॥ सा विद्या या विमुक्तये ॥

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

'ज्ञानतीर्थ', विष्णुपुरी, नांदेड - ४३१ ६०६ (महाराष्ट्र राज्य) भारत

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

'Dnyanteerth', Vishnupuri, Nanded - 431 606 (Maharashtra State) INDIA

Established on 17th September, 1994, Recognized By the UGC U/s 2(f) and 12(B), NAAC Re-accredited with'B++' grade

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

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Academic-1 (BOS) Section

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विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरण २०२० च्या अनुषंगाने शैक्षणिक वर्ष २०२३–२४ पासून संलग्न महाविद्यालये व विद्यापीठ संकुलांत पदव्युत्तर पदवी प्रथम वर्ष आणि विद्यापीठ संकुले व न्यू मॉडेल डिग्री कॉलेज मध्ये पदवी प्रथमवर्ष अभ्यासक्रम लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, शासन निर्णय क्र. एनईपी २०२०/प. क्र. ०९/विशि–३/शिकाना, दिनांक २० एप्रिल २०२३ व शासन पत्र. क्र एनईपी २०२०/प. क्र. ०९/विशि–३, दिनांक १६ जून २०२३ अन्वये सूचित केल्यानुसार राष्ट्रीय शैक्षणिक धोरण २०२०च्या अनुषंगाने दिलेल्या आराखडया नुसार दिनांक १६ जून २०२३ रोजी संपन्न झालेल्या मा. विद्यापरिषदेच्या बैठकीत ऐनवेळचा विषय क्र. ०५/५६–२०२३ अन्वये मान्यता दिल्यानुसार प्रस्तुत विद्यापीठाच्या विज्ञान व तंत्रज्ञान विद्याशाखा अंतर्गत खालील पदव्युत्तर पदवी अभ्यासक्रम (AICTE, PCL, BCI, CoA, NCTE इ. सारख्या नियमक संस्थाची मान्यता आवश्यक असलेले अभ्यासक्रम वगळून) संलग्न महाविद्यालये, विद्यापीठ परिसर व उपपरिसर संकुलांमध्ये आणि पदवी प्रथम वर्ष अभ्यासक्रम विद्यापीठ परिसर व उपपरिसर संकुले व विद्यापीठ संचलित न्यू मॉडेल डिग्री कॉलेज, हिंगोली येथे शैक्षणिक वर्ष २०२३–२४ पासून लागू करण्यात येत आहे.

1) M.Sc. Biotechnology (1st Year) - Campus School
2) M.Sc. Biotechnology (1st Year) – Affiliated colleges
3) B.Sc. Biotechnology (1st Year) – New Model Degree College, Hingoli
4) M.Sc. Botany (1st Year) - Campus School
5) M.Sc. Botany (1st Year) – Affiliated colleges
6) M.Sc. Herbal Medicine (1st Year) - Affiliated colleges
7) M.Sc. Chemistry (1st Year) - Campus School
8) M.Sc. Chemistry (1st Year) - Affiliated colleges
9) M.Sc. Computer Science / Computer Network / Computer Applications (1st Year) University campus, sub campus Latur
10) M.Sc. System Administration & Networking (1st Year) – Affiliated colleges
11) M.Sc. Computer Management (1st Year) – Affiliated Colleges
12) M.Sc. Computer Science (1st Year) – Affiliated Colleges
13) M.Sc. Dairy Science (1st Year) - Affiliated colleges
14) M.Sc. Electronic (1st Year) - Affiliated colleges
15) M.Sc. Geology (1st Year) – University Campus
16) M.Sc. Geography (1st Year) – University Campus
17) M.Sc. Applied Mathematics (1st Year) – Affiliated Colleges
18) M.Sc. Mathematics (1st Year) – Affiliated Colleges
19) M.Sc. Microbiology (1st Year) - University Campus
20) M.Sc. Microbiology (1st Year) – Affiliated colleges

21) M.Sc. Physics (1st Year) - University Campus
22) M.Sc. Physics (1st Year) – Affiliated Colleges
23) M.Sc. Statistics (1st Year) - University Campus
24) M.Sc. Statistics (1st Year) – Affiliated colleges
25) M.Sc. Biochemistry (1st Year) – Affiliated Colleges
26) M.Sc. Zoology (1st Year) – Affiliated Colleges

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी, ही विनंती.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.:शै–१/एनइपी२०२०/S&T/अक/२०२३–२४/ 130

सहा.कुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

दिनांक : ३०.०६.२०२३.

प्रत : १) मा. प्राचार्य, सर्व संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
२) मा. संचालक, सर्व संकुले परिसर व उपपरिसर, प्रस्तुत विद्यापीठ
३) मा. प्राचार्य, न्यु मॉडेल डिग्री कॉलेज हिंगोली.
४) मा. समन्यवक, कै. श्री उत्तमराव राठोड आदिवासी विकास व संशोधन केंद्र, किनवट.

प्रत माहितीस्तव :
१) मा. कुलगुरू महोदयांचे कार्यालय, प्रस्तुत विद्यापीठ.
२) मा. कुलसचिव, प्रस्तुत विद्यापीठ.
३) मा. सर्व आधिष्ठाता, प्रस्तुत विद्यापीठ.
४) सर्व प्रशासकीय विभाग प्रमुख साहाय्यक, प्रस्तुत विद्यापीठ.
५) सिस्टीम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ.

SWAMI RAMANAND TEERTH

MARATHWADA UNIVERSITY, NANDED - 431 606

(R-2023)

स्वामी रामानंद तीर्थ
मराठवाडा विद्यापीठ, नांदेड.

TWO YEAR MASTERS PROGRAMME IN SCIENCE (M. Sc.)

Subject _BIOCHEMISTRY

(Affiliated Colleges)

Under the Faculty of
Science and Technology

Effective from Academic year 2023 – 2024

From the Desk of the Dean, Faculty of Science and Technology

Swami Ramanand Teerth Marathwada University, Nanded, enduring to its vision statement "***Enlightened Student: A Source of Immense Power",*** is trying hard consistently to enrich the quality of science education in its jurisdiction by implementing several quality initiatives. Revision and updating curriculum to meet the standard of the courses at national and international level, implementing innovative methods of teaching-learning, improvisation in the examination and evaluation processes are some of the important measures that enabled the University to achieve the **3Es, the *equity, the efficiency and the excellence*** in higher education of this region. To overcome the difficulty of comparing the performances of the graduating students and also to provide mobility to them to join other institutions the University has adopted the *cumulative grade point average* (CGPA) system in the year 2014-2015. Further, following the suggestions by the UGC and looking at the better employability, entrepreneurship possibilities and to enhance the latent skills of the stakeholders the University has adopted the *Choice Based Credit System* (CBCS) in the year 2018-2019 at graduate and post-graduate level. This provided flexibility to the students to choose courses of their own interests. To encourage the students to opt the world-class courses offered on the online platforms like, NPTEL, SWAYM, and other MOOCS platforms the University has implemented the credit transfer policy approved by its Academic Council and also has made a provision of reimbursing registration fees of the successful students completing such courses.

SRTM University has been producing a good number of high caliber graduates; however, it is necessary to ensure that our aspiring students are able to pursue the right education. Like the engineering students, the youngsters pursuing science education need to be equipped and trained as per the requirements of the R&D institutes and industries. This would become possible only when the students undergo studies with an updated and evolving curriculum to match global scenario.

Higher education is a dynamic process and in the present era the stakeholders need to be educated and trained in view of the self-employment and self-sustaining skills like start-ups. Revision of the curriculum alone is not the measure for bringing reforms in the higher education, but invite several other initiatives. Establishing industry-institute linkages and initiating internship, on job training for the graduates in reputed industries are some of the important steps that the University would like to take in the coming time. As a result, revision of the curriculum was the need of the hour and such an opportunity was provided by the New Education Policy 2020. National Education Policy 2020 (NEP 2020) aims at equipping students with knowledge, skills, values, leadership qualities and initiates them for lifelong learning. As a result the students will acquire expertise in specialized areas of interest, kindle their intellectual curiosity and scientific temper, and create imaginative individuals.

The curriculum given in this document has been developed following the guidelines of NEP-2020 and is crucial as well as challenging due to the reason that it is a transition from general

science-based to the discipline-specific-based curriculum. All the recommendations of the ***Sukanu Samiti*** given in the **NEP Curriculum Framework-2023** have been followed, keeping the disciplinary approach with rigor and depth, appropriate to the comprehension level of learners. All the Board of Studies (BoS) under the Faculty of Science and Technology of this university have put in their tremendous efforts in making this curriculum of international standard. They have taken care of maintaining logical sequencing of the subject matter with proper placement of concepts with their linkages for better understanding of the students. We take this opportunity to congratulate the Chairman(s) and all the members of various Boards of Studies for their immense contributions in preparing the revised curriculum for the benefits of the stakeholders in line with the guidelines of the Government of Maharashtra regarding NEP-2020. We also acknowledge the suggestions and contributions of the academic and industry experts of various disciplines.

We are sure that the adoption of the revised curriculum will be advantageous for the students to enhance their skills and employability. Introduction of the mandatory ***On Job Training, Internship*** program for science background students is praise worthy and certainly help the students to imbibe first-hand work experience, team work management. These initiatives will also help the students to inculcate the workmanship spirit and explore the possibilities of setting up of their own enterprises.

