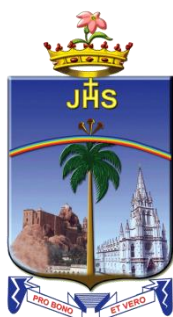


**M.Sc. BIOCHEMISTRY**  
**LOCF SYLLABUS – 2021**

**SCHOOLS OF EXCELLENCE**  
**WITH CHOICE BASED CREDIT SYSTEM (CBCS)**



**DEPARTMENT OF BIOCHEMISTRY**  
**SCHOOL OF BIOLOGICAL SCIENCES**  
**ST.JOSEPH'S COLLEGE (AUTONOMOUS)**

Special Heritage Status Awarded by UGC  
Accredited at A<sup>++</sup> Grade (IV Cycle) by NAAC  
College with Potential for Excellence by UGC  
DBT-STAR & DST-FIST Sponsored College  
Tiruchirappalli - 620 002, Tamil Nadu, India

## **SCHOOLS OF EXCELLENCE WITH CHOICE BASED CREDIT SYSTEM (CBCS) POSTGRADUATE COURSES**

St. Joseph's College (Autonomous), a pioneer in higher education in India, strives to maintain and uphold the academic excellence. In this regard, it has initiated the implementation of five "Schools of Excellence" from the academic year 2014 – 15, to meet and excel the challenges of the 21<sup>st</sup> century.

Each School integrates related disciplines under one roof. The school system enhances the optimal utilization of both human and infrastructural resources. It also enhances academic mobility and enriches employability. The School system preserves the identity, autonomy and uniqueness of every department and reinforces Student centric curriculum designing and skill imparting. These five schools adhere to achieve and accomplish the following objectives.

Optimal utilization of resources both human and material for the academic flexibility leading to excellence.

Students experience or enjoy their choice of courses and credits for their horizontal mobility.

The existing curricular structure as specified by TANSCH and other higher educational institutions facilitate the Credit-Transfer Across the Disciplines (CTAD) - a uniqueness of the choice based credit system.

Human excellence in specialized areas

Thrust in internship and / or projects as a lead towards research and

The multi-discipline nature of the School System caters to the needs of stake-holders, especially the employers.

### **Credit system:**

Weightage to a course is given in relation to the hours assigned for the course. Generally one hour per week has one credit. For viability and conformity to the guidelines credits are awarded irrespective of the teaching hours. The credits and hours of each course of a programme is given in the table of Programme Pattern. However, there could be some flexibility because of practical, field visits, tutorials and nature of project work.

For PG courses, a student must earn a minimum of 110 credits as mentioned in the programme pattern table. The total number of minimum courses offered by the Department is given in the Programme Structure.

## **OUTCOME-BASED EDUCATION (OBE)**

### **LEARNING OUTCOME-BASED CURRICULUM FRAMEWORK (LOCF)**

**OBE** is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience, each student should have achieved the goal. There is no single specified style of teaching or assessment in OBE; instead, classes, opportunities and assessments should all help the students achieve the specific outcomes

Outcome Based Education, as the name suggests depends on Outcomes and not Inputs. The outcomes in OBE are expected to be measurable. In fact each Educational Institute can state its own outcomes. The ultimate goal is to ensure that there is a correlation between education and employability

**Outcome –Based Education (OBE):** is a student-centric teaching and learning methodology in which the course delivery, assessment are planned to achieve, stated objectives and outcomes. It focuses on measuring student performance i.e. outcomes at different levels.

### **Some important aspects of the Outcome Based Education**

**Course:** is defined as a theory, practical or theory cum practical subject studied in a semester.

**Course Outcomes (COs):** are statements that describe significant and essential learning that learners have achieved, and can reliably demonstrate at the end of a course. Generally three or more course outcomes may be specified for each course based on its weightage.

**Programme:** is defined as the specialization or discipline of a Degree.

**Programme Outcomes (POs):** Programme outcomes are narrower statements that describe what students are expected to be able to do by the time of graduation. POs are expected to be aligned closely with Graduate Attributes.

**Programme Specific Outcomes (PSOs):**

PSOs are what the students should be able to do at the time of graduation with reference to a specific discipline.

**Programme Educational Objectives (PEOs):** The PEOs of a programme are the statements that describe the expected achievement of graduates in their career, and also in particular, what the graduates are expected to perform and achieve during the first few years after Graduation.

### **Some important terminologies repeatedly used in LOCF.**

#### **Core Courses (CC)**

A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course. These are the courses which provide basic understanding of their main discipline. In order to maintain a requisite standard certain core courses must be included in an academic program. This helps in providing a universal recognition to the said academic program.

#### **Discipline Specific Elective Courses (DSE)**

Elective course may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective (DSE). These courses offer the flexibility of selection of options from a pool of courses. These are considered specialized or advanced to that particular programme and provide extensive exposure in the area chosen; these are also more applied in nature.

DSE: Four courses are offered, one course in each semester.

**Note:** To offer **one DSE**, a minimum of two courses of equal importance / weightage is a must.

One DSE Course in semester two is offered as interdisciplinary/common course among the departments in a School (Common Core Course) at the PG level.

#### **Generic Elective Courses**

An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

Generic Elective courses are designed for the students of **other disciplines**. Thus, as per the CBCS policy, the students pursuing particular disciplines would have to opt Generic Elective courses offered by other disciplines, as per the basket of courses offered by the college. The scope of the Generic Elective (GE) Courses is positively related to the diversity of disciplines in which programmes are being offered by the college.

Two GE Courses are offered, one each in semesters II and III. The GE course offered in semester II is within the school level and the GE in semester III is Between Schools level

#### **The Ability Enhancement Courses (AEC)**

One Main discipline related Ability Enhancement Course for 3 credits is offered for a PG programme by the Department.

#### **Skill Enhancement Courses (SECs)**

These courses focus on developing skills or proficiencies in the student, and aim at providing hands-on training. Skill enhancement courses can be opted by the students of any other discipline, but are highly suitable for students pursuing their academic programme.

One SEC is offered in semester II as a compulsory course on Soft Skills, offered by the Department of Human Excellence, common to all the students of PG programme.

**Self-paced Learning:** It is a course for two credits. It is offered to promote the habit of independent/self learning of Students. Since it is a two credit course, syllabus is framed to complete within 45 hours. It is not taught in the regular working hours.

**Comprehensive Examinations:** A detailed syllabus consisting of five units to be chosen from the courses offered over the five semesters which are of immense importance and those portions which could not be accommodated in the regular syllabus.

**Extra Credit Courses:** In order to facilitate the students, gaining knowledge/skills by attending online courses MOOC, credits are awarded as extra credits, the extra credit are at three semesters after verifying the course completion certificates. According to the guidelines of UGC, the students are encouraged to avail this option of enriching their knowledge by enrolling themselves in the Massive Open Online Courses (MOOC) provided by various portals such as SWAYAM, NPTEL and etc.

### Course Coding:

The following code system (10 alphanumeric characters) is adopted for Post Graduate courses:

21	PXX	N	XX	NN/NNX
Year of Revision	PG Department Code	Semester number.	Part Category	running number/with choice

N:- Numerals X :- Alphabet

#### Part Category

CC - Core Theory

CP- Core Practical

#### IS- Internship

#### SP- Self Paced Learning

#### CE- Comprehensive Examination

#### PW- Project Work & viva-voce

#### Electives Courses

ES – Department Specific Electives

EG- Generic Electives

EC - Additional core Courses for Extra Credits (If any)\*

#### Ability Enhancement Courses

AE – Ability Enhancement Course

SE – Skill Enhancement Course – Soft skills

CW - SHEPHERD & Gender Studies (Outreach)

### CIA AND SEMESTER EXAMINATION

#### Continuous Internal Assessment (CIA):

Distribution of CIA Marks	
Passing Minimum: 50 Marks	
Library Referencing	5
3 Components	35
Mid-Semester Test	30
End-Semester Test	30
CIA	100



### MID-SEM & END-SEM TEST

Centralised – Conducted by the office of COE

1. Mid-Sem Test & End-Sem Test: (2 Hours each); will have Objective and Descriptive elements; with the existing question pattern PART-A; PART-B; PART-C and PART D.
2. One of the CIA Component II/III for UG & PG will be of 15 marks and compulsorily a online objective multiple choice question type.
3. The online CIA Component must be conducted by the Department / faculty concerned at a suitable computer centre.
4. The one marks of PART-A of Mid-Sem and End-Sem Tests will comprise only: OBJECTIVE MULTIPLE CHOICE QUESTIONS.
5. The number of hours for the 5 marks allotted for Library Referencing/ work would be 30 hours per semester. The marks scored out of 5 will be given to all the courses (Courses) of the Semester.

**Duration of Examination must be rational;** proportional to teaching hours 90 minute-examination / 50 Marks for courses of 2/3 hours/week (all Part IV UG Courses) 3-hours examination for courses of 4-6 hours/week.

#### Knowledge levels for assessment of Outcomes based on Blooms Taxonomy

S. No.	Level	Parameter	Description
1	K1	Knowledge/Remembering	It is the ability to remember the previously learned
2	K2	Comprehension/Understanding	The learner explains ideas or concepts
3	K3	Application/Applying	The learner uses information in a new way
4	K4	Analysis/Analysing	The learner distinguishes among different parts
5	K5	Evaluation/Evaluating	The learner justifies a stand or decision
6	K6	Synthesis /Creating	The learner creates a new product or point of view

#### WEIGHTAGE of K – LEVELS IN QUESTION PAPER

(Cognitive Level) K- LEVELS	Lower Order Thinking			Higher Order Thinking			Total %
	K1	K2	K3	K4	K5	K6	
<b>SEMESTER EXAMINATIONS</b>	15	20	35	30			<b>100</b>
<b>MID / END Semester TESTS</b>	12	20	35	33			<b>100</b>

QUESTION PATTERN FOR SEMESTER EXAMINATION	
SECTION	MARKS
<b>SECTION-A</b> (No choice ,One Mark) <b>THREE</b> questions from each unit (15x1 =15)	<b>15</b>
<b>SECTION-B</b> (No choice ,2-Marks) <b>TWO</b> questions from each unit (10x2 =20)	<b>20</b>
<b>SECTION-C</b> (Either/or type) (7- Marks) <b>ONE</b> question from each unit (5x7 =35)	<b>35</b>
<b>SECTION-D</b> (3 out of 5) (10 Marks) <b>ONE</b> question from each unit (3x10 =30)	<b>30</b>
<b>Total</b>	<b>100</b>

<b>BLUE PRINT OF QUESTION PAPER FOR SEMESTER EXAMINATION</b>							
<b>DURATION: 3. 00 Hours.</b>				<b>Max Mark : 100</b>			
<b>K- LEVELS</b>	<b>K1</b>	<b>K2</b>	<b>K3</b>	<b>K4</b>	<b>K5</b>	<b>K6</b>	<b>Total Marks</b>
<b>SECTIONS</b>							
<b>SECTION–A</b> (One Mark, No choice) (15x1 =15)	15						<b>15</b>
<b>SECTION-B</b> (2-Marks, No choice) (10x2=20)		10					<b>20</b>
<b>SECTION-C</b> (7- Marks) (Either/or type) (5x7=35)			5				<b>35</b>
<b>SECTION-D</b> (10 Marks) (3 out of 5) (3x10=30) Courses having only <b>K4</b> levels				3			<b>30</b>
Courses having <b>K4</b> and <b>K5</b> levels <b>One K5 level question is compulsory</b>				2	1		
(Courses having <b>all the 6</b> cognitive levels <b>One K5 and K6 level questions can be compulsory</b>				1	1	1	
<b>Total</b>	<b>15</b>	<b>20</b>	<b>35</b>	<b>30</b>			<b>100</b>

<b>QUESTION PATTERN FOR MID/END TEST</b>		
<b>SECTION</b>		<b>MARKS</b>
<b>SECTION–A</b> (No choice, One Mark) (7x1 =7)		<b>7</b>
<b>SECTION-B</b> (No choice , 2-Marks) (6x2 =12)		<b>12</b>
<b>SECTION-C</b> (Either/or type) (7- Marks) (3x7 =21)		<b>21</b>
<b>SECTION-D</b> (2 out of 3) (10 Marks) (2x10=20)		<b>20</b>
<b>Total</b>		<b>60</b>

<b>BLUE PRINT OF QUESTION PAPER FOR MID/END TEST</b>								
<b>DURATION: 2. 00 Hours.</b>				<b>Max Mark: 60.</b>				
<b>K- LEVELS</b>	<b>K1</b>	<b>K2</b>	<b>K3</b>	<b>K4</b>	<b>K5</b>	<b>K6</b>	<b>Total Marks</b>	
<b>SECTIONS</b>								
<b>SECTION –A</b> (One Mark, No choice) (7 x 1 = 7)	7							<b>07</b>
<b>SECTION-B</b> (2-Marks, No choice) (6 x 2 = 12)		6						<b>12</b>
<b>SECTION-C</b> (Either/or type) (7-Marks ) (3 x 7 =21)			3					<b>21</b>
<b>SECTION-D</b> (2 out of 3) (10 Marks) (2x10=20) Courses having only <b>K4</b> levels				2				<b>20</b>
Courses having <b>K4</b> and <b>K5</b> levels <b>One K5 level question is compulsory</b>				1	1			
Courses having <b>all the 6</b> cognitive levels <b>One K6 level question is compulsory</b>					1	1		
<b>Total Marks</b>	<b>07</b>	<b>12</b>	<b>21</b>	<b>20</b>				<b>60</b>
<b>Weightage for 100 %</b>	<b>12</b>	<b>20</b>	<b>35</b>	<b>33</b>				<b>100</b>

### Assessment pattern for two credit courses.

S. No.	Course Title	CIA	Semester Examination	Total Marks
1	Self Paced Learning Course	25 + 25 = 50	50 Marks MCQ ( COE)	100
2	Comprehensive Examinations	25 +25 = 50	50 Marks (MCQ) (COE)	100
3	Internship	100	--	100
4	Field Visit	100	--	100
5	Ability Enhancement Course (AEC) for PG (3 credits)	50 (Three Components)	50 (COE) Specific Question Pattern	100
<b>Assessment Pattern for Courses in Part - IV</b>				
6	Value Education Courses and Environmental Studies	50	50 Marks (For 2.00 hours) ( COE)	100
7	Skill Enhancement Courses(SECs)	50 marks (by Course in-charge) 50 Marks ( by an External member from the Department)		100
8	SEC: SOFT SKILLS ( For UG and PG)	100	(Fully Internal)	100

## EVALUATION

### GRADING SYSTEM

Once the marks of the CIA and the end-semester examination for each of the courses are available, they will be added and converted as final mark. The marks thus obtained will then be graded as per the scheme provided in Table-1.

From the second semester onwards, the total performance within a semester and the continuous performance starting from the first semester are indicated by semester Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA) respectively. These two are calculated by the following formulae:

$GPA = \frac{\sum_{i=1}^n C_i G_i}{\sum_{i=1}^n C_i}$	$WAM \text{ (Weighted Average Marks)} = \frac{\sum_{i=1}^n C_i M_i}{\sum_{i=1}^n C_i}$
<p>Where,</p> <p><math>C_i</math> is the Credit earned for the Course <math>i</math></p> <p><math>G_i</math> is the Grade Point obtained by the student for the Course <math>i</math></p> <p><math>M_i</math> is the marks obtained for the course <math>i</math> and</p> <p><math>n</math> is the number of Courses <b>Passed</b> in that semester.</p>	

**CGPA:** Average GPA of all the Courses starting from the first semester to the current semester.

### CLASSIFICATION OF FINAL RESULTS:

- i) The classification of final results shall be based on the CGPA, as indicated in Table-2.
- ii) For the purpose of Classification of Final Results, the candidates who earn the CGPA 9.00 and above shall be declared to have qualified for the Degree as 'Outstanding'. Similarly the candidates who earn the CGPA between 8.00 and 8.99, 7.00 and 7.99, 6.00 and 6.99 and 5.00 and 5.99 shall be declared to have qualified for their Degree in the respective programmes as 'Excellent', 'Very Good', 'Good', and 'Above Average' respectively.
- iii) A Pass in SHEPHERD will continue to be mandatory although the marks will not count for the calculation of the CGPA.
- iv) Absence from an examination shall not be taken an attempt.

**Table-1: Grading of the Courses**

Marks Range	Grade Point	Corresponding Grade
90 and above	10	O
80 and above and below 90	9	A+
70 and above and below 80	8	A
60 and above and below 70	7	B+
50 and above and below 60	6	B
Below 50	0	RA

**Table-2: Final Result**

CGPA	Corresponding Grade	Classification of Final Result
9.00 and above	O	Outstanding
8.00 to 8.99	A+	Excellent
7.00 to 7.99	A	Very Good
6.00 to 6.99	B+	Good
5.00 to 5.99	B	Above Average
Below 5.00	RA	Re-appearance

Credit based weighted Mark System is adopted for the individual semesters and cumulative semesters in the column 'Marks secured' (for 100)

#### Declaration of Result

Mr./ MS. \_\_\_\_\_ has successfully completed the Post Graduate in \_\_\_\_\_ programme. The candidate's Cumulative Grade Point Average (CGPA) is \_\_\_\_\_ and the class secured is \_\_\_\_\_ by completing the minimum of 110 credits.

The candidate has also acquired \_\_\_\_\_ (if any) extra by attending MOOC courses.

## Relationship matrix for Course outcomes, Programme outcomes /Programme Specific Outcomes

The Programme Outcomes(POs)/Programme Specific Outcomes(PSOs) are the qualities that must be imbibed in the graduates by the time of completion of their programme. At the end of each programme the PO/PSO assessment is done from the CO attainment of all curriculum components. The POs/PSOs are framed based on the guidelines of LOCF. There are five POs UG programme and five POs for PG programme framed by the college. PSOs are framed by the departments and they are five in numbers.

For each Course, there are five Course Outcomes to be achieved at the end of the course. These Course outcomes are framed to achieve the POs/PSOs. All course outcomes shall have linkage to POs/PSOs in such a way that the strongest relation has the weight 3 and the weakest is 1. This relation is defined by using the following table.

Mapping	<40%	$\geq 40\%$ and < 70%	$\geq 70\%$
Relation	Low Level	Medium Level	High Level
Scale	1	2	3

<b>Mean Scores of COs =</b> $\frac{\text{Sum of values}}{\text{Total No.of POs \& PSOs}}$		<b>Mean Overall Score =</b> $\frac{\text{Sum of Mean Scores}}{\text{Total No.of COs}}$	
<b>Result</b>	<b>Mean Overall Score</b>	< 1.2	# Low
		$\geq 1.2$ and < 2.2	# Medium
		$\geq 2.2$	# High

If the mean overall score is low then the course in charge has to redesign the particular course content so as to achieve high level mean overall score.

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		$\geq 2.2$	# High

If the mean overall score is low then the course in charge has to redesign the particular course content so as to achieve high level mean overall score.

### **Vision**

Forming globally competent, committed, compassionate and holistic persons, to be men and women for others, promoting a just society.

### **Mission**

- Fostering learning environment to students of diverse background, developing their inherent skills and competencies through reflection, creation of knowledge and service.
- Nurturing comprehensive learning and best practices through innovative and value-driven pedagogy.
- Contributing significantly to Higher Education through Teaching, Learning, Research and Extension.

### **Programme Educational Objectives (PEOs)**

- Graduates will be able to accomplish professional standards in the global environment.
- Graduates will be able to uphold integrity and human values.
- Graduates will be able to appreciate and promote pluralism and multiculturalism in working environment.

### **Programme Outcomes (POs)**

1. Graduates will be able to apply assimilated knowledge to evolve tangible solution to emerging problems.
2. Graduates will be able to analyze and interpret data to create and design new knowledge.
3. Graduates will be able to engage in innovative and socially relevant research and effectively communicate the findings.
4. Graduates will become ethically committed professional and entrepreneurs upholding human values.
5. Graduates imbued with ethical values and social concern will be able to understand and appreciate cultural diversity, social harmony and ensure sustainable environment.

### **Programme Specific Objectives (PSOs)**

1. Graduates are prepared to be creators of new knowledge in the field of life sciences, causing innovation and entrepreneurship, employable in various sectors such as private, government, and clinical /biomedical research organizations.
2. Graduates are trained to study and evolve the biomolecular mechanisms for the life processes in health and diseases.
3. Graduates are groomed to carry on research in biology on chemical basis, by exploring their knowledge independently.
4. Graduates are encouraged to design and conduct experiments, to analyze and interpret biological problems behind the research.
5. Graduates ought to have the ability of effectively communicating the findings of Biological sciences with existing knowledge ethically.

