॥ 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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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)

TWO YEAR MASTERS PROGRAMME IN SCIENCE

Subject: Microbiology

(Campus School)

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*

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

Credit Framework for Two Year PG Program

Subject: Microbiology

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	**SMICC-401**	Microbial Genetics	04	--	**04**	04	--
	SMICC-402	Microbial Physiology	04	--	**04**	04	--
	SMICC-403	Immunology	04	--	**04**	04	--
Elective (DSE)	**SMICE-401**	Biostatistics & Bioinstrumentation (besides M.Sc. micro students available for all life science students in school)	03	--	**03**	03	--
Research Methodology	**SVECR401**	Research Methodology	03	--	**03**	03	
DSC Practical	**SMICP-401**	Lab 1	--	01	**01**	--	02 X 02(A+B)
	SMICP-402	Lab 2	--	01	**01**	--	02 X 02(A+B)
	SMICP-403	**Lab 3**	--	01	**01**	--	02 X 02(A+B)
DSE Practical	**SMIEP-401**	Elective Lab	--	01	**01**	--	02 X 02(A+B)
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***)]

(For illustration we have considered a paper of 02 credits, 50 marks, need to be modified depending on credits of individual paper)

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	**SMICC-401**	Microbial Genetics	20	20	20	80	--	--	100
	SMICC-402	Microbial Physiology	20	20	20	80	--	--	100
	SMICC-403	Immunology	20	20	20	80	--	--	100
Elective (DSE)	**SMICE-401**	Bio-statistics and Biomolecular Techniques	15	15	15	60	--	--	75
Research Methodology	**SVECR401**	Research Methodology	15	15	15	60	--	--	75
DSE Practical	**SDSCP401**	Lab 1	--	--	--	--	05	20	25
	SDSCP402	Lab 2	--	--	--	--	05	20	25
	SDSCP403	**Lab 3**	--	--	--	--	05	20	25
DSE Practical	**SDSEP401**	Elective Lab	--	--	--	--	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	**SMICC-451**	Extremophiles and Biodiversity	04	--	**04**	04	--
	SMICC-452	Microbial Metabolism	04	--	**04**	04	--
	SMICC-453	Virology	04	--	**04**	04	--
Elective (DSE)	**SMICE-451**	Applied Enzymology & Molecular Biology besides M.Sc. micro students available for all life science students in school)	03	--	**03**	03	--
On Job Training	**SDSCO-451**	Hybrid mode training of 3-week duration with 90 contact hrs. in vacation	03	--	**03**	03	
DSC Practical	**SMICP-451**	Lab 1	--	01	**01**	--	02 X 02(A+B
	SMICP-452	Lab 2	--	01	**01**	--	02 X 02(A+B
	SMICP-453	**Lab 3**	--	01	**01**	--	02 X 02(A+B
DSE Practical	**SMICEP-451**	Elective Lab	--	01	**01**	--	02 X 02(A+B

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	**SMICC-451**	Extremophiles and Biodiversity	20	20	20	80	--	--	100
	SMICC-452	Microbial Metabolism	20	20	20	80	--	--	100
	SMICC-453	Virology	20	20	20	80	--	--	100
Elective (DSE)	**SMICE-451**	Applied Enzymology & Molecular Biology (besides M.Sc. micro students available for all life science students in school)	15	15	15	60	--	--	75
On Job Training	**SDSCO-451**	Hybrid mode training of 3-week duration with 90 contact hrs. in vacation	15	15	15	60	--	--	75
DSE Practical	**SDSCP451**	Lab 1	--	--	--	--	05	20	25
	SDSCP452	Lab 2	--	--	--	--	05	20	25
	SDSCP453	**Lab 3**	--	--	--	--	05	20	25

DSE Practical	**SDSEP451**	Elective Lab	--	--	--	--	05	20	25

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

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	**SMICC-501**	Fermentation Technology	04	--	**04**	04	--
	SMICC-502	Medical Microbiology	04	--	**04**	04	--
	SMICC-503	Diagnostic Microbiology and Bioinformatics	04	--	**04**	04	--
Elective (DSE)	**SMICE-501**	Food and Dairy Microbiology (besides M.Sc. micro students available for all life science students in school)	03	--	**03**	03	--
Research Methodology	**SMICR-551**	Research Project	04	--	**04**	--	04
DSC Practical	**SMICP-501**	Lab 1	--	01	**01**	--	02 X 02(A+B)
	SMICP-502	Lab 2	--	01	**01**	--	02 X 02(A+B)
DSE Practical	**SMIEP**	Elective Lab	--	01	**01**	--	02 X 02(A+B)
Total Credits			**18**	**04**	**22**	**14**	**08**