Dr. L. M. Waghmare, ***Dean,*** *Faculty of Science and Technology*
Dr. M. K. Patil, ***Associate Dean,*** *Faculty of Science and Technology*

Details of the Board of Studies Members in the subject Chemistry under the faculty of Science & Technology of S.R.T.M. University, Nanded

Sr No	*Name of the Member*	*Designation*	*Address*	*Contact No.*
1	*Dr. Munde. D*	*Chairman*		
2	*Dr. Junne*	*Member*	*Profrssor* *Dept. of Chemistry* *Yashwant College, Nanded*	*7588525265*
3	*Ms Shumbhangi Pawade*	*Member*	*Asst. Professor* *Dept. of Chemistry* *Shivaji College, Udgir*	*8806242440*
4	*Mr. Khadse.J.J*	*Member*	*Asst. Professor* *Dept. Of Microbiology* *Late Pushpadevi PatilArts & Science College,Resod, Washim*	*8805546156*
5	*Ms. Rutika B.Hatkar*	*Member*	*Gramin Science College, Vishnupuri Nanded*	*9011173011*
	Dr Jamdhade V.C	*Member*	*Gramin Science College, Vishnupuri Nanded*	

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

Credit Framework for Two Year PG Program

Subject: BIOCHEMISTRY

Year & Level 1	Sem. 2	Major Subject (DSC) 3	Major Subject (DSE) 4	RM 5	OJT / FP 6	Research Project 7	Practicals 8	Credits 9	Total Credits 10
1	1	**SDSCCBCH-401 Microbial Biochemistry (4 Cr)** **SDSCCBCH-402- Enzymology (4 Cr)** **SDSCCBCH-403 Molecular Biology (4 Cr)**	**SDSCEBCH-401 Bioenergetic & Metabolism OR Nutritional Biochemistry** (3+1 Cr)	**SVECR 401** *Research Methodology* **(3 Cr)**	--		**SDSCPBCH-401 Lab Course Based on Microbial Biochemistry 1Cr)** **SDSCPBCH-402 Lab Course Based on Enzymology (1Cr)** **SDSCPBCH-403 Lab Course Based on Molecular Biology (1Cr)**	22	44
	2	**SDSCCBCH-451 Phytochemistry (4 Cr)** **SDSCCBCH-452 Immunology (4 Cr)** **SDSCCBCH-453 Endocrinology (4 Cr)**	**SDSCEBCH-451 Medical Biochemistry OR Cytology** (3+1 Cr)	---	**SDSCOJ 451 (3 Cr)**	--	**SDSCPBCH-451 Lab Course Based on Phytochemistry (1Cr)** **SDSCPBCH-452 Immunology (1Cr)** **SDSCPBCH-453 Endocrinology (1Cr)**	22	

Exit option: Exit Option with PG Diploma *(after 2024-25)*									
2	**3**	**SDSCCBCH-Pharmaceutical Biochemistry (4 Cr) SDSCCBCH-502 Genetic Engineering(4 Cr) SDSCCBCH-503 501Drug Design (4 Cr)**	**SDSCEBCH-501 (4 Cr) Study of Natural Plant Products OR** (***From same Department / School)***	--		Research Project **SDSCR551 (4Cr)**	**SDSCPBCH-501 (1 Cr) SDSCEBCH-502 (1 Cr)**	**22**	**44**
	4	**SDSCCBCH-551Industrial Biochemistry (4 Cr) SDSCCBCH-552 Drug Metabolism(4 Cr)**	**SDSCEBCH-551Diagnostic Virology OR (4 Cr)** (***From same Department / School)***	**SVECP 551** Publication Ethics (2 Cr)		Research Project **SDSCR552 (6 Cr)**	**SDSCPBCH-551 (1Cr) SDSCEBCH-552 (1Cr)**	**22**	
Total Credits		**44**	**16**	**05**	**03**	**10**	**10**	**88**	

M. Sc. First Year Semester I *(Level 6.0)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	**SDSCCBCH-401**	**Microbial Biochemistry**	04	--	**04**	04	--
	SDSCCBCH-402	**Enzymology**	04	--	**04**	04	--
	SDSCCBCH-403	**Molecular Biology**	04	--	**04**	04	--
Elective (DSE)	**SDSCEBCH-401**	**Bioenergetic Metabolism OR Nutritional Biochemistry**	03	--	**03**	03	--
Research Methodology	**SVECR401**	**Research Methodology**	03	--	**03**	03	
DSC Practical	**SDSCPBCH-401**	**Lab Course Based on Microbial Biochemistry**	--	01	**01**	--	02
	SDSCPBCH-402	**Lab Course Based on Enzymology**	--	01	**01**	--	02
	SDSCPBCH-403	**Lab Course Based on Molecular Biology**	--	01	**01**	--	02
DSE Practical	**SDSCEBCH-401**	**Bioenergetic Metabolism OR Nutritional Biochemistry**	--	01	**01**	--	02
Total Credits			**18**	**04**	**22**	**14**	**08**

M. Sc. First Year Semester I *(Level 6.0)*

Examination Scheme

[20% Continuous Assessment (***CA***) and 80% End Semester Assessment (***ESA***)]

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Avg of (T1+T2)/2 (6)	Total (7)	CA (8)	ESA (9)	
Major	SDSCCBCH-401	Microbial Biochemistry	20	20	20	80	--	--	100
	SDSCCBCH-402	Enzymology	20	20	20	80	--	--	100
	SDSCCBCH-403	Molecular Biology	20	20	20	80	--	--	100
Elective (DSE)	SDSCEBCH-401	Bioenergetic Metabolism OR Nutritional Biochemistry	15	15	15	60	--	--	75
Research Methodology	SVECR401	RESEARCH Methodology	15	15	15	60	--	--	75
DSC Practical	SDSCPBCH-401	Lab Course Based on Microbial Biochemistry	--	--	--	--	05	20	25
	SDSCPBCH-402	Lab Course Based on Enzymology	--	--	--	--	05	20	25
	SDSCPBCH-403	Lab Course Based on Molecular Biology	--	--	--	--	05	20	25
DSE Practical	SDSCEBCH-401	Bioenergetic Metabolism OR Nutritional Biochemistry	--	--	--	--	05	20	25

M. Sc. First Year Semester II *(Level 6.0)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	SDSCCBCH-451	Phytochemistry	04	--	**04**	04	--
	SDSCCBCH-452	Immunology	04	--	**04**	04	--
	SDSCCBCH-453	Endocrinology	04	--	**04**	04	--
Elective (DSE)	SDSCEBCH-451	Medical Biochemistry OR Cytology	03	--	**03**	03	--
On Job Training	SDSCO451	ON Job Training	03	--	**03**	03	
DSC Practical	SDSCCBCH-451	Lab Course Based on Phytochemistry	--	01	**01**	--	02
	SDSCCBCH-452	Lab Course Based on Immunology	--	01	**01**	--	02
	SDSCCBCH-453	Lab Course Based on Endocrinology	--	01	**01**	--	02
DSE Practical	SDSCEBCH-451	Lab Course Based on Medical Biochemistry OR Cytology	--	01	**01**	--	02
Total Credits			**18**	**04**	**22**	**14**	**08**

M. Sc. First Year Semester II *(Level 6.0)*

Examination Scheme

[20% Continuous Assessment (***CA***) and 80% End Semester Assessment (***ESA***)]

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Avg of (T1+T2)/2 (6)	Total (7)	CA (8)	ESA (9)	
Major	SDSCCBCH-451	Phytochemistry	20	20	20	80	--	--	100
	SDSCCBCH-452	Immunology	20	20	20	80	--	--	100
	SDSCCBCH-453	Endocrinology	20	20	20	80	--	--	100
Elective (DSE)	SDSCEBCH-451	Medical Biochemistry OR Cytology	15	15	15	60	--	--	75
On Job Training	SDSCO451	ON Job Training	15	15	15	60	--	--	75
DSC Practical	SDSCCBCH-451	Lab Course Based on Phytochemistry	--	--	--	--	05	20	25
	SDSCCBCH-452	Lab Course Based on Immunology	--	--	--	--	05	20	25
	SDSCCBCH-453	Lab Course Based on Endocrinology	--	--	--	--	05	20	25
DSE Practical	SDSCEBCH-451	Lab Course Based on Medical Biochemistry OR Cytology	--	--	--	--	05	20	25

M. Sc. Biochemistry
Semester I
SBTTC-401 Biochemistry(60 Hrs, 4 Credits)

Coursepre-requisite:

i. A solid foundation in basic chemistry, including a thorough understanding of organic chemistry, inorganic chemistry, and physical chemistry. This knowledge is essential for comprehending the chemical principles and reactions that underlie biochemistry.

ii. Prior knowledge of molecular biology and genetics is crucial as it forms the basis for understanding the genetic mechanisms and molecular processes involved in biochemistry. Familiarity with topics such as DNA replication, transcription, translation, and gene regulation provides a strong foundation for studying the biochemical aspects of biotechnology.

Course objectives:

i. To provide a comprehensive understanding of the principles and applications of biochemistry in the field of biotechnology.

ii. To develop advanced theoretical and practical skills in biochemical techniques used in biotechnology research and industry.

iii. To enhance critical thinking and analytical abilities to evaluate and solve complex biochemical problems encountered in biotechnological processes.

iv. To foster interdisciplinary collaboration and communication skills necessary for effective participation in research, development, and implementation of biotechnological advancements in the field of biochemistry.

Course outcomes:

i. Understand the fundamental principles and concepts of biochemistry, including the structure and function of biomolecules, enzymology, metabolism, and cellular processes.

ii. Apply theoretical knowledge of biochemistry to analyze and interpret experimental data, and demonstrate proficiency in various biochemical techniques commonly used in biotechnology research.

iii. Develop critical thinking and problem-solving skills to address complex biochemical issues encountered in biotechnological processes, such as protein engineering, metabolic engineering, and biocatalysis.

iv. Effectively communicate scientific information related to biochemistry and biotechnology through oral presentations, scientific reports, and research papers, demonstrating proficiency in scientific writing and communication skills.

