2**
Map Code : H (PRACTICAL - EXPERIMENTS)	Total Contact Hours: **48**
CIA : **40 Marks**	SEE : **60 Marks**
Programme: **BSC-BC**	

List of Experiments:

1. Estimation of Total Carbohydrates by Anthrone method.
2. Estimation of Glycogen by Anthrone method.
3. Estimation of Iron by Wong's method.

4. Estimation of Hydrogen peroxide by colorimetric method.
5. Determination of Total cholesterol from blood sample by KIT method.
6. Extraction of lecithin from egg yolk.
7. Separation of Glycine, Methionine by TLC method.
8. Estimation of Urea by DAM – TSC method.
9. Separation of DNA by Agarose Gel Electrophoresis.
10. Estimation of RNA by Orcinol method.

Course Title :**ENZYMOLOGY (T)**	Course Code : 43B
Semester : **IV**	Course Group : **DSC-VIII**
Teaching Scheme in Hrs (L:T:P) : **4:0:0**	Credits : **4**
Map Code : **C(THEORY CONCEPTS)**	Total Contact Hours : **60**
CIA : **25 Marks**	SEE : **75 Marks**
Programme: **BSC-BC**	

Course outcome: (Cos)

No.	Course Outcome (Cos): After completion of this course, the students will be able to	POs & PSOs	Cl. Ses	CL

CO1	Describe the Nomenclature and Classification of enzymes according to International Union of Biochemistry (IUB)	PSO 1	10	A
CO2	Illustrate the enzyme kinetics and enzyme inhibition in enzyme catalytic reaction.	PSO 2	10	R
CO3	Discuss the structure and functions of Coenzymes and role of coenzymes in various metabolic reaction.	PSO 2	10	U
CO4	Describe the methods of Immobilizations and its applications in various Industrial aspects.	PSO 3	10	U
CO5	Discuss the Biosensor, various types and its application in clinical aspects.	PSO3	10	R
CO6	Describe the role of enzymes in Medicine , Food and Textile industry.	PSO3	10	U

UNIT- I (LECTURE HOURS: 10)

ENZYME :INTRODUCTION AND CLASSIFICATION:

Enzyme: Introduction – (Properties and History) & Nomenclature - According to IUB system. Digit number, Suffix "ase" Classification - Six main classes, (Definition & suitable examples) Active site-(Introduction & Mode of action) - Salient features of active site residues.-(Binding sites and catalytic sites). Lock and Key model – (Definition, mechanism & diagrammatic presentation) Induced fit model – (Definition, mechanism & diagrammatic presentation)

UNIT –II(LECTURE HOURS: 10)

ENZYME KINETICS:

Steady state theory – (Introduction, Rate of formation of ES, Graph) Michaelis-Menton equation, Km - Michaelisconstant.- (Introduction and Derivation.) LB Plot : LB Plot Graph. Hanes plot - Based on the MM equation. (Introduction & Derivation) Enzyme inhibition & factors affecting enzyme activity – (Introduction and Mechanism) Reversible inhibitors, Irreversible inhibitors. Competitive, Non-competitive & Uncompetitive inhibition – (Mechanism with examples) Effect of various factors affecting enzyme activity –(Vital role in metabolic regulation Substrate, enzyme, temperature & PH, Saturation point, Vmax, Km, Optimum PH & Temperature)

UNIT –III (LECTURE HOURS: 10)

CO ENZYME :

Coenzyme :(Introduction and Properties) Nicotinamide coenzymes - NAD+ and NADP+- (Structure and Function) .Flavin nucleotides - FMN and FAD- (Structure and Function) TPP – Thiamine Pyro Phosphate- (Structure and Function). PP- Pyridoxal Phosphate- (Structure and function) Biotin- (Structure and Function) Folic acid- (Structure and Function) Isoenzymes- (Introduction and properties) Multienzyme complex – (Definition & examples) Pyruvate dehydrogenase – (Mechanism & reactions)

UNIT- IV(LECTURE HOURS: 10)

ENZYME IMMOBILIZATION

Enzyme Immobilization (Introduction – Definition.) Methods of immobilization – (Principle and Types) Adsorption, Covalent bonding, Cross linking. Encapsulation, Entrapment, Advantage of immobilization process – (Advantage in immobilization techniques in industry aspects) Applications of immobilized enzymes – (Components of analytical systems, continuously operated process)