<b>M.Sc. BIOCHEMISTRY</b>					
<b>PROGRAMME STRUCTURE</b>					
<b>Sem.</b>	<b>Specification</b>	<b>No. of Courses</b>	<b>No. of Hours</b>	<b>Credits</b>	<b>Total Credits</b>
I-IV	Core Courses : Theory	<b>11</b>	<b>49</b>	<b>47</b>	<b>47</b>
I-IV	Core Courses : Practicals	04	29	<b>22</b>	22
II	Self-paced learning	1	-	<b>2</b>	02
IV	Comprehensive Examination	1	-	<b>2</b>	02
IV	Project work & Viva Voce	1	06	<b>5</b>	05
<b>I- IV</b>	Discipline Specific Elective	4	20	<b>16</b>	16
I	Ability Enhancement Course	1	4	<b>3</b>	03
II	Skill Enhancement Course (Soft Skills)	1	4	<b>3</b>	03
II	Generic Elective IDC (WS)	1	4	<b>3</b>	03
III	Generic Elective IDC (BS)	1	4	<b>3</b>	03
II - IV	Online courses (MOOC)	3	-	<b>(2)</b>	(06)
<b>I-IV</b>	<b>Outreach Programme</b>	1	-	<b>04</b>	04
	<b>Total</b>	30	<b>120</b>	<b>110</b>	<b>110(6)</b>



<b>M.Sc. BIOCHEMISTRY</b>							
<b>PROGRAMME PATTERN</b>							
<b>Course Details</b>					<b>Scheme of Exams</b>		
<b>Sem</b>	<b>Code</b>	<b>Course Title</b>	<b>Hrs</b>	<b>Cr</b>	<b>CIA</b>	<b>SE</b>	<b>Final</b>
<b>I</b>	21PBI1CC01	Biomolecular Chemistry	5	4	100	100	100
	21PBI1CC02	Microbiology	4	4	100	100	100
	21PBI1CC03	Bioenergetics and Enzymology	4	4	100	100	100
	21PBI1CP01	Lab course I	8	6	100	100	100
	21PBI1ES01A	<b>DSE-1:</b> Developmental Biology	5	4	100	100	100
	21PBI1ES01B	<b>DSE-1:</b> Biochemistry of Natural Products					
	21PBI1AE01	<b>AEC:</b> Fundamentals of Forensic Science	4	3	50	50	50
<b>Total</b>			<b>30</b>	<b>25</b>			
<b>II</b>	21PBI2CC04	Genetic Engineering	4	4	100	100	100
	21PBI2CC05	Human Physiology	4	4	100	100	100
	21PBI2CC06	Molecular Biology	4	3	100	100	100
	21PBI2CP02	Lab course II	5	4	100	100	100
	21PBI2SP01	<b>Self-Paced Learning:</b> Advanced Nutrition	-	2	50	50	50
	21SBS2ES02A	<b>DSE-2:</b> Immunology	5	4	100	100	100
	21PBI2ES02	<b>DSE-2:</b> Solid Waste Management					
	21PSS2SE01	<b>SEC:</b> Soft skills	4	3	100	-	100
	21PBI2EG01	<b>GE-1(WS):</b> Herbal Technology	4	3	100	100	100
		Extra Credit Courses(MOOC)-1	-	(2)			
<b>Total</b>			<b>30</b>	<b>27(2)</b>			
<b>III</b>	21PBI3CC07	Pharmaceutics and Nanotechnology	4	4	100	100	100
	21PBI3CC08	Research methodology	5	5	100	100	100
	21PBI3CC09	Advances in Clinical research	4	4	100	100	100
	21PBI3CP03	Lab course III	8	6	100	100	100
	21PBI3ES03A	<b>DSE-3:</b> Life sciences for Competitive exams -1	5	4	100	100	100
	21PBI3ES03B	<b>DSE-3:</b> Molecular Diagnostics					
	21PBI3EG02	<b>GE-2 (BS):</b> First Aid Management	4	3	100	100	100
		Extra Credit Courses(MOOC)-2		(2)			
<b>Total</b>			<b>30</b>	<b>26(2)</b>			
<b>IV</b>	21PBI4CC10	Clinical Biochemistry	6	6	100	100	100
	21PBI4CC11	Advanced Endocrinology	5	5	100	100	100
	21PBI4CP04	Lab course IV	8	6	100	100	100
	21PBI4ES04A	<b>DSE-4:</b> Pharmaceutical Biochemistry	5	4	100	100	100
	21PBI4ES04B	<b>DSE-4:</b> Life Sciences for Competitive Exams-2					
	21PBI4PW01	Project work & Viva Voce	6	5	100	100	100
	21PBI4CE01	Comprehensive Examination	-	2	50	50	50
		Extra Credit Courses(MOOC)-3	-	(2)			
<b>Total</b>			<b>30</b>	<b>28(2)</b>			
<b>I-IV</b>	21PCW4OR01	Outreach Programme (SHEPHERD)		4			
<b>Total(Four Semesters)</b>			<b>120</b>	<b>110(6)</b>			

\*For courses with scheme of Exam 50 in CIA and SE will be converted to 100.

<b>GENERIC ELECTIVE -1: 2<sup>nd</sup> Semester</b> <b>Within school (WS)- Offered to students belong to other Departments in the School</b>							
Course Details					Scheme of Exams		
School	Course Code	Course Title	Hrs	Cr	CIA	SE	Final
<b>SBS</b>	21PBI2EG01	Herbal Technology	4	3	100	100	100
	21PBT2EG01	Medical Biotechnology	4	3	100	100	100
	21PBO2EG01	Medicinal Botany	4	3	100	100	100
<b>SCS</b>	21PCA2EG01	Applied Statistics using R	4	3	100	100	100
	21PMA2EG01	Mathematical Foundations	4	3	100	100	100
	21PCS2EG01	Mobile Adhoc Networks (MANET)	4	3	100	100	100
<b>SLAC</b>	21PEN2EG01A	Indian Literature in Translation	4	3	100	100	100
	21PEN2EG01B	English Literature For Competitive Examinations					
<b>SMS</b>	21PCO2EG01	Supply Chain Management	4	3	100	100	100
	21PEC2EG01	Labour Economics	4	3	100	100	100
	21PHR2EG01	Organizational Behaviour	4	3	100	100	100
	21PCC2EG01	Stress Management	4	3	100	100	100
<b>SPS</b>	21PCH2EG01	Industrial Products	4	3	100	100	100
	21PPH2EG01A	Solar Energy and Utilization	4	3	100	100	100
	21PPH2EG01B	Renewable Energy Resources	4	3	100	100	100

<b>GENERIC ELECTIVE -2: 3<sup>rd</sup> Semester</b> <b>Between schools (BS)- Offered to students in the Departments belong to other Schools</b> (Except the school offering the course)							
Course Details					Scheme of Exams		
School	Course Code	Course Title	Hrs	Cr	CIA	SE	Final
<b>SBS</b>	21PBI3EG02	First Aid Management	4	3	100	100	100
	21PBT3EG02	Food Technology	4	3	100	100	100
	21PBO3EG02	Horticulture and Landscaping	4	3	100	100	100
<b>SCS</b>	21PCA3EG02	Web Design	4	3	100	100	100
	21PMA3EG02	Operations Research	4	3	100	100	100
	21PCS3EG02	Advances in Computer Science	4	3	100	100	100
	21PDS3EG02	Deep Learning	4	3	100	100	100
<b>SLAC</b>	21PEN3EG02	English for Effective Communication	4	3	100	100	100
<b>SMS</b>	21PCO3EG02	Basics of Taxation	4	3	100	100	100
	21PEC3EG02	Managerial Economics	4	3	100	100	100
	21PHR3EG02	Counselling and Guidance	4	3	100	100	100
	21PCC3EG02	Dynamics of Human Behaviour in Business	4	3	100	100	100
<b>SPS</b>	21PCH3EG02	Health Science	4	3	100	100	100
	21PPH3EG02A	Physics for Competitive Exam	4	3	100	100	100
	21PPH3EG02B	Nano Science	4	3	100	100	100

Semester	Course Code	Title of the Course	Hours	Credits
I	21PBI1CC01	<b>CORE-1: BIOMOLECULAR CHEMISTRY</b>	5	4

CO. No.	CO-Statements	Cognitive Level (K-Level)
On successful completion of the course, the students will be able to		
<b>CO-1</b>	recall the molecular makeup of the living cells	<b>K1</b>
<b>CO-2</b>	understand the types, structure and functions of carbohydrates	<b>K2</b>
<b>CO-3</b>	relate structures of amino acids and proteins with their functions	<b>K3</b>
<b>CO-4</b>	analyze the metabolism of dietary and endogenous carbohydrates	<b>K4</b>
<b>CO-5</b>	evaluate the relationship between the biomolecular constitution and metabolic processes Replicate biosynthesis and chemical reactions of lipids	<b>K5 &amp; K6</b>

### Unit - I: Biomolecules

(15 Hours)

Composition of living matter: Water – Physiochemical properties, biomolecular reactions. Macromolecules and their monomeric subunits: Carbohydrates – classification, structure and isomerism. Monosaccharides, oligosaccharides & polysaccharides – structure and properties. Amino acids - structures, classification and properties. Proteins – classification, types, characteristics and structures, functions. Lipids – classification, sources and biological functions. Nucleic acids - bases, nucleosides & nucleotides. Introduction to metabolism - Anabolism and catabolism in living cells (Overview).

### Unit – II: Metabolism of carbohydrates

(15 Hours)

Glycolysis, Citric acid cycle, HMP shunt, Glucuronic acid pathway, Gluconeogenesis, Glycogenesis, Glycogenolysis, Glyoxylate cycle. Regulations of Glycolysis and Gluconeogenesis. Metabolism of Amino sugars - Sialic acids, Mucopolysaccharides and glycoproteins.

### Unit - III: Metabolism of Proteins and Amino acids

(15 Hours)

Biosynthesis of aspartate, pyruvate and aromatic amino acid families, Amphibolic activity of amino acids. Methods for determining protein conformations - symmetry and functional properties, protein folding, denaturation & renaturation, Ramachandran plot. Solid state synthesis of peptides and sequence determination. Degradation of proteins and amino acids. Urea cycle and its significance.

### Unit - IV: Metabolism of lipids

(15 Hours)

Biosynthesis of fatty acids, hydroxy fatty acids, acylglycerols and their regulation. Membrane lipids - phospholipids, sphingolipids & eicosanoids. Cholesterol biosynthesis and its

regulation. Fatty acid degradation. Lipoproteins - types, methods of inter organ transport of fatty acids and functions. Formation of ketone bodies.

#### **Unit - V: Metabolism of nucleic acids**

**(15 Hours)**

Structure of RNAs and DNA, forces stabilizing nucleic acid structures. Unusual Nucleic acids. Fractionation, sequencing and chemical synthesis of oligonucleotides. Denaturation and hybridization. Synthesis of purines and pyrimidines, synthesis of deoxy ribonucleotides. Biosynthesis of nucleotide coenzymes, nucleotide degradation – purines and pyrimidines.

#### **Books for study**

1. Robert K. Murray *et al.*, 2000. Harper's Biochemistry, Appleton and Lange Stanford Publishers, Connecticut (e-book).  
**Unit-I** (Chapter 2-Pages-5 to 9, Chapter 13-Pages 102 to 110, Chapter 14-page 111, Chapter 3-Pages 14 to 20 Chapter 35-Pages 303-314)  
**Unit-II** (Chapter 17-Pages 136 to 145, Chapter 18 Pages 145 to 152, Chapter 16 Pages 130 to 135, Chapter 19 Pages 153 to 162, Chapter 20 Pages 163 to 172, Chapter-48 Pages 542 to 545, Chapter 47 Pages 514-534)  
**Unit-III** (Chapter 28 –Pages 237 to 241, Chapter 29-Pages 242 to 248, Chapter 30 - Pages 249 to 263)  
**Unit-IV** (Chapter 21 - Pages 173 to 180, Chapter 22- Pages 181 to 190, Chapter 23 Pages 191 to 197, Chapter 24 Pages 198-205, Chapter 25 Pages 205 to 219 Chapter 26 Pages 219 to 231)  
**Unit-V** (Chapter 34 Pages 293 to 303)
2. Lehninger, A. L. *et al.*, 1993. Principles of Biochemistry, Worth Publishers. Inc. USA (e-book).  
**Unit-I** (Chapter-2-2.1-Pages 43-51, Chapter-7 7.1-Pages 235-241, 244-246 Chapter-3-3.1 Pages-72-74 Chapter 8-8.1-Pages 271-276 Chapter 10-10.1- Pages-343-346)  
**Unit-II** (Chapter 14 14.1 to 14.5 Pages-528-563, Chapter 16, 16.1 to 16.4 Pages-616-639, Chapter 22-22.2 Pages-860-872)  
**Unit-III** (Chapter 3 -3.4-Pages 92-102, Chapter 4- 4.2 Pages 117 to 122, 4.4-Pages 140-146, Chapter 18 18.2-18.3 Pages 682-684, 687-701)  
**Unit-IV** (Chapter 21- 21.1 to 21.4 Pages-805-836, Chapter 17-17.1 to 17.3-Pages 648-667)  
**Unit-V** (Chapter-8.3-Pages 287-297, Chapter 22-22.4 Pages-882-893)
3. Robert Horton *et al*; 2011. Principles of Biochemistry, Pearson Education, Inc. U.S.A, 5<sup>th</sup> Edition (e-book).  
**Unit –I** (Chapter-I ,1.1 to 1.3 Pages 2 to 9, Chapter 2 Pages 28 to 50, Chapter 8 Pages 227-238, 8.6 –Pages 240-244. Chapter 3, 3.1 to 3.5-Pages 56-67, Chapter 9, 9.1 to 252-259)

**Unit- II** (Chapter 11-Pages 325 to 347, Chapter 12-Pages 356 to 373, Chapter 13-Pages 387 to 409)

**Unit - III** (Chapter-17, 17.3 Pages 520 to 529, 17.6 and 17.7-Pages 534 to 547 Chapter-4, 4.1 Pages 88- 91, 4.11 Pages 114 to 116)

**Unit-IV** (Chapter 16- 476 to 499, 505 to 507, Chapter 16.11 Pages-508 to 511)

**Unit-V** (Chapter-18-652-668)

### Books for study

1. Robert K. Murray *et al*, 2000. Harper's Biochemistry, Appleton and Lange Stanford Publishers, Connecticut (e-book).
2. Lehninger, A. L. *et al.*, 1993. Principles of Biochemistry, Worth Publishers. Inc. USA (e-book).
3. Rawn, J.D. (1989): Biochemistry (Neil Patterson Publ. North Carolina)

### Books for References

1. Stryer, I., 1988. Biochemistry (2<sup>nd</sup> Edition), W.H. Freeman & Co., New York.
2. White, A. *et al.*, 1959. Principles of Biochemistry, McGraw Hill Book Co., New York.
3. Donald Voet and Judith, G. Voet. 2011. Biochemistry. (4<sup>th</sup> Edition). John Wiley and Sons, New York.

### Relationship matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
I	21PBI1CC01	CORE -1 :BIOMOLECULAR CHEMISTRY									5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5		
CO1	3	3	2	3	3	3	3	3	3	2	2.8	
CO2	2	3	3	3	3	1	3	3	3	3	2.7	
CO3	3	2	3	0	3	3	2	3	2	2	2.3	
CO4	3	3	3	2	3	3	2	0	3	3	2.5	
CO5	3	3	3	2	3	2	3	3	3	3	2.8	
Mean overall score											2.62	
Result											High	

Semester	Course Code	Title of the Course	Hours	Credits
I	21PBI1CC02	CORE-02: MICROBIOLOGY	4	4

CO. No.	CO-Statements	Cognitive Level (K-level)
On successful completion of the course, the students will be able to		
CO-1	recall the classification and characteristic features of microbes	K1
CO-2	understand the implications of microbes in the environment	K2
CO-3	apply and analyze the microbial metabolism for the benefits of mankind	K3 & K4
CO-4	evaluate the infectious diseases, their diagnosis and treatment options	K5
CO-5	produce nutrients for the use of mankind	K6

### Unit - I: General microbiology

(12 Hours)

Introduction - history and scope of microbiology. Brief study of structure and organization of major groups of microorganisms – Archaeobacteria, cyanobacteria, eubacteria, fungi, algae, protozoa and viruses. Culture of microorganisms – batch, continuous and pure cultures. Growth curve – factors affecting it. Control of microorganisms – physical, chemical and chemotherapeutic agents. Preservation of microorganisms. Microscopy – Principles and types – Simple, Compound and Phase contrast.

### Unit – II: Environmental microbiology

(12 Hours)

Microbiology of soil - soil microflora, role of soil microbes in biogeochemical cycles (C,N,S). Marine and fresh water microbiology. Contamination of domestic and marine waters. Water purification and sewage treatment. Microbes in waste water treatments. Microbiology of air (Indoor and Outdoor).

### Unit – III: Industrial microbiology

(12 Hours)

Selection of industrially useful microbes. Fermentors and fermentation technology. Industrial production of alcohol, vinegar, lactic acid, antibiotics (Penicillin, and Streptomycin), enzymes (Alpha amylase, Cellulase, Renin), Vitamins (Ascorbic acid, Thiamine, B12) and amino acids. Microbiology of food: sources of contamination, food spoilage and food preservation methods.

### Unit – IV: Clinical microbiology

(12 Hours)

Epidemic, endemic, pandemic and sporadic diseases. Epidemiology, pathogenicity, virulence and infection of diseases. Bacterial diseases of human (typhoid, cholera, syphilis, gonorrhoea and pertussis). Fungal diseases of human (superficial, cutaneous, subcutaneous and systemic mycoses) Mycotoxins – Aflatoxin A and B (Mode of action). Viral diseases of human (AIDS,

hepatitis, polio, rabies and measles). Mycoplasmal, Chlamydial, Rickettsial and protozoan diseases of human (Malaria and Kala-azar).

### **Unit – V: Applied Microbiology**

**(12 Hours)**

Role of microbes in the manufacture of vaccines. Microorganisms as biofertilizers. Microbes as foods - SCP production. Role of microbes in biogas production, petroleum industry and mining. Microbial degradation of lignin, cellulose and pesticides. Microbial immobilization. Microbes in biowar.

### **Text books for study**

1. Ananthanarayan, R. and Jayaram Paniker, C.K. 2007. Text Book of Microbiology. (7<sup>th</sup>Edition). Orient Longman Ltd., Chennai.  
**UNIT-I** Chapter I Pages-1 to 7, Chapter 3 and 4 – Pages-34 to 43, Chapter 2– Pages-8 to 23. Chapter 48 - Pages 430-439. Chapter 64-Pages 603-610.  
**UNIT-IV** Chapter 9 Pages 64 to 71, Chapter 25 Pages-222 to 231, Chapter 32- Pages 290 to 304 Chapter 37- Pages 339 to 344, Chapter 43 Pages 395 to 400, Chapter 46 and 47-Pages 412 to 429. Chapter-56 Pages 513 to 520, Chapter 59-427 to 432. Chapter- 62-Pages 582 to 598, Chapter- 65-Pages 610 to 627.
2. Lansing M Prescott, John P Harley and Donald A Klein. 2007. Microbiology. (7<sup>th</sup>Edition). McGraw Hill, New York.  
**UNIT-I** Chapter-I Pages 1 to 16, Chapter 20 -26 Pages-503 to 629, Chapter 7 Pages 149 to 165, Chapter 6.3 and 6.4 Pages 128 to 130, Chapter 16 and 17 Pages 407 to 446.  
**UNIT-II** Chapter 26 Pages-629-635 Chapter 27 to 28 Pages 643 to 714, Chapter-41 Pages 1049 to 1054.  
**UNIT-III** Chapter 40 Pages 1023 to 1030.  
**UNIT-IV** Chapter33 Pages 815 to 832, Chapter 36 Pages 885 to 911.
3. Sivakumar.P.K, JOE. M. M and Suresh.K An introduction to Industrial microbiology First edition 2010 (S.Chand and Company Ltd, New Delhi).  
**UNIT-III** Chapter 2 Pages 21 to 46, Chapter 3 Pages 47 to 62, Chapter 5 Pages 86 to 99, Chapter 6 Pages 113 to 123, Chapter 9 Pages 164 to 183, Chapter 12 Pages 262 to 264.  
**UNIT-V** Chapter 10 Pages 184 to 193, Chapter 11 Pages 208 to 211, 213 to 215, Chapter 12 Pages 250 to 261.

### **Books for study**

1. Ananthanarayan, R. and Jayaram Paniker, C.K. 2007. Text Book of Microbiology. (7<sup>th</sup>Edition). Orient Longman Ltd., Chennai.
2. Lansing M Prescott, John P Harley and Donald A Klein. 2007. Microbiology. (7<sup>th</sup>Edition). McGraw Hill, New York.