Course objective :-

1. To understand the basics of microbiology and biochemistry.
2 To study microbial growth and different biochemical pathways used for the same.

Course outcomes:-

1.Understand the basic microbial structure and functions of various physiological groups of prokaryotes and eukaryotes and also learn the theory and practical skills in microscopy handling and staining techniques
2.Know various Culture media and their applications and understand various physical and chemical means of sterilization and also learn various techniques for isolation of pure cultures
3.Comprehend the various methods for identification of unknown microorganisms and study microbial metabolism – Autotrophy and heterotrophy modes of nutrition

4. Understand the microbial physiology and know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement
5. Apply the knowledge to understand the microbial physiology and to identify the microorganisms.
6. Understand the regulation of biochemical pathway and possible process modifications for improved control over microorganisms for microbial product synthesis.

Title of paper:- Microbial Biochemistry

oduleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0	**Unit 1**	**Introduction to Microbiology and Microbial Handling**	**15**
	1.1	Microorganisms: types, structure, and Classification: fungi, bacteria, viruses	
	1.2	Microbial growth and reproduction, viral replication, cultivation.	
	1.3	Microbial Handling and Aseptic Techniques staining techniques of bacteria : grams stain, ZN stain, capsular stain	
	1.4	Preparation of culture media , types of media, and microbial inoculation and growth curve of bacteria	
2.0	**Unit 2**	**Microbial Culture Techniques**	**15**
	2.1	Sterilization techniques :- Moist heat sterilization, Dry heat sterilization , chemical sterilization and aseptic handling	
	2.2	Good laboratory practices and safety measures	
	2.3	Pure culture techniques and isolation methods\,Culture maintenance and preservation	
3.0	**Unit 3**	**Microbial Identification and Characterization**	**15**
	3.1	Microscopy :-Light , fluorescence, electron microscopy	
	3.2	Microscopic Observation and interpretation	
	3.3	Genotypic Methods of Microbial Identification: PCR, DNA sequencing, 16S rRNA gene sequencing for bacterial identification, DNA barcoding for species identification Next-generation sequencing (NGS) approaches for microbial identification	
4.0	**Unit 4**	**Biochemical and Physiological Tests**	**15**
	4.1	Phenotypic characterization of microorganisms	
	4.2	Biochemical tests for microbial identification	
	4.3	Physiological assays for metabolic profiling	
	4.4	Serological techniques: agglutination, ELISA, and Western blotting, Antibiotic susceptibility test	
		Total	**60**

Text Books:

1. *Text Books:* "Microbiology: A Textbook" by Pelczar, Chan, and Krieg
2. "Introduction to Microbiology" by Baveja and Baveja
3. "Microbiology: Principles and Explorations" by Black and Black
4. "Textbook of Microbiology" by Ananthanarayan and Paniker
5. "A Textbook of Industrial Microbiology" by Sharma and Singh
6. "Microbiology: Fundamentals and Applications" by Parija
7. "Microbiology" by Dubey and Maheshwari
8. "Microbiology: Principles and Applications" by Wagle and Damle
9. "Textbook of Microbiology" by Chandrasekharan and Pillai
10. "Microbiology: Laboratory Theory and Application" by Leboffe and Pierce

Reference Books:

1. "Prescott's Microbiology" by Willey, Sherwood, and Woolverton
2. "Brock Biology of Microorganisms" by Madigan, Martinko, and Parker
3. "Microbiology: Principles and Explorations" by Black, Jacquelyn
4. "Microbiology: A Systems Approach" by Cowan, Marjorie
5. "Molecular Microbiology: Diagnostic Principles and Practice" by Tang and Stratton

Title of paper:- Enzymology
Paper code :- SDSCCBCH-402

Course pre-requisite:

Course objective :-.

1.To acquire fundamental knowledge on enzymes and their importance in biological reactions.
2. To understand ability to difference between a chemical catalyst and biocatalyst.
3. Exposure to the nature of non-protein enzymes such as ribozymes.
4. Understanding the role of enzymes in clinical diagnosis and industries.
5. To understand the kinetics and mechanisms of action of enzymes,
6. to become familiar with the basic methods of studying enzymes, and to appreciate how individual reactions are controlled and integrated into the metabolic pathways of the cell.
7. Acquired theoretical and experimental knowledge will enable students to find appropriate employment in different development, scientific-research laboratories, or to continue their further studies in biochemistry or related disciplines

Course outcomes:-

1.This course will provide fundamental knowledge on enzymes and their importance in biological reactions.
2. Students will understand the difference between a chemical catalyst and biocatalyst and understand activation energy.
3 They will study non-protein enzymes such as ribozymes and will be exposed to the Industrial and biomedical applications of enzymes

Title of paper:- Enzymology
Paper code :- SDSCCBCH-402

oduleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0	**Unit I**	**Introduction to Enzymes**	**15**
	1.1	Definition ,Classification of Enzymes, general Characteristics s of enzymes	
	1.2	Mechanisms of enzyme action; concept of active site and energetics of enzyme substrate complex formation;	
	1.3	Specificity of enzyme action; principles of catalysis – collision theory, transition state theory; role of entropy in catalysis.	
	1.4	Theories of enzyme catalysis: Lock and key model, Koshland's induced fit theory Importance in Biological System:	
2.0	**Unit II**	**Kinetics of Enzyme Action**	**15**
	2.1	Kinetics of single substrate reactions; estimation of	

		Michelis – Menten parameters	
	2.2	multisubstrate reactions - mechanisms and kinetics; turnover number; types of inhibition & models – substrate, product.	
	2.3	Allosteric regulation of enzymes, Monod Changeux Wyman model, pH and temperature effect on enzymes & deactivation kinetics	
3.0	**Unit III**	**Enzyme Immobilization & Biosensors**	
	3.1	Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages	
	3.2	Design of enzyme electrodes and their application as biosensors in industry, healthcare and environment.	
	3.3	Biotransformation Application Of Enzymes:- Hydrolytic- Ester bond, Amide, Epoxides, Nitriles, Reduction reactions –aldehydes, Ketones, C=C, Oxidation reactions – Alkanes, Aromatic, Baeyer-Villiger, Enzymes in organic synthesis – esters, amide, peptide , Modified and Artificial Enzymes , Catalytic antibodies	**15**
4.0	**Unit IV**	**Purification & Characterization Of Enzymes from Natural Sources**	
	4.1	Production and purification of crude enzyme extracts from plant, animal and microbial sources;	**15**
	4.2	methods of characterization of enzymes;	
	4.3	Development of enzymatic assays	
		Total	**60**

Text Books:

Reference Books

1. Dixon, M., and E. C. Webb. "Enzyme inhibition and activation." Enzymes 3 (1979): 126-136.

2. Palmer, T. Understanding Enzymes, 4th ed., Prentice Hall/Ellis Horwood, London (1995).

3. Price, Nicholas C., and Lewis Stevens. Fundamentals of Enzymology. Oxford Science Publications. Second edition. New York, 2001.

4. Buchholz, Klaus, Volker Kasche, and Uwe Theo Bornscheuer. Biocatalysts and enzyme technology. John Wiley & Sons, 2012. 5. Copeland, Robert A. Enzymes: a practical introduction to structure, mechanism, and data analysis. John Wiley & Sons, 2004.

Title of paper:- Molecular Biology
Paper Title :- SDSCCBCH-403

Course Objective:-

The structure of present core course molecular biology has been magnificently designed with to achiveve following key objectives

1. to promote comprehensive background of silent features of Nucleic Acid & DNA to the course learners.
2. To impart understanding of key events of Molecular Biology comprising of mechanism of DNA Replication ,Transcription in Prokaryotes & Eukaryotes.
3. To provide adequate knowledge about Post Transcriptional Modifications & Processing of eukaryotic RNA ot the course learners
4. To give detailed explanation of Transcriptional Regulation with example of lac operon and tryptophan operon in Prokaryotic as well as eukaryotic organism along with key concept of Gene Silencing to the course learners.
5. To develop comprehensive understanding regarding DNA Repair Mechanism in the course learners.
6. To provide glimpse of types of Regulatoey RNAs by imparting adequate information about Ribo-switches, RNA Interference, miRNA & siRNA to the course learners

Course outcomes:-

1. After successful accomplishment of the course, the learners will be able to acquire better understanding & comprehensive knowledge regarding most of the essential aspect of Molecular Biology subject which in will provide opportunity to develope professional skill related to the field of Molecular Biology