UNIT – V (LECTURE HOURS: 10)

ENZYME SENSOR

Enzyme Biosensor: Introduction – (Definition and Principle) Types and Applications - Colorimetric, Optical &immunosensor. (Principle and application) Enzyme in Industrial aspects – (Role in Food& Textile industry) Role of enzyme in medicine - Treatment of various diseases (Asparginase, Collagenase, Urokinase, Streptokinase) Food and drink industries – (Baking of bread, brewing industries.)Other industries – (Washing powders, Immobilized glutamate dehydrogenase linked to alcohol dehydrogenase) Role of enzymes in Free Radical Scavenging – (SOD, GSH Reductase, Catalase, Etc.)

Text Books :

T1 - Fundamentals of Enzymology | Edition:2 | Oxford Science Publications, Newyork. | Nicholas c. price, Lewis stevens 2010

T2 - Enzymes - Biochemistry, Biotechnology, Clinical chemistry. | Edition:3 | East west Press Pvt Ltd, New Delhi. | Trevor palmer. and Philip bonner (2014)

Reference Books :

R1 – Lehninger Principles of Biochemistry, David. L.Nelson, Michael M. Cox . Eight edition ,2021.

R2- Harper's Illustrated Biochemistry, Victor Rodwell, David Bender, Kathleen Botham and Peter Kennelly, Thirty First Edition -May-2018.

R2- Enzyme Chemistry: Impact and Applications, 3rd Edition by Colin J Suckling and Gibson Colin .L -2010

Course Title :**ENZYMOLOGY (P)**	Course Code : 43Q
Semester : **IV**	Course Group : **DSC-VIII**
Teaching Scheme in Hrs (L:T:P) : **0:0:4**	Credits : **2**
Map Code : H (PRACTICAL - EXPERIMENTS)	Total Contact Hours: **60**
CIA : **40 Marks**	SEE : **60 Marks**
Programme: **BSC-BC**	

List of Experiments:

1. Determine the pH on the activity of Salivary Amylase

2. Determine the Temperature on the activity of Salivary Amylase

3.Determine the pH on the activity of Alkaline Phosphatse

4. Determine the Temperature on the activity of Alkaline Phosphatse

5. Determine the pH on the activity of Catalase

6. Determine the Temperature on the activity of catalase

7. Determine the pH on the activity of Acid Phosphatase

8. Determine the Temperature on the activity Acid Phosphatse

9.Determine the SOD Enzyme activity

10.Determination of GSH Reductase activity

Course Title	:CLINICAL RESEARCH	Course Code	: 43E
Semester	: **IV**	Course Group	: **DSE-II**
Teaching Scheme in Hrs (L:T:P) : **6:0:0**		Credits	: **4**
Map Code	: **D(THEORY CONCEPTS)**	Total Contact Hours	: **60**
CIA	: **25 Marks**	SEE	: **75 Marks**
Programme: **BSC-BC**			

S.No	Course Outcome	POs & PSOs	Cl. Ses	
CO1	To understand the basic concept of Clinical research	PSO 1	12	Understand
CO2	To remember the drug development process specially the phases of clinical trials.	PSO 2	12	Remember
CO3	To learn the students on conceptualizing, designing, conducting, managing and reporting	PSO 2	12	Understand
CO4	To understand the ethical requirement for conducting clinical trials	PSO 3	12	Understand
CO5	To know how to protect the rights, safety and wellbeing of trial subjects	PSO3	12	Analyse

UNIT-I - (LECTURE HOURS: 12)

INTRODUCTION TO CLINICAL RESEARCH:

Historical Perspective–**(**Nuremberg Code, Thalidomide study, Nazis Trials, Tuskegee Syphilis Study, The Belmont).Report - **(**The declaration of HelsinkiOrigin and Principles of International Conference on Harmonization - Good Clinical Practice(ICH-GCP) guidelines
Definition- **(**Types) and Design of clinical trials – **(**Prevention trials, diagnostic trials, treatment trials).Randomized trials and uncontrolled trials- (Crossover and factorial designs, Equivalence, non-inferiority and superiority trials

UNIT-II- (LECTURE HOURS: 12)

Phases of clinical trials- phase 1, phase 2, phase 3, phase 4
Principles of controlled clinical trials-Clinical trial design (observational and interventional) protocol, consent in clinical trials, placebo, bias and methods to prevent bias