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

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	**SMICC-551**	Microbial Technology	04	--	**04**	04	--
	SMICC-552	Pharmaceutical Microbiology	04	--	**04**	04	--
Elective (DSE)	**SMICE-551**	Genetic Engineering (besides M.Sc. micro students available for all life science students in school)	03	--	**03**	03	--
RM	**SMICE-551**	Publication Ethics in Microbiology	02	--	**02**	02	
Research Project	**SMICR-552**	Research Project		06	**06**		06
DSC Practical	**SMICP-551**	Lab 1	--	01	**01**	--	02 X 02(A+B)
	SMICP-552	Lab 2	--	01	**01**	--	02 X 02(A+B)
DSE Practical	**SMIEP**	Elective Lab	--	01	**01**	--	02 X 02(A+B)
Total Credits			**18**	**04**	**22**	**14**	**08**

SMICC-401 Microbial Genetics

4 credit **Periods 60**

Course Objectives

- **To learn the basics of microbial genome organization, mutation, DNA repair, recombination and regulation. To acquire knowledge on applicability of genetics**
- **To acquire basic and advanced knowledge ofgenome organization in microorganisms,**
- **To learn the recombination and gene transfer mechanism**

Learning Outcomes

on successful completion of this course students will be able;

- **Describe fundamental principles of microbial genetics.**
- **Understand mechanism of DNA damage, mutation and repair.**
- **Describe mechanism of gene transfer between and within the bacterial cells.**

Module I

Unit – I

Brief historical evidences of genetic material in bacteria and viruses, features of genome organizations in viruses, prokaryotes, archaea and eukaryotes.

1.1 Plasmids; bacteria and yeast

1.2 Concept of operon, interrupted genes, gene families

1.3 Structure of chromatin and chromosome, unique and repetitive DNA, heterochromatin, euchromatin, Allele, transposons.

Module II

Unit – II

2.1 DNA Damage and Repair

2.2 Mutation; spontaneous and induced, molecular mechanism of mutation, mutation rate, mutation priority, effect of mutation on gene product, significance of mutants, reversion of mutation, intragenic and intergenic mutation, suppressor mutation and complementation.

2.3 DNA protection and Repair: Role of restriction modification system in DNA protection and repair.

Module III

Unit – III 14

3.1 Recombination and methods of gene transfer in bacteria; Homologous recombination, site-specific recombination, illegitimate recombination.

3.2 Conjugation: F-plasmid; structure and function, origin of conjugation, Hfr and F strain, interrupted and un-interrupted mating, time map and recombination, conjugation in E. coli, F-factor and their use in genetic mapping.

3.3 Transformation: Natural and artificial, competence, transformation in Bacillus, Himophillus and Streptococcus, mechanism of recombination, genetic mapping.

3.4 Transduction: Generalized and specialized transduction, λ-phage and P1-phage, HFT and LFT lysate, co-transduction and transduction mapping.

3.5 Transposons: Discovery of transposition, classes of bacterial transposons, analysis of transposition, transposon mutagenesis and Mu-transposon.

Module IV

Unit – IV 16

4.1 Gene regulation: control of gene expression, co-ordinated control of structural genes, stringent response, catabolite repression, instability of bacterial RNA

4.2 Positive regulation in E. coli (arabinose operon) and negative regulation in E. coli (lac operon),

4.3 Inducers and repressors, Trp operon- regulation by attenuation

4.4 Gal, Tol operon and regulons with recent advances.

References:

1. Fundamental Bacterial Genetics by Nancy Trun and Jenanine Trumphy (2003), Publisher: Blackwell Publishers.
2. Genetics a conceptual approach (5^{th} Ed.) by Benjamin A. Pierce (2008) Publisher: W.H. Freeman and Company
3. Genetics A Molecular Approach (2^{nd} / 3^{rd} Ed.) by Peter J Russell (2006)
4. Modern Microbial Genetics (2^{nd} Ed.) by Uldis N. Streips, Ronald Yasbin. Publisher: Wiley-Liss, Inc.
5. Microbial Genetics by Maloy et.al. 1994. Jones and Bartlett Publishers.
6. Molecular Genetics of Bacteria by J.W.Dale 1994 John Wiley and Sons.
7. Gene XII by Lewin Oxford University press. 2017
8. Organization of Prokaryotic genome. 1999 by Robert L Charlebois, ASM Publications.
9. Recombinant DNA by Watson J.D.