2. On completion of course students are able to understand

i) Concept of gene, gene cistron relationship in prokaryotes and eukaryotes,

ii) DNA regulation and replication

ii) Types of DNA damage, DNA repair pathways

iv)Transcription in prokaryotes

v) Reverse transcription

vi) Repeated sequences

vii) Transposons types and transposition mechanism

Title of paper:- Molecular Biology
Paper Title :- SDSCCBCH-403

oduleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0	**UNIT I**	**Introduction**	**15**
	1.1	**Discovery of DNA** - The genomes of bacteria, viruses, plasmids, mitochondria and chloroplast Gene transfer in microorganisms- conjugation- transformation, transduction – protoplasmic fusion.	
	1.2	**Nucleic acids** - DNA and RNA structure and functions, DNA as genetic material. Griffth, Avery- McCarty- MCLeod, Hershy- Chase, Franklin Conrat Experiments	
	1.3	**DNA Structure**: Chemistry of DNA, Forces stabilizing DNA structure, Helix parameters, Forms of DNA (A,B,C,D,T and Z), Watson – Crick and Hoogsteen base	

		pairing , Physical Properties of ds DNA (UV absorption spectra Denaturation and renaturation), Chemical that react with DNA.	
	1.4	**Organization of genome**: Components of eukaryotic chromatin - chromatin and chromosome structure- DNA-supercoiling - linking number- Cot curve,	
2.0	**UNIT II**	**DNA Replication & Transcription**	**15**
	2.1	Mechanism of DNA polymerase catalyzed synthesis of DNA, types of DNA polymerases in bacteria and their role. Initiation of chromosomal DNA replication and its regulation in prokaryotes assembly of replisome and progress of replication fork, termination of replication.	
	2.2	Types and function of eukaryotic DNA polymerases initiation of replication in eukaryotes, role of telomerases in replication of eukaryotic chromosomes. Inhibitor of DNA replication (Blocking precursor synthesis nucleotide polymerization, altering DNA structure).	
	2.3	RNA polymerases, features of prokaryotic and eukaryotic promoters. Strong and weak promoters. Assembly of transcription initiation complex in prokaryotes and eukaryotes and its regulation; synthesis and processing of prokaryotic and eukaryotic transcripts. Post Transcriptional Modification Mechanism of splicing.	
	2.4	Transport of RNA within eukaryotic cell. Regulatory elements of genes-promoters. Fate of mRNA.	
3.0	**UNIT III**	**Translation**	**15**
	3.1	Synthesis and Processing of Proteome: Structure and role of tRNA in protein synthesis, ribosome structure, basic feature of genetic code and its deciphering	
	3.2	translation (initiation, elongation and termination in detail in prokaryotes as well as eukaryotes),	
	3.3	Post translational processing of protein (protein folding, processing by proteolytic cleavage, processing by chemical modification, inteins).	
	3.4	Intracellular Protein Targeting, Targeting of Protein to Mitochondria, Lysosome, ER, Plasma Membrane,Peroxisomes,Chloroplast. Protein degradation.	
4.0	**UNIT IV**	**Damage, Repair and Mutation**	**15**
	4.1	Causes (spontaneous, chemical agent, radiation) and types of DNA damage	
	4.2	Mechanism of DNA repair: Direct repair, base excision repair, nucleotide excision repair, mismatch repair, recombination repair.	

	4.3	Molecular basis of mutation, types of mutation (missense mutation, nonsense mutation, silent mutation, point mutation, frameshift mutation).	
	4.4		
		Total	**60**

Text Books:

1. Freifelder, D; Molecular Biology. Narosa Publishing House, New Delhi. 2008.

Reference Books:

1. Maloy S.R, Cronan JR, JE. Freifelder, D; Microbial Genetics. Jones and Barlette publishers. 1994.

2. Lodish H, Baltimore O, Berk A, Zipursky SL, MAtsudaira P, Darnell, J.; Molecular Cell Biology. Scientific American Books. 1995.

3. Lewin B; Genes VIII. Oxford University Press. 2004. 14

4. William Haynes; The Genetics of Bacteria and Their Viruses. Blackwell Scientific Publishers, Oxford. 1985.

5. E.D.P. De Robertis, E.M.F. De Robertis,Jr., Cell And Molecular Biology, Lippincott Williams and Wilkins. Ed. 8; 2001.

6. B.Alberts, A,Johnson, J.Lewis, M.Roff, K.Roberts, P.Walter, Mol;ecular Biology of The Cell, Garland science,NY. Ed. 4; 2002.

7. Robert F.Weaver, Molecular Biology, McGraw – Hill. Ed.4; 2008. 15MIM006 Molecular Immunology and Immunogenetics (Theory)

1. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2014) Molecular Biology of Gene. Cold Spring harbor, New York.
2. Nelson, D.L. and Cox, M.M. (2012) Lehninger's Principle of Biochemistry. W.H. Freeman, New York.
3. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A., Martin, K.C. (2016) Molecular Cell Biology. W.H. Freeman, New York.
4. Krebs, J.E., Goldstein, E.S., Kilpatrick, S.T. (2014) Lewin's Gene XI. Jones and Bartlett Learning, Massachusetts.
5. Freifelder D (2012). Molecular Biology, 5th edition. Narosa Publishing House, India
6. Berg JM, Tymoczko JL, Gatto GJ and Stryer L (2015) Biochemistry, 8th Edition, WH Freeman & Co., New York.
7. Allison A. Lizabeth (2012) Fundamental Molecular Biology, 2nd Edition. J Willey and Sons, Hoboken,New Jersey.
8. Freifelder D and Malacinski GM (2005) Essentials of Molecular Biology, 4th Edition, John and Bartlett Publishing, UK
9. Krebs JE., Kilpatrick ST and Goldstein ES. (2013). Lewin' GENES XI, Jones & Bartlett Learning. Burlington, MA.

Title of paper:- Bioenergetics & Metabolism
Paper code :- SDSCCBCH-401

Title of Paper: - Bioenergetics & Metabolism (SDSCCBCH-403)

Course Objective:-
The Bioenergetics course will carry out a study in depth on the relationship between energy and living systems. The subjects of the course are listed in the contents. The aim of the course is that students acquire a solid knowledge about:

1) The application of the principles of classical Thermodynamics to the study of the fundamental biochemical processes
2) Energy and chemical and physical mechanisms involved in the production of ATP in respiration and photosynthesis
3) Energy transformations in biosynthesis, cellular transport and mechanical work
4) Applications of Thermodynamics of open systems to the study of the energetics of living systems. The possible applications of Bioenergetics for the solution of energy problems in our technological civilization will also be considered.

Course outcomes:-
1.Students will able to apply open-system thermodynamics to the study of energy in living systems.
2. Students will able to Collaborate with other work colleagues.
3. Students will able to Describe the biological membranes in the physical and chemical mechanisms involved in the energy transformations associated with ATP formation in respiration and photosynthesis.
4. Students will able to Describe the molecular principles of the selective transport of substances through cell membranes, and how it is regulated.
5. Students will able to Design experiments and understand the limitations of experimental approaches.
6. Students will able to Explain the chemical, thermodynamic and structural bases of energy transformations for ATP formation and for the cell tasks of biosynthesis, transport and mechanics .
7. Students will able to Interpret experimental results and identify consistent and inconsistent elements.
8. Students will able to Make an oral, written and visual presentation of ones work to a professional or non-professional audience in English and understand the language and proposals of other specialists.
9. Students will able to Read specialised texts both in English and ones own language.
10. Students will able to Understand the language and proposals of other specialists.
11. Students will able to Use ICT for communication, information searching, data processing and calculations

Title of Paper: - Bioenergetics & Metabolism (SDSCCBCH-403)

oduleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0	**UNIT I**	**Bioenergetics**	
	1.1	Thermodynamics –First law of thermodynamics, second law of thermodynamics, Gibbs free energy, endergonic & exergonic reactions,. Standard state free energy changes- DG, DG^0 and DG'^0,	**10**
	1.2	Relationship between equilibrium constant and DG'^o, Feasibility of reactions. Simple problems, ATP-Structure,	

		properties and energy currency of the cell,.	
	1.3	Importance of Coupled reactions, High energy compounds, simple problems	
	1.4	Introduction to Metabolism – Catabolism, anabolism, catabolic, anabolic and amphibolic pathways	
2.0	**UNIT II**	**Carbohydrate Metabolism**	
	2.1	Introduction, Aerobic and anaerobic pathways: Glycolysis and its regulation , Gluconeogenesis and its regulation.	**10**
	2.2	TCA cycle, amphibolic & anaplerotic reactions. Electron Transport chain, Oxidative phosphorylation, & production of ATP, balance sheet of glucose oxidation, Oxidative stress.	
	2.3	Pentose phosphate pathway (HMP shunt) & its regulation Photosynthesis – 'light' and 'dark' reactions: C4-pathway	
3.0	**UNIT III**	**Lipid Metabolism**	
	3.1	Beta – oxidations of saturated & unsaturated fatty acids. Ketone bodies, production during starving and diabetes	**10**
	3.2	Biosynthesis of fatty acids – Acetyl-CoA carboxylase reaction, Fatty acid synthase complex, biosynthesis of palmitate, energetics, Regulation of fatty acid biosynthesis.	
	3.3	Biosynthesis of triacylglycerols, Biosynthesis of cholesterol, regulation.	
4.0	**UNIT IV**	**Amino Acid / Nucleic Acid Metabolism**	
	4.1	Biodegradation of amino acids – deamination, transamination, decarboxylation, urea cycle including its regulation.	**10**
	4.2	Biosynthesis of amino acids, Fate Of Carbon Skeleton Of Amino Acids	
	4.3	Biosynthesis & Degradation Of Purine Nucleotides	
	4.4	Biosynthesis & Degradation Of Pyrimidine Ribonucleotides	
		Total	**60**

Text Books

1. Lehninger, Nelson and Cox, Principles of Biochemistry, 4 Edition, W.H.Freeman & Company, 2004.
2. Voet & Voet, Fundamentals of Biochemistry, Upgrade Edition, Wiley, 2002.
3. Lubert Stryer, Biochemistry, 4th Edition, W.H.Freeman and Company, 1995

Title of paper:- Nutritional Biochemistry
Paper code :- SDSECBCH-401

Course objective:-

Upon completion of this course, students should be able to:
1 Identify the components of a healthy diet.
2 Describe concepts of normal nutrition and nutrition balance.
3 Apply nutritional principles in planning of a diet which promotes health.
4. Discuss nutrients essential to life as well as their balance recommended for the preservation of health.
5..Recognize and discuss the relationship of exercise to nutrition balance and overall health maintenance.