### **Books for References**

1. Martin Alexander (1969): Introduction to soil microbiology. Wiley International, NY.

2. Gladwin and Trattler, 2013, Clinical Microbiology Made Ridiculously Simple (6<sup>th</sup> Edition), Medmaster, UK.
3. Mackie and McCarthy, 1994. Medical Microbiology, (4<sup>th</sup> Edition). Churchill Livingstone, New York.
4. Michael Pelczar, Microbiology 5<sup>th</sup> Edition, 2001. McGraw Higher Ed Publisher.
5. M. R. Adams, M. O. Moss. Food microbiology (3<sup>rd</sup> Edition), 2008. Royal Society of Chemistry, Thomas Graham House, Science Park, Milton Road, Cambridge, UK.

**Relationship matrix for Course Outcomes, Programme Outcomes  
and Programme Specific Outcomes**

Semester	Course Code	Title of the Course									Hours	Credits
I	21PBI1CC02	CORE -2: MICROBIOLOGY									4	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5		
CO1	2	3	2	2	2	2	3	2	3	2	2.3	
CO2	2	2	2	2	3	3	2	3	2	2	2.3	
CO3	3	2	2	2	2	2	2	3	3	2	2.3	
CO4	3	2	2	2	2	2	2	3	3	2	2.3	
CO5	2	3	3	3	2	2	2	2	2	3	2.4	
	Mean overall score											2.32
	Result											High



Semester	Course Code	Title of the Course	Hours	Credits
I	21PBI1CC03	<b>CORE-03: BIOENERGETICS AND ENZYMOLOGY</b>	4	4

CO No.	CO-Statements	Cognitive Level (K-levels)
	On successful completion of the course, the students will be able to	
CO-1	recall the different types of biotransformation reactions involving enzyme	K1
CO-2	predict the bioenergetics of enzyme mediated catalysis	K2
CO-3	apply the use of enzymes in various fields	K3
CO-4	analyze the mechanism of action of selected enzymes	K4
CO-5	evaluate the rate of enzyme action (kinetics) and design the methodology of purification of enzymes	K5 & K6

### Unit - I: Thermodynamics

(12 Hours)

Thermodynamic terms and basic concepts – types of thermodynamic systems, intensive and extensive properties, state of system, reversible and irreversible thermodynamic processes. Biological redox reactions. Electron transport chain and oxidative phosphorylation. High-energy phosphate compounds, role of ATP in biological system; acyl-phosphate group transfer.

### Unit – II: Basics of Enzymology

(12 Hours)

Historical aspects of enzymology, nomenclature and classification of enzymes according to IUB-EC-1964. Intracellular localization of enzymes, homogenization techniques, isolation and fractionation of enzymes – classical methods of purification and crystallization, separation based on molecular size (Gel filtration), electric charge (SDS PAGE and Ion Exchange), solubility difference and selective adsorption (Adsorption chromatography, Affinity Chromatography). Criteria of purity, units of enzyme activity. Turn over number, specific activity. Active site - definition, organization and determination of active site residues.

### Unit – III: Criteria of chemical reactions

(12 Hours)

Collision & transition state theories, specificity of enzymes. Proximity and orientation effects, general acid-base catalysis, concerted acid - base catalysis, nucleophilic and electrophilic attacks, catalysis by distortion, metal ion catalysis. Coenzymes - structure and functions. Mechanism of enzyme action - lysozyme, chymotrypsin, carboxypeptidase and DNA polymerase. Isoenzymes. Multienzymes system- mechanism of action and regulation of pyruvate dehydrogenase, LDH and fatty acid synthase complex.

**Unit - IV: Kinetics of catalyzed reaction****(12 Hours)**

Single and bisubstrate reactions, concept and derivation of Michaelis–Menten equation. Briggs Haldane relationship. Determination and significance of kinetic constants, limitations of Michaelis – Menten kinetics. Enzyme regulation - Allosteric inhibition, cooperative, cumulative, feedback inhibition. Inhibition kinetics- competitive, non-competitive and uncompetitive.

**Unit – V: Applications of Enzymes****(12 Hours)**

Various methods of immobilization - ionic bonding, adsorption, covalent bonding (based on R groups of amino acids), microencapsulation and gel entrapment. Immobilized multienzyme systems. Biosensors - glucose oxidase, cholesterol oxidase, urease and antibodies as biosensors. Abzymes and ribozymes. Enzymes of clinical and diagnostic significance-LDH, SGOT and SGPT. Industrial significance- Renin, Papain, Elastase. Enzyme engineering.

**Books for Study**

1. Basic concepts in biochemistry, Hiram F. Gilbert , second edition, McGraw-Hill Health Professions Division.  
**Unit-I** Chapter 14, Chapter 24  
**Unit-IV** Chapter 7, Chapter 8
2. Harper's Illustrated Biochemistry, twenty-sixth edition, Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell, Lange Medical Books/McGraw- Hill, Medical Publishing Division.  
**Unit-III** Section 1
3. Price and Stevens, 1999, Fundamentals of Enzymology, Oxford University Press, UK.  
**Unit-II** Chapter 3, Chapter 9  
**Unit-V** Chapter 10
4. Dixon, M. and Webb, J.F., 1979, Enzymes, Longman Publishing, London.
5. Price and Stevens, 1999, Fundamentals of Enzymology, Oxford University Press, UK.

**Books for References**

1. Trevor Palmer, 1991, Understanding Enzymes, 3rd Edition, Ellis Harwood, UK.
2. Lehninger, A. H. *et al.*, 1993, Principles of Biochemistry, Worth Publ. Inc., USA.
3. Jeremy M. Berg., John L Tymoczko and Lubert Stryer. 2007. Biochemistry. (6th Edition). W H Freeman and Co, New York.

**Relationship matrix for Course Outcomes, Programme Outcomes  
and Programme Specific Outcomes**

Semester	Course Code		Title of the Course					Hours	Credits		
I	21PBI1CC03		CORE -3 : BIOENERGETICS AND ENZYMOLOGY					4	4		
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean score of COs
	PO1	PO2	PO3	PO4	PO5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	
CO1	2	3	3	3	2	2	3	3	3	3	2.7
CO2	3	2	3	3	2	2	3	3	2	3	2.6
CO3	3	2	3	3	2	3	3	2	3	2	2.6
CO4	3	2	3	2	2	3	3	2	3	3	2.7
CO5	3	2	3	2	2	3	3	3	3	3	2.7
	Mean overall score										2.66
	Result										High

Semester	Course Code	Title of the Course	Hours	Credits
I	21PBI1CP01	LABORATORY COURSE – 1	8	6

CO. No.	CO- Statements	Cognitive Level (K-level)
	On successful completion of the course, the students will be able to	
CO-1	recall the knowledge in use of pipettes, making solutions for enzyme and biochemical studies	K1
CO-2	examine the culture of microbial colonies	K2
CO-3	apply the culture techniques and characterize microbial species	K3
CO-4	analyze the nutritive value of oils	K4
CO-5	estimate the biocompounds and design the methodology for their characterization	K5 & K6

## BIOCHEMISTRY

1. Estimation of liver glycogen.
2. Estimation of amino acids by Sorenson's formal titration.
3. Estimation of Iodine value of oil.
4. Estimation of Acid value of oil.
5. Estimation of Reducing sugars by Benedict's titration.
6. Estimation of Vitamin C. (Titration and Colorimetric)
7. Extraction and Estimation of DNA and RNA.
8. Colorimetric estimation of Vitamin A
9. Colorimetric estimation of Vitamin E
10. Estimation of Fructose

## MICROBIOLOGY

1. Media preparation and Culture techniques.
2. Staining techniques (simple, differential and capsular)
3. Biochemical Characterization of Microbes.
  - Amylase activity
  - Methyl Red test – VP test
  - TSI Agar test
  - Citrate Utilization test
4. Qualitative test for Milk.
  - Methylene Blue Reductase Test.
  - Phosphatase test.
5. Antibiotic sensitivity test.

### Books for References

1. Praful. B. Godkar, 2014, Text book of Medical laboratory technology; III edition, Volume I and II, Bhalani Publishing house.
2. Alan H. Gowenlock, Varley's Practical Clinical Biochemistry, 6<sup>th</sup> Edition; CBS Publishers.
3. Sadasivam, S. and Manickam, A. 2010. Biochemical Methods. (3<sup>rd</sup> Edition), New Age International (P) Ltd., New Delhi.
4. David T. Plummer. 1988. Practical Biochemistry (3<sup>rd</sup> Edition). Tata McGraw Hill Publishers, New Delhi.

### Relationship matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
I	21PBI1CP01	LABORATORY COURSE – 1									8	6
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5		
CO1	2	3	3	3	2	3	2	3	2	2	2.5	
CO2	2	3	3	2	3	3	2	3	1	2	2.4	
CO3	3	2	2	2	3	2	3	3	2	3	2.5	
CO4	3	2	2	3	2	2	3	2	3	2	2.4	
CO5	3	2	2	3	3	2	3	2	3	2	2.5	
	Mean overall score											2.46
	Result											High

Semester	Course Code	Title of the Course	Hours	Credits
<b>I</b>	<b>21PBI1ES01A</b>	<b>DSE – 1: DEVELOPMENTAL BIOLOGY</b>	<b>5</b>	<b>4</b>

CO. No.	CO- Statements	Cognitive Level (K-level)
	On successful completion of the course, the students will be able to	
<b>CO-1</b>	describe the cellular basis and embryonic development	<b>K1</b>
<b>CO-2</b>	elucidate the process and mechanisms of sex determination in mammals	<b>K2</b>
<b>CO-3</b>	assign the gene function to the phenotype of an organism	<b>K3</b>
<b>CO-4</b>	analyze mechanisms of the development of various organs	<b>K4</b>
<b>CO-5</b>	evaluate the role of environment in the developmental process	<b>K5 &amp; K6</b>

**Unit - I: Basic concepts (15 Hours)**

General principles of cell-cell communication in development: cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, paracrine factors. General concept of organisms development: Potency, commitment, specification, induction, competence, determination & differentiation; morphogenetic gradients; cell fate & cell lineages; genomic equivalence and cytoplasmic determinants; imprinting.

**Unit – II: Fertilization, development and sex determination in humans (15 Hours)**

Gametogenesis - Sperm & Egg formation; ultra-structure of sperm and ovum, egg types, egg membrane. Fertilization, cleavage, Morula, Implantation, blastulation, gastrulation, formation of germ layers, axis formation - anterior and posterior. Sex determination - chromosomes and environment.

**Unit – III: Organogenesis - I (15 Hours)**

Central nervous system and the epidermis - Formation of neural tube, Differentiation of the neural tube, tissue architecture of the central nervous system, origin of cutaneous structures. Neural crest cells and axonal specificity - specification, Trunk neural crest, pattern generation in the nervous system.

**Unit – IV: Organogenesis - II (15 Hours)**

Paraxial and intermediate mesoderm - Somites formation, Osteogenesis, Urogenital system. Lateral plate mesoderm and endoderm - Heart formation, digestive tube and its derivatives.

**Unit – V: Implications of developmental biology (15 Hours)**

Medical implications of developmental biology - genetic disorders in human development, environmental assaults on human development, Future therapies and developmental biology,

Environmental regulation of animal development - Environment as a part of normal development, Polyphenisms and plasticity, Learning system.

### Books for Study

1. S. Chattopadhyay. 2016. An Introduction to Developmental Biology. Books and Allied (P) Ltd. Kolkata.  
  
**Unit I** Chapter 4 (Pages 73-101)  
Chapter 5 (Pages 101-117)  
Chapter 7 (Pages 131-154)  
**Unit II** Chapter 9 (Pages 189-212)  
Chapter 10 (Pages 214-226)  
**Unit III** Chapter 16 (Pages 351 – 384)
2. Scott F. Gilbert. 2010. Developmental Biology, (Ed: 9) Sinauer Associates Inc. Massachusetts.  
**Unit I** Part 1 - Chapter 3, 6  
**Unit II** Part 2 - Chapter 7, 8, 9, 11, 17  
**Unit III** Part 3 – Chapter 12, 13  
**Unit IV** Part 3 – Chapter 14, 15  
**Unit V** Part 4 – Chapter 21
3. Paul A. Iaizzo Editor, University of Minnesota Department of Surgery Minneapolis, MN, USA. Handbook of Cardiac Anatomy, Physiology, and Devices, Third edition, Springer International Publishing Switzerland 2015 (eBook).  
**Unit IV – Part – II Chapter – 3 – 3.1 to 3.6**
4. Schoenwolf, Bleyl, Brauer and Francis-West. “Larsen's Human Embryology” 5<sup>th</sup> Edition, Elsevier, Churchill Livingstone, 1600 John F. Kennedy Blvd. Ste 1800 Philadelphia, PA 19103-2899 (Ebook).  
**Unit II** Chapter – 1(Pages 14-38)  
**Unit III** Chapter – 4 (Pages 82-107)

### Text books for Study

1. Gilbert S.F. 2010. Developmental Biology, (Ed: 9) Sinauer Associates Inc. Massachusetts.
2. S. Chattopadhyay. 2016. An Introduction to Developmental Biology. Books and Allide (P) Ltd. Kolkata.

### Books for References

1. Alberts B. *et al.* 2002. Molecular Biology of the Cell, (Ed: 3) Garland Science, NY.
2. Harvey Lodish., Arnold Berk and Paul Matsudaira. 2008. Molecular Cell biology. (5<sup>th</sup> Edition). W. H. Freeman and Company, New York.

**Relationship matrix for Course Outcomes, Programme Outcomes  
and Programme Specific Outcomes**

Semester	Course Code	Title of the Course									Hours	Credits
I	21PBI1ES01A	DSE-1: DEVELOPMENTAL BIOLOGY									5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5		
CO1	2	3	2	2	3	2	2	2	2	2	2.2	
CO2	2	3	3	2	1	2	3	3	3	3	2.5	
CO3	2	2	3	2	3	3	2	2	3	3	2.5	
CO4	2	3	2	3	2	3	2	3	3	2	2.5	
CO5	2	3	2	2	1	2	3	2	3	3	2.3	
	Mean overall score											2.4
	Result											High



Semester	Course Code	Title of the Course	Hours	Credits
I	21PBI1ES01B	<b>DSE-1: BIOCHEMISTRY OF NATURAL PRODUCTS</b>	5	4

CO No.	CO-Statements	Cognitive Level (K-level)
	On successful completion of the course, the students will be able to	
CO-1	describe the occurrence, properties and economic importance of natural products from plants, animals and microbes	K1
CO-2	Compare the medicinal properties of secondary metabolites	K2
CO-3	classify the natural compounds based on chemistry and applications	K3
CO-4	apply the various methods of isolation of natural products	K4
CO-5	evaluate quantitatively and qualitatively and design the methodology of isolation of secondary metabolites	K5

#### **Unit – I: General aspect of sources of medicinal plant products (15 Hours)**

Introduction to primary and secondary metabolites, types of secondary metabolites, production under stress, isolation of active constituent from plant material.

#### **Unit – II: Alkaloids (15 Hours)**

Definition, general properties, classification based on nitrogen heterocyclic ring, types - phenylalkylamines, pyridine alkaloids, tropane alkaloids, quinolizidine and pyrrolizidine alkaloids, isoquinoline alkaloids, quinoline, monoterpene, indole alkaloids, purine alkaloids, ruta alkaloids, medicinal importance of each type. Role of alkaloids in plants.

#### **Unit – III: Saponins and Steroids (15 Hours)**

Definition, general properties, medicinal importance of saponins. Important saponins of plant origin - diosgenin, hecogenin, glycyrrhizin, aescin and ginseng. Steroids: General properties, classification. Introduction and medicinal importance of - cardiac glycosides from *Digitalis*, *Strophanthus*, *Urginea*, steroids from *Withania somnifera*, *Holarrhena* and *Solanum*.

#### **Unit – IV: Terpenoids (15 Hours)**

Definition, general properties, classification, introduction and medicinal importance of terpenoids. General account and medicinal importance of myrcene, ocimene, citronellol, menthol and camphor. Tannins, lignins and pectins: General properties and classification.

#### **Unit – V: Plant pigments (15 Hours)**

Occurrence, classification, introduction and applications of carotenoids, xanthophylls, anthocyanins, flavones, flavonols. Acetate pathway and Shikimic acid pathway. Definition, general properties and importance of Pyrethroids and rotenones of plant origin. Natural products of therapeutic importance from animals - Zooterapy - Venom, Body fluids as

medicines - Urine, Saliva and Faeces. Isolation, qualitative and quantitative analysis of secondary metabolites (Skill component).

### **Books for study**

1. K. G. Ramawat and J. M. Merillon (Eds.), 2010, Biotechnology - secondary metabolites, Oxford & IBH publishing Co. Pvt. Ltd.  
**UNIT-I** Chapter 2-Pages 21 to 59, Chapter 7 pages 179 to 201  
**UNIT-II** Chapter 8 pages 209 to 231
2. G. E. Trease and W. C. Evans, 2002, Pharmacognosy and Phytochemistry, 15th Edition, W.B. Saunders Edinburgh, New York.  
  
**UNIT-V** Chapter 13-pages-144 to 147
3. Michael Wink 2010 Biochemistry of Plant Secondary Metabolism (Annual Plant Reviews, Volume 40, Second Edition) A John Wiley & Sons, Ltd., Publication.  
**UNIT-II** Chapter 2-pages 20 to 66  
**UNIT-III** Chapter 4 pages 182 to 230, Chapter 6-pages 304 to 347  
**UNIT-IV** Chapter 5 pages 258 to 285

### **Text books for Study**

1. K. G. Ramawat and J. M. Merillon (Eds.), 2010, Biotechnology - secondary metabolites, Oxford & IBH publishing Co. Pvt. Ltd.
2. J. Mann, R. S. Davidson, J. B. Hobbs, D. V. Banthorpe, J. B. Harborne, 1994, Natural Products: Their Chemistry and Biological Significance, Longman Pub Group.

### **Books for References**

1. Chemistry and biology of herbal medicine: V. P. Agrawal and V. P. Khamboj, (Eds.) (Society of Biosciences).
2. G. E. Trease and W. C. Evans, 2002, Pharmacognosy and Phytochemistry, 15<sup>th</sup> Edition, W.B. Saunders Edinburgh, New York.
3. Gurdeep Chatwal, 1995, Organic chemistry of natural products, Himalaya publishing House, India.

**Relationship matrix for Course Outcomes, Programme Outcomes and  
Programme Specific Outcomes**

<b>Semester</b>	<b>Course Code</b>	<b>Title of the Course</b>									<b>Hours</b>	<b>Credits</b>
<b>I</b>	<b>21PBI1ES01B</b>	<b>DSE -1: BIOCHEMISTRY OF NATURAL PRODUCTS</b>									<b>5</b>	<b>4</b>
<b>Course Outcomes (COs)</b>	<b>Programme Outcomes (POs)</b>					<b>Programme Specific Outcomes (PSOs)</b>					<b>Mean score of COs</b>	
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO 1</b>	<b>PSO 2</b>	<b>PSO 3</b>	<b>PSO 4</b>	<b>PSO 5</b>		
<b>CO1</b>	2	3	2	3	2	3	2	2	3	2	2.4	
<b>CO2</b>	3	2	3	2	3	2	3	2	1	3	2.4	
<b>CO3</b>	3	2	3	2	3	3	3	2	2	3	2.6	
<b>CO4</b>	2	3	2	2	2	2	3	2	3	2	2.3	
<b>CO5</b>	2	3	2	3	2	2	3	3	2	3	2.5	
	<b>Mean overall score</b>											<b>2.44</b>
	<b>Result</b>											<b>High</b>

Semester	Course Code	Title of the Course	Hours	Credits
I	21PBI1AE01	AEC: FUNDAMENTALS OF FORENSIC SCIENCE	4	3

CO No.	CO-Statements	Cognitive Level (K-level)
On successful completion of the course, the students will be able to		
CO-1	describe thorough knowledge about the basics of forensic science	K1
CO-2	compare knowledge on sample collection from crime scene and wild life forensics	K2
CO-3	apply the knowledge on crime scene management and legal court procedures	K3
CO-4	analyze poisonous chemicals and illicit liquor from victims in a crime scene	K4
CO-5	evaluate tool marks and recognize finger prints and other evidences from the crime scene and give possible suggestions to the judicial	K5 & K6

**Unit – I: (12 Hours)**

Forensic science: Definitions, History and Development. Crime scene management and investigation; collection, preservation, packaging and forwarding of physical and trace evidence for analysis. Legal and court procedure pertaining to expert testimony.

**Unit – II: (12 Hours)**

Fresh blood – grouping and typing of fresh blood samples including enzyme types. Analysis of stains of blood and allied body fluids for their groups and enzyme tests. Disputed paternity and maternity problems – DNA extraction and profiling techniques. Wild life forensics – Scope, evidences and identification.