UNIT-III–(LECTURE HOURS: 12)

Clinical data management (CDM)- (handling of data/ information, clinical trial management systems, Data safety monitoring board and Committees) Clinical Trial Monitoring-(various types of monitoring plans and monitoring visits, Investigators, Study Coordinator, Sponsor, Monitor, Contract Research OrganizationProject management Documentation, Monitoring, Audits and Inspections)

UNIT-IV- - (LECTURE HOURS: 12)

ETHICS IN CLINICAL RESEARCH

Developing clinical trial protocols- (Institutional Review Board/ Independent Ethics committee-formation and working procedures)Declaration of Helsinki and Informed consent- (process and procedures) HIPAA- (A new requirement to clinical study process).Pharmacovigilance- (safety monitoring in clinical trials).
UNIT-V- (LECTURE HOURS: 12)

Regulations Governing Clinical Trials ICH – (GCP guidelines) Clinical Research regulations in India – CDSCO guidelines)Clinical trial application requirements in India- (IND, ANDA, AADA and NDAUSFDA regulations to conduct drug studies)Clinical Research regulations in UK – (Medicines and Healthcare Products RegulatoryAgency (MHRA)Clinical Research regulations in Europe (EMEA)

REFERENCES
R1: Handbook of clinical research. Julia Lloyd and Ann Raven Ed. Churchill Livingstone c.

R2: Principles of Clinical Research edited by Giovanna di Ignazio, Di Giovanna and Haynes.

R3: Textbook of Clinical Trials edited by David Machin, Simon Day and Sylvan Green, March 2005, John Wiley and Sons.

R4**:**Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance By Fay A. Rozovsky and Rodney K. Adams

R5: Clinical trial of drugs and biopharmaceuticals | Edition:- | CRC Press | CHI-JEN LEELUCIA H LEE(2006)

Course Title	:BIOCHEMICAL PHARMACOLOGY (T)	Course Code	: 53A

Semester : **V**	Course Group : **DSC-XI**
Teaching Scheme in Hrs (L:T:P) : **4:0:0**	Credits : **4**
Map Code : **C(THEORY CONCEPTS)**	Total Contact Hours : **60**
CIA : **25 Marks**	SEE : **75 Marks**
Programme: **BSC-BC**	

No.	Course Outcome	POs & PSOs	Cl. Ses	CL
CO1	To understand the basic concepts of pharmacology	PSO 1	12	U
CO2	To explain the principle of absorption, distribution, metabolism and excretion of drugs	PSO 2	12	Ap
CO3	To understand the mode of action of a drug, and the method by which it can be synthesized	PSO 2	12	Ap
CO4	To remember the causes of disease and effects of existing drugs and development of new modes of treatment.	PSO 2	12	R
CO5	To understand the mechanism of drug abuse	PSO 1	12	R

UNIT – I- **(LECTURE HOURS: 12)**

DRUGS

Introduction to drugs:Pharmacodynamics, Pharmacokinetics, Pharmacognosy, Pharmacy, The nature of drugs: stimulants, depressants, painkillers and hallucinogens Sources of drugs –(Plants, Animals, Mineral, Synthetic, Semi-synthetic sources, Microbiological sources), Genetic engineering- (rDNA technology) Routes of drug administration - Oral, Injections, (Subcutaneous,Intramuscular, Intradermal, Intravenous, Intra-arterial, Intrathecal,IntraperitonealSubcutaneous, TransmucosalSubcutaneous). Cell surface receptors –(Ion channels, G protein coupled receptors, Tyrosine kinases). Drug receptor interaction –(Agonist, Antagonist, Inverse agonist, partial agonist).

UNIT – II–**(LECTURE HOURS: 12)**

ADME

Absorption - Passive Diffusion, (Facilitated passive diffusion of lipid soluble substances)Acitve transport (water soluble substances), pinocytosis (fluid or particles are engulfed by a cell). Distribution - Plasma,(blood and tissue binding proteins, pH, and perfusion) Interstitial fluid compartment, transcellular fluid compartment, cellular fluid compartment (Volume of Distribution). Metabolism –(Site of action, cytochrome P450) Phase I –(Oxidation, reduction and hydrolysis Mixed function oxidases - Epoxidation, hydroxylation, O, N and S-Dealkylation, N-Dealkylation). Phase II. –(Sulphation, methylation, Aminoacid conjugation and glutathione conjugation). Elimination - Renal system (Passive glomerular filtration and Active Tubular secretion).