SMICC-402 Microbial Physiology

4 credit Periods 60

Course Objectives:

- **To develop a sufficient background to students about the growth of Microbes.**
- **To acquire knowledge on basic aspects of bacterial respiration and photosynthesis.**
- **To acquire knowledge on microbial stress response.**

Learning Outcomes

- **Knowledge on growth of Microbes**
- **General Information about microbial respiration and photosynthesis**
- **Clear idea on physiological adaptations under stress conditions.**

Module I

Unit- I

14

1.1 Structure and functions of prokaryotes, Appandages, Glycocalyx, cell wall, Periplasm, Cell membrane and cytoplasm

1.2 Microbial Nutrition- Nutritional requirement for growth (macronutrients, micronutrients and growth factors)

1.3 Nutritional types of microorganism

Module II

Unit –II

14

2.1 Measurement of growth, growth physiology, cell division, growth yields

2.2 Growth kinetics, steady state growth and continuous growth

2.3 Solute transport: ABC transporters, phosphotransferase system, iron transport

2.4 Chemotaxix and flagellar movement

2.5 Protein export, liposomes and proteo liposomes.

Module III

Unit **III**

16

3.1 Oxidation reduction potential, Free Oxidative phosphorylation and theories of ATP formation

3.2 Electron transport chain: Components, Inhibition of electron transport chain, Coupling sites, Q loops, Q cycles and proton pumps, patterns of electron flow in aerobic and anaerobic bacteria

3.3 ATP synthesis in heterotrophic and phototrophic bacteria

3.4 Phototrophic prokaryotes, photosynthetic pigments, reactions of photosynthetic apparatus, photosynthetic apparatus of cyanobacteria, photosynthesis in halobacteria,

Module IV

Unit-IV

16

4.1 Introduction to two component system, regulatory systems during aerobic, anaerobic shifts: Arc, Enr, Nar, Fhl A regulon, response to phosphate supply: The pho regulon, Quorum sensing : A to C signalling system,

4.2 Sporulation in Bacillus subtilis, control of competence in *Bacillus subtilis*.

4.3 Response to environmental stress and homeostasis: Heat shock responses, response to osmotic stress, PH homeostasis and osmotic homeostasis.

References:

1. Madigan, M.T., Martinka, M., Parker, J. and Brock, T.D. 2000. Twelth Edition, Biology Microorganisms, Prentice Hall, New Jerry.

2. Moat, A.G. and Foster, W.2002. Microbial Physiology, Fourth Edition, John Wiley and Sons, New York.

3. Postgate,J. 1998, Nitrogen Fixation, third edition,Cambridge University Press.

4. Salisbury,F.W. and W.Ross, 1992, Plant Physiology, fourth edition, Wardsworth Publishing Company, California.

5. Deb, A.C. 2006. Fundamentals of Biochemistry, New Central Book Agency Pvt. Ltd., Kolkata.

6. Donald Voet and Judith G. Voet, 2011. Biochemistry. Third Edition, John Wiley and Sons, Inc. New York. 7. Stryer, L. 2010. Biochemistry, Seventh Edition, W.H. Freeman and Company, New York.

8. Nelson, D.L. and Cox, M.M. 2012. Lehingers's Principles of Biochemistry, Sixth Edition, Mac Millan worth Publishers, New Delhi.

9. Srivastava, M.L. 2008. Microbial Biochemistry, Narosa Publishing House, New Delhi.

10. Satyanarayana, U. and Chakrapani, U. 2013. Biochemistry, Fourth Edition Book and Allied Pvt. Ltd., Kolkata.

11. Bacterial metabolism by Gerhard Gottschalk (second edition), (1986) Springer Verlag New York Inc.

SMICC-403 Immunology

4 credit **Periods 60**

Course objectives

- **To facilitate conceptual understanding of Components and functions of Immune system,**
- **To acquire knowledge on basic aspects Development of Immune response interdependence of HI and CMI.**
- **To acquire knowledge on basic aspects Disorders of Immune system**
- **Learning outcome**
- **At the completion of course student will able to illustrate Anatomy and function of cells and organs of immune system,**
- **student will have clear idea on Antigen ,Antibody and their interactions. student will able to explain auto-immunity, hypersensitivity**