**Unit – III: (12 Hours)**

Analysis of illicit liquor including methyl and ethyl alcohol and alcohol in body fluids and breathe. Analysis of chemicals in trap cases (Petroleum product, Chemical examination of insecticides, pesticides and psychotropic drugs – Sedatives, stimulants, opiates and drugs of abuse). Detection of poisons from viscera, tissues and body fluids.

**Unit – IV: (12 Hours)**

Classification of fire arms, ammunition and their compositions. Forensic examination and identification of cartridges, bullets, fire arms, bombs and explosives. Tool marks – meaning, type and examination. Photography - types application in criminal investigations and forensic evidence examination.

**Unit – V:****(12 Hours)**

History, classification, search, lifting and examination of fingerprints, development of latent fingerprints by various methods. Medicolegal aspects of wounds, Post-mortem examination and PM changes, asphyxia death, sexual offences, infanticide. Forensic psychiatry and lye detection.

**Books for Study**

1. Text book of Forensic Medicine and Toxicology; Fifth Edition by Krishan Vij; 2011; Elsevier Publications  
**UNIT-I** Chapter I and II  
**UNIT-III** Chapter 41  
**UNIT-IV** Chapter 3  
**UNIT-V** Chapter 14, 15, 16, 17
2. Blood stain pattern analysis: Third Edition by Tom Bevel and Ross M Gardiner.2008: CRC press.  
**UNIT-II** Chapter 1,2,3,4
3. Text Book of Medical Jurisprudence; Sixth Edition by Rai Bahadur Jaising; Butterworth and Co press.  
**UNIT-I** Chapter I  
**UNIT-II** Chapter I  
**UNIT-III** Chapter 08  
**UNIT-IV** Chapter 12  
**UNIT-V** Chapter 15

**Books for Reference (e Books)**

1. Crime Scene Photography by Edward M. Robinson: Second Edition: Elsevier Publication 2010.
2. Criminal Law and Justice by Noel Cross: Sage Publications 2010.
3. Drugs of Abuse by Raphael C. Wong; Humana press 2010.
4. Forensic Criminology by Wein A Patherick and Brent E. Turvey, 2010.

**Relationship matrix for Course Outcomes, Programme Outcomes  
and Programme Specific Outcomes**

Semester	Course Code					Title of the Course					Hours	Credits
<b>I</b>	<b>21PBI1AE01</b>					<b>AEC: FUNDAMENTALS OF FORENSIC SCIENCE</b>					<b>4</b>	<b>3</b>
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5		
<b>CO1</b>	2	1	3	2	2	2	2	1	1	2	1.8	
<b>CO2</b>	3	2	2	3	2	2	2	3	2	2	2.3	
<b>CO3</b>	3	2	1	2	2	1	3	2	3	2	2.1	
<b>CO4</b>	2	3	2	3	2	1	2	2	2	3	2.2	
<b>CO5</b>	2	2	3	2	2	1	2	2	3	3	2.2	
	<b>Mean overall score</b>										<b>2.12</b>	
	<b>Result</b>										<b>High</b>	

Semester	Course Code	Title of the Course	Hours	Credits
II	21PBI2CC04	Core - 04: GENETIC ENGINEERING	4	4

CO No.	CO- Statements	Cognitive Level (K- level)
On successful completion of the course , the students will be able to		
CO-1	remember the various underlying principles of genetic engineering and enzymes concerned with it	K1
CO-2	understand the methodologies of gene transfer	K2
CO-3	apply the analytical procedures involving DNA	K3
CO-4	analyze the uptake of genes following screening procedures	K4
CO-5	evaluate the methods of recombinant selection and construct gene cassettes and vectors	K5&K6

#### Unit – I: Introduction to Genetic engineering

(12 Hours)

Isolation (Mechanical, cDNA, Shot gun) & purification of nucleic acid, PCR; Enzymes in molecular biology – restriction endonuclease, ligases, reverse transcriptase, nucleases, polymerase, alkaline phosphatase, terminal transferase, T4 polynucleotide kinase; linker, adaptors & homopolymers.

#### Unit – II: Expression cassette

(12 Hours)

Promoters (constitutive, inducible, tissue specific), terminators, reporters, markers (antibiotic resistant, herbicide resistant, antimetabolite), Vectors in gene cloning – Plasmids (pBR322, pUC), Bacteriophages (Phage  $\lambda$ , M13), cosmids, phagemids, yeast plasmid vector, viral vectors (adenovirus, adeno associated virus, baculo virus, herpes virus, retrovirus, cauliflower mosaic virus, tobacco mosaic virus, potato virus X), artificial chromosome (BAC, YAC, HAC), shuttle vector, Expression vector.

#### Unit – III: Gene transfer methods

(12 Hours)

Transformation – physical method (electroporation, micro-injection, particle bombardment, liposome mediated transfer), chemical method (PEG mediated, DEAE Dextran mediated,  $\text{CaPO}_4$  mediated gene transfer), Biological method (*Agrobacterium* mediated gene transfer). Expression systems – prokaryotes (Bacteria) and eukaryotes (yeast, mammalian and, insect cell lines).

#### Unit – IV: Screening and selection methods

(12 Hours)

Insertional inactivation, blue-white selection, colony - *in situ* hybridization, *in vitro* selection, *in vitro* translation, radioactive antibody test, immunological techniques, DNA labelling, dot blot hybridization, Molecular beacons. Gene Silencing, RNA interference, antisense therapy, gene knockout. Blotting techniques – southern, northern, western and south-western.

**Unit – V: Molecular Techniques****(12 Hours)**

RFLP, RAPD, AFLP, DNA Finger printing, DNA Foot printing, Microarray (DNA & Non-DNA). Libraries - Genomic library; C-DNA library & its types; BAC library; YAC library; Methyl filtration libraries; COT fractionation based libraries. Bioethics & Biosafety in genetic engineering; IPR & Patenting.

**Books for Study**

- Glick R. and J. J. Pasternak. 2002. Molecular Biotechnology (3rd Edition). ASM Press, Washington, USA.  
**UNIT-II** Chapter IV, VII  
**UNIT-III** Chapter V  
**UNIT-V** Chapter XX
- Old R.W and S.B. Primrose. 1989. Principles of gene manipulation (Ed: 4). Blackwell Scientific Publications, London.  
**UNIT-I** Chapter II, III  
**UNIT-II** Chapter IV, V  
**UNIT-III** Chapter VIII, IX, X  
**UNIT-IV** Chapter VI  
**UNIT-V** Chapter XIV

**Books for References**

- David M Glove. 1984. Gene cloning - The mechanisms of DNA manipulations. Chapman and Hall, New York.
- Ernst L Winnacker. 2002. From genes to clones - Introduction to gene technology. VCR Pub., Weinheim.
- James D Watson. *et al.* 1992. Recombinant DNA. WH freeman and Co., NY.

**Relationship matrix for Course Outcomes, Programme Outcomes and  
Programme Specific Outcomes**

Semester	Course Code	Title of the Course									Hours	Credits
<b>II</b>	<b>21PBI2CC04</b>	<b>CORE-04 : GENETIC ENGINEERING</b>									<b>4</b>	<b>4</b>
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5		
<b>CO1</b>	2	1	1	2	3	2	2	3	3	2	2.1	
<b>CO2</b>	3	2	2	2	3	3	2	3	2	3	2.5	
<b>CO3</b>	2	3	2	3	2	3	2	2	3	3	2.5	
<b>CO4</b>	2	2	2	3	2	3	3	2	3	3	2.5	
<b>CO5</b>	2	3	3	3	2	3	3	3	3	3	2.8	
	<b>Mean overall score</b>										<b>2.48</b>	
	<b>Result</b>										<b>High</b>	

Semester	Course Code	Title of the Course	Hours	Credits
II	21PBI2CC05	CORE- 05: HUMAN PHYSIOLOGY	4	4

CO No.	CO- Statements	Cognitive Level (K-level)
On successful completion of the course, the students will be able to		
CO-1	describe the anatomy of the human body	K1
CO-2	understand the mechanism of gastrointestinal tract	K2
CO-3	apply the knowledge in relating the structure with the functions of nervous system	K3
CO-4	analyse the interrelationships within and between anatomical and physiological systems of the human body	K4
CO-5	evaluate the influence of environment and feelings in the physiological processes and suggest the possible ways for the well-being	K5&K6

#### Unit – I:

(12 Hours)

**General and Cellular Physiology** - Cell as the living unit of the body. The internal environment- homeostasis. Control systems, organization of a cell, transport across cell membranes, functional systems in the cells, blood – composition of body fluids and compartments. Homeostasis –Mechanisms, Homeostatic regulation of water and electrolytes. Plasma proteins and its function. Formed elements – development and function. Hemoglobin – structure and function. Blood Clotting mechanisms.

#### Unit – II:

(12 Hours)

**Gastro-intestinal System** - General principles of GI function - mastication & swallowing, esophageal motility, salivary secretion, gastric mucosal barrier, pancreatic & biliary secretion, gastrointestinal motility, digestion & absorption, functions of colon, pathophysiology of peptic ulcer, gastrointestinal hormones and their actions, absorption of carbohydrates, fats and proteins, vitamins, water and electrolytes.

#### Unit – III:

(12 Hours)

**Cardio-vascular and Respiratory Physiology** - Properties of cardiac muscle, cardiac cycle, heart as a pump, cardiac output, specialized tissues of the heart, coronary circulation, generation & conduction of cardiac impulse, control of excitation & conduction, electrocardiogram-arrhythmias. Cardiac failure, circulatory shock. Respiration – functional anatomy of respiratory system, pulmonary ventilation, alveolar ventilation, mechanics of respiration, pulmonary circulation, principles of gaseous exchange - oxygen & carbon dioxide transport, regulation of respiration.



**Unit – IV:****(12 Hours)**

**Nerve and Muscle Physiology** - General design of nervous system: Classification and Properties of nerve fibers, nerve conduction, Classification of somatic senses, sensory receptors, sensory transduction. Special senses - vision, hearing, smell, taste and their perceptions. Autonomic nervous system, limbic system and hypothalamus. EEG, sleep, emotions & behavior. Learning & memory. Functional anatomy of skeletal muscle, mechanisms of muscle contraction, smooth muscles.

**Unit – V:****(12 Hours)**

**Renal Physiology** - Structure and functions of kidney – Structure of nephron, glomerular filtration, tubular reabsorption of glucose, water and electrolytes. Tubular secretion. Urine formation, renal mechanisms for the control of blood volume, blood pressure (Renin-angiotensin system) micturition, diuretics and renal failure.

**Environmental physiology** - physiology of hot and cold environment, high altitude, aviation physiology, space physiology, deep sea diving & hyperbaric conditions.

**Books for Study**

1. Arthur C. Guyton and John E. Hall., “ Textbook of Medical Physiology” 11<sup>th</sup> Edition, Elsevier Saunders, Elsevier Inc. 1600 John F. Kennedy Blvd., Suite 1800 Philadelphia, Pennsylvania 19103-2899  
**Unit-I** Chapter 1 (Page No. 3-6)  
**Unit-I** Chapter 32 (Page No. 420)  
**Unit-II** Chapter 62, 63, 64, 65 and 66  
**Unit-III** Chapter 37 (Page No. 471, 472, 477, Chapter 38, 39 and 40)  
**Unit-IV** Chapter 45, 49, 50, 51, 52, 53, 57, 58, 59
2. M N Chatterjea and Rana Shinde., “ Textbook of Medical Biochemistry” 8<sup>th</sup> Edition, Jaypee Brothers Medical Publishers (P) Ltd., 4838/24, Ansari Road, Daryaganj, New Delhi 110 002, India.  
**Unit-I** Chapter 7 (Page No. 97-108)
3. Chandi Charan Chatterjee., “Human Physiology” Vol. I and Vol. II, Reprint (2007), Kalyani Publishers, 13/1B, Old Ballygunge 2<sup>nd</sup> Lane, Kolkata 700 019.  
**Unit-III** Vol. I - Chapter VII (Page No. 226, 227, 248, 249-254)  
Vol. I - Chapter VIII (Page No. 365)  
**Unit-IV** Vol. II – Chapter 5-2, 5-10, 5-16  
**Unit-V** Vol. II – Chapter 1-1, 1-15, 1-18, 1-40, 1-60  
Vol. II – Chapter 8-1, 8-2
4. Paul A. Iaizzo Editor, University of Minnesota Department of Surgery Minneapolis, MN, USA. Handbook of Cardiac Anatomy, Physiology, and Devices, Third edition, Springer International Publishing Switzerland 2015.  
**Unit-III** Part I – Chapter 1.2.4

**Text books for study**

1. Arthur C. Guyton, 2005, Text Book of Medical Physiology, WB Saunders's, USA.
2. C. C Chatterjee, 1985, Human Physiology *Vol I & Vol II*. 11<sup>th</sup> Edn, Kalyani Mukerjee Publications, Kolkata, India.

**Books for References**

2. Kathleen, J.W. Wilson and Anne Waugh. 1998. Ross and Wilson Anatomy and Physiology in health and illness. (8<sup>th</sup> Edition). Churchill Livingstone, New York.
1. Gerald J. Tortora and Sandra Reynolds. 2003. Principles of Anatomy and Physiology. (10<sup>th</sup> Edition). John Wiley and Sons. Inc. Pub. New York
2. Abraham White, Philip Handler and Emil L. Smith. 1983. Principles of Biochemistry. (6<sup>th</sup> Edition). Tata Mc Graw – Hill Publishing Company, New Delhi.

**Relationship matrix for Course Outcomes, Programme Outcomes and  
Programme Specific Outcomes**

Semester	Course Code	Title of the Course									Hours	Credits
<b>II</b>	<b>21PBI2CC05</b>	<b>CORE 5 – HUMAN PHYSIOLOGY</b>									<b>4</b>	<b>4</b>
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5		
<b>CO1</b>	3	2	2	2	2	2	3	2	3	3	2.4	
<b>CO2</b>	2	3	2	2	2	2	3	2	3	3	2.4	
<b>CO3</b>	2	2	3	2	3	3	2	2	3	3	2.5	
<b>CO4</b>	2	3	2	3	2	3	2	3	3	2	2.5	
<b>CO5</b>	2	3	2	2	1	2	3	2	3	3	2.3	
	<b>Mean overall score</b>										<b>2.42</b>	
	<b>Result</b>										<b>High</b>	

Semester	Course Code	Title of the Course	Hours	Credits
II	21PBI2CC06	CORE- 06: MOLECULAR BIOLOG	4	3

CO No.	CO- Statements	Cognitive Level (K-level)
On successful completion of the course, the students will be able to		
CO-1	recall the pioneering experiments involved in molecular biology	K1
CO-2	predict the mechanisms concerned with the mobile genetic elements	K2
CO-3	apply the isolation procedures of nucleic acids	K3
CO-4	analyze the steps involved in the induction of transcription	K4
CO-5	evaluate the errors and correction mechanisms of informational molecules and synthesize the DNA molecules artificially	K5&K6

### Unit – I: Introduction (12 Hours)

Terms and definitions – DNA is the Genetic Material: Griffith's Experiment, Avery, Hershey & chase Experiment. RNA as the Genetic Material: Conrat & Singer Experiment with TMV – Central Dogma. Organization of prokaryotic genome: Bacterial genome, Viral genome – types of RNA and their role.

### Organization of Chromosome (12 Hours)

Structural organization of eukaryotic chromosomes. Types and basic structure of chromosomes. Chromosomal Proteins – Histones and Protamines – nucleosomes – levels in the organization of Metaphase Chromosome. Special types of Chromosomes: Polytene and Lamp brush chromosomes. Duplication & segregation of Chromosomes.

### Unit – II: Transposons (12 Hours)

Discovery of IS elements, Transposons in Bacteria (Tn elements), Maize (Ac/Ds and Sp/Dsp elements), Drosophila (P elements) and Yeast (Ty elements). Transposition, Genetic and evolutionary significance of transposons.

### Extra chromosomal DNA (12 Hours)

Maternal Inheritance, Structure, gene contents and functions of Chloroplast and Mitochondrial DNA, theory of prokaryotic endosymbionts. Plasmids: Definition, Types, Structure, Properties, gene content. Use in rDNA technology.

### Unit – III: DNA replication: (12 Hours)

Models – Messelson & Stahl Experimental proof for Semi-conservative replication - Rules, requirements, problems and molecular mechanism of the replication of linear and circular (Rolling circle Model) DNA in prokaryotes and eukaryotes. DNA polymerases – structure and function. Replication of RNA – RNA and DNA mediated.

## Recombination

Homologous and non-homologous recombination - Site specific recombinations & transposition of DNA.

## Unit – IV: Transcription

(12 Hours)

RNA types (tRNA, mRNA, rRNA, Ribozyme, snRNA, hnRNA, RNAi, RNA-P and microRNA), structure and functions. Transcription mechanism in prokaryotes and eukaryotes – initiation, elongation and termination, Post transcriptional modifications. Antibiotic inhibitors of transcription.

## Translation

Genetic code and its features. Wobbling hypothesis. Machinery, initiation, elongation and termination of translation in bacteria and eukaryotes. Translational proof reading, translational inhibitors, post-translational modifications, chaperones and protein targeting- translocation, heat shock proteins, glycosylation; SNAPs and SNAREs. Bacterial signal sequences.

Mitochondrial, chloroplast and nuclear protein transport. Endocytosis – viral entry. Ubiquitin TAG protein destruction.

## Unit – V: Chromosomal changes and consequences

(12 Hours)

Changes in the chromosome number: euploidy and aneuploidy and related genetic disorders. Changes in the chromosome structure: addition, deletion, inversion and translocation and related genetic disorders.

## Mutation

Definition, chemical basis and types. Mutagens: Physical, chemical and Biological. Mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal versus somatic mutants, insertional mutagenesis. DNA repair mechanism: thymine dimer, light activation, excision, recombinational, SOS and mismatch repair.

## Books for study

1. Molecular cell Biology. Fifth edition By Harvey Lodish, Arnold Berk, Chris A Kaser  
**UNIT-I** Chapter 10  
**UNIT-II** Chapter 10  
**UNIT-IV** Chapter 11
2. David Freifelder, 2008. Molecular Biology. (Ed: 2). Narosa Publications. New Delhi.  
**UNIT-I** Chapter VIII  
**UNIT-II** Chapter XX  
**UNIT-III** Chapter IX  
**UNIT-IV** Chapter XII  
**UNIT-V** Chapter X, XX IV

3. Jeffrey M. Cooper & Rober E. Hausman. 2000. The Cell: A Molecular Approach ASM Press, Washington D.C.

**UNIT-I** Chapter IV

**UNIT-II** Chapter VI

**UNIT-III** Chapter VI

**UNIT-IV** Chapter VII

**UNIT-V** Chapter VI, XVIII

### Books for References

1. Ajoy Paul. 2007. Textbook of Cell and Molecular Biology. Books and Allied, Kolkata
2. De Robertis and De Robertis. 1990. Cell and Molecular Biology. Saunders, Philadelphia.
3. Gerald Karp. 2008. Cell and Molecular Biology. (Ed: 5). John Wiley and Sons, New York.
4. Lewin's. 2017. GENES XII. 12th edition. Jones and Bartlett Publishers, Inc; Burlington, Massachusetts, USA.

### Text books for study

1. David Freifelder, 2008. Molecular Biology. (Ed: 2). Narosa Publications. New Delhi.
2. Jeffrey M. Cooper & Rober E. Hausman. 2000. The Cell: A Molecular Approach ASM Press, Washington D.C.

### Books for References

1. Ajoy Paul. 2007. Textbook of Cell and Molecular Biology. Books and Allied, Kolkata
2. De Robertis and De Robertis. 1990. Cell and Molecular Biology. Saunders, Philadelphia.
3. Gerald Karp. 2008. Cell and Molecular Biology. (Ed: 5). John Wiley and Sons, New York.
4. Lewin's. 2017. GENES XII. 12th edition. Jones and Bartlett Publishers, Inc; Burlington, Massachusetts, USA.