UNIT - III **(LECTURE HOURS: 12)**

CHEMOTHERAPY

Introduction - Definition and history. Antibacterial - Sulphonamides, Penicillin, Streptomycin, tetracycline.(source, structure, mechanism of action, therapeutic uses and adverse effects)Antiviral – Hydroxychloroquine and Ivermectin (source, structure, mechanism of action, therapeutic uses and adverse effects) Antimalarial - Life cycle of malaria,Quinine and chloroquine(source, structure, mechanism of action, therapeutic uses and adverse effects)Anti-Tuberculosis - Isonicotinic acid hydrazide and Rifampicin(source, structure, mechanism of action, therapeutic uses and adverse effects)Anticancer - Cyclophosphamide and methotrexate.(source, structure, mechanism of action, therapeutic uses and adverse effects)

UNIT - IV**(LECTURE HOURS: 12)**

DRUGS ACTING ON VARIOUS DISEASES

Central nervous system –(Introduction, Structure and mode of action of barbiturates and salicylates).Cardiovascular system –(Introduction, Structure and mode of action of Cardiac glycosides). Hepatic diseases (Liver enzymes and fatty liver). Renal diseases- (Kidney stones)

UNIT - V**(LECTURE HOURS: 12)**

DRUGS OF PLANT ORIGIN

Primary and Secondary metabolites :Drug Dependence and AbuseTypes –(Psychic dependence and physical dependence), Factors which facilitate abuse –(Availability of drugs, peer group pressure, socioculture)Principles of Treatment –(Hospitalization, drug therapy, substitution therapy).

Text Books :

T1: Pharmaceutical Pharmacology | Edition:4 | New age International publishers | S C MethaAshutoshKar, (2011)

T2: Pharmolocology and Pharmacotherapeutics | Edition:23 | Prakasam Pvt. Ltd, Mumbai | BhandarkarS.D AND SatoskarR.S(2013)

Reference Books :
R1: Essentials of Medical Pharmacology | Edition:Seventh Edition | Jay Pee Brothers Medical Publishers, New Delhi. | Tripathi,K.D(2010)
R2: Pharmacology | Edition:5 | Lippincott Williams & Wilkins publishers | ChampeP.C AND HarveyR.A AND MycekM.J(2010)

Course Title :**BIOCHEMICAL PHARMACOLOGY(P)**	Course Code : 53P
Semester : **V**	Course Group : **DSC-IX**
Teaching Scheme in Hrs (L:T:P) : **0:0:4**	Credits : **2**
Map Code : H (PRACTICAL - EXPERIMENTS)	Total Contact Hours: **60**
CIA : **40 Marks**	SEE : **60 Marks**
Programme: **BSC-BC**	

List of Experiments:

1. Study of different routes of drugs
2. Collection of blood samples
3. Free radical scavenging activity –
   a. DPPH
   b. ABTS
4. Gram staining and simple staining
5. Antimicrobial activity
6. Estimation of SGOT
7. Estimation of SGPT
8. Phytochemical screening
9. Estimation of Phenols

Course Title :**IMMUNOLOGY**	Course Code : 53B

(T)	
Semester : **V**	Course Group : **DSC-X**
Teaching Scheme in Hrs (L:T:P) : **4:0:0**	Credits : **4**
Map Code : **C(THEORY CONCEPTS)**	Total Contact Hours : **60**
CIA : **25 Marks**	SEE : **75 Marks**
Programme: **BSC-BC**	

No.	Course Outcome	POs & PSOs	Cl. Ses	CL
CO1	To understand the concept immune system for protection against diseases	PSO 1	10	U
CO2	To remember the antigen andantibody structure, types, function and immunological	PSO 2	10	Ap
CO3	To apply immune techniques to understand know the measurement of antigen and antibody interaction .	PSO 2	10	Ap
CO4	To explain the different types of hypersensitivity and various immunological disorders .	PSO 2	10	R
CO5	To understand the significance of different vaccines.	PSO 1	10	R
CO6	To study the important organs transplantation and its impact of rejection	PSO 1	10	R

UNIT-I (LECTURE HOURS: 10)