Module I

UNIT-I 14

1.1 Innate nonspecific immunity.

1.2 Adaptive specific immunity, humoral and antibody mediated immune response.

1.3 Haematopoiesis

1.4 Cells and organs of immune system.

Module II

Unit II

2.1 Antigens and factors that affect antigenicity

2.2 Epitopes, hapten, Superantigen

2.3 immunoglobulin structure and function

2.4 Monoclonal Antibodies

Module III

Unit III

3.1 Antigen antibody interaction, cross reactivity

3.2 Precipitation reaction , Agglutination reaction, ELISA

3.3 Antigen processing and presentation

3.4 Endogenous and cytosolic pathway

Module IV

Unit IV

4.1 MHC molecule location and functions

4.2 Structure of Class I and class II MHC

4.3 Complement activation classical by pathway

4.4 Gell and coombs classification of hypersensitive reactions, IgE mediated Hypersensitivity

Reference Books:

1. Kuby Immunology by Kindt TJ, Goldsby RA, Osborne BA, Kuby J: 6th edition. New York. WH Freeman; 2006.
2. Cellular and Molecular Immunology by Abbas AK, Lichtman AH, Pillai S: Saunders Elsevier; 2007.
3. Immunobiology: The immune system in health and disease by Janeway CA,Travers P,Walport M, Shlomchik MJ: 6th edition. New York. Garland Science Publishing; 2005.
4. Medical Microbiology and Immunology by Levinson W, Jawetz E: Lange publication; 2001.
5. 4. Ananthanarayan and Paniker. Text book of microbiology. University press. 8th edition 5. Pelczar, MJ Chan ECS and Krieg NR, Microbiology McGraw-Hill. 6. Willey,Sherwood,Woolverton. Prescott,Harley, and Klein's Microbiology McGraw-Hill publication
6. Tortora,Funke,Case. Microbiology.Pearson Benjamin Cummings.

7 DavidFrifielder,Stanely R.Maloy, Molecularbiologyand Microbialgenetics. 2ndEdition,JonesandBarlettPublishers. (1994).

9.Roitt's Essential Immunology by Delves PJ, Martin SJ, Burton DR, Roitt IM; 11th edition. Blackwell

SMICE-401 Bio-statistics and Biomolecular Techniques

3 credit **Periods 45**

Course Objectives

- **To learn how to effectively collect data, describe and use data to make inferences**
- **Demonstrate understanding of hypothesis testing and choose and apply appropriate statistical methods for analyzing variables.**
- **To learn the principle, working and applications of basic bio-molecular techniques advanced instrumentation techniques.**

Learning Outcomes

- **General Information about basic bio-molecular techniques**
- **Knowledge on advanced instrumentation techniques.**
- **General Information about collection and analysis of data use of statistical method in analysis and interpretation of biological data.**

Module I 14

1.1 Introduction to biostatistics, collection of data, sampling methods, processing and presentation of data

1.2 Measures of central tendency and dispersion. Correlation, calculation of Karl Pearson's coefficient of correlation, Regression Analysis

1.3 Hypothesis testing: Types of hypothesis testing: t-test, χ^2 -test, and F- test, ANOVA.

1.4 Software used in biostatistics- SPSS.

Module II

Unit II- Basic techniques 14

2.1 Principle, Working and Applications of chromatography (paper, thin layer, gel filtration, ion exchange, affinity, gas chromatography, HPLC, HPTLC)

2.2 Centrifugation (preparative, analytical, ultracentrifugation, differential and density gradient methods). 2.3 Electrophoretic Techniques: Basic principles, working and applications of paper, agarose gel electrophoresis, native and denaturing PAGE and two-dimensional electrophoresis.

Module III

Unit III 16

3.1 Principle, working and applications of UV, visible, IR, NMR, Fluorescence, Atomic Absorption, Mass and Raman Spectroscopy.