Course outcomes:-
The student will be able to
1. Gathering basic knowledge of energy sources.
2. Understand the different factor affect BMR.
3. Know the Malnutrition.
4. Explaining Mineral metabolism
5. Distinguish between protein and lipid metabolism

Title of Paper: - Nutritional Biochemistry

oduleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0	**UNIT I**	**Introduction to Human Nutrition**	**15**
	1.1	Concept and definition of terms-Nutrition, Malnutrition and Health: Scope of Nutrition	
	1.2	Nutritional aspect of carbohydrate lipid and protein and fiber. Disease related to digestion & absorption of food. Minerals major and miner minerals physiological and biochemical function assay.	
	1.3	Energy value of food (Protein, carbohydrate, fats, & protein). BMR and factor affecting BMR Disease caused by mal nutrition's (Protein, mineral & vitamins)	
	1.4	Minimum Nutritional Requirement and RDA: formulation of RDA and Dietary Guidelines Reference Man and Reference Woman, Adult consumption unit.	
2.0	**UNIT II**	**Energy & Nutrition**	**10**
	2.1	Energy in Human Nutrition: Idea of Energy and its unit, Energy Balance,	
	2.2	Assessment of Energy Requirements deficiency and excess,	
	2.3	Determination of Energy in food, B.M.R. and its regulation, S.D.A	
3.0	**UNIT III**	Protein Nutrition & Lipid Nutrition	**10**
	3.1	Protein food Nutritional significances of protein from milk, legumes, egg, meat & fish. Protein efficiency ratio,	

		biological value and digestibility coefficient.	
	3.2	Source of fat & oil function and utilization, required daily allowances, excess & deficiency.	
	3.3	Role of cholesterol & arteriosclerosis. Obesity – definition, complications prevention & treatment.	
4.0	**UNIT IV**	Water & Mineral Metabolism	**10**
	4.1	Significance of water in metabolism.	
	4.2	Dehydration & oedema. Source & significance of calcium & phosphate metabolism..	
	4.3	Iodine metabolism. Significance, preservation of physiological PH & anion and cation balance.	
	4.4	Acid – base balance in body fluids	
		Total	**60**

REFERENCES BOOKS:-

1. Nutrition and dietetics - Shubhangi Joshi
2. Principles of nutrition - E.D.Wilson
3. Hardbook of food nutrition - M.Swaminathan
4. Applied nutritions - R.Rajlaxmi
5. Lehninger's Principles of Biochemistry by D. L. Nelson and M. M. Cox, CBS Publications, 2000 6.
6.Biochemistry by LubertStryer, 4th Edition
7. Biochemistry by David Raw

Title of Paper: - Lab Course Based on Microbial Biochemistry

Sr. No.	Name Of The Experiment	
1.	Cultivation of anaerobe by candle jar method.	
2.	Flagella staining by liefson's method.	
3.	Replica technique.	
4.	IMVIC test	
5.	Capsule staining by Hiss & Maneval's method.	
6.	Antibacterial Susceptibility test.	
7.	Determination of growth curve of bacteria (E. coli, Pseudomonas).	
8.	Isolation of feacal coliform.	
9.	Determination of thermal death time of microorganism.	
10.	Determination of thermal death point of microorganism	
11.	MBRT	
12.	Antifungal activity of lactic acid bacteria.	
13.	Study of gene expression in E. coli with reference to Lac operon.	
14.	Isolation of antibiotic resistant mutant by action of physical mutagenic agents.	
15.	Repair mechanism of E. coli.	
16.	Effect of UV radiation to study the survival pattern of E.coli.	
17.	Effect of temperature/ pH on growth of bacteria.	
18.	Monochromatic staining.	
19.	Ion oxidation rate of Thiobacillius ferroxidance.	
20.		

Title of Paper: -- Lab Course Based on Enzymology

Sr. No.	Name Of The Experiment	
1.	Detection of enzymes. a) Amylase b) Pepsin c) Lipase d) Urease e) Invertase	
2.	Effect of amylase activity on starch.	
3.	Purification of enzymes by ammonium sulphate precipitation and dialysis.	
4.	Determination of Vmax.	
5.	Determination of Km.	
6.	Determination of Enzyme inhibition.	
7.	To measure the Alpha Amylase enzyme activity and specific activity.	
8.	To measure the Invertase enzyme activity and specific activity.	
9.	Extraction of Urease enzyme from horse gram.	
10.	To measure the Urease enzyme activity and specific activity.	
11.	To determine the effect of temperature on amylase enzyme activity.	
12.	To determine the effect of pH on Amylase enzyme activity.	
13.	To determine the effect of time on Amylase enzyme activity.	
14.	To determine the effect of substrate concentration on amylase enzyme activity.	
15.	To determine the effect of enzyme concentration on Amylase enzyme activity.	
16.	To study the effect of inhibitor on Amylase enzyme activity.	
17.	To study the effect of Activator on Amylase enzyme activity.	
18.	Immobilization of alpha amylase enzyme.	
19.	Isolation and purification of Beta Amylse from sweet potato.	
20.	To study membrane bound enzyme.	

Title of Paper: -- Lab Course Based on Molecular Biology

Sr. No.	Name Of The Experiment	
1.	Isolation of DNA from E.Coli.	
2.	Isolation of DNA from Yeast.	
3.	Estimation of RNA by orcinol method.	
4.	Estimation of DNA by DPA method.	
5.	Isolation of plasmid DNA.	
6.	Assement of purity of DNA by 260/280 ratio.	
7.	Genomic DNA Extraction from Plant Tissue	
8.	Characterization of DNA by Spectrophotometric Assay and Melting Temperature (Tm)	
9.	Digestion of DNA with Restriction Enzymes	
10.	Sanger Sequencing	
11.	Bacterial Transformation	

12.	Study on hyper chromic effect of DNA.	
13.	Extraction of RNA from baker's yeast.	
14.	Ligation	
15.	PCR	
16.	Separation of DNA fragments by agarose gel electrophoresis.	
17.	DNA Amplification	
18.	Blotting	
19.		
20.		

Title of Paper: -- Lab Course Based on Bioenergetics Metabolism

Sr. No.	Name Of The Experiment	
1.	Estimation of Protein by Biuret method.	
2.	Estimation of Protein by Lowry's method.	
3.	Colorimetric analysis Proteins by Bradford Method.	
4.	Estimation of Amino Acids.	
5.	Estimation of carbohydrate by Phenol sulphuric acid method.	
6.	Estimation of Carbohydrates by the Anthrone Method.	
7.	Estimation of Carbohydrates by the Furfural colorimetric method.	
8.	Estimation of reducing sugar by DNSA method.	
9.	Estimation of cholesterol by Liebermann-Burchard (LB) method.	
10.	Estimation of total lipids by colorimetric method.	
11.	Separation of triglycerides (Oils) on TLC.	
12.	Estimation of inorganic phosphate.	
13.	Estimation of free proline.	
14.	Isolation and estimation of casein in milk.	
15.	Isolation of cholesterol and lecithin from egg	

Title of Paper: -- Lab Course Based on Nutritional Biochemistry

Sr. No.	Name Of The Experiment	
1.	Milk analysis – total solids, lactose estimation by Lane – Eynon volumetric method (specific gravity by lactometer).	
2.	Detection of Adulterants in food.	
3.	Detection of probable adulteration in the following : A) Oil – groundnut B) Spices – Black pepper C) Clinnamomum – chilly powder. D) Cerals – Bajara E) Beverages – Tea and coffee F) Pulses – Gram dal flour G) Food products mango pulp.	
4.	Qualitative test for the detection of adulteration in milk and milk products.	
5.	Determination of activity in Curd / Paneer / Milk, - by titration method.	
6.	Estimation of fat (centrifugation or soxhlet method)	
7.	Estimation of proteins(by kjeldahl method)	
8.	Estimation of fibre.	
9.	Estimation of ash	
10.	Estimation of moisture	
11.	Estimation of ascorbic acid(titrimetric/ colorimetric method/)	
12.	Estimation of calcium (titrimetric method/)	
13.	Estimation of iron(wong's method)	

Title of Paper: - Phytochemistry

Paper code :- SDSCCBCH-451

Course objective :-

This Course deals with selected topics of high important plant Physiology and Biochemistry.
This Course deals with study of Plant water relations
This Course deals with study of Plant Enzyme
This Course deals with study of Plant Photosynthesis
This Course deals with study of Plant Respiration
This Course deals with study of Plant Nitrogen Metabolism
This Course deals with study of Plant Lipid Metabolism
This Course deals with study of Plant Plant Growth
This Course deals with study of Plant.

Course objectives

1. These topics will enable the students to Understand the plant cell, photosynthesis, transporters, and important primary metabolites.
2. Illustrate plant growth regulators, plant's responses to various biotic and abiotic stresses.
3. Explain about plant secondary metabolites and their functional importance
4. After completion of the course the students are familiar with various physiological aspects involved in the plant development.
5. Also the role of enzymes in it and mechanism of photosynthesis, respiration, nitrogen and¬ lipid metabolism.
6. The students are able to isolate starch, pectine and various nutritive products from the¬ plants.
7. Qualitative and quantification of the plant contents and its biochemistry and mode¬ /mechanism of synthesis etc

oduleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0	**Unit: I**		**15**
	1.1	**Plant cell:** Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins,	
	1.2	stomatal movement, transpiration,	
	1.3	photoperiodism and biological clocks,	
	1.4	plant movement.	
2.0	**Unit: II**		**15**
	2.1	**Photosynthesis:** Photosynthetic apparatus, pigments of photosynthesis,	
	2.2	Calvin cycle (C3 plants), Hatch slack (C4 plants) & CAM pathways of carbon reduction and its regulation,	
	2.3	Structure, function and regulation of RUBISCO, Crassulacean acid metabolism in plants.	
	2.4	Photorespiration: photorespiration pathway and significance, cyanide resistance, relationship between photosynthesis, photorespiration.	