Immunology

Introduction to Immunology (Definition and general principles of Immunology),Innate immunity and Acquired immunity (Physiological, genetic, anatomic and inflammatory Live and attenuated

vaccines, Active and Passive), Antibody mediated immune response (Primary and secondary immune response),Cell mediated immune response (Lymphocytes),Primary lymphoid organs (Thymus and Bone Marrow), Secondary lymphoid organs (Spleen, Lymph node),Cells of immune system (RBC,WBC, NK CELLS),Structure and function (Neutrophils, eosinophils, basophils, macrophages and phagocytes)

UNIT-II (LECTURE HOURS: 10)

Antigen

Introduction- (Definition and Types Properties,Specificity, cross reactivity, antigenicity, immunogenecity Chemical nature Epitope, haptens, adjuvant, super antigen Introduction (Definition and properties) Structure and function - (Light Chain, Heavy Chain, Hinge region, Disulphide bonds), Class and subclass (Ig G, Ig A, Ig M, Ig E & Ig D), Clonal selection theory (Response of B cells to antigen) antigen- antibody reactions (Primary, Secondary and Tertiary - Precipitation and agglutination experiments). Complement system Introduction -(Definition and mechanism of formation),Complement pathway (Components and pathway)

UNIT-III (LECTURE HOURS: 10)

Measurement of antigen and antibody combination

Introduction -(Introduction of diffusion and agglutination methods) , Immunodiffusion- (Types Radial immuno diffusion, double immuno diffusion). Immuno electrophoresis- (Principles and techniques), agglutination -(Types Slide and Table agglutination), Widal test -(Method) immunological test Application RIA, ELISA, monoclonal antibodies

UNIT-IV (LECTURE HOURS: 10)

Allergy and hypersensitivity

Types I & II- (Mechanism and clinical manifestation),Types III & IV- (Mechanism and clinical manifestation) immunological disorders Autoimmune diseases- (Rheumatoid Arthritis and Myasthenia Gravis),Immuno-deficiency disease- (AIDS)

UNIT-V (LECTURE HOURS: 08)

Transplantation immunology

Introduction - (Allograft rejection and Graft vs Host diseases), Allograft rejection-(Mechanism of graft rejection), Rejection to tumors - (tumors rejection) Vaccination Types of immunization- (Active and Passive immunization), Types of vaccines -(Recombinant DNA vaccines and Edible vaccine), Effects -(Benefits and adverse effects of vaccination)

Text Books :

T1: Immunology | Edition:2 | Lippincott Williams & Wilkins |Melvold, Roger AND Doan, Thao AND Viselli, Susan(2012)

T2: Kuby Immunology | Edition:8 | W.H. Freeman Publishers | Jenni Punt AND Judy Owen AND Patricia Jones AND Sharon Stranford(2019)

Reference Books :
R1: Immunology | Edition:4 | Elsevier publishers | David B RothIvanRoitt AND David Male AND Jonathan Brostoff(2012)

Course Title :**IMMUNOLOGY (P)**	Course Code : 53Q
Semester : V	Course Group : **DSC-X**
Teaching Scheme in Hrs (L:T:P) : **0:0:4**	Credits : **2**
Map Code : H (PRACTICAL - EXPERIMENTS)	Total Contact Hours: **60**
CIA : **40 Marks**	SEE : **60 Marks**
Programme: **BSC-BC**	

List of Experiments:

Separation of serum and plasma from blood sample -

Estimation of WBC -

ASO latex test -

RA test -

Rocket immunoelectrophoresis -

Widal test -

Estimation of uric acid -

ELISA test -

Visit to vaccination center -

Course Title :**MICROBIAL PHYSIOLOGY (T)**	Course Code : 63B
Semester : V**I**	Course Group : **DSC-XI**
Teaching Scheme in Hrs (L:T:P) : **4:0:0**	Credits : **4**
Map Code : **C(THEORY CONCEPTS)**	Total Contact Hours : **60**
CIA : **25 Marks**	SEE : **75 Marks**
Programme: **BSC-BC**	

No.	**Course Outcome**	**POs & PSOs**	**Cl. Ses**	**CL**
CO1	Understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes	PSO 1	10	U
CO2	Understand the structural similarities and differences among various physiological groups of Microbes.	PSO 1	10	U& R
CO3	Understand and distinguish the Microorganisms based on their nutritional requirements and uptakes of nutrients.	PSO 1	10	An
CO4	Elucidate the growth and growth factors of Microorganism.	PSO 2	10	U & An
CO5	Provide knowledge about the Metabolic and Biosynthetic pathways.	PSO 3	10	U & An
CO6	Acquire the knowledge about aerobic and anaerobic respiration of Microorganisms.	PSO 2	10	U & An

UNIT – I(LECTURE HOURS 12)

Nutrition: Nutritional requirements of Microorganisms – (Autotrophs, Heterotrophs,Photoautorophs, Chemoautotrophs, Copiotrophs, Oligotrophs). Transport Mechanisms Diffusion – (Facilitated Diffusion, Active Transport Group Translocation). Phagocytosis – (Pinocytosis).