### Relationship matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
II	21PBI2CC06	CORE -6 : MOLECULAR BIOLOGY									4	3
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO 2	PSO 3	PSO 4	PSO 5		
CO1	2	2	3	2	2	3	2	3	2	3	2.4	
CO2	3	2	2	3	2	3	2	2	3	3	2.5	
CO3	3	2	3	2	2	3	3	3	2	2	2.5	
CO4	3	2	3	3	2	3	3	2	2	2	2.5	
CO5	3	2	3	2	2	3	3	2	2	3	2.5	
Mean overall score											2.48	
Result											High	

Semester	Course Code	Title of the Course	Hours	Credits
II	21PBI2CP02	LABORATORY COURSE II	5	4

CO No.	CO-Statements	Cognitive Level (K-level)
On successful completion of the course, the students will be able to		
CO-1	describe the isolation procedures of the enzymes	K1
CO-2	explain the factors affecting the enzyme action and the importance of the blood circulation and changes in the physiology of the circulation during exercise	K2
CO-3	apply the knowledge to study the effect of various factors over the activity of different enzymes	K3
CO-4	analyze the patterns of cardiac cycle during normal and in exercise condition	K4
CO-5	evaluate the banding pattern in protein and prepare seeds artificially	K5&K6

### ENZYMOLGY

1. Assay of acid phosphatase.
2. Factors influencing reaction rates of acid Phosphatase.
  - i) Effect of Temperature.
  - ii) Effect of Time.
  - iii) Effect of pH.
  - iv) Effect of Enzyme concentration.
  - v) Effect of substrate concentration (Measurements of Vmax & Km)

### PHYSIOLOGY

1. Blood Pressure - Measurement – Effect of exercise and postural variation on BP.
2. ECG recording
3. Body Mass index calculation

### MOLECULAR TECHNIQUES

1. Agarose gel electrophoresis of Nucleic acids (DNA & RNA)
2. Polyacrylamide gel electrophoresis (protein)
3. Isolation of chromosomal DNA from blood samples by Phenol-Chloroform method.
4. Preparation of genomic DNA from bacteria
5. Synthetic seed preparation

### Books for References

1. Lansing M Prescott, John P Harley and Donald A Klein. 2007. Microbiology. (7<sup>th</sup> Edition). Mc Graw Hill, New York.
2. James G. Cappucino and Sherman Natalie 2005. Microbiology – A Laboratory Manual. (7<sup>th</sup> edition). Pearson education India, New Delhi.
3. Glick R. and J. J. Pasternak. 2002. Molecular Biotechnology (3rd Edition). ASM Press, Washington, USA.
4. Old R.W and S.B Primrose. 1989. Principles of gene manipulation (Ed: 4). Blackwell Scientific Publications, London.
5. Praful. B. Godkar, 2014, Text book of Medical laboratory technology; III Edition, Volume I and II, Bhalani Publishing house.
6. Alan H Gowenlock, Varley's Practical Clinical Biochemistry, 6<sup>th</sup> Edition; CBS publishers.

### Relationship matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
II	21PBI2CP02	LABORATORY COURSE II									5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5		
CO1	3	2	3	2	3	2	2	3	2	3	2.5	
CO2	2	2	3	2	2	2	3	2	3	3	2.4	
CO3	2	2	3	3	2	2	3	2	3	3	2.5	
CO4	2	3	3	3	2	2	2	3	2	3	2.5	
CO5	3	2	2	3	3	2	3	2	2	3	2.5	
	Mean overall score										2.48	
	Result										High	

Semester	Course Code	Title of the Course	Hours	Credits
II	21PBI2SP01	SELF-PACED LEARNING: ADVANCED NUTRITION	-	2

CO. No.	CO- Statements	Cognitive Level (K-level)
On successful completion of the course, the students will be able to		
CO-1	Study the basic requirement of nutrition at different stages of life	K1
CO-2	Learn the proximate principles of nutrition with reference to RDA	K2
CO-3	Apply the experimental procedures concerned with energy metabolism and nutritional assessment for various disease status and agegroups	K3
CO-4	Quantify the nutritional content of the food items	K4
CO-5	Evaluate the disorders associated with nutrition	K5

### Unit – I: Energy Metabolism:

Basal metabolism – Basal metabolic rate – Factors affecting BMR, - determination of BMR, direct and indirect methods, - Benedict's Roth apparatus, - respiratory quotient – Biological oxygen demand. Anthropometry; Height, Weight, Skin fold thickness and arm circumference - Their importance in nutrition.

### Unit – II: Introduction to Nutritional Biochemistry:

Carbohydrate; Source of energy; Glycogen, Fiber in diet. Proteins – essential amino acids and non-essential amino acids – sources, functions – relation with Marasmus, Kwashiorkor disease. Protein calorie malnutrition. Biological value of proteins.

Fats: Sources- Saturated and unsaturated fatty acids, essential and non-essential fatty acids – outline of disorders concerned with fatty acid metabolism.

### Unit – III: Vitamins:

Fat soluble and water soluble vitamins—their source, daily requirements and deficiency manifestations. Role of Vitamins as co-factors- in Electron transport chain; and enzyme reactions; Vitamins involved in haemopoiesis; Role as antioxidants.

### Unit – IV: Minerals:

Micro, macro and trace elements – daily requirements – functions – deficiency manifestations – Role as electrolytes - sodium and potassium. Food fads and Facts.



**Unit – V: Nutrition at different Stages of life:**

During infancy, School children, adolescence, pregnancy, lactation and aging. Assessment of nutritional status, - methods – intake, Biochemical and clinical methods.

**Text books for study**

1. Swaminathan, M. 2004, Essentials of Food and Nutrition. The Bangalore Printing and Publishing Co. Ltd., Bangalore.
2. Anthony A. Albanase (1972), Newer Methods of Nutritional Biochemistry (Academic Press, New York)

**References**

1. Garrow, J. S. and James, W. P. T. 2000. Human Nutrition and Dietetics. (10<sup>th</sup> Edition). Churchill Livingstone Publishers, UK.
2. Wong, D. W. S. 1996. Mechanism and Theory in Food Chemistry. CBS, New Delhi.

**Relationship matrix for Course Outcomes, Programme Outcomes and  
Programme Specific Outcomes**

Semester	Course Code		Title of the Course								Hours	Credits
II	21PBI2SP01		Self-Paced Learning ADVANCED NUTRITION								-	2
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5		
CO1	2	1	3	1	2	3	1	2	2	2	1.9	
CO2	3	1	1	1	2	3	1	3	2	3	2	
CO3	3	1	3	2	3	2	1	3	3	1	2.2	
CO4	2	3	3	3	2	3	1	1	3	1	2.2	
CO5	3	3	1	3	1	3	2	1	1	2	2	
	Mean overall score											2.06
	Result											Medium

Semester	Course Code	Title of the Course	Hours	Credits
II	21SBS2ES02A	DSE - 2: IMMUNOLOGY	5	4

CO. No.	CO-Statements	Cognitive Level (K-level)
On successful completion of the course, the students will be able to		
CO-1	describe the anatomy of the immune reactions	K1
CO-2	compare the adverse effects of various hypersensitivity reactions	K2
CO-3	apply the knowledge of tissue matching procedures	K3
CO-4	analyze the structural and functional details of various types of antibodies	K4
CO-5	Evaluate the biochemical basis of immune disorders and produce monoclonal antibodies and vaccines	K5&K6

**Unit – I: (15 Hours)**

**Introduction to Immunology:** Infection- types, factors influencing infection pathogenicity. Sources and carriers of infectious agents. Immune system- definition and properties. Cells of the immune system. Lymphoid organs- primary and secondary; structure and functions. Natural defenses of the body (Innate immunity) - skin, mucous membrane, lysozyme and phagocytes. Reticuloendothelial system and its components.

**Unit - II: (15 Hours)**

**Antigens and Antibodies:** definition, properties- antigenicity and immunogenicity, antigenic determinants and haptens. Types of antigens - flagellar, somatic, capsular, soluble, heterophile, tumour and autoantigens. Antigen - antibody interactions - molecular mechanism of binding. Affinity, avidity, valency, cross reactivity and multivalent binding. Complement system; components - alternate and classical pathways, initiators and MAC. Inflammation - acute and chronic; mechanism and significance.

**Unit – III: (15 Hours)**

**Immunoglobulins:** Basic structure, classes and distribution of antibodies. Antibody diversity - genetic and other factors. Theories of antibody formation. Acquired immunity - Humoral: Biosynthesis of antibodies; B and T lymphocyte cooperation. Primary and secondary immune response. Cell Immunity-components of T lymphocytes, T cell receptor diversity and CD molecules. Role of antigen presenting cells. Regulation of immune response. Cytokines, types and role in immunity. Mitogens and immunosuppressants. Immunological tolerance- at birth and in adults; induction and termination.

**Unit – IV:****(15 Hours)**

**Immune system in health & disease:** Transplantation immunology- graft rejection and HLA antigens. Role of MHC and T cells. Prevention of graft rejection. Hypersensitivity- Immediate and delayed types; mechanism of reaction. Vaccines and toxoids: types, production and uses. Active and passive immunization, immunization schedule. Tumor immunology: tumor antigens, immunosurveillance and NK cells. Auto immunity-mechanism of breakdown, pathogenesis and specific diseases.

**Unit – V:****(15 Hours)**

**Immunological techniques:** Polyclonal antibodies - principle and production of antisera. Monoclonal antibodies - hybridoma technique, applications, merits and demerits. Recombinant antibodies. Principle and applications of RIA, ELISA. Precipitation reaction - Immunodiffusion, immunoelectrophoresis, precipitin ring test. Agglutination tests - hemagglutination, febrile and latex agglutination. Widal, VDRL, pregnancy and rheumatoid factor tests.

**Text books for study**

1. Kuby Richard, A. Goldsby., Thomas J. Kint and Barbara. A. Osborne. 2000. Immunology. (4th Edition), W.H. Freeman and Company, New York.  
**UNIT-I** Chapter II  
**UNIT-II** Chapter III  
**UNIT-III** Chapter IV, XI, XII  
**UNIT-IV** Chapter VII, XVI, XX  
**UNIT-V** Chapter XXIII
2. Cellular and Molecular Immunology, 7<sup>th</sup> Edition, Abul K Abbas, Andrew H Litchman Elsevier Publications 2012 (Ebook)  
**UNIT-I** Chapter I and II  
**UNIT-II** Chapter V  
**UNIT-III** Chapter V, IX, X  
**UNIT-IV** Chapter XVI, XVII and XVIII  
**UNIT-V** Appendix IV
3. Charles A. Janeway and Paul, J. R. 1994. Immunobiology. (4th Edition), Travels Blackwell Scientific Publishers, New York.  
**UNIT-I** Chapter I  
**UNIT-II** Chapter II  
**UNIT-III** Chapter IV, V, VI, VII, VIII  
**UNIT-IV** Chapter XII XIII  
**UNIT-V** Chapter Appendix I

**References**

1. Fahim Halim Khan, 2009, The Elements of Immunology, Pearson education, New Delhi.
2. Frank C. Hay and Olwyn M. R. Westwood, 2006, Practical Immunology, Blackwell Publishing, India.
3. Ivan M. Roitt and Peter J. Delves. 2005. Roitt's Essential Immunology. (10th Edition). Blackwell Scientific Publishers, New York.

**Text books for study**

1. Charles A. Janeway and Paul, J.R. 1994. Immunobiology. (4<sup>th</sup> Edition), Travels Blackwell Scientific Publishers, New York.
2. Kuby Richard, A. Goldsby., Thomas J. Kint and Barbara. A. Osborne. 2000. Immunology. (4<sup>th</sup> Edition), W.H. Freeman and Company, New York.

**References**

1. Fahim Halim Khan, 2009, The Elements of Immunology, Pearson education, New Delhi.
2. Frank C. Hay and Olwyn M. R. Westwood, 2006, Practical Immunology, Blackwell Publishing, India.
3. Ivan M. Roitt and Peter J. Delves. 2005. Roitt's Essential Immunology. (10th Edition). Blackwell Scientific Publishers, New York.

**Relationship matrix for Course Outcomes, Programme Outcomes and  
Programme Specific Outcomes**

Semester	Course Code		Title of the Course							Hours	Credits
II	21SBS2ES02A		DSE-2: IMMUNOLOGY							5	4
Course Outcomes(COs)	Programme Outcomes (POs)					Programme Specific Outcomes(PSOs)					Mean score ofCOs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	1	3	3	1	2	3	3	1	2	2.2
CO2	3	1	2	2	3	3	2	1	2	2	2.1
CO3	2	1	3	1	3	3	1	2	3	3	2.2
CO4	1	2	3	1	3	3	2	1	3	3	2.2
CO5	3	2	1	3	2	3	2	3	2	2	2.3
	Mean overall score										2.2
	Result										High

Semester	Course Code	Title of the Course	Hours	Credits
II	21PBI2ES02	DSE - 2: SOLID WASTE MANAGEMENT	5	4

CO No.	CO-Statements	Cognitive Level (K-level)
On successful completion of the course, the students will be able to		
CO-1	discuss the importance solid waste management and collection of wastes.	K1
CO-2	predict the mechanisms of degradation of organic matters	K2
CO-3	apply the methods of vermin composting	K3
CO-4	analyze different types of wastes and their processing methods	K4
CO-5	evaluate the economic importance of waste management and produce mushroom industrially	K5&K6

#### **Unit-I (15 Hours)**

Definition-scope and importance of solid waste management-Types of solid wastes-garbage, rubbish, agricultural, hospital and domestic wastes. Collection-transport and processing of solid wastes. Waste as a resource: organic compost-process of composting-Role of microbes in composting. Significance of organic compost.

#### **Unit-II (15 Hours)**

Organic matter decomposition- Decomposition of litter, cellulose, hemicelluloses, lignin, water soluble components and proteins. Carbon assimilation and immobilization. Microbes associated with organic matter decomposition. Factors affecting organic matter decomposition.

#### **Unit -III (15 Hours)**

Solid waste management- methods of solid waste management- open dumping, land filling, incineration, pyrolysis Biogas production-mechanism of methane gas formation. Factors affecting methane formation Utilization of Biogas.

#### **Unit-IV (15 Hours)**

Vermicomposting-Earthworm and its characteristics-internal anatomy digestive, excretory, respiratory and reproductive systems. Preparatory methods of vermiculture. Economic and ecological importance of vermicomposting and vermi wash.

#### **Unit-V (15 Hours)**

Mushroom culture- classification-Tests for identification-Characteristics of common edible mushrooms-Nutritive value of mushrooms. Culture techniques-preparation of spawn- Preparation compost- spawn running and harvesting. Preservation and storage. Recipes of mushroom.

#### **Books for Study**

1. Dubey, RC. (2009). A Text book of microbiology, S. Chand & Co. Ltd, New Delhi.
2. Ramesha Chandrappa (2012) ebook: Solid waste management, Springer, London.

**UNIT I: Chapter I**

**UNIT II: Chapter II**

**UNIT III: Chapter III**

**UNIT IV: Chapter V**

**Books for Reference**

1. NIIR Board, 2004, The Complete Technology Book on Biofertilizers and Organic Farming, National Institute of Industrial Research.
2. Mohoney, R. Lab Techniques in Zoology, (UK: Butterworth, 1966)
3. Vasantaraj David, S. and Kumaraswamy, T. Elements of Economic Entomology, (Chennai: Popular Book Depo, 1998).

**Relationship matrix for Course Outcomes, Programme Outcomes and  
Programme Specific Outcomes**

Semester	Course Code	Title of the Course									Hours	Credits
II	21PBI2ES02	DSE -2:SOLID WASTE MANAGEMENT									5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO 4	PSO5		
CO1	3	1	2	3	1	2	3	3	1	2	2.1	
CO2	3	1	1	2	3	3	2	1	2	2	2.0	
CO3	2	1	3	1	3	3	1	2	3	3	2.2	
CO4	1	3	3	1	3	3	2	1	3	2	2.2	
CO5	3	3	2	3	2	3	2	3	3	2	2.6	
	Mean overall score											2.22
	Result										High	

Semester	Course Code	Title of the Course	Hours	Credits
II	21PSS2SE01	SKILL ENHANCING COURSE: SOFT SKILLS	4	3

#### **Programme outcome (Pos)**

- To identify the skill gap of the college students and provide a focused training on soft skills and empower the students with employability skills that make them industry fit
- To encourage small group learning that promote individual attention and rigorous evaluations as hallmarks of the course
- To adapt a teaching and learning methodology that is purely dependent on activity based learning, participation, assignments, interactions, assessments and evaluations that take away boredom of participants
- To create an interface between industries and educational institutions that match the expectations of employers and abilities of the employees
- To respond and reach out to other institutions the impact of Soft Skills on faculty and students that effectively serve as a corollary to technical education

#### **Programme Specific outcomes (PSOs)**

##### **After the successful completion of the course, students will learn:**

- the dynamics of effective and professional communication skills and put them into daily use
- to write a Professional resume using creative methods of online platforms
- the dynamics of interview skills and GD preparations and presentations in public platforms and present the best of themselves as job seekers
- to understand, analyze and express their personality styles and personal effectiveness in various environments
- to learn and update themselves with the required knowledge in Numerical ability and Test of Reasoning for competitive examinations

#### **Course outcomes (COS)**

##### **Upon completion of this course, students will:**

- be exposed and trained in various nuances of Soft Skills in a Professional manner responding to the requirements of national and international market
- be able to synthesize the knowledge and practical skills learnt to be personal effective in any managerial positions
- be equipped to construct plans and strategies to work for better human society
- be able to illustrate the problems at work and home and design solutions and maintain a balance of work and home
- be able to connect on a continuum and maintain growth and sustainability and creativity in employment that increases in productivity, profit for individuals and the society.

#### **Module 1: Effective Communication & Professional communication**

Effective communication: Definition of communication, Process of Communication, Barriers of Communication, Non-verbal Communication. JOHARI Window as a tool of effective communication.

Professional Communication: The Art of Listening, The passage, Kinesthetic, Production of Speech, Speech writing , Organization of Speech, Modes of delivery, Conversation Techniques, Good manners and Etiquettes, Different kinds of Etiquettes, Politeness markers.

## **Module II. Resume Writing & Interview Skills**

**Resume Writing:** Meaning and Purpose. Resume Formats. Types of s Resume. Functional and Mixed Resume, Steps in preparation of Resume, Model resumes for an IT professional Chronological, Types of interviews, Creative resumes using online platforms

**Interview Skills:** Common interview questions, Dos and Don'ts for an interview, Attitude, Emotions, Measurement, Body Language, Facial expressions, Different types of interviews, Telephonic interviews, Behavioral interviews and Mock interviews (Centralized).

## **Module III: Group Discussion & Team Building**

**Group Discussion:** Group Discussion Basics, GD as the first criterion for selecting software testers, Essentials of GD, Factors that matter in GD, GD parameters for evaluation, Points for GD Topics, GD Topics for Practice, Tips for GD participation. Video shooting of GD presentation & Evaluation (Centralized)

**Team Building:** Characteristics of a team, Guidelines for effective team membership, Pedagogy of team building, Team building skills. Team Vs Group – synergy, Types of synergy, Synergy relates to leadership ,Stages of Team Formation, Broken Square-Exercise, Leadership, Leadership styles, Conflict styles, Conflict management strategies & Exercises

## **Module IV: Personal Effectiveness**

Personal Effectiveness: Self Discovery: Personality, Characteristics of personality, kinds of self, Personality inventory table, measuring personality, intelligence and Exercises

Self Esteem: Types -High & Low self-esteem, Ways of proving self-esteem, Hypersensitive to criticism, activities. Goal setting: Goal setting process, Decision making process & Exercises.

Stress Management: Identifying stress, Symptoms of stress, Responding to Stress, Sources of stress, Coping with stress and Managing stress.

## **Module V: Numerical Ability**

Average, Percentage, Profit and Loss, Problems of ages, Simple Interest, Compound Interest, , Area, Volume and Surface Area, Illustration, Time and Work, Pipes and Cisterns, Time and Distance, Problems on Trains, Illustrations, Boats and Streams, Calendars and Clocks.

## **Module VI: Test of Reasoning**

Verbal Reasoning: Number series, letter series, coding and decoding, logical sequence of words, Assertion and Reasoning, Data Sufficiency, Analogy, Kinds of relationships.

**Non-Verbal Reasoning: Completion of Series, Classification, analogical, Pattern comparison, Deduction of figures out of series, Mirror Reflection Pattern, Hidden figures, Rotation pattern, Pattern completion and comparison, Sense of direction, Blood relations.**



### **Text cum Exercise book**

Melchias G, Balaiah John, John Love Joy (Eds), 2018. *Winners in the Making: A primer on soft skills*. SJC, Trichy.

### **References**

- \* Aggarwal, R.S. *Quantitative Aptitude*, S.Chand & Sons
- \*.Aggarwal, R.S. (2010). *A Modern Approach to Verbal and Non Verbal Reasoning*. S.Chand & CO, Revised Edition.
- \* Covey, Stephen. (2004). *7 Habits of Highly effective people*, Free Press.
- \* Egan, Gerard. (1994). *The Skilled Helper* (5<sup>th</sup> Ed). Pacific Grove, Brooks/Cole.
- \* Khera ,Shiv (2003). *You Can Win*. Macmillan Books , Revised Edition.