3.2 Use of radioisotopes in biological sciences, Principle and application of tracer techniques

3.3 Geiger- Muller and Scintillation counters

3.4 Autoradiography and its applications

References:

1. Statistics in biology, Vol. 1 by Bliss, C.I.K. (1967) Mc Graw Hill, NewYork.
2. Practical Statistics for experimental biologist by Wardlaw, A.C. (1985).
3. Statistical Methods in Biology - 2000 by Bailey, N.T. J. English Univ. Press.
4. Practical Statistics for experimental biologist by Wardlaw, A.C. (1985).
5. Fundamental of Biostatistics by Khan
6. Biostatistics by P Rama Krishna, Saras Publication, 1995.
7. Biostatistical Methods by Lachin Bio-instrumentation
8. *Biochemistry.* 6th Edition by Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Freeman,New York.
9. *Biophysics: An Introduction* by Cotterill, R. M. J. (2002). John Wiley & Sons, England.
10. *Principles of protein X-ray crystallography* by Drenth, J. (2007). 3rd Ed. Springer,Germany.
11. *Biochemistry.* 3rd edition by Garrett, R. H. and Grisham, C. M. (2004). Brooks/Cole,Publishing Company, California.
12. *Understanding NMR Spectroscopy* by Keeler, J. (2002). John Wiley & Sons, England.
13. *Bioinformatics: sequence and genome analysis* by Mount, D. W. (2001). ColdSpringHarbor Laboratory Press, New York.

14. *Methods in Modern Biophysics.* Second Edition by Nölting, B. (2006). Springer,Germany.
15. *Biophysics* by Pattabhi, V. and Gautham, N. (2002). Kluwer Academic Publishers,NewYork and Narosa Publishing House, Delhi.
16. *Principles and Techniques of Biochemistry and Molecular Biology* by Wilson Keith and Walker John (2005), 6th Ed. Cambridge University Press, New York.
17. *Proteins NMR Spectroscopy: Principles and Practice* by Cavanagh John *et.al.* (1995),Academic Press
18. *Molecular Biophysics: Structures in Motion* by Daune M. and W. J. Duffin (1999),Oxford University Press.
19. *Methods in Modern Biophysics by* Nalting B. and B. Nalting (2003) Springer Verlag
20. *Computational Analysis of Biochemical Systems by* Voit E. O. (2000) CambridgeUniversity Press.
21. *Physical Biochemistry: Applications to Biochemistry and Molecular Biology* by Freilder,D. Freeman, San. Francisco, 1976
22. *Biochemical Techniques: Theory and Practice* by Robyt, John F.; White, Bernard J.Waveland Press, Inc., U.S.A. Published: 1990.

Lab Course –I SMICP-401based on SMICC-401

Lab Course – II SMICP-401 Based on SMICC-402

Lab Course- III SMICP-401 based on SMICC- 403

1 Detection of antigen antibody interaction using Widal test ,

2 Detection of antigen antibody interaction VDRL/RPR TEST,

3 Detection of antigen antibody interaction using RA TEST,

4 Detection of blood group antigens

5 Detection of antigen antibody interaction performing Radial immunodiffusion ,

6 Enumeration of cells of Immune system DLC (differential leucocyte count) technique

Lab Course- IV SMICP-401 based on SMICE- 401

SMICC-451 EXTREMOPHILES AND BIODIVERSITY

4 credit **Periods 60**

Course Objectives

- **To facilitate conceptual understanding of extremophiles and their types,**
- **To study Adaptive strategies in typical extremophiles,**
- **To Know systematic and occurrence of Archaea, methods of identification, Application of mycorrhiza**

Learning outcome

- **At the completion of course student will able to illustrate**
- **Student will acquire knowledge on Extreme habitats ,**
- **Student will acquire knowledge on applications of extremophiles, culture dependent and independent**

Module I

Unit I

1.1 Classification of extremophile and Their applications.

1.2 Thermophiles, Adaptation in thermophiles, Distribution and Their application

1.3 Psychrophiles, Classification Adaptation and Distribution

1.4 Halophiles Classification adaptations and uses

Module II

Unit II

2.1 Radiation resistant organism Deioncoccus radiodurans ultrastructure and mechanism of resistance

2.2 Acidophiles Adaptation and uses of Acidophiles

2.3 Alkaliphiles classification and adaptation

2.4 Industrial application of extremozymes

Module III

Unit III

3.1 Systematics, taxonomy and Prokaryotic diversity

Characteristics of primary domains nomenclature and bergey's Manual

3.2purple and green bacteria, cyanobacteria, Sulphur and Iron oxidizing bacteria

3.3 nitrifying bacteria, Methanotroph, sulfate and Sulphur reducing bacteria.

3.4 Diversity and classification of Archaea, extremely Halophilic Archaea, Methane producing archaea,

Hyper thermophilic archaea

Module IV

Unit IV

4.1 methods used for identification of microorganism, culture dependent method(sugar utilization pattern enzyme profile etc.