3.0	**Unit: III**		
	3.1	**Phytohormones:** Biosynthesis, transport, physiological effects, mode of action and signal transduction of auxins, gibberlic acid, abscisic acid, ethylene and cytokinins in germination, embryogenesis, growth and development of plant.	
	3.2	**Nitrogen metabolism:** Nitrogen fixation, nitrogenise complex, biochemistry and genetics of nitrogen fixation and ammonium assimilation, structure of 'NIF' genes and its regulation, structural features of nitrate reductase and nitrite reductase, regulation of nitrate and sulphate assimilation.	**15**
	3.3	Secondary plant metabolites: Nature, distribution, biosynthesis and function of plant metabolites, biosynthesis of nicotine.	
	3.4	Biochemistry of plant toxins, phytohemagglutinins, lathyrogens, nitriles, protease inhibitors, protein toxins, role of secondary metabolites in chemical defence.	
4.0	**Unit: IV**		
	4.1	Plant stress physiology: Plant stress, plant responses to abiotic and biotic stresses, salinity, water, heat, chilling, anaerobiosis, heavy metals, radiations and their impact on plant growth	
	4.2	metabolism, mechanisms of resistance to biotic stress and abiotic stress, antioxidative defence mechanism.	**15**
	4.3	**Plant defence:** Genetic basis of plant-pathogen interactions, antio R-Avr gene interactions and isolation of R genes	
	4.4	hypersensitive response (HR), systemic acquired resistance (SAR) and induced systemic resistance (ISR).	
		Total	**60**

Reference Books :-

1. Lehninger's Principles of Biochemistry - Nelson & Cox. CBS Publishers & Distributors, 2013

2. Principles of Biochemistry - Moran, Horton, Scrimgeour, Perry. Pearson, 5 thEdition , 2011 3.

3. Plant Biochemistry - P.M. Dey & J.B. Harborne. Hart Court Asia Pvt Ltd. 1997 4.

4. Plant Biochemistry and Molecular Biology - P. Lea & Richard C Leegood., John Wiley & Sons. 1999 5.

5.Introduction to Plant Biochemistry - Goodwin and Mercer. CBS Publisher and Distributors. 2005 6.

6. Biochemistry and Molecular Biology of Plants - Buchanan, Greussem and Jones. American Society of Plant Physiologists. 2000 7.

7. Natural Products from plants. Peter B. Kaufman, Leland J. Cseke, Sara Warber, James A. Duke, Harry L. Brielmann, CRC Press, Boca Raton 1999.

8. Natural Products Targeting Clinically Relevant Enzymes. Paula B. Andrade, Patricia Valentao David M. Pereira. Wiley-VCH Verlag GmbH & Co 2017 21 | P a g e

9. Plant Cell Tissue and Organ Culture: Fundamental Methods - O.L. Gamborg & G.C. Phillips Narosa Publishers, New Delhi, 1995.

10. Kant R. Sweet proteins – Potential replacement for artificial low calorie sweeteners. Nutrition J. 2005; 4:5 doi:10.1186/1475-2891-4-5.

11. Misaka T. Molecular mechanisms of the action of miraculin, a taste-modifying protein. Seminars Cell Develop Biol. 24:222-225, 2013. 12. Temussi PA. Natural sweet macromolecules: how sweet proteins work. Cell Molec Life Sci CMLS. 63:1876-1888, 2006

Books recommended

Introduction of Plant Biochemistry, by Goodwin T. W. and E.I. Mercer, Pergamon Press, Oxford, 1983.

Plant Physiology, 5th Edition, by Lincoln Taiz and Eduardo Zeiger, Amazon press, 2012

Introduction of Plant Biochemistry, by Goodwin T. W. and E.I. Mercer, Pergamon Press, Oxford. Buchanan BB, Gruissem W & Jones RL. 2000.

Biochemistry and Molecular Biology of Plants. 2nd Ed. John Wiley. Dey PM &Harborne JB. 1997. Plant Biochemistry. Academic Press. Heldt HS. 1997.

Plant Biochemistry and Molecular Biology. Oxford Univ.Press.

Title of Paper: - Immunology
Paper Code:- Paper code :- SDSCCBCH-452

Course objectives:-

1. To provide knowledge on essential features of antigens and antibodies and their types and different theories of Antibody formation.
2. To acquire knowledge on types of immunity, phagocytosis, interferons and complement system.
3. To explain the concept of hypersensitivity, auto immunity and transplantation.
4. To provide knowledge on immune deficiencies and several immunological techniques.

Course Outcomes:

The student will be able to

1. Gain knowledge on different types of antigens, antibodies and how different types of antibodies are produced.
2. Out line, compare and contrast the key mechanism of innate and adaptive immunity
3. Gain knowledge on undesirable immunological reactions and their complications in health management
4. Apply knowledge in disease diagnosis through serological tes**ts**

Title of Paper: - Immunology
Paper Code:- SDSCCBCH-452

oduleNo.	**UnitNo.**	**Topic**	**Hrs. Required to cover the contents**
1. 0	**Unit I**	**Historic perspectives and introduction to immunology**	**15**
	1.1	History and scope of immunology; Types of Immunity- Innate/basic immunity, Acquired immunity natural, artificial, active and passive immunity; PAMPs, DAMPs; PRRs-Toll like receptors, acute phase proteins;	
	1.2	nature of antigens, immunogenicity, antigenicity, epitopes;	
	1.3	functions of cells of myeloid and lymphoid lineage- granulocytes, dendritic cells, macrophages, T and B lymphocyrtes; Inflammatory response;	
	1.4	Pathways of complement activation and its regulation	
2.0	**Unit II**	**Functions of Lymphoid organs**	**15**
	2.1	Primary and Secondary lymphoid organs; development of T and B lymphocytes in Thymus and Bone marrow-positive and negative selection	
	2.2	MHC restriction- types and significance of MHC molecules	
	2.3	antigen processing and presentation to T cells- endogenous and exogenous pathways	
	2.4	Formation of effecter T and B lymphocytes in the secondary lymphoid organs; Lymphocyte recirculation	

3.0	**Unit III**	**Humoral Immunity and Immunological Techniques**	
	3.1	Immunoglobulins - structure, types and biological functions; Primary and Secondary immune response;	
	3.2	Molecular basis of antibody diversity-multiple germ-line gene segments, somatic gene recombination, N and P nucleotide addition and somatic hypermutation;	
	3.3	Mechanism of antigen antibody interaction; principle and applications of precipitation, agglutination reactions, ELISA, RIA, Western Blotting, and immune fluorescence techniques;	**15**
	3.4	Hybridoma technique- principle and methodology for production of monoclonal antibodies; Biomedical applications of murine and humanized monoclonal antibodies	
4.0	**Unit IV**	**Cell Mediated Immunity**	
	4.1	Functions of T cell subsets-Th1, Th2, Treg, CTLs, and NK cells; Mechanism of activation of T cells; Tolerance mechanisms-central and peripheral tolerance-clonal deletion, clonal anergy;	
	4.2	Role of cytokines in immune regulation; T cell-B cell interaction-immunoglobulin class switching; Mechanism of target cell killing by CTLs and NK cells-death signaling-induction of apoptosis intrinsic and extrinsic pathways	
	4.3	**Immunopathology-** Types and causes of hypersensitivity reactions, autoimmune diseases and immune deficiency diseases; Transplantation immunity-types of grafts and the mechanism of graft rejection;	**15**
	4.4	Applications of physical, chemical and biological immunosuppressive agents. **Vaccines**: conventional vaccines-attenuated, killed and subunit vaccines; Modern vaccines- recombinant vaccines, DNA vaccines and Edible vaccines	
		Total	**60**

Text Books:

1. Richard Coico, Geoffrey Sunshine, Eli Benjamini. Immunology – A Short Course. Wiley-Liss, New York. 5th ed., 2003.

Essential immunology- Ivan M. Roitt.

2. Introduction to Immunology – John W.Kinball.

3. Immunology – D.M. Weir.

4. Immunology – Janis Kuby.

REFERENCE BOOKS:

1. Ivan M. Roitt, J. Brostoff and D. K. Male, Immunology, Gower Medical Publishing, London.1993.

2. Clark WR, The experimental foundations of modern immunology. John Wiley and Sons Inc. New York. 1991.

3. Janis Kuby, Immunology, II edition. W. H. Freeman and Company, New York. 1993.

4. Janeway Travers, Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd ed.,1997.

5. Peter J. Delves, Ivan M. Roitt, Encyclopedia of Immunology; Academic Press. 2 nd Ed., 1998.

6. Chapel H and Halbey M, Essentials of Clinical Immunology. ELBS. 1986.

7. Leslie Hudson and Frank C. Hay. Practical Immunology. Blackwell Scientific Publication. 3rd ed., 1989.

8. Pravash Sen. Gupta, Clinical Immunology. Oxford University Press. 2003.

9. Noel R. Rose, Herman Friedman, John L. Fahey. Manual of Clinical Laboratory Immunology. ASM. 3rd ed., 1986.

10. Punt, J., Stranford, S., Jones, P., Owen, J. (2018) Kuby's Immunology, W. H. Freeman, New York. 2. Murphy, K. and Weaver, C. (2016) Janeway' s Immunobiology, Garland Science, New York.

11. Delves, P.J., Martin, S.J., Burton, D.R., Roitt, I.M. (2017) Roitt's Essential 20 Immunology, Wiley-Blackwell Publishers, New Jersey

Title of Paper: - Endocrinology
Paper Code:- SDSCCBCH-452

Course objectives :-

1. Provide students with broad and balanced knowledge of the key concepts of endocrine system functioning.
2. Develop practical skills necessary for understanding and independent solving problems in the field of biochemistry of hormones using a standard methodology

Course Outcomes

After successful completion of this course the student is able to

1. Understand the function of hormones and their regulation.
2. Know how hormonal systems act in an integrated manner to regulate overall body• functions.
3. Understand how failure of these normal physiologic functions and integrations are• associated with some endocrine disorders
4. Explain the concepts related to intercellular communication and the maintenance of homeostasis,
5. define the metabolic role of individual tissues and hormones in physiological and / or pathological processes in the body,
6. describe the structure of certain hormones and processes by which they synthesize and secrete,
7. explain the mechanism of action of certain hormones,
8. analyze the connection between catabolic and anabolic processes,
9. explain the regulation of metabolic pathways,
10. applies the standard experimental methods used in the study of metabolism.