### **Other Text Books**

- \* Murphy, Raymond. (1998). *Essential English Grammar*. 2<sup>nd</sup> ed., Cambridge University Press.
- \* Prasad, L. M. (2000). *Organizational Behaviour*, S.Chand & Sons.
- \* Sankaran, K., & Kumar, M. *Group Discussion and Public Speaking* . M.I. Pub, Agra, 5<sup>th</sup> ed., Adams Media.
- \* Schuller, Robert. (2010) . *Positive Attitudes*. Jaico Books.
- \* Trishna's (2006). *How to do well in GDs & Interviews*, Trishna Knowledge Systems.
- \*\* Yate, Martin. (2005). *Hiring the Best: A Manager's Guide to Effective Interviewing and Recruiting*\*

Semester	Course Code	Title of the Course	Hours	Credits
II	21PBI2EG01	GE -2: HERBAL TECHNOLOGY	4	3

CO No.	CO- Statements	Cognitive Level (K-level)
On successful completion of the course, the students will be able to		
CO-1	describe the medicinal value of plants	K 1
CO-2	outline the medicinally used traditional herbs	K 2
CO-3	apply the various methods involved in preservation of medicinal plants and conservation of rare plants	K 3
CO-4	investigate the phytochemical reactions of secondary metabolites	K 4
CO-5	evaluate secondary metabolites and prepare therapeutic formulations	K5&K6

#### Unit I (12 Hours)

**Introduction:** Herbal medicines: history and scope - definition of medical terms - role of medicinal plants in Indian systems of medicine; Ayurveda, Yoga, Siddha, Unani and Homeo. Cultivation - harvesting - processing - storage - marketing and utilization of medicinal plants.

#### Unit II (12 Hours)

**Pharmacognosy:** Systematic position, medicinal uses of the herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Goose berry and Ashoka. Drug Formulations- Types, Advantages and Disadvantages. Packing Materials

#### Unit III (12 Hours)

**Phytochemistry:** active principles and methods of their testing - identification and utilization of the medicinal herbs; *Catharanthus roseus* (cardiotonic), *Withania somnifera* (drugs acting on nervous system), *Clerodendron phlomoides* (anti-rheumatic) and *Centella asiatica* (memory booster).

#### Unit IV (12 Hours)

**Analytical pharmacognosy:** Drug adulteration - types, methods of drug evaluation – Biological testing of herbal drugs - screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids and phenolic compounds).

## Unit V

(12 Hours)

**Conservation of herbs:** Medicinal plant banks micro propagation of important species (*Withania somnifera*, neem and tulsi) - Herbal foods in weight management, diabetes mellitus and hypertension. Future of Pharmacognosy.

### Books for Study

1. Text book of Pharmacognosy and Phytochemistry, Biren N. Shah, A.K. Seth, First Edition 2010.  
**UNIT-II** Chapter 1 (Pages 1-26)  
**UNIT-IV** Chapter 4 (pages 105-138)
2. Chemistry, biochemistry and Ayurveda of Indian medicinal plants, I.P. Tripathi, 2013 International E-Publication.  
**UNIT-I** Chapter 3 (130-153)  
**UNIT-III** Chapter 1(Pages 1-12)  
**UNIT-V** Chapter 1(Pages 13-40)

### Text Books for Study

1. Glossary of Indian medicinal plants, R.N. Chopra, S.L. Nayar and I.C. Chopra, 1956. C.S.I.R, New Delhi.
2. The indigenous drugs of India, Kanny, Lall, Dey and Raj Bahadur, 1984. International Book Distributors.

### Books for Reference

1. Herbal plants and Drugs Agnes Arber, 1999. Mangal Deep Publications.
2. Ayurvedic drugs and their plant source. V.V. Sivarajan and Balachandran Indra 1994. Oxford IBH publishing Co.
3. Ayurveda and Aromatherapy. Miller, Light and Miller, Bryan, 1998. Banarsidass, Delhi.
4. Principles of Ayurveda, Anne Green, 2000. Thomsons, London.

**Relationship matrix for Course Outcomes, Programme Outcomes and  
Programme Specific Outcomes**

<b>Semester</b>	<b>Course Code</b>	<b>Title of the Course</b>									<b>Hours</b>	<b>Credits</b>
<b>II</b>	<b>21PBI2EG01</b>	<b>GE -2: HERBALTECHNOLOGY</b>									<b>4</b>	<b>3</b>
<b>Course Outcomes (COs)</b>	<b>Programme Outcomes (POs)</b>					<b>Programme Specific Outcomes (PSOs)</b>					<b>Mean score of COs</b>	
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>		
<b>CO1</b>	1	2	2	3	2	1	3	2	2	3	2.1	
<b>CO2</b>	2	1	3	2	1	1	3	2	3	3	2.1	
<b>CO3</b>	2	2	2	3	3	2	2	3	2	2	2.3	
<b>CO4</b>	3	2	3	2	1	2	1	1	3	2	2	
<b>CO5</b>	3	2	3	2	2	3	3	1	3	3	2.5	
	<b>Mean overall score</b>										<b>2.2</b>	
	<b>Result</b>										<b>High</b>	

Semester	Course Code	Title of the Course	Hours	Credits
III	21PBI3CC07	CORE -07: PHARMACEUTICS AND NANOTECHNOLOGY	4	4

CO No.	CO-Statements	Cognitive Level (K- level)
On successful completion of the course, the students will be able to		
CO-1	discuss various drug delivery systems	K1
CO-2	explain the methods of quality control in pharmaceutical industry	K2
CO-3	apply the methods in the preparation of tablets and capsules	K3
CO-4	analyze the various types of glasses used in packaging of medicinal preparations	K4
CO-5	Synthesize and characterize various nanoparticles	K5&K6

**Unit – I: (12 Hours)**

**Tablets:** Characteristics, advantages and disadvantages. Types of tablets, excipients, granulation methods and machinery involved. Tablet compression operation-single punch and rotary tablet presses, processing problems, evaluation, packaging. Tablet coating: Types-sugar coating, film coating, compression coating, electrostatic and enteric coating. Film forming materials, formulation of coating solution, equipment for coating, processing problems in coating, evaluation.

**Unit – II: (12 Hours)**

**Capsules:** Advantages and disadvantages of capsules. Materials and method of production of hard gelatin capsule, size of capsules, Formulation, method of filling, equipment involved, finishing techniques and evaluation. Storage of capsules. Soft gelatin capsules-shell and capsule content, manufacture, processing and control. Sterilization of injections, formulations, aerosols, ophthalmic preparations, surgical ligatures and sutures, Blood products and plasma substitutes.

**Unit – III: (12 Hours)**

**Packaging materials:** Types of glasses and plastics employed for packing and their evaluation. Cosmetics. Introduction, fundamentals of cosmetic science. Formulation, preparation, packaging and evaluation of following Cosmetics - cosmetics for skin and face, Nail polish, lipstick, rouge, Hair preparation - Shampoo, Hair dyes, depilatories, shaving cream, after shave lotion. Oral hygiene preparation - dentifrices, mouth washes.

**Unit – IV: (12 Hours)**

**Controlled drug delivery systems:** Advantages of controlled drug delivery systems. a) An introduction to novel drug delivery systems- Liposomes, niosomes, nanoparticles and

osmotically controlled systems b) Micro encapsulation c) Transdermal drug delivery systems-  
Formulation and evaluation.

#### **Unit – V:**

**(12 Hours)**

**Introduction to Nanotechnology:** Properties and Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Bucky balls, Nanotubes), Green synthesis, characterization of Nano material; Absorption, Fluorescence, and Resonance; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging. Applications of nanotechnology in medicine & health, food, agriculture, livestock, aquaculture, forestry and sustainable environment.

#### **Textbooks for Study**

1. Theory and practice of industrial pharmacy; by Leon Lachman, Herbert. A. Lieberman, Joseph. L. Kanig; Third edition; Lea & Febiger.  
**UNIT-I** (*Sec III*)  
**UNIT-II** (*Sec III, Sec IV*)  
**UNIT-III** (*Sec IV*)
2. Dr. Mustafa Ersoz, Dr. Arzum isitan Meltem Balaban, Nanotechnology 1 (Fundamentals of Nanotechnology), 1<sup>st</sup> Edition – October 2018.  
**UNIT-V** (*Sec I, Sec 3*)
3. Pharmaceutics, The Science of Dosage Form Design: Michael. E. Aulton; Second edition; English language book society/Churchill Livingstone.  
**UNIT-IV** *Chapter 3(Pages 213-234)*

#### **Text books for Study**

1. Theory and practice of industrial pharmacy; by Leon Lachman, Herbert. A. Lieberman, Joseph. L. Kanig; Third edition; Lea & Febiger.
2. Pharmaceutics, The Science of Dosage Form Design: Michael. E. Aulton ; Second edition; English language book society/Churchill Livingstone.

#### **Books for References**

1. Pharmaceutical dosage forms: Tablets, Volume 1, 2, 3; Herbert. A. Lieberman, Leon Lachman & Joseph. B. Schwartz; Marcel Dekker INC.
2. Nanobiotechnology: Concepts, Applications and Perspectives, Christ of M. Niemeyer (Editor), Chad A. Mirkin (Editor), Wiley-VCH; 1 edition, 2004.
3. NanoBioTechnology: BioInspired Devices and Materials of the Future by Oded Shoseyov and Ilan Levy, Humana Press; 1<sup>st</sup> edition 2007.

**Relationship matrix for Course Outcomes, Programme Outcomes and  
Programme Specific Outcomes**

Semester	Course Code	Title of the Course									Hours	Credits
III	21PBI3CC07	CORE 7 - PHARMACEUTICS AND NANOTECHNOLOGY									4	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	3	2	1	1	2	2	3	3	2	1	2	2
CO2	2	3	1	1	2	3	2	2	1	3	2	2
CO3	2	1	2	3	2	1	1	2	3	1	1.8	
CO4	2	2	2	3	2	2	2	2	3	1	2.1	
CO5	2	2	3	2	2	1	2	3	3	2	2.2	
	Mean overall score											2.01
	Result											High

Semester	Course Code	Title of the Course	Hours	Credits
III	21PBI3CC08	CORE -08: RESEARCH METHODOLOGY	5	5

CO. No.	CO- Statements	Cognitive Level (K-level)
On successful completion of the course, the students will be able to		
CO-1	describe the knowledge on the working principle, construction of lab instruments	K1
CO-2	explain the principle and application of electrophoresis, chromatography and centrifugation and the nuances of scientific writing and publishing	K2
CO-3	apply lab instruments based on the need and various bioinformatics tools	K3
CO-4	analyze the output of various spectroscopic methods	K4
CO-5	evaluate the project results using statistical procedures and design methodologies for the isolation for bioactive compounds	K5&K6

#### Unit – I: (15 Hours)

**Electrochemical techniques** – Principles, electrochemical cells and reaction – pH and buffers. Measurement of pH – glass electrode and titration curves. Ion selective and gas sensing electrodes, oxygen electrode, and their applications.

**Chromatographic techniques** – General principle; adsorption and partition chromatography. Techniques and application of paper, column, thin layer, normal phase and reverse phase - ion-exchange chromatography, exclusion chromatography, affinity chromatography, GLC and HPLC, HPTLC.

#### Unit – II: (15 Hours)

**Centrifugation:** Principles, differential and analytical centrifugation, density gradient centrifugation; Analysis of sub cellular fractions, ultracentrifuge and its application.

**Electrophoresis:** Principles, electrophoretic mobility, factors influencing electrophoretic mobility – paper, disc, slab gel electrophoresis. Isoelectric focusing, 2D PAGE, blotting techniques, capillary electrophoresis.

#### Unit – III: (15 Hours)

**Spectroscopy** – Properties of EMR, absorption spectrum, absorption Vs emission spectrophotometry, AAS& flame photometer, UV / VIS spectroscopy, IR, NMR, GCMS, MALDI-TOF, LC-MS.

**Tracer technique:** Nature of Radioactivity: Patterns of decay, half-life and its application, Geiger Muller Counter- principle and applications. Scintillation counter – Principle, types and applications. Use of isotopes in biological studies.



**Unit – IV:****(15 Hours)**

**Research Methodology:** Selection of research problems – hypothesis – definition and characteristics. Experimental approaches – biological, physical and chemical methods.

Sources of information: Journals, e-journals, books, biological abstracts, Preparation of index cards, Review writing, Article writing – structure of article. Selection of journals for publication- Impact factor – Citation index and H index. Proposal writing for funding.

**Biostatistics:**

Basics and uses of Measures of Central values, Measures of Dispersion (Standard Deviation and coefficient of variation) in data analysis and presentation. Sample Testing: Large samples (Z), small sample test: t, Chi-square, ANOVA - one way & two way, SPSS.

**Unit – V:****(15 Hours)**

**Bioinformatics:** Introduction to Bioinformatics, Bioinformatics and its applications, Information networks - EMB net and NCBI. Databases; Primary Nucleic acid databases - EMBL; Gene Bank and DDBJ. Structure of Gene bank entries. Protein sequences databases; primary databases PIR, MIPS, SWISS - PROT, TrEMBL, NRL-3D. Structure of SWISS - PROT entries. Secondary Databases; PROSITE, PROFILES, PRINTS, Pfam, BLOCKS and IDENTITY. Composite protein Databases.

**Text books for Study**

1. Avinash Upadhyay, Kakoli Upadhyay and Nirmalendu Nath, 2014 Biophysical Chemistry (Principles and Techniques) (4<sup>th</sup> Edition,) Himalaya Publishing House, India.  
**UNIT-I** Chapter 1(Pages 1-63), Chapter 2(Pages 66-73), and Chapter 11 (Pages-416)  
**UNIT-II** Chapter 10 (Pages 301-343), Chapter 12 (Pages 422-474)  
**UNIT-III** Chapter 8(Pages 175-186,192-221,243-262), Chapter 13(489-555)
2. Fundamentals of research methodology and data collection. Chinelo Igwenagu, Enugu State University of Science and Technology (April 2016), Faculty of Physical Sciences University of Nigeria, Nsukka.  
**UNIT-IV** Chapter 1 (Sec 1.1, 1.3, 1.5, 1.6), Chapter 2 (Sec 2.3), Chapter 3 (3.1), Chapter 6.
3. Andreas D. Baxevanis, B. F. Francis Ouellette, Bioinformatics, A Practical Guide to the Analysis of Genes and Proteins, (2<sup>nd</sup> Edition, 2001), A John Wiley & Sons., Inc., publication.  
**UNIT-V** Chapter 2(Page 19), Chapter 3(Page 45), Chapter 4, Chapter 5 and Chapter 8.

**Text books for Study**

1. Avinash Upadhyay, Kakoli Upadhyay and Nirmalendu Nath, 2014 Biophysical Chemistry (Principles and Techniques) (4<sup>th</sup> Edition,) Himalaya Publishing House, India.
2. Research Methodology, Methods and Techniques C.R. Kothari, (2<sup>nd</sup> Edn), New Age International Publishers. New Delhi.

## Books for References

1. Wayne W. Daniel, 2006, Biostatistics: A Foundation for Analysis in the Health Sciences (9<sup>th</sup> Edition), John Willey and Sons Inc., USA.
2. Attwood, T. K., and Parry-Smith, D.J. 1999. Introduction to bioinformatics. Pearson Education Ltd., Delhi, India.
3. Rodney F. Boyer. 1993. Modern Experimental Biochemistry. (2nd Edition), Benjamin-Cummings Publishing, Redwood City, CA.

## Relationship matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
III	21PBI3CC08	CORE - 8: RESEARCH METHODOLOGY									5	5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO 2	PSO 3	PSO 4	PSO5		
CO1	2	1	3	1	2	3	1	2	1	2	1.8	
CO2	3	1	1	1	2	3	1	3	2	2	1.9	
CO3	2	3	3	2	3	2	1	3	3	1	2.3	
CO4	2	3	2	3	1	3	2	1	3	1	2.1	
CO5	4	2	1	3	1	3	3	1	1	2	2.1	
	Mean overall score											2.04
	Result											Medium

Semester	Course Code	Title of the Course	Hours	Credits
III	21PBI3CC09	<b>CORE -09: ADVANCES IN CLINICAL RESEARCH</b>	4	4

CO No.	CO- Statements	Cognitive Level (K-level)
On successful completion of the course, the students will be able to		
CO-1	discuss the basic introductory knowledge on the clinical research	K1
CO-2	compare the protocols related to the clinical trial procedures in India and abroad	K2
CO-3	apply the GLP in clinical research lab	K3
CO-4	test the activity of the newly formulated drugs in experimental animals	K4
CO-5	evaluate the formulations preparation and usage of the newly revealed drug for human consumption and design the protocols for clinical trials	K5&K6

### **Unit I - Introduction to clinical research**

**(12 Hours)**

Introduction to clinical research, terminologies and definition in clinical research, origin and history of clinical research, difference between clinical research and clinical practice, types of clinical research, phases of clinical research, clinical trials in India - the national perspective, post marketing surveillance, pharmaceutical industry - global and Indian perspective, clinical trial market, career in clinical research.

### **Unit II - Pharmacology and drug development**

**(12 Hours)**

Introduction to pharmacology, concept of essential drugs, routes of drug administration, introduction to drug discovery and development, hurdles in drug development, sources of drugs, basics of drug, discovery & development, approaches to drug discovery, evolutionary classification of the strategies for drug discovery, emerging technologies in drug discovery, preclinical testing, investigational new drug application, clinical trials, new drug application and approval, pharmacokinetics, pharmacodynamics, recent advances - pharmacogenomics and protein based therapies.

### **Unit III - Ethical considerations and guidelines in clinical research**

**(12 Hours)**

Historical guidelines in clinical research, Nuremberg code, declaration of Helsinki, Belmont report, international conference on harmonization (ICH)-brief history of ICH, structure of ICH, ICH harmonization process, guidelines for good clinical practice, glossary, the principles of ICH GCP, institutional review board / independent ethics committee,

investigator, sponsor, clinical trial protocol and protocol amendment(s), investigator's brochure, essential documents for the conduct of a clinical trial.

#### **Unit IV - Regulation in clinical research & management (12 Hours)**

Introduction of clinical trial regulation, European Medicine Agency, US FDA, drug and cosmetic act, Schedule Y, ICMR Guideline. Clinical Trial Management project management, protocol in clinical research, informed consent, case report form, investigator's brochure (IB), selection of an investigator and site, clinical trial stakeholders, ethical and regulatory submissions, documentation in clinical trials, pharmacovigilance, training in clinical research, roles and responsibilities of clinical research professionals.

#### **Unit V - Clinical data management (12 Hours)**

Introduction to CDM, CRF Design, clinical data entry, electronic data capture, data validation, discrepancy management, clinical data coding, SAE reconciliation, quality assurance & clinical data management, guideline & regulation in clinical trial data.

#### **Books for Study**

1. Fundamentals of Clinical Trials by Lawrence M Friedman: Fifth Edition: Springer Publications.  
**UNIT-I** Chapter 1, 2  
**UNIT-II** Chapter 3, 4  
**UNIT-IV** Chapter 15, 16  
**UNIT-V** Chapter 18
2. Text Book of Clinical Trials by David Machin and Simon day, 2004; John Wiley publications.  
**UNIT-I** Chapter 1, 2  
**UNIT-II** Chapter 6, 7, 8  
**UNIT-III** Chapter 4  
**UNIT-V** Chapter 7, 8

#### **Books for Reference**

1. Clinical Trials by Tom Brody, Second Edition: 2016 Elsevier Publications. Unit IV: Chapter 25.
2. Principle and Practice of Clinical Research By John I Gallin, Second Edition: 2002.
3. Health Research Methodology by WHO 2001: Second Edition.

**Relationship matrix for Course Outcomes, Programme Outcomes and  
Programme Specific Outcomes**

Semester	Course Code	Title of the Course									Hours	Credits
III	21PBI3CC09	CORE 9 - ADVANCES IN CLINICAL RESEARCH									4	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO 2	PSO 3	PSO 4	PSO 5		
CO1	1	2	2	3	1	1	3	2	2	3	2	
CO2	2	1	3	3	1	2	3	2	3	3	2.3	
CO3	2	2	2	3	3	1	2	3	2	2	2.2	
CO4	3	2	3	2	1	2	1	1	3	2	2	
CO5	3	2	3	2	3	3	3	1	3	3	2.6	
	Mean overall score											2.22
	Result											High

Semester	Course Code	Title of the Course	Hours	Credits
III	21PBI3CP03	LABORATORY COURSE – III	8	6

CO. No.	CO-Statement	Cognitive Level (K-level)
On successful completion of the course, the students will be able to		
CO-1	discuss the immune techniques used in the clinical diagnosis	K1
CO-2	demonstrate sperm morphology, sperm count and its viability	K2
CO-3	apply the histopathological screening of the various organs in animal models	K3
CO-4	analyze the results of various diagnostic procedures	K4
CO-5	evaluate disease progression and design the methodologies for the diagnosis of various disease, as well as the protocols for the isolation of secondary metabolites from plant source	K5&K6

### **I. Immunology techniques**

1. Widal test – rapid slide test for typhoid
2. VDRL test – test for syphilis
3. Latex agglutination test for rheumatoid factor and Pregnancy
4. Immunoelectrophoresis
5. Skin Prick Test.