4.2 culture independent methods used for microbial identification(RFLP, RAPD, 16s r RNA techniques)

4.3 Mycorrhiza classification and application

4.4 Algal fuel , cultivation of algae and algal fuel production

References:

1.Biology of Extremophiles. Microbiology of Extreme Environments edited by C. ... Environments, Academic Press. 5 Kushner, D.J., ed. (1978) Microbial Life.

2.Brock Biology of Microorganisms Hardcover – Import, 17 Dec 2010 by Michael T. Madigan (Author), John M. Martinko (Author), David A. Stahl

3.Advances in applied microbiology. Vol.X, by Wayne W. Umbreit and D. Pearlman Academic Press.

4. Microbial ecology. Fundamental and applications by Ronald M. Atlas and Richard Bartha. II and IV edition.

5. Microbial Ecology. IInd edition by R. Campbell. Blackwell scientific publication.

6. Microbial life in extreme Environment by D.J. Kushner. Academic Press.

7. Microbiology of extreme Environment and its potentials for Biotechnology by N. S. Da Coasta, J. C. Duarata,, R.A.D. Williams. Elsisver applied science, London 8. Thermophiles. General, Molecular and applied Microbiology by Thomas D.Brock. Wiley Interscience publication.

8 Recent Advances on Mycorrhizal Fungi (Fungal Biology) by Marcela C. Pagano (Editor)

9 Extreme environment. Metabolism of microbial Adaptation by Milton R., Heinirich Academic Press.

SMICC-453 Virology

4 credit Periods 60

Course Objectives

- **To facilitate conceptual understanding of Classification of viruses**
- **To acquire knowledge on basic aspects cultivation of viruses**
- **To acquire knowledge on basic aspects important viral diseases.**

Learning outcome

- **student will able to illustrate morphology and replication strategy of viruses.**
- **student will acquire information on viral cultivation**
- **student will acquire information on diseases**

Module-I

UNIT- I 14

1.1 Brief outline on discovery and origin of viruses.

1.2 Classification and general properties of major families of viruses

1.3 Morphology and ultra-structure of viruses, capsid and their arrangements, types of envelopes and their composition.

1.4 Viral genome; their types and structure, viroid and prions.

Module II

UNIT-II 14

2.1 Cultivation of viruses using embryonated eggs, experimental animals and cell lines.

2.2 Assay of viruses: physical and chemical methods, end point method. Serological methods

2.3 Plant viruses and their classification , Structure and pathogenicity of TMV

2.4 Transmission of plant viruses with vector (insect, nematodes and fungi) and without vector (contact, seed and pollens).

Module III

UNIT-III
16

3.1 Animal viruses: nomenclature and classification of animal viruses

3.2 Structure, genomic organization of animal viruses

3.3 Pathogenesis and control of Human Herpes virus, Adeno virus

3.4 Pathogenesis and control of corona virus birds flu and swine flu virus

Module IV

Unit-IV 16

4.1 Bacteriophage: classification, morphology and ultra structure.

4.2 One step growth curve (latent period, eclipse period, and burst of size.)

4.3 Life cycle: lytic and lysogenic life cycle of bacteriophages. .

4.4 Brief account of M13, Mu, T4, Ø x174 and lambda phage.

Reference Books:

1. Virology; Renato Dulbecco and Harold S. Ginsberg, Fourth edition, J.B. Lippincott Company, USA
2. An Introduction to viruses, S. B. Biswas and Amita Biswas. Forth edition, Vikas Publishing House PVT LTD New Delhi.
3. Textbook of Microbiology by Ananthnarayanan and Paniker's, eighth edition, Universities Press
4. Microbiology; Lansing M Prescott, John P. Harley, Donald A Klein, Sixth edition, Mc Graw Hill Higher education.
5. Pelczar M., Chan E.C.S. and Krieg, N.R. Microbiology. Tata Mc Grew Hill Publishing Co. Ltd., New Delhi.
6. Stainier R.V., Ingraham, J.L., Wheelis, M.L. and Painter P.R. The Microbial World Printice-Hall of India (Pvt.) Ltd., New Delhi
7. . Ellen Strauss, James Strauss.Viruses and Human Disease 2nd Edition. Academic Press

