Government Arts and Science College
Ratlam (M. P.) 457001

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For the session 2021-22 the syllabus applied respectively in UG I is adopted from Central Board of Studies Bhopal designed according to NEP2020. For UG II and III and PG the syllabus of the previous session have been followed.

Principal

Govt. Arts and Science College

Ratlam (M.P.)

Principal
Govt. Arts & Science College
Ratlam (M.P.)

भाग अ - परिचय			
कार्यक्रम: प्रमाण पत्र	कक्षा: बी.एस-सी.	वर्ष: प्रथम वर्ष	सत्र-2021-22

विषय- सूक्ष्मजीवविज्ञान			
1	पाठ्यक्रम का कोड	S1-MBIO1T	
2	पाठ्यक्रम का शीर्षक	सामान्य सूक्ष्मजीवविज्ञान एवं कोशिका संरचना (प्रश्न पत्र 1)	
3	पाठ्यक्रम का प्रकार	कोर कोर्स	
4	पूर्वापेक्षा (यदि कोई हो)	इस पाठ्यक्रम का अध्ययन करने हेतु विद्यार्थी का कक्षा 12 वीं में जीवविज्ञान विषय होना अनिवार्य है।	
5	पाठ्यक्रम अध्ययन की परिलब्धियां (कोर्स लर्निंग आउटकम) (CLO)	इस प्रमाण-पत्र पाठ्यक्रम को पूर्ण करने के पश्चात विद्यार्थी निम्नलिखित ज्ञान प्राप्त कर सकेंगें - • सूक्ष्मजीव विज्ञान का भारतीय पारम्परिक ज्ञान तथा इसकी ऐतिहासिक पृष्ठभूमि की समझ विकसित होगी । • विषाणुओं की संरचना तथा संचरण की समझ विकसित होगी । • जीवाणु कोशिका की संरचना एवं संगठन का ज्ञान प्राप्त होगा।। • विभिन्न प्रकार के एककोशिकीय प्रोकेरिओटिक तथा यूकेरिओटिक सूक्ष्मजीवों को उनके विशिष्ट लक्षणों के आधार पर वर्गीकरण करने की समझ विकसित होगी । • महत्वपूर्ण यूकेरिओटिक सूक्ष्मजीवों के सामान्य लक्षणों का ज्ञानार्जन होगा।	
6	क्रेडिट मान	4	
7	कुल अंक	कुल अंक अधिकतम अंक: 25+75	न्यूनतम उत्तीर्ण अंक: 33

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भाग ब- पाठ्यक्रम की विषयवस्तु		
व्याख्यान की कुल संख्या- 60 व्याख्यान - ट्यूटोरियल- प्रायोगिक (प्रति सप्ताह घंटे में): L-T-P: 4-0-0		
इकाई	विषयवस्तु	व्याख्यान की संख्या
1	**सूक्ष्मजीवों का संसार** 1.1 सूक्ष्मजीव विज्ञान का भारतीय पारम्परिक ज्ञान तथा वैश्विक ऐतिहासिक पृष्ठभूमि। 1.2 बायोजेनेसिस का सिद्धान्त, जर्मथ्योरी आफ डिसीस, किण्वन। 1.3 सूक्ष्मजीव विज्ञान का महत्व- (अ) सूक्ष्मजीव विज्ञान की शाखाऐं। (ब) सूक्ष्मजीव विज्ञान के रुझान वाले क्षैत्र - आनुवंशिक अभियान्त्रिकी तथा जैव तकनीकी। 1.4 सूक्ष्मजीव विज्ञान के क्षैत्र में निम्नलिखित वैज्ञानिकों का योगदान - लुइस पाश्चर, राबर्ट कोच, एडवार्ड जैनर, अलेक्जेंडर फलेमिंग, जोसेफ लिस्टर, सर्ज एन. विनोग्राड्स्की, मार्टिनस विलेम बिजेरिंक, मित्री इवानोव्स्की, वेंडेल एम. स्टेनले तथा हंस क्रिश्चियन ग्राम। **सार बिंदु (की वर्ड)/टैग:** *History of Microbiology, Renowned microbiologists, Genetic Engineering, Biotechnology*	15
2	**अकोशिकीय तथा प्रोकेरिओटिक सूक्ष्मजीव** 2.1विषाणु- निम्नलिखित विषाणुओं के सामान्य लक्षण -बैक्टिरिओफेज (टी 4 फेज तथा λ फेज), पादप विषाणु (टी.एम.वी.), प्रिआन्स तथा वाईराइड्स। 2.2 व्हिट्टेकर का पंचसंघी वर्गीकरण: मोनेरा, प्रोटिस्टा, फन्जाई, प्लान्टा तथा एनिमालिया। 2.3 कार्ल वू का तीन अनुक्षेत्रिय वर्गीकरण: आर्चिआ, बैक्टिरिया तथा यूकेरिया। 2.4जीवाणु-स्पाइरोकीट्स, रिकेट्सिया, क्लेमाइडिया, माइकोप्लाज्मा तथा एक्टिनोमाइसिटीस का अध्ययन। 2.5 सायनोबैक्टिरिआ- एनाबीना तथा स्पाइरुलीना का प्रारुपिक अध्ययन। **सार बिंदु (की वर्ड)/टैग:** *Prokaryotes, Whittaker, Carl Woese, Bacteria, Cyanobacteria*	15