### **II. Andrology**

1. Total sperm count.
2. Motility Test.
3. Fructose estimation.

### **III. Hormone Assay**

1. ELISA (TSH, T3, T4, ESTROGEN AND PROGESTERONE – Any Two)

### **IV. Miscellaneous**

1. Extraction of phytochemicals using Soxhlet apparatus.
2. Identification of active principles by spectral studies (FTIR, UV-Vis)
3. Histopathology

### **V. Visit to National Research Centers.**

### **Books for Reference**

1. Kuby Richard, A. Goldsby., Thomas J. Kint and Barbara. A. Osborne. 2000. Immunology. (4<sup>th</sup> Edition), W.H. Freeman and Company, New York.
2. Ivan M. Roitt and Peter J. Delves. 2005. Roitt's Essential Immunology. (10<sup>th</sup> Edition). Blackwell Scientific Publishers, New York.

**Relationship matrix for Course Outcomes, Programme Outcomes and  
Programme Specific Outcomes**

Semester	Course Code		Title of the Course							Hours	Credits
III	21PBI3CP03		LABORATORY COURSE III							8	6
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO 4	PSO5	
CO1	2	3	2	3	1	3	3	3	1	2	2.3
CO2	3	3	2	3	1	3	3	1	2	2	2.3
CO3	3	3	2	3	3	2	3	3	1	3	2.6
CO4	3	2	3	3	3	3	2	3	1	3	2.6
CO5	3	3	2	3	2	3	2	2	3	2	2.5
	Mean overall score										2.46
	Result										High

Semester	Course Code	Title of the Course	Hours	Credits
III	21PBI3ES03A	DSE -3: LIFE SCIENCES FOR COMPETITIVE EXAMINATIONS – 1	5	4

CO No.	CO-Statements	Cognitive Level (K-level)
On successful completion of the course , the students will be able to		
CO-1	describe the fundamental knowledge on plant kingdom classification	K1
CO-2	demonstrate the preparation of herbarium	K2
CO-3	illustrate the mechanisms of action of hormones and its role in physiology	K3
CO-4	analyze the principles of ecosystems	K4
CO-5	evaluate the bioremediation and phytoremediation	K5

**Unit – I: Basics of Taxonomy: (15 Hours)**

Principles & methods of taxonomy, classical & modern methods of taxonomy of plants, animals and microorganisms. Levels of structural organization: Unicellular, colonial and multicellular forms. Levels of organization of tissues, organs & systems. Herbarium preparation.

**Unit – II: System of classifications: (15 Hours)**

Outline classification of plants, animals & microorganisms, structural details: Important criteria used for classification in each taxon. Classification of plants (Bentham and Hooker), animals (Whitaker's) and microorganisms. Prokaryote and eukaryote cell: structural and function of cell wall, mitochondria, chloroplast, ribosomes, E.R., Golgi complex and nucleus.

**Unit – III: Plant hormones and Nitrogen metabolism: (15 Hours)**

Plant hormones - Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action. Sensory photobiology & Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks. Nitrogen metabolism- Nitrate and ammonium assimilation.

**Unit – IV: Photosynthesis and plant physiology: (15 Hours)**

Photosynthesis – Light reaction and dark reaction fixation C3, C4 and CAM pathways, photorespiratory pathway. Translocation of water, ions, solutes and macromolecules from



soil-xylem and phloem, transpiration, introduction to sec metabolites. Stress physiology. Response of plants to biotic (pathogens and insects) and abiotic (water, temp and salt) stresses.

**Unit – V: Environmental hazards and management: (15 Hours)**

Environmental pollution; global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches. Bioremediation; Phytoremediation; Solid waste management: toxic effects and treatments, methods, technologies for management of hospital waste – incineration, autoclaving, mechanical/chemical, microwave, plasma torch, detoxification, advanced wet oxidation and thermal, dry heat.

**Text book for study**

1. Verma P. S & V. K. Agarwal, 2003, Cytology, Genetics, Evolution and Ecology, S. Chand & Co Ltd., New Delhi.

**UNIT-II** Chapter 5 (Pages 112-153), Chapter 6(Pages 154-165), Chapter 7 (Pages 166-174), Chapter 10(pages 191-219), Chapter 12(Pages 243-256), Chapter 14 (Pages 280-292).

**UNIT-I** Section 1 (Pages 5-16), Section 3(pages 182-192).

**UNIT-III** Chapter 17 (Pages 494-505), Chapter 19 (Pages 546-562), Chapter 20 (Pages 584-612), Chapter 21 (Pages 622-641), Chapter 22 (Pages 650-667), Chapter 23(pages 674-690), Chapter 25 (Pages 720-748).

2. Bir Bahadur, Manchikatla Venkat Rajam Leela Sahijram K.V. Krishnamurthy Editors, Plant Biology and Biotechnology, Volume I: Plant Diversity, Organization, Function and Improvement.

**UNIT-IV** Chapter 22 (Pages 569-591).

**UNIT-V** Chapter 1(Pages3-32), Chapter2 (33-49), Chapter 4 (pages 61-103)

**Text books for study**

1. Verma P.S & V.K. Agarwal, 2003, Cytology, Genetics, Evolution and Ecology, S.Chand & Co Ltd., New Delhi.
2. S. K. Verma, 1999, Text Book of Plant Physiology, S. Chand & Co Ltd., New Delhi.

**Books for References**

1. Lawrence G H M, 1995, The Taxonomy of Vascular Plants, Mac Millan Publishers, NY.
2. Noggle G.R and Fritz GJ, 1976, Introductory Plant Physiology, Prentice-Hall Publishers, India.

**Relationship matrix for Course Outcomes, Programme Outcomes and  
Programme Specific Outcomes**

Semester	Course Code		Title of the Course							Hours	Credits
III	21PBI3ES03A		DSE- 3: LIFE SCIENCES FOR COMPETITIVE EXAMINATIONS-1							5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO 2	PSO 3	PSO 4	PSO 5	
CO1	2	2	1	2	3	3	3	2	3	3	2.4
CO2	2	3	3	1	1	2	3	3	2	3	2.3
CO3	2	1	3	2	3	1	2	3	3	2	2.2
CO4	2	3	1	2	3	1	2	3	1	3	2.1
CO5	2	1	2	3	2	2	3	1	3	3	2.2
	Mean overall score										2.24
	Result										High

Semester	Course Code	Title of the Course	Hours	Credits
III	21PBI3ES03B	DSE-3: MOLECULAR DIAGNOSTICS	5	4

CO. No.	CO-Statements	Cognitive Level (K-level)
On successful completion of the course , the students will be able to		
CO-1	discuss knowledge on the progress and developments in cell culture techniques	K1
CO-2	demonstrate the molecular basis of disease	K2
CO-3	apply various molecular techniques and karyotyping	K3
CO-4	analyze the results of various procedures	K4
CO-5	evaluate the results of molecular tools available for diagnosis of various diseases	K5

**Unit – I: Molecular mechanisms of diseases: (15 Hours)**

Detection of genetic defects, detection of infectious agents, tumor diagnosis markers and grading. Molecular genetics of B-cell neoplasia. Liver specific expression of cloned human genes, technology of carrier erythrocytes: a tool for diagnosis and therapy. Diagnosis of single gene disorders - spinal muscular atrophy, DMD and BMD, Fragile X syndrome.

**Unit – II: Restriction Fragment Length Polymorphism (RFLP): (15 Hours)**

DNA probes detection of mutations and deletions in gene. Eg: thalassemia, haemophilia, sickle cell anemia, retinoblastoma. DNA finger printing. Genetic disease probes. Chromosomal DNA probes for prenatal diagnosis of X-linked retinitis pigmentosa, prenatal sex determination.

**Unit – III: Hereditary persistence of fetal hemoglobin: (15 Hours)**

Model for abnormal development regulation. Apolipoprotein genes, DNA polymorphism and hyperlipidemia, cDNA of human protein C for diagnosis of protein C deficiency. Prenatal diagnosis and carrier detection of phenylketonuria by gene, fluorescent *in situ* hybridization (FISH). DNA probes - fluorescent labeling, chromosome painting and spectral karyotyping, peptide mapping.

**Unit – IV: Approaches in hybridoma technology: (15 Hours)**

Hybridoma variants affecting isotype, antigen binding and idiotype: isolation of class and subclass switch variants by selection. MHC locus, HLA polymorphisms, HLA nomenclature, molecular analysis of the MHC, serological analysis DNA-based typing, combining typing results, HLA test discrepancies, coordination of HLA test methods, additional recognition factors, minor histocompatibility antigens, nonconventional MHC antigens, killer cell immunoglobulin-like receptors, MHC & its disease association.

**Unit – V: Polymerase Chain Reaction in diagnosis:****(15 Hours)**

Its applications in diagnosis of infectious diseases - eg: HIV, hepatitis B and tuberculosis. Identification of gene mutations and deletions - eg: p53 mutations. Use in solving paternity disputes and crime detection. Molecular oncology - classification of neoplasms, molecular basis of cancer, analytical targets of molecular testing - gene and chromosomal mutations in solid tumors, microsatellite instability, loss of heterozygosity. Enzyme linked immunosorbent assay (ELISA) - Diagnosis of infectious diseases and cancer antigens, HIV detection.

**Text books for study**

1. Lela Buckingham, Maribeth L. Flaws, 2007, Molecular Diagnostics - Fundamentals, Methods, & Clinical Applications, F.A. Davis & Company, Philadelphia. (e COPY)  
**UNIT-I Chapter IX**  
**UNIT-II Chapter XI**  
**UNIT-III Chapter XI**  
**UNIT-IV Chapter XV**  
**UNIT-V Chapter XIV**

**Text books for study**

1. Lela Buckingham, Maribeth L. Flaws, 2007, Molecular Diagnostics - Fundamentals, Methods, & Clinical Applications, F.A. Davis & Company, Philadelphia.

**References**

1. Gath, D. D, 1994. PCR-based diagnostics in infectious diseases. Blackwell Scientific, UK.
2. Fazal Ahmed, 1984, Advances in Gene technology: human genetic disorders, ICSU, Paris.
3. Stanely, A. *et al*, 1994, Vaccines, W. B. Saunders & Co., USA.

**Relationship matrix for Course Outcomes, Programme Outcomes and  
Programme Specific Outcomes**

Semester	Course Code	Title of the Course									Hours	Credits
<b>III</b>	<b>21PBI3ES03B</b>	<b>DSE- 3: MOLECULAR DIAGNOSTICS</b>									<b>5</b>	<b>4</b>
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO 4	PSO5		
<b>CO1</b>	2	1	2	3	3	3	2	3	1	2	2.3	
<b>CO2</b>	3	2	1	2	3	2	2	3	3	2	2.3	
<b>CO3</b>	2	3	3	1	3	1	1	2	3	3	2.2	
<b>CO4</b>	3	2	1	2	2	3	3	1	3	2	2.2	
<b>CO5</b>	3	2	1	3	1	2	2	3	1	3	2.1	
	<b>Mean overall score</b>										<b>2.22</b>	
	<b>Result</b>										<b>High</b>	

Semester	Course Code	Title of the Course	Hours	Credits
III	21PBI3EG02	GENERIC ELECTIVE -2 (BS): FIRST AID MANAGEMENT	4	3

CO. No.	CO- Statements	Cognitive Level (K- level)
On successful completion of the course, the students will be able to		
CO-1	describe the basic assessment of an emergency situation	K1
CO-2	identify and assess the first aid procedures in the management of any injury	K2
CO-3	apply ABC rule in various emergency situations	K3
CO-4	analyze various critical scenario like hemorrhage, fracture, snakebite, poisoning and other situations	K4
CO-5	evaluate psychological intelligence during critical situations	K5

**Unit – I: (12 Hours)**

**Principles of First Aid Management:** Basic knowledge about human body organs and their functions. Principles of First Aid. Causality assessment. Priorities of first aid, unconsciousness and recovery positions. Resuscitation, control of major bleedings, choking, and treatment of shocks. Emergency aid in schools and others.

**Unit – II: (12 Hours)**

**Causality assessment:** Patient management and care, labeling of causalities. Approach to a causality. Handling and transport of injured persons. Disaster management and multiple causalities.

**Unit – III: (12 Hours)**

**Bleeding and injuries:** Internal and external bleeding, injuries to muscles, joints and bones, stroke. Miscellaneous injuries, splinting skill tests, head, neck, back, chest, abdomen injuries. Poisoning - bites - stings. Drug abuse. Frostbite and cold exposure. Burns and Scalds. Heat stroke, heat cramps and heat exhaustion.

**Unit – IV: (12 Hours)**

**Emergency Care:** Accident reporting, first aid to victims of road accidents. Patient assessment and management, breathing emergencies, defibrillation. Sudden illness – heart attack, stroke, fainting, convulsion epilepsy, prevention of heart attack and apoplexy.

**Unit – V:****(12 Hours)**

**First aid rooms and equipments:** first aid kits, cleaning of wounds, dressing and bandages. Antiseptics – types and action. Injury assessment in factories and in rural areas. Psychological first aid.

**Textbooks for Study**

1. St. John's Ambulance (India), "First aid to the injured". 1 Red Cross Road, New Delhi – 110001.  
**UNIT-I** Pages 21-41, 197-198, 176-185,  
**UNIT-II** Pages 186-190, 227-229, 230-270,  
**UNIT-III** Pages 81-103  
**UNIT-V** Pages 191-196, 272-274,
2. Manivannan C. and Latha Manivannan T. "Textbook of First aid and emergency nursing", Published by Manjunath S. Hedge, EMMESS Medical Publishers, No.26/3, 1<sup>st</sup> Cross, 1<sup>st</sup> 'R' Block, Rajajinagar, Bangalore – 560 010.  
**UNIT-IV** Pages 96, 97, 101, 117, 128

**Books for References**

1. John Furst, "The complete First Aid Pocket". Adams Media, New Delhi, India.
2. Standard First Aid and Personal Safety 8<sup>th</sup> edition – American Red Cross.

**Relationship matrix for Course Outcomes, Programme Outcomes and  
Programme Specific Outcomes**

Semester	Course Code	Title of the Course									Hours	Credits
III	21PBI3EG02	GENERIC ELECTIVE – 2: FIRSTAID MANAGEMENT									4	3
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO 4	PSO 5		
CO1	3	2	2	3	3	2	3	2	3	3	2.6	
CO2	2	3	1	2	3	3	1	3	1	3	2.2	
CO3	2	3	1	3	2	3	2	3	3	2	2.4	
CO4	2	3	3	3	3	1	3	3	2	3	2.6	
CO5	2	1	3	3	2	3	3	3	5	1	2.6	
Mean overall score											2.48	
Result											High	

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PBI4CC10	CORE- 10: CLINICAL BIOCHEMISTRY	6	6

CO.No.	CO-Statements	Cognitive Level (K-level)
On successful completion of the course , the students will be able to		
CO-1	discuss thoroughly about the biochemical basis of various diseases and disorders	K1
CO-2	understand the mechanisms of blood clotting and the related disorders	K2
CO-3	apply a wide range of protocols in clinical biochemistry analysis	K3
CO-4	analyze the symptoms of various diseases	K4
CO-5	evaluate various diagnostic procedures for diseases and disorders and initiate blood banking	K5&K6

#### Unit – I: (18 Hours)

**Blood and body fluids:** Collection and preservation, Disturbances in Blood clotting – haemophilia A and haemophilia B. Haemoglobin in anaemias-sickle cell, thalassemia, abnormal haemoglobins. Porphyrrias and porphyrinurias. Anticoagulants. Hemolytic diseases of the new born. Adverse reactions of blood transfusions. Blood banking.

**Cellular injury:** causes, pathogenesis and morphology of cell injury. Intercellular alterations in lipids, proteins and carbohydrates, cellular adaptation, atrophy and hypertrophy. Basic mechanism involved in the process of inflammation and repair: alteration in vascular permeability and blood flow. Brief outline of the process of repair.

#### Unit – II: (18 Hours)

**Disturbances of carbohydrate and Lipid metabolism:** Blood sugars – Its maintenance, hyper and hypoglycemia. Regulation of blood glucose concentration. Diabetes mellitus – complications, secondary degenerative diseases. Laboratory diagnosis of early and latent diabetes. Glucose tolerance test. Dietary regimes in diabetes mellitus. Hypoglycemic agents. Galactosemia, fructosuria and lactose intolerance.

Hypo and hyper cholesteremia, Hypo and hyper lipoproteinemia, hypocholesteremic agents, hypertension –causes and its management. Lipid storage diseases- fatty liver & obesity.

#### Unit – III: (18 Hours)

**Protein deficiency diseases:** Plasma proteins - their significance and variation in health and diseases. Agammaglobulinemia, Multiple myeloma, Proteinuria, Wilson's disease, Cystinuria, Hartnup disease, Maple syrup urine disease, Alkaptonuria, Albinism, Tyrosinosis, Phenylketonuria. Disorders of sulphur containing amino acid and urea cycle.

**Nucleic acid disorders:** Orotic aciduria, and Xanthinuria, Gout, Lesch-nyhan syndrome.

**Unit – IV:****(18 Hours)**

**Diseases of the liver:** Macro and micro anatomy of liver, Hepatitis and its types, jaundice and its types. Cirrhosis, alcoholic liver diseases. Cholestatic liver diseases. Hepatic tumors and biliary tract diseases - clinical manifestation of liver diseases. Liver functions tests.

Disorders of bilirubin metabolism. Enzyme released from diseased liver tissue. Pancreatic function test; Gastric function test. Biochemical parameters of CSF in health and disease.

**Unit – V:****(18 Hours)**

**Renal Diseases:** Renal stress and its analysis. Renal function tests - biochemical changes in acute and chronic renal failure. Normal and abnormal urinary constituents. Enzyme parameters in pathological conditions.

**Cardiac pathology** - Major manifestations of heart disease - Ischaemic heart diseases, angina pectoris, myocardial infarction. Cardiac markers in infarction - LDH, creatine kinase. Serological tests in infectious diseases and viral infections. Amniotic fluid and maternal serum in ailment and in pregnancies.

**Textbooks for Study**

1. M N Chatterjea and Rana Shinde., “ Textbook of Medical Biochemistry” 8<sup>th</sup> Edition, Jaypee Brothers Medical Publishers (P) Ltd., 4838/24, Ansari Road, Daryaganj, New Delhi 110 002, India.  
**Unit II** Pages 384-388  
**Unit III** Chapter – 7 (Pages 97-107)  
**Unit IV** Chapter – 31 (Pages 659-72)  
**Unit V** Chapter – 36 (Pages 651-56)
2. Gundu HR Rao, Ted Eastlund and Latha Jagannathan (Editors), “Handbook of Blood Banking and Transfusion Medicine”. Jaypee Brothers Medical Publishers (P) Ltd, EMCA House, 23/23B Ansari Road, Daryaganj, New Delhi 110 002, India  
**Unit I** Chapter 1-10
3. Dinesh Puri. “Textbook of Medical Biochemistry” 3<sup>rd</sup> Edition, Elsevier A division of Reed Elsevier India Private Limited, Registered Office: 622, Indraprakash Building, 21 Barakhamba Road, New Delhi 110 001.  
**Unit V** Chapter – 34 (Pages 695-697)
4. Thomas M. Devlin (Editor), Textbook of Biochemistry with Clinical Relationship matrix s, 7<sup>th</sup> Edition, John Wiley & Sons, Inc. (Ebook)  
**Unit I** Chapter – 23 – 23.4 (Pages – 982- 997)  
**Unit II** Chapter – 16 – 16.1 to 16.5  
**Unit III** Chapter – 19 – 19.1, 19.2, 19.7 to 19.11 and 19.21
5. John W. Baynes and Marek H. Dominiczak. “Medical Biochemistry” 4<sup>th</sup> Edition, Saunders, Elsevier (Ebook).  
**Unit I** Chapter 4  
**Unit II** Chapter 21



### Text books for study

1. Devlin, 1997, Textbook of Biochemistry (with Clinical Relationship matrix ), John Wiley, UK.
2. M. N. Chatterjee and Rana Shinde 1995. Text book of Medical Biochemistry 2nd Edition, Jaypee Brothers Medical publishers Private Limited, New Delhi.