   Christopher Burrell Colin Howard Frederick Murphy. Fenner and White's MedicalVirology 5th Edition.Academic Press
8. Bernard N. Fields.Fields Virology Lippincott Williams & Wilkins S. Jane Flint..Principles of Virology.American Society for Microbiology

SMICC-452 Microbial Metabolism

4 credit **Periods 60**

Course Objectives

- **To learn the characteristics of enzymes**
- **To acquire knowledge on metabolism of bio - molecules.**
- **To acquire knowledge on methane fermentation, Sulfide fermentation**

Learning Outcomes

- **Student will know about General Information about enzymes**
- **Student will have Knowledge on metabolism of bio – molecules**
- **Student will have Knowledge on regulation of enzyme synthesis**

Module I

Unit-I 14

1.1 General characteristics of enzymes, activation energy, coupled reactions, active site and its importance, forms and derivation of M.M Equation, Significance of Vmax and Km, types of enzyme inhibition.

1.2 Regulation of enzyme synthesis: Induction, catabolite repression, end product repression and attenuation, Allosteric enzymes and allosteric control, covalent modification of enzymes Nitrogen fixing organisms, biochemistry of nitrogen fixation, regulation of nitrogenase.

Module II

Unit-II 14

2.1 Growth of E. coli on glucose and substrates other than glucose, PPP, ED pathway, citric acid cycle-Reversed TCA cycle, anapleurtotic reactions, glyoxylate cycle, Calvin cycle.

2.2 Assimilation of nitrate and sulfate, Dissimilation of nitrate and sulfate, ammonia oxidizing bacteria, nitrite oxidizing bacteria, sulfur and iron oxidizing bacteria, Metabolism of hydrocarbons and lipids.

Module III

Unit-III 16

3.1 Biosynthesis of amino acids- oxaloacetate and pyruvate family, phosphoglycerate family, α-oxoglutarate family and aromatic amino acid.

3.2 Biosynthesis of fatty acids, phosphatidic acids, phospholipids and macromolecules (Glycogen, cell wall, outer membrane layer, Levan and dextran synthesis), Biosynthesis of purines and pyrimidines

Module IV

Unit- IV 16

4.1 Alcohol fermentation, Lactate fermentation, Butyrate and acetone –butanol fermentation, Propionate and succinate fermentation.

4.2 Methane fermentation, Sulfide fermentation, Anaerobic food chain, Fermentation of single amino acids, Stickland reaction and heterocyclic compounds.

References:

1. Bacterial metabolism by Gerhard Gottschalk (second edition), (1986) Springer Verlag New York Inc.
2. Bacterial metabolism by H. W. Doelle (Second edition), (2005), Academic press, Inc.
3. Biochemistry by A. L. Lehninger,
4. Biochemistry, Seventh Edition by Jeremy M. Berg, John L. Tymoczko and LubertStryer (Dec 24, 2010), W.H. Freeman & Company.
5. Chemolithoautotrophic bacteria: Biochemistry and environmental biology by Tateo Yamanaka, (Jan. 2008). Springer.
6. Lehninger: Principles of Biochemistry by Albert L. Lehninger, Michael Cox and David L. Nelson (4 May 2004), W. H. Freeman.
7. Microbial Biochemistry (Second Edition) by G.N. Cohen, (2011) Springer Dordrecht Heidelberg London New York.
8. Principles of Biochemistry (Lehninger Principles of Biochemistry) by Albert L.

Lehninger, Michael M. Cox and David L. Nelson (February 2008), W. H. Freeman.

SMICE-451 Applied Enzymology and Molecular Biology

3 credit **Periods 45**

Course Objectives

- **To learn the enzyme modification and recent developments in enzymes**
- **To acquire knowledge on applicability of enzymes.**
- **To acquire basic and advanced molecular biology**

Learning Outcomes

- **Student will have knowledge about enzyme modifications.**
- **Knowledge on applications of enzymes**
- **Student will have knowledge about basic and advanced molecular biology**

Module I

Unit I 14

1.1 Introduction to enzyme engineering and their application, genetic and chemical modification, methods of enzyme immobilization, homology modeling, biosensors, abzymes, ribozymes.

1.2 Enzymes in genetic recombination.

1.3 Enzymes in medical diagnosis and therapy:nEnzyme in cancer therapy, genetic diseases, clotting disorders, Neonatal jaundice.