Title of Paper: - Endocrinology
Paper Code:- SDSCCBCH-452

oduleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0	**Unit I**	**Introduction to Endocrinology**	**15**
	1.1	Chemical nature and classification of hormones. Defination and role of endocrine system, exocrine, endocrine,heterocrine glands. Hormones as chemical messengers. Feedback control of hormone action.	
	1.2	Hypothalamo-Hypophysial portal system.	
	1.3	Pituitary gland- location and anatomy. Histology and hormones of Adenohypophysis.	
	1.4	Histology and hormones of Neurohypophysis. Disorders of pituitary hormones.	
2.0	**Unit II**	**Adrenal Gland**	**15**
	2.1	Structure and histology, function of Adrenal gland Adrenal cortex hormones- Mineralocorticoids and Glucocorticoids and Renin-Angiotensin system.	
	2.2	Hormones of Adrenal Medulla- Epinephrine and Norepinephrine.	
	2.3	Disorders of adrenal steroids hormones.	

	2.4	Hormones of Pancreas- Insulin and Glucagon Types of Diabetes: Insulin Dependent Diabetes Mellitus (IDDM) and Insulin Independent Diabetes Mellitus (IIDM)	
3.0	**Unit III**	**Thyroid and other endocrine systems**	**15**
	3.1	Endocrine Role of Pineal Gland- Melatonin. Properties and role of Local hormones- NO (Nitric oxide), Histamine, Endorphins, neuropeptides.	
	3.2	Structure and Histology of Thyroid Gland, Hormones of Thyroid- Thyroxine and Triiodothyroxine biosynthesis. Disorders of hormones of thyroid.	
	3.3	Structure and histology of parathyroid gland; Parathyroid hormones- Parathormone andcalcium metabolism. Gastrointestinal Hormones- Gastrin, Secretin, Cholecystokinin (CCK), Gastric Inhibitory Peptide (GIP), Vasoactive Intestinal Peptide (VIP).	
4.0	**Unit IV**	**Reproductive and Gastro-intestinal endocrinology**	**15**
	4.1	Hormones of Female Reproductive Physiology- Estrogens and Progesterone. Hormonal regulation of pregnancy, parturition and lactation.	
	4.2	Structure of placenta, functions of hormones of placenta- HCG.	
	4.3	Hormones of Male Reproductive Physiology- Testosterone, Dihydrotesterone. Male and female contraceptives and their mode of functioning.	
	4.4	Disorders of reproductive steroid hormones. Infertility in humans and their remedial measures.	
		Total	**60**

Text Books:

1. Online resources like academic, research databases etc are recommended.
2. Williams Text Book of Endocrinology – 10th Ed, Saunders, 2003.
3. Endocrinology – Mac E. Hadley, 5th Ed, Pearson Education, 2004.
4. Molecular Endocrinology – Bolander, F.F., Academic, Son–Diego, 1989.
5. Textbook of Endocrinology – Griffin J.E., S.R. Ojeda, Oxford, New York, 1988.
6. Basic and Clinical Endocrinology – Greenspan, F.S., 3rd Ed., Appleton and Lange.
7. Basic Medical Endocrinology – Goodman, H.M., Raven, New York, 1988.
8. Hormones - From Molecules to Diseable, Bailiene, E.E. & P.A. Kelly, Herman, New York, 1991.
9. Text Book Medical Physiology – Guyton Hall, 10th Ed, Saunders, 2003.
10. Norman AW, Litwack G (1997), Hormones, 2 nd Edition, Elsevier Publications.
11. Bolander F (2004), Molecular Endocrinology, 3 rd Edition, Elsevier Publications.
12.. Rifai N (2007), Teitz Fundamentals of Clinical Chemistry, 6 th Edition, Elsevier Publications

13. Henry's Clinical Diagnosis and Management by Laboratory Methods (2011), 22nd Edition, Elsevier.

14. Vasudevan DM (2011), Text book of Medical Biochemistry, 6 th Edition, Jaypee Publishers

15. Chatterjea MN & Shinde R (2012), Text book of Medical Biochemistry, 8 th Edition, Jayppe Publications

16. Bishop ML, Fody EP, Schoeff LE (2013), Clinical Chemistry: Principles, Techniques, and Correlations, 7th Edition, Wiley Publications

17. J N Singh (2017), Biochemistry General, Hormonal and Clinical - 1 st Edition, Atithi books Publishers.

18. Rifai N (2017), Teitz Textbook of Clinical Chemistry and Molecular Diagnostics, 6 th Edition Saunders Publications.

Title of Paper: - Medical Biochemistry
Paper Code:- SDSECBCH-451

Course objective :-

The course aims to provide an advanced understanding of the biochemical mechanisms and pathophysiological processes responsible for common biochemical disorders.

The course provides an overview of normal and abnormal metabolic functions, the impact of disorders on metabolic processes, an overall picture about the molecular basis of diseases and novel strategies to prevent the diseases

Course outcomes:-

1. Understand the Basic concepts and principles of Clinical Biochemistry, detail on the various biological specimens including the process of collection, preservation and storage.

2. Describe of the blood clotting pathways and the blood clotting disorders.

3. Enumerate of the different types of anemias based on aetiology.

4. Understand the pathophysiological processes responsible for common biochemical disorders such as jaundice, Pancreatitis, Fatty liver etc.

5. Differentiate three types of jaundice and their systematic analysis. Detailed study of Jaundice, Cirrhosis, Hepatitis, Fatty liver and gall stones. Serum enzyme activities in diseases.

6. Understand Formation of urine and gain perception on the various renal function tests and renal disorders

7. Gain understanding of the need for Gastric function tests, Collection of gastric contents, their examination.

8. Understand the aetiology, types, clinical manifestations and treatment of Diabetes mellitus and various disorders of carbohydrate metabolic pathways.

9. Understand on the etiology, types, clinical manifestations, diagnosis and treatment of various amino acidurias.

10. Detail the nucleic acid metabolism disorders.

11.Elaborate on the role of Serum lipids including triglycerides, cholesterol and phospholipids in diseases.

12. Detail the clinical role of serum cholesterol and state the Clinical features of atherosclerosis.

Title of Paper: - Medical Biochemistry
Paper Code:- SDSECBCH-451

oduleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	Basic concept- Health and disease, Normal and pathological changes affecting cell in the body.	
	1.2	Cell death and physiological causes-physical, chemical and biologically agent, nutritional deficiencies.	
	1.3	Diogonstic enzymology- Mechanism of elevated enzyme activites such as alkaline phosphates, creatine kinse, LDH, AST, ALT, Isoenzyme	
	1.4	Blood composition, Cell function. Function of plasma protein and lipoprotein in diseases. Disorder of hemoglobin- Thalassemia, Sickle cell anemia	
2.0		**Inborn errors of metabolism**	**15**
	2.1	**Carbohydrate-** , glycogen storage disease, galctosemia, lactose intolerance, galactosure.	
	2.2	**Protein**- Phenylketonuria, Alkaptonuria,Albinism, Maple	

		syrup urine disease.	
	2.3	**Lipids**- Gauche's disease, Nieman Pick's disease, and Tay sach's disease.	
	2.4	**Nucleic acid**- Nyhan syndrome, Gout.	
3.0			
	3.1	Liver-Bile pigment- formation of bilurubin, urobilinogen bile acid, jaundice- prehepatic, hepatic and post hepatic.	
	3.2	Diagnosis of liver function test, Disease of liver- hepatitis, cholestasis,cirrhosis,Gallstones	**15**
	3.3	Endocrine disorder- Laboratory diagnosis of function of pituitary, adrenal and gonads. Disorder- Grave's disease, Addison's disease, hypo and hyper secretion of hormone.	
4.0			
	4.1	Diabetes mellitus- classification, etiology, managment, structure and biosynthesis of insulin, mechanism of action of insulin.	**15**
	4.2	Glycosuria and Hypoglycemia: introduction and types.	
	4.3	laboratory investigation-GTT,	
	4.4	Disorder of amino acid metabolism	
		Total	**60**

Reference Book

1. Pattabiraman R.N. Text book of Biochemistry, All India Publisher distribution.
2. Chatterjee M.N., Shinde, R. Text book of Medical Biochemistry, Jaypee Publishers.
3. Vasudevan, D.M., Sreekumari S., Text book of Biochemistry for Medical Students, Jaypee Publishers.
4. Berg, Jeremy M., Tymoczko, John L., Stryer Lubert. Biochemistry, W.H. Freemann, N. York.
5. David, L.N., Michael, M.C., Lehninger, Albert, Biochemistry, Kalyani Publications, N.
6. Murray, Robert K., Bender, David A., Botham Kathleen M. et al. Harper's Illustrated Biochemistry, Appleton & Lange.
7. Kaplan Lawrence A., Amadeo J. Clinical Chemistry: Theory, Analysis, Correlation, Mousby Publisher, Missouri.
8. Ranjna Chawla, Practical Clinical Biochemistry, Jaypee publishers
9. Harold Varley, Alam H. Guwnelock et al. Varley's Practical Clinical Biochemistry
10. Satanarayana (2006), textbook of Biochemistry, U.Staynarayana and U.Chakrapani edition third.
11. Clinical Pathology – Manual for Undergraduates, Sabitri Sanyal, B.I. Churchill Living stone, Pvt.eddition first.
12. Textbook of Human Biochemistry by G.P.Talwar
13. Harper's book of Biochemistry edited by Murray and Granner, Appleton and Lange,
14. latest edition.
15. Clinical pathology – Sood.R, Jaypee Pub. New Delhi.