### Books for References

1. Henry, R. J., Cannon, D. C, and Winkelman, J. W., 1974. "Clinical Chemistry: Principles and Techniques" 2nd ed. Harper and Row, Hagerstown, Maryland.
2. Cantrow and Trumper, 1962, Clinical Biochemistry, 6<sup>th</sup> edition, VY.B. Saunders Company, Philadelphia.
3. Luxton. R, 2008, Clinical Biochemistry, 2<sup>nd</sup> edition, Scion Publishing Ltd., Bloxham, United Kingdom.
4. John W. Baynes and Marek H. Dominiczak. "Medical Biochemistry" 4<sup>th</sup> Edition, Saunders, Elsevier (Ebook).

### Relationship matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
IV	21PBI4CC10	CORE 10 - CLINICAL BIOCHEMISTRY									6	6
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO 4	PSO 5		
CO1	3	3	2	3	3	3	3	2	3	2	2.7	
CO2	3	3	3	1	3	3	2	1	3	2	2.6	
CO3	2	3	1	3	3	3	2	1	3	2	2.3	
CO4	3	2	2	3	3	2	3	1	1	3	2.3	
CO5	3	2	2	2	3	3	1	2	3	1	2.2	
	Mean overall score										2.42	
	Result										High	

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PBI4CC11	CORE- 11: ADVANCED ENDOCRINOLOGY	5	5

CO. No.	CO-Statements	Cognitive Level (K-level)
On successful completion of the course , the students will be able to		
CO-1	recall the basics and molecular features of hormones and glands	K1
CO-2	comprehend the hormonal regulations of various physiological functions and signaling mechanisms	K2
CO-3	study the signal transduction mediated by cell surface receptors	K3
CO-4	analyze the mechanism and role of nuclear receptors	K4
CO-5	evaluate the endocrine diseases	K5

#### Unit – I: (15 Hours)

**Introduction:** Hormones - definition; classical and nonclassical endocrinology. Pituitary hormones and their control by the hypothalamus. Thyroid metabolic hormones. Adrenocortical hormones. Feedback mechanisms (HPA&HPG). Inactivation and degradation of hormones. Hypothalamus - neurohypophyseal hormones. Hormone resistant syndrome and multiendocrine neoplasia – different types. Melatonins and serotonin – light and dark cycles. RIA and ELISA in Bioassay of hormones. Genetic control of hormone formation.

#### Unit – II: (15 Hours)

**Hormones acting through cell surface receptors:** Hormones acting through cell surface receptors. Hormone – receptor interaction; multiple hormone subunits, Scatchard analysis; peptide hormone receptors: types of receptors- beta – adrenergic receptor and insulin receptor- structure and mechanism of action. Signal transducers and second messengers- protein kinases, cAMP, IP3, DAG, Calcium and Calmodulin. Eicosanoids and mechanism of action.

#### Unit – III: (15 Hours)

**Molecular endocrinology of insulin resistance:** Endocrinology of adipose tissues - leptin, ghrelin, adiponectin, resistin. Fetal endocrine programming of adult disorders (FEPAD): Adverse effects of glucocorticoids in programming events. Endocrinology of insulin like growth factors (IGF's) and its binding proteins (IGFBP). Modulation of placental hormones and growth factors in FEPAD.

#### Unit – IV: (15 Hours)

**Reproductive Endocrinology:** Genetic, endocrine and biochemical aspects of testis and ovarian differentiation and development. Neuroendocrine perspectives of mammalian reproduction. Endocrine, paracrine and autocrine regulation of spermatogenesis, oogenesis, ovulation and steroidogenesis (Testosterone, 17B-estradiol, Progesterone). Control of synthesis and release of steroid hormones. Structure, function and regulation of male and female accessory sex organs. Transport of steroid hormones in blood. Conception and

contraception. Apoptosis – steroid hormone action at cell level. Hormonal physiology of parturition and lactation.

#### **Unit – V:**

**(15 Hours)**

**Nuclear receptors (NR): General Features, Ligands that act via** nuclear receptor and its sub classes (Orphan receptor and variant receptors). Domain structure of NR - hormone binding domain, antigenic domain and DNA binding domain. Hormone response elements. Detailed study of thyroxine, estrogen, androgen, vitamin D, glucocorticoids, Peroxisome proliferator activated receptor and Liver X Receptor. PPAR in insulin resistance. Receptor activation – upregulation and down regulation. Selective estrogen receptor modulator. Endocrine responsive cancer - breast, endometrial and prostate cancers.

#### **Textbooks**

1. Thomas M. Devlin (Editor), “Textbook of Biochemistry with Clinical Relationship matrix s”, 7th Edition, John Wiley & Sons, Inc. (EBook)  
**UNIT-II** Chapter 22 – 22.1 to 22.8  
**UNIT-II** Chapter 13.4, 13.8, 13.9, 13.10, 13.11, 13.12  
**UNIT-V** Chapter 22.8
2. Arthur C. Guyton and John E. Hall., “ Textbook of Medical Physiology” 11<sup>th</sup> Edition, Elsevier Saunders, Elsevier Inc. 1600 John F. Kennedy Blvd., Suite 1800 Philadelphia, Pennsylvania 19103-2899  
**UNIT-I** Unit XIV - Chapter – 75, 76, 77, 79  
**UNIT-II** Unit XIV - Chapter - 78  
**UNIT-IV** Unit XIV - Chapter – 80, 81, 82
3. Franklyn F. Bolander. “Molecular Endocrinology” 3<sup>rd</sup> Edition. Academic Press An imprint of Elsevier, 525 B Street, Suite 1900, San Diego, California 92101-4495, USA.  
**Unit V** Chapter 6 (Pages - 125-146)
4. John W. Baynes and Marek H. Dominiczak. “Medical Biochemistry” 4<sup>th</sup> Edition, Saunders, Elsevier (Ebook).  
**UNIT-I** Chapter - 39  
**UNIT-II** Chapter - 21  
**UNIT-III** Chapter - 40  
**UNIT-V** Chapter - 17
5. Dinesh Puri. “Textbook of Medical Biochemistry” 3<sup>rd</sup> Edition, Elsevier A division of Reed Elsevier India Private Limited, Registered Office: 622, Indraprakash Building, 21 Barakhamba Road, New Delhi 110 001.  
**UNIT-II** Chapter 29, 30 and 31

#### **Text books for study**

1. Devlin, 1997, Textbook of Biochemistry (with clinical Relationship matrix ), John Wiley, USA.
2. Wilson and Foster, 1992, Textbook of Endocrinology, (8<sup>th</sup>edn), W. B. Saunders, USA.

### Books for References

1. Robert, K. Murray *et al*, 2003, Harper's Biochemistry (25<sup>th</sup> Edition), Mc Graw Hill Publishers (Asia), India.
2. Arthur C. Guyton and Hall, 2006, Text Book of Medical Physiology, Elsevier India Pvt. Ltd., New Delhi.
3. Mac. E. Hadley and Jon. E. Levin, 2009, Endocrinology 6<sup>th</sup> ed., Darling Kindersly Pvt. Ltd., India.

### Relationship matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
IV	21PBI4CC11	CORE 11 – ADVANCED ENDOCRINOLOGY									5	5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	3	3	3	2	3	2	3	2	3	1	2.5	
CO2	2	3	3	3	3	3	1	1	3	2	2.4	
CO3	3	2	1	2	3	3	2	1	2	3	2.2	
CO4	3	2	3	1	2	3	2	2	1	3	2.2	
CO5	2	3	1	3	2	3	2	1	3	3	2.3	
	Mean overall score										2.32	
	Result										High	

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PBI4CP04	LABORATORY COURSE – IV	8	6

CO. No.	CO-Statements	Cognitive Level (K-level)
On successful completion of the course, the students will be able to		
CO-1	describe the concept of Phlebotomy in clinical biochemistry	K1
CO-2	understand various modes of administration of xenobiotics to the experimental animals	K2
CO-3	apply various blood parameters of the Diabetic patients	K3
CO-4	analyze the levels of clinical marker enzymes in various diseases	K4
CO-5	evaluate the clinical situation based on the level of the parameters	K5

### I. Biochemical analysis of blood

1. Estimation of blood glucose (2 methods)
2. Estimation of serum proteins
3. Estimation of plasma fibrinogen
4. Estimation of A: G ratio in serum
5. Estimation of blood urea (2 methods)
6. Estimation of serum uric acid
7. Estimation of serum creatinine.
8. Estimation of serum triglycerides.
9. Estimation of serum cholesterol.
10. Estimation of serum phospholipids.
11. Estimation of serum calcium.
12. Estimation of serum bilirubin.

### II. Hematological studies

1. Collection of Blood
2. Estimation of hemoglobin content.
3. Total RBC count.
4. Total WBC count.
5. Determination of Packed Cell Volume.
6. Differential WBC count (DC).
7. Absolute Eosinophil count (AEC).
8. Total platelet count.
9. Determination of clotting time
10. Determination of ESR.
11. Grouping of blood and Rh typing.

### III. Enzyme assays

1. Determination of serum alkaline phosphatase
2. Determination of serum acid phosphatase

#### IV. Urology

1. Identification of normal (Collection, Preservation, Color, Odour, Specific gravity, pH and Volume)
2. Screening of abnormal constituents.
3. Urinary crystals and deposits.

#### V. Miscellaneous

1. Estimation of clinical parameters (sugar, Hb, Cholesterol, Proteins and creatinine) using semiautomated analyzer.
2. Routes of administration of drugs/Xenobiotics.
3. Dissection of animals and aseptic removal of individual organs.
4. Laboratory animal handling and maintenance.

#### References

1. Praful. B. Godkar, 2014, Text book of Medical laboratory technology; III Edition, Volume I and II, Bhalani Publishing house.
2. Alan H. Gowenlock, Varley's Practical Clinical Biochemistry, 6<sup>th</sup> Edition; CBS publishers.
3. Kanai L. Mukerjee, Volume 1, 2 and 3. Medical Laboratory Technology, 2<sup>nd</sup> Edition, Tata McGraw Hill Education Private Limited. New Delhi.

#### Relationship matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes

Semester	Course Code	Title of the Course									Hours	Credits
IV	21PBI4CP04	LABORATORY COURSE-IV									8	6
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO 4	PSO 5		
CO1	3	2	3	2	3	2	1	3	1	3	2.3	
CO2	3	3	2	1	3	2	3	1	2	3	2.3	
CO3	3	2	3	3	3	2	3	1	3	2	2.5	
CO4	3	3	3	2	3	2	1	3	1	3	2.4	
CO5	3	3	2	3	3	3	3	1	2	3	2.6	
	Mean overall score										2.42	
	Result										High	

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PBI4ES04A	DSE – 4: PHARMACEUTICAL BIOCHEMISTRY	5	4

CO. No.	CO-Statements	Cognitive Level (K-level)
On successful completion of the course, the students will be able to		
CO-1	discuss different drugs, particularly their actions on living systems in detail	K1
CO-2	explore pharmacokinetics and pharmacodynamics of drugs	K2
CO-3	advocate appropriate drugs for the treatment of various diseases	K3
CO-4	analyze the structural details of the drugs related to their functions	K4
CO-5	evaluate the quality of drugs and create new avenues based on molecular docking methods	K5

**Unit – I: (15 Hours)**

Drugs: Definition, source and nature, types of classification and nomenclature, dose response curve and LD50. Routes of drug administration. Drug targets: Enzymes, receptors, carrier proteins. Structural proteins, nucleic acids. Drug absorption, distribution, metabolism, Phase I and Phase II reactions. Excretion and dosing.

**Unit – II: (15 Hours)**

Pharmacology of bacterial infections- Inhibitors of Replication, Transcription and Translation. Antimycobacterial agents- Inhibitors of murein monomer synthesis, polymerization and inhibitors of cell wall synthesis. Antifungal agents- Inhibitors of DNA synthesis, Inhibitors of fungal mitosis and cell wall synthesis. Antiviral Drugs. Antimalarials and Anthelmintics.

**Unit – III: (15 Hours)**

Pharmacology of Cardiovascular system-Antihypertensive drugs, Vasodilators and treatment of Angina Pectoris, Antihypercholesterolemic drugs and diuretic agents. .Drugs with action on smooth muscles- Histamine, Serotonin and Ergot Alkaloids. Vasoactive peptides- Vassopressin, Natriuretic peptides and Endothelin.

**Unit – IV: (15 Hours)**

Miscellaneous Drugs - Immunosuppressants-Glucocorticoids, Tacrolimus and Cyclosporine, Azathioprine and Mycophenolic acid, Antithymocyte globulin and mAbs.. Drugs Used in the treatment of GI diseases- Metoclopramide and domperidone, Lubiprostone. Nonsteroidal Anti-Inflammatory Drugs, Disease-Modifying Antirheumatic Drugs, Non-opioid Analgesics, & Drugs Used in Gout.

**Unit – V:****(15 Hours)**

Methods of quality control- Density meter, Polarimeter, and Loss on Drying, Karl Fisher titration, Uniformity of Dosage units by Mass variation, and weight variation. Data integrity. Drug development: Target – oriented drug design, computer aided drug design, Quantitative structure, activity relationship – binding interaction, functional groups and pharmacophore. High throughput screening and Molecular docking.

**Text books for study**

1. Principles of pharmacology –The pathophysiological basis of drug therapy by David E Golan and Ehrin J Amstrong (Fourth Edition) Wolter Kluver Publications (2017). (e BOOK)  
**UNIT-I** Chapter 3, 4  
**UNIT-II** Chapter 34, 35, 36, 37, 38  
**UNIT-III** Chapter 23, 24, 25, 26  
**UNIT-IV** Chapter 46, 47
2. General and Molecular Pharmacology – Principles of Drug action by Francesco Commenti – Wiley Publications 2015.
3. Basic and Clinical Pharmacology, by Bertram G. Katzung, (14th Edition) Mc. Graw Hill Publications (eBOOK).  
**UNIT-I** Chapter 1, 2, 3, 4  
**UNIT-II** Chapter 43, 44, 45, 46  
**UNIT-III** Chapter 11,12,13,14, 17  
**UNIT-IV** Chapter 55, 36

**Books for References**

1. Goodman and Gilman Pharmacological Basis of Therapeutics. 12<sup>th</sup> Edition. McGraw Hill Publications (Ebook).
2. Essentials of Medical Pharmacology by K D Tripathi MD, Sixth Edition. JAYPEE Brothers Medical Publishers (P) Ltd (Ebook).
3. Bertram Katzung, Basic and Clinical Pharmacology, (12<sup>th</sup> edition), Lange Publishers, 2012.
4. Robert K. Murray, Daryl K. Granner, Peter A. Mayer and Victor W. Rodwell, Harper's Biochemistry. (25<sup>th</sup> edition), Mc Graw Hill, New York, 2006.
5. Gareth Thomas, Fundamentals of Medicinal Chemistry, Wiley Blackwell Publishers, 2003.

**Text books for study**

1. K. D. Tripathi, Essentials of Medical Pharmacology, (7<sup>th</sup> Edition), Jaypee Publishers, 2010.
2. Jayashree Ghosh, A Textbook of Pharmaceutical Chemistry (3rd edition). S.Chand & Company Ltd., New Delhi, 2010.



**Relationship matrix for Course Outcomes, Programme Outcomes  
and Programme Specific Outcomes**

<b>Semester</b>	<b>Course Code</b>	<b>Title of the Course</b>									<b>Hours</b>	<b>Credits</b>
<b>IV</b>	<b>21PBI4ES04A</b>	<b>DSE-4:PHARMACEUTICAL BIOCHEMISTRY</b>									<b>5</b>	<b>4</b>
<b>Course Outcomes (COs)</b>	<b>Programme Outcomes (POs)</b>					<b>Programme Specific Outcomes (PSOs)</b>					<b>Mean score of COs</b>	
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO 4</b>	<b>PSO5</b>		
<b>CO1</b>	3	2	1	2	3	2	3	1	2	3	2.2	
<b>CO2</b>	2	1	2	3	2	3	2	1	1	3	2	
<b>CO3</b>	2	1	2	3	2	3	2	1	3	2	2.1	
<b>CO4</b>	3	2	3	1	1	3	2	1	2	3	2.1	
<b>CO5</b>	1	2	3	1	2	3	1	3	3	1	2	
	<b>Mean overall score</b>										<b>2.08</b>	
	<b>Result</b>										<b>High</b>	

Semester	Course Code	Title of the Course	Hours	Credits
IV	21PBI4ES04B	DSE -4: LIFE SCIENCES FOR COMPETITIVE EXAMINATIONS – 2	5	4

CO. No.	CO- Statements	Cognitive Levels (K-levels)
On successful completion of the course, the students will be able to		
CO-1	discuss the basic theories of evolution	K1
CO-2	explain the topics of the CSIR UGC – NET and SET syllabus that are not included in the core courses	K2
CO-3	correlate the fossil evidences with evolution	K3
CO-4	analyze the energy transfer within the different ecosystems	K4
CO-5	evaluate the mechanisms of maintaining the environmental health	K5

#### Unit – I: (15 Hours)

**Emergence of evolutionary thoughts:** Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; spontaneity of mutations. Origin of cells and unicellular evolution: Origin of basic biological molecules; abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiment of Miller; The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; anaerobic metabolism, and aerobic metabolism.

#### Unit – II: (15 Hours)

**Paleontology and evolutionary history:** The evolutionary time scale; eras, periods and epoch; major events in the evolutionary time scale; origins of unicellular and multi cellular organisms; major groups of plants and animals; Stages in primate evolution including Homo. Molecular evolution: concepts of neutral evolution, molecular divergence and molecular clocks; molecular tools in phylogeny, classification and identification.

#### Unit – III: (15 Hours)

**Mechanisms of speciation and behavior:** Speciation; allopatricity and sympatricity; convergent evolution; Sexual selection; co-evolution. Approaches and methods in study of behavior; Proximate and ultimate causation; altruism and evolution; neural basis of learning, memory, cognition, sleep and arousal; biological clocks; social communication; social dominance; use of space and territoriality; mating systems, parental investment and reproductive success; parental care; aggressive behavior; habitat selection and optimality in foraging; migration, orientation and navigation; domestication and behavioral changes.

**Unit – IV:****(15 Hours)**

**The Environment;** biotic and abiotic interactions. Concept of habitat and niche; population ecology; concept of metapopulation. Species interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis. Community ecology: nature, structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological succession: Types, mechanisms, changes involved in succession & concept of climax.

**Unit – V: Ecosystem ecology:****(15 Hours)**

Ecosystem structure, function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine). Biogeography: major terrestrial biomes; theory of island biogeography; biogeographical zones of India. Conservation biology: principles and management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

**Textbook for study**

1. Verma P. S & V. K. Agarwal, 2003, Cytology, Genetics, Evolution and Ecology, S. Chand & Co. Ltd., New Delhi.

**UNIT-I** Chapter 2 (Pages 8-17), Chapter 3 (Pages 22-44)

**UNIT-II** Chapter 1(Pages 3-7)

**UNIT-III** Chapter 10 (Pages 124-136)

**UNIT-IV** Chapter 4 (Pages 49-76), Chapter 5 (Pages 77-93) and Chapter 7 (Pages 109-126)

**UNIT-V** Chapter 9 (137-153)

**Text books for study**

1. Verma P. S & V. K. Agarwal, 2003, Cytology, Genetics, Evolution and Ecology, S.Chand & Co. Ltd., New Delhi.
2. Sharma P.D., 1999, Ecology and Environment, Rastogi Publishers, Meerut.

**Books for References**

1. Odum. E.P, 1970, Fundamentals of Ecology, 3rd edition, W.B. Saunders Ltd., U.K.
2. Karl J. Nikias, 1981, Paleobotany, Paleoecology & Evolution, Praeger Pub., USA.
3. Pranav Kumar and Usha Mina. Pathfinder Academy: CSIR-JRF-NET Life Sciences Six Book Combo Set: CSIR-JRF-NET Life Sciences. Edition: 2016. Pathfinder Publication.
4. Rupendra Singh, Dr Madhu Gupta and Anubha Shukla. CSIR NET/JRF Life Sciences MCQ Practice book. Catalyst Center of excellence Pvt. Ltd; Seventh Edition (2017).

**Relationship matrix for Course Outcomes, Programme Outcomes and  
Programme Specific Outcomes**

Semester	Course Code	Title of the Course									Hours	Credits
IV	21PBI4ES04B	<b>DSE -4: LIFE SCIENCES FOR COMPETITIVE EXAMINATIONS-2</b>									5	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes(PSOs)					Mean score of COs	
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	3	3	2	1	3	3	2	2	3	3	2.5	
CO2	2	3	1	3	2	3	1	2	3	1	2.1	
CO3	3	1	2	3	3	1	3	2	3	3	2.4	
CO4	2	3	3	1	2	3	3	1	3	2	2.3	
CO5	3	3	3	3	3	1	1	3	3	2	2.5	
	Mean overall score											2.36
	Result											High