1.4 Industrial applications of enzymes.

Module II

Unit – II

2.1 The structure of Nucleic Acid, Weak chemical interactions. A, B and Z DNA, Mitochondrial DNA, Structure of RNA., Topological properties of nucleic acid, Organization of prokaryotic and eukaryotic genome

2.3 DNA replication; models and Enzymes of replication, replication in prokaryotes and eukaryotes, Action of topoisomerases, Telomere maintenance, single stranded DNA replication, Relationship between DNA replication and cell cycle

Module III

Unit – III

3.1 Concept of gene, Transcription machinery of prokaryotes and eukaryotes, transcription enzymes, Promoters, enhancers, silencers, activators transcription process and regulation. Post transcriptional processes: RNA processing, RNA editing, RNAi and miRNA, antisense RNA.

3.2 The genetic code, translation process in prokaryotes and eukaryotes, regulation of translation, inhibitors of translation. Post translational processes: protein modifications, folding, chaperones, transportation.

Reference Books:

1. Advances in Enzymology by Alton Meister (1996), Interscience Publishers.
2. Allosteric enzymes – kinetic Behaviour by B.I Kurganov (1982) John Wiley and sond
3. Inc., New York.
4. Biology enzymes in biotechnology by H.J.Rehm and G. Reed Verlag (1983) VCH
5. Publishers. New York.
6. Enzymes as Drugs by John S. Hoilenberg and Joseph Roberts (2001). John Wiley and
7. Sons New York.
8. Enzymes by Dixon, M., and E. C. Webb, 3rd edition, (1980), Academic Press. New York.
9. Enzymology by palmer
10. Hand Book of Enzyme Biotechnology by Wiseman (1985), Ellis Horwood.
11. Methods in Enzymology by W. A. Wood (1980) Academic Press New York.
12. Methods in Enzymology. Volume 22- Enzyme purification and related techniques by
13. William B. Jakoby. Academic press, New York.
14. Methods of Enzymatic Analysis by Hans Ulrich. Bergmeyer (1974) Verlag Chemie.
15. Topics in enzymes and fermentation biotechnology by L.N.Weiseman, John wiley andSons.
16. Lewin B. (2004) Gene VIII, Pearson Prentice Hall, Pearson Education, Inc., NT, USA (ISBN: 0-13-123826-4).
17. Watson JD, Baker JA, Bell SP, Gann A, Lewin M, Losick R (2004) Molecular Biology of the Gene, Benjamin Cummings- CSHL Press, USA.
18. Dale WJ and Schontz VM (2007) From Genes to Genomes. John Wiley & sons ltd., England.
19. Stryer, Lubert Biochemistry 5^{th} edn. W. H. Freeman & Co., New York.
20. Brown TA (1995) Essential Molecular Biology, Vol. I, A Practical Approach, IRL Pres, Oxford, UK.

21. Nelson DL & Cox MM (2005) Lehninger's Principles of Biochemistry, 4th edn., McMillan Worth Publ. Inc. NY.
22. Watson, JD, Baker AT and Bell PS (2008). Molecular Biology of Gene. 5th edn. Pearson Education Inc.
23. Kornberg A and Baker AT (2005) DNA Replication. 2nd edition. University Science Book, California.
24. Turner PC, McLennan AG, Bates AD and White, MRH (2002) Instant Notes: Molecular Biology, 2nd edn. Viva Books Pvt. Ltd., New Delhi (ISBN: 81-7649-215-9).
25. Gerald Karp (1996). Cell and Molecular Biology- Concepts and Experiments. John Wiley and Sons, Inc., New York.

Lab Course –I SMICP-451based on SMICC-451

1 Studies on halophiles from sea water (pigmentation and salt tolerance).

2 Studies on alkalophiles isolated from lonar water (at least one enzyme).

3 Isolation of acidophiles from metal sulphides or acid mine water.

4 Demonstration of iron oxidation rate of Thiobacillus thiooxidans isolated

5)Physico chemical analysis of water sample ph, DO, phosphate,BOD,and COD.

6)Study of VAM fungi.

7)Demonstration of sewage treatment

Lab Course – II SMICP-452 Based on SMICC-452

Lab Course- III SMICP-453 based on SMICC- 453

1 Isolation and enumeration of bacteriophage .

2 Enumeration of Growth phase of phage and burst size.

3 Detection of viruses using Turbidometric assay

4 Study of plant viruses

5 collection of infected plant material and identification

6 Study of morphology of lesions on infected plant

Lab Course- IV SMICP-451 based on SMICE- 451