UNIT – II(LECTURE HOURS 12)

Different phases of growth: Growth curve – (Generation time factors influencing Microbial growth – Temperature, pH, Pressure , Salt concentration) , Nutrients – (synchronous growth and continous cultivation) . Diauxic growth. Sporulation – (Endospore formation in bacteria).

UNIT –III(LECTURE HOURS 12)

Metabolism :EMP – HMP – ED pathways. TCA cycle- Electron transport chain – Oxidative and Substrate level phosphorylation- (Introduction and mechanism).

UNIT- IV(LECTURE HOURS 12)

Anaerobic respiration – sulphur , nitrogenous compounds and CO2 as final electron Acceptor - Fermentation – alcoholic, propionic and mixed acid fermentation. Lactic acid fermentation.

UNIT- V(LECTURE HOURS = 12)

Photosynthesis in Cyanobacteria (BGA) – Oxygenic and Anoxygenic , Carbon dioxide fixation, Biosynthesis of bacterialcellwall, Biosynthesis of aminoacids (Glutamic acid family)- Bioluminescence.

References

R1: Prescott, L.M J.P. Harley and C.A. Klein 2009. Microbiology 5th edition Wm, C. Brown publishers.
R2: David White. The Physiology and Biochemistry of Prokaryotes. Oxford University Press. 4th
Edition. 2011.
R3:Tortora, Funke and Case. Microbiology - An Introduction. Books a la carte Edition. 11th Edition
R4: Caldwell. D.R.2008, Microbial physiology and Metabolism. WmC Brown Publishers, England.
R5: Jacquelyn G Black & Laura J Black, 2015. Microbiology, Principles and Exporation, 9th Edition. Willey and Co.

Course Title	:MICROBIAL PHYSIOLOGY (P)	Course Code	: 63Q
Semester	: VI	Course Group	: **DSC-XII**
Teaching Scheme in Hrs (L:T:P) : **0:0:4**		Credits	: **2**

Map Code : H (PRACTICAL - EXPERIMENTS)	Total Contact Hours: **60**
CIA : **40 Marks**	SEE : **60 Marks**
Programme: **BSC-BC**	

List of Experiments**:**

1. Preparation and sterilization of media.
2. Isolation and numeration of microbes from soil.
3. Effect of temperature, pH on Growth curve of *E. Coli*.
4. Gram staining &Endospore Staining.
5. Identification of microorganisms by Biochemical tests.
6. Production of alcohol using *Yeast* Fermentation.
7. Impact of soil types on chlorophyll synthesis in plants.

Course Title :**PLANT BIOCHEMISTRY (T)**	Course Code : 63A
Semester : V**I**	Course Group : **DSC-XI**
Teaching Scheme in Hrs (L:T:P) : **4:0:0**	Credits : **4**
Map Code : **C(THEORY CONCEPTS)**	Total Contact Hours : **60**

CIA : **25 Marks**	SEE : **75 Marks**
Programme: **BSC-BC**	

No.	**Course Outcome**	**POs & PSOs**	**Cl. Ses**	**CL**
CO1	Develop a basic understanding of biochemical events associated with structural arrangement of plant cell and organization	PSO 1	10	U
CO2	Explain and understand the biochemistry of photosynthetic process and its relation to man and its environment.	PSO 1	10	U& R
CO3	Understand the mechanism of Nitrogen fixation and its importance in agricultural production and economics.	PSO 1	10	An
CO4	Know the significance of plant growth regulators in the development of plants.	PSO 2	10	U & An
CO5	Explain and understand the biochemistry of plant growth and development.	PSO 3	10	U & An
CO6	Acquire knowledge about the importance of plant tissue culture and its industrial applications.	PSO 3	10	U & Ap