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3	**यूकेरिओटिक सूक्ष्मजीव** 3.1 यूकेरिओटिक सूक्ष्मजीवों का आधारभूत ज्ञान तथा उनका विकासीय प्रतिमान। 3.2 कवक- सैकेरोमाइसिस सेरेविसी, म्यूकर, एस्परजिलस, राइजोपस एवं पेनिसिलियम का अध्ययन। 3.3 प्रोटोजोआ- यूग्लिना, ट्रिपेनोसोमा, लेश्मानिया, अमीबा, एंटामिबा तथा प्लास्मोडियम का अध्ययन। **सार बिंदु (की वर्ड)/टैग:** *Eukaryotes, Fungi, Protozoa*	15
4	**सूक्ष्मजीवों की कोशिका संरचना का परिचय** 4.1 जीवाणु कोशिका का अध्ययन-परिमाण, आकार तथा कोशिका संयोजन के प्रकार। 4.2 कोशिका कला के बाहर की संरचनाए - ग्लाइकोकैलिक्स (संपुट, अवपंक), कशाभिका, रोम, वृन्त, प्रोस्थिका तथा ग्राम धनात्मक एवं ग्राम ऋणात्मक जीवाणुओं की कोशिका भित्ति। 4.3 कोशिका भित्ति के अन्दर की संरचनाए - कोशिका झिल्ली, कोशाद्रव्य, कोशाद्रव्य की अंतर्वस्तुऐं, केंद्रकाभ, सम्पुट एवं पुटी। 4.4 बैक्टिरिया में प्रजनन - द्विभाजन, मुकुलन एवं विखण्डन द्वारा। **सार बिंदु (की वर्ड)/टैग: :** *Bacterial cells, Gram Positive Bacteria, Gram Negative Bacteria, Binary fission*	15

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भाग स- अनुशंसित अध्ययन संसाधन

पाठ्य पुस्तकें, संदर्भ पुस्तकें, अन्य संसाधन

अनुशंसित सहायक पुस्तकें /ग्रन्थ/अन्य पाठ्य संसाधन/पाठ्य सामग्री:

1. Pelczar, M.J., Chan, E.C.S. and Krieg, N.R., "Microbiology". Tata McGraw-Hill, New Delhi. (2001).

2. Tortora G.J., Funke B.R., and Case C.L., "Microbiology: An Introduction." 9th edition Pearson Education. (2008).

3. Willey J.M., Sherwood L.M., and Woolverton C.J., "Prescott's Microbiology". 9th edition. McGraw Hill Higher Education. (2013).

4. Madigan, M.T., Martinko,J.M., Dunlap, P.V. and Clark D.P., "Brock Biology of Microorganisms, 12th Edition. Pearson Benjamin Cummings, San Francisco. (2009).

5. Sumbali, Geeta and Mehrotra, R.S., "Principles of Microbiology". McGraw Hill Edition. (2017).

6. Ananthanarayana, R. and Panicker, C.K.S., "Text Book of Microbiology", 6th Edition. Oriental Longman Publications, USA. (2000).

7. Dubey, R.C. and Maheshwari,D.K., "A Textbook of Microbiology". S. Chand & Company Ltd., New Delhi. (2008).

8. Sharma, P.D.,"Microbiology". Rastogi Publications, Meerut. (2014).

9. Singh, R.P., "Applied Microbiology". Kalyani Publishers, New Delhi. (2007).

10. Shammi, Q.J., "Microbiology-I". Kailash Pustak Sadan, Bhopal. ISBN: 978-81-89900-43-4.

11. Shammi, Q.J. and Uike, J., "Cell Biology and Immunology". Kailash Pustak Sadan, Bhopal. ISBN : 978-81-89900-95-3

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अनुशंसित डिजिटल प्लेटफॉर्म वेब लिंक:

1. https://www.mooc-list.com/course/small-and-mighty-introduction-microbiology-futurelearn
2. https://www.mooc-list.com/course/microbiology-saylororg
3. https://www.mooc-list.com/course/bacteria-and-chronic-infections-coursera
4. https://www.coursera.org/lecture/bacterial-infections/1-1-introduction-to-bacteria-by-bioinformatician-phd-peder-worning