Title of Paper: - Cytology
Paper Code:- SDSECBCH-451

Course Objectives :-

Course Outcomes:-

1. The student at the completion of the course will be able to:
2. Understand the structure and function of all the cell organelles.
3. Know about the chromatin structure and its location.
4. To be familiar with the basic principle of life, how a cell divides leading to the growth of an organism and also reproduces to form new organisms.
5. How one cell communicates with its neighboring cells?
6. Understand the basic principles of genetics and how genes (earlier called factors) are inherited from one generation to another.

oduleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**Structure and Function of Cell Organelles**	**15**
	1.1	Steucture of prokaryotic & Eukaryotic cell.	
	1.2	Plasma membrane: chemical structure-lipids and proteins	
	1.3	Cell-cell interaction: cell adhesion molecules, cellular junctions	
	1.4	Endomembrane system: protein targeting and sorting, endocytosis, exocytosis	
2.0		**Structure and Function of Cell Organelles**	**15**
	2.1	Cytoskeleton: microtubules, microfilaments, intermediate filaments	
	2.2	Mitochondria: Structure, oxidative phosphorylation	
	2.3	Peroxisome and ribosome: structure and functio•	
	2.4	Gogli Apparatus, ER, Lysosome,etc.	
3.0		**Nucleus and Chromatin Structure**	**15**
	3.1	Structure and function of nucleus in eukaryotes	
	3.2	Chemical structure and base composition of DNA and RNA	
	3.3	DNA supercoiling, chromatin organization, structure of chromosomes Types of DNA and RNA•	
4.0		**Cell cycle, Cell Division and Cell Signalling**	**15**
	4.1	Cell division: mitosis and meiosis	
	4.2	Cell cycle and its regulation, apoptosis	
	4.3	Signal transduction: intracellular signaling and cell surface receptors, via G-protein linked receptors,	
	4.4	JAK-STAT pathway	
		Total	**60**

Reference Books:-

1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004).

2. Alberts et al: Molecular Biology of the Cell: Garland (2002).
3. Cooper: Cell: A Molecular Approach: ASM Press (2000).
4. Karp: Cell and Molecular Biology: Wiley (2002). Pierce B. Genetics. Freeman (2004).
5. Lewin B. Genes VIII. Pearson (2004).
6. Watson et al. Molecular Biology of the Gene. Pearson (2004).
7. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis KubyKuby Immunology. W H Freeman (2007).
8. Delves Peter J., Martin Seamus J., Burton Dennis R., Roitt Ivan M. Roitt's Essential Immunology, 13th Edition. Wiley Blackwell (2017).
9. Shetty Nandini Immunology Introductory Textbook. New Age International. (2005)

Title of Paper: -- Lab Course Based on Phytochemistry

Sr. No.	Name Of The Experiment	
1.	Study of changes in carbohydrate , protene content during germination	
2.	To estimate lysine content in grains	
3.	To estimate methionine content in grains	
4.	To estimate tryptophane content in cereals	
5.	To estimate strength of glycine by formal titration	
6.	To estimate free amino acid by ninhydrin method	
7.	Qualitative estimation of oil content by soxhlet method	
8.	Determination of ascorbic acid by using 2 6 dichlorophenolindophenol dye	
9.	Induction of protenease , amylase & lipase during germination.	
10.	Induction of vit. C synthesis during germination	
11.	Isolation and characterization of trypsin inhibitor	
12.	Isolation of DNA from plant cell	
13.	Estimation of carotene, ascorbic acis , phenol, & Tannins in fruits and vigitables.	
14.	Isolation of chloroplast from spinach leaves	
15.	Isolation o mitochondria from spinach leaves	
16.	Estimation of chlorophyll a & b from chloroplast	

Title of Paper: -- Lab Course Based on Immunology

Sr. No.	Name Of The Experiment	
1.	Identification of various immune cells by morphology – Leishman staining, Giemsa staining.	
2.	Differential counts.	
3.	Total counts.	
4.	Agglutination Reactions- Latex Agglutination reactions- RF, ASO, CRP	
5.	Heamagglutination Reactions- Blood Grouping – forward and reverse, Rh Typing, Coomb's test, TPHA.	
6.	Visit to blood bank.	
7.	Serum electrophoresis.	
8.	PAGE of serum proteins.	
9.	Blood film preparation and identification of cells	
10.	VDRL	
11.	CRP	
12.	ELISA	
13.	ASO	
14.	WIDAL	
15.	Purification of IgG from serum	
16.	Lymphoid organs and their microscopic organization	
17.	Double diffusion and Immuno-electrophoresis	

Suggested Readings:

1. Benjamin E. (1996), Immunology – A short course 3rd Edition, John Wiley, New York.
2. Kuby J. (1997), Immunology, 3rd Edition, W.H. Freeman & Co., New York.
3. Roitt, I.M. (1997), Essential Immunology, 9th Edition, Oxford Black Well Science, London.
4. Tizard I.R. (1995), Immunology – An introduction, 4th Edition, Philadephia Sauders College press.
5. Gupta P.K. (2003), Biotechnology and Genomics, Rastogi Publications, Meerut.
6. Anant Narayan, Text Book of Immunology.
7. Pommerville et al (2004), Alcamo's Fundamentals of Microbiology, Jones and Barteett Publishers.
8. Richard Coico (2009) Immunology - A short course, Geoffrey Sunshine (Wiley Blackwell).
9. William Paul (1999) Fundamentals of immunology , (Lippincott Williams & Wilkins).
10. Peter John Wood, Dorling KInderseley (2007), Understanding immunology, (Pearson Education, India).

Title of Paper: -- Lab Course Based on Endocrinology

Sr. No.	Name Of The Experiment	
1.	**Lab investigations in measuring hormone levels.**	
2.	**T3/T4 Test**	
3.	**TSH Test**	
4.	**Thyroid Blood Test**	
5.	**FSH Test**	
6.	**LH Test**	
7.	**Testosterone Test**	
8.	**Prolactin Test**	
9.	**Estrogen Hormone Test.**	
10.	**ACTH Test**	
11.	**Sex hormone – binding globulin (SHBG)/** **Sex Steroid– binding globulin (SSBG)**	
12.	**Estimation Of Blood Glucose Level**	
13.	**Detection of HCG**	
14.		

Title of Paper: -- Lab Course Based on Medical Biochemistry

Sr. No.	Name Of The Experiment	
1.	Estimation of lipoprotein	
2.	Glucose tolerance test	
3.	Estimation of bilirubin. (Total & Direct).	
4.	Estimation of blood urea	
5.	Blood sugar determination by Folin – Wu method.	
6.	Estimation of creatine phospokinase.	
7.	Normal and abnormal constituents of urine.	
8.	Determination of blood cholesterol with HDL.	
9.	Estimation of SGOT.	
10.	Estimation of SGPT	
11.	Estimation of Total protein.	
12.	Estimation of Uric acid	
13.	Estimation of albumin.	
14.	Estimation of Triglycerides.	
15.	Estimation of alkaline Phosphates.	
16.	Estimation of alpha amylase.	
17.	Estimation of glucose.	
18.	Estimation of LDH	
19.		
20.	Coomb's Test	

Reference Book

1. Plummer D. T. (2005) An Introduction to Practical Biochemistry, TATA McGraw-Hill.

2. Sadasivam S. and Manickam A. (2008) Biochemical Methods, 3rd edition, New Age International Publishers.

3. Rao B. S. and Deshpande V. (2005) Experimental Biochemistry: A Student Companion, I.K. International Pvt. Ltd., New Delhi.

4. Sawhney S.K. and Singh Randhir (2011) introductory practical Biochemistry, Narosa Publication House Pvt. Ltd.

5. Jayaraman J. (1981) Laboratory Manual in Biochemistry, New Age International Publishers

6. Aneja K.R. (2007) Experiments in Microbiology, Plant Pathology and Biotechnology, New Age International Publishers.

7. Kale V. and Bhusari K. (2010) Practical Microbiology: Principles and Techniques, Himalaya Publishing House.

8. Godkar P.B. and Godkar D.P. (2003) Textbook of Medical Laboratory Technology, Second Edition, Bhalani Publishing House.

9. Rajgopal G. and Toora B.D. (2005) Practical Biochemistry, 2nd edition, Ahuja Publishing House.

10. Maheshwari D.K. (2002) Practical Microbiology, S. Chand Publishing.

11. Rajan S. and Christy Selvi R. (2015) Experimental Procedures in Life Sciences, CBS Publishers and Distributors Pvt. Ltd.

Guidelines for Course Assessment:

A. Continuous Assessment (CA) (20% of the Maximum Marks):

This will form 20% of the Maximum Marks and will be carried out throughout the semester. It may be done by conducting **Two Tests** (Test I on 40% curriculum) and **Test II** (remaining 40% syllabus). Average of the marks scored by a student in these two tests of the theory paper will make his **CA** score (col. 6).

B. End Semester Assessment (80% of the Maximum Marks):

(For illustration we have considered a paper of 04 credits, 100 marks and need to be modified depending upon credits of an individual paper)

1. **ESA Question paper will consists of 6 questions, each of 20 marks.**
2. **Students are required to solve a total of 4 Questions.**
3. **Question No.1 will be compulsory and shall be based on entire syllabus.**
4. Students need to solve **ANY THREE** of the remaining Five Questions (Q.2 to Q.6) and shall be based on entire syllabus.

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