UNIT I (LECTURE HOURS: 12)

Plant cell

Cell wall.:-Structure and function of cell wall.Chloroplast - Structure and function vacoules. - Structure and function of vacoules. Absorption and translocation of water–(Active absorption, Passive absorption)Mechanisms - active and passive –(Active absorption of water -Osmotic absorption Non osmotic absorption). Passive absorption Ascent of sap: Mechanism and theories. –(Three theories)Transpiration –(Water evaporation, Factors affecting Transpiration-Temperature Light, Available soil water wind)mechanism of stomatal opening; - Mechanism factors affecting transpiration –(Temperature Light Available soil water wind)guttation- (Watery solution oozes out from uninjured margin)

UNIT II (LECTURE HOURS: 12)

Photosynthesis:Photosynthetic pigments: Photosynthetic apparatus- (-chlorophyll – chlorophyll, phycobillins, carotenoidcarotenoid and phycobillin**;** - (Yellow **or** orange pigment, Red and blue

pigmentLight reactions) - Two kinds of chemical system - photosystem-1 - Two phytochemical process 1 & 2 680mu.(Light absorbtion. and 2-evidences in support of light reaction**.** - Two phytochemical process 1 & 2 700mu)Hills reaction- Absorption of light energy (Activation of chlorophyllcyclic and non-cyclic phosphorylation)- Z - scheme Electron transport chain-Darkreaction: Calvin's cycle (C3 plants**),** - (Carboxylation Reduction, formation)Hatch-slack cycle **(**C4 plants)- C4 (decarboxylationpathway.-)Factors affecting photosynthesis**.** –(Internal, External factors)

UNIT III (LECTURE HOURS: 12)

Cycles of element:Nitrogen cycle - Soil, Air, Plant. ammonification, nitrification –(ammonification reduction and denitrification)–Introduction .Nitrogen fixation**:** - symbiotic and non-symbiotic nitrogen fixation. nitrate release of sulfur from organic compounds.Sulfur cycle**:** -(oxidation of sulfur compounds; reduction of sulfate)Plant nutrition:Macronutrients–(Carbon, Hydrogen, oxygen, nitrogen, Sulphur, phosphorus, calcium, potassium, magnesium and iron.-)Micronutritients–(manganese, boron, copper, zinc, molybdenum and chlorine).

UNIT IV (LECTURE HOURS: 12)

Plant growth hormones: Auxins:- biosynthesis, (mode of action and applications) Synthetic auxins.Gibberellins:- (biosynthesis and mechanism of action, applications).Cytokinins–(mode of action and physiological role.) Abscicic acid–(physiological role and mode of action).Ethylene: -(physiological role and mode of action) .Biochemistry of fruit ripening–(Fruit ripening process)

UNIT V (LECTURE HOURS: 12)

Plant Tissue culture–(Biochemistry of seed germination)**.** - Physiology of seed germination (Totipotency)-Media- MS media :(composition and preparation). Callus culture-Undifferentiated masses of cells .Micropropagation–(Applications).Biochemical changes during senescence**.** –(Introduction).Protoplast fusion–(Polyethylene glycol)

Text Books :

T1: Fundamentals of plant physiology | Edition:11th edition | S.Chand& Company Ltd | V.K.Jain(2004)

Reference Books :

R1: Plant biochemistry and molecular biology | Edition:1 | ohm wiley and sons | Lea AND Leawood(2000) (books has to be included)

Course Title	:**PLANT BIOCHEMISTRY (P)**	Course Code	: 63P
Semester	: V**I**	Course Group	: **DSC - XI**
Teaching Scheme in Hrs (L:T:P) : **0:0:4**		Credits	: **2**

Map Code : H (PRACTICAL - EXPERIMENTS)	Total Contact Hours: **60**
CIA : **40 Marks**	SEE : **60 Marks**
Programme: **BSC-BC**	

List of Experiments:

1. Isolation and Estimation of starch from potato (Anthrone method)
2. Estimation of total free Amino Acid in plant tissues
3. Estimation of Beta Carotenoids in carrots
4. Separation of chlorophyll pigments by column chromatography
5. Determination of macronutrients- Calcium, Phosphorus
6. Determination of macronutrients- Iron, Copper
7. Assay of Urease Enzyme Activity
8. Quantitative measurement of IAA
9. Streilization and media preparation
10. Callus induction and micro propagation

Course Title : **DECISION AND ITERPRETATION OF CLINICAL DATA**	Course Code : 63E
Semester : **VI**	Course Group : **DSE - IV**
Teaching Scheme in Hrs (L:T:P) : **0:0:4**	Credits : **2 Credits**
Map Code: H (PRACTICAL EXPERIMENTS)	Total Contact Hours: **60**
CIA: **40 Marks**	SEE # : **60**
Programme: **BSC-BC**	**#** - **Semester**

No.	Course Outcome	POs & PSOs	Cl. Ses	CL

CO1	Interpret data to inform business decisions	PSO 1	10	U
CO2	Recognize trends, detect outliers, and summarize data sets	PSO 1	10	U& R
CO3	Analyze relationships between variables	PSO 1	10	An
CO4	Develop and test hypotheses	PSO 2	10	U & An
CO5	Craft sound survey questions and draw conclusions from population samples	PSO 3	10	U & An
CO6	Implement regression analysis and other analytical techniques in Excel	PSO 3	10	U & Ap

UNIT 1 (LECTURE HOURS: 12)

Descriptive Statistics–(Central values for data, conditional means, percentiles, variability) Descriptive statistics in excel, coefficient of variation.Relationships Between Two Variables –(Scatter plots, correlation, hidden variables, time series. Hands on Practice)Practice Problems–Solution.

UNIT 2 (LECTURE HOURS: 12)

Sampling and Estimation.Introduction–(Sampling at Amazon). Creating Representative and UnbiasedSamples –(Samples Vs Population, Sample size, Avoiding Bias) The NormalDistribution - Rules of thumb, The Normal function NORM.DIST, The Normal function NORM.INV, The central limit theoremConfidence Intervals–(Estimating the population mean, Large samples, small samples, Choosing a sample size, Estimating the population proportion). Amazon's Inventory Sampling - Amazon's Inventory SamplingHands on Practice (Practice Problems– Solution)

UNIT 3 (LECTURE HOUR: 12)

Hypothesis Testing. Introduction–(Amazon's use of Hypothesis Testing .Designing andPerforming HypothesisTests) - Developing Hypothesis, Constructing a range of likely sample means, using p-values, Type I and Type II Errors, One sided testing, Comparing two populations Improving the Customer Experience–(The shopping cart A/B test, The arrow A/B test, The magazine A/B testHands on Practice). Practice Problems –(solutions)

Designing and Performing HypothesisTests - Developing Hypothesis, Constructing a range of likely sample means, using p-values, (Type I and Type II Errors) One sided testing, Comparing two populations.Improving the Customer Experience–(The shopping cart A/B test, The arrow A/B test, The magazine A/B test .Hands on Practice -Practice Problems–Solution)

UNIT 4 (LECTURE HOURS: 12)

Single Variable Linear RegressionIntroduction - Regression at Disney Studios Regression Line–(Visualizing the Relationship, The best fit line, The structure of the Regression

line)Forecasting–(Point Forecasts, Prediction intervals.)Interpreting the regression output – (Quantifying predictive power, testing for a significant relationship), R-square vs p-value, Residual analysisPerforming Regression Analysis–(Regression Analysis in excel, Using dummy variablesForecasting Home Video Units - The Disney Studio Model, Just a starting point..Hands on Practice. Practice Problems - Practice Problems

UNIT 5 (LECTURE HOURS: 12)

Multiple Regression. Introduction - Multiple Regression at Caesars .Multiple Regressionequation - Single Vs Multiple Regression, Interpreting the multiple regression equation, forecasting. Adapting concepts from single regression - Adjusted R-square, Residual Analysis, Testing for Significance of Variables,New Concepts in Multiple Regression– MutiCollinearity, Dummy variables, lagged variables. The Caesars Staffing Problem - Developing the model, Analyzing the results, Improving the model .Hands on PracticePracticeProblem**s** - Practice Problems

Text Books :

T1-An Introduction to Statistical Learning with Applications | Edition:1 | Springer | Daniela Witten AND Gareth James AND Robert Tibshirani AND Trevor Hastie(2017)

Reference Books :

R1-Business Analytics | Edition: | Harvard Business School | Janice Hammond( )

R2-Open Intro Statistics | Edition:3 | Christopher D Barr AND David M Diez AND Mine Cetin | Christopher D Barr AND David M Diez AND Mine Cetinkaya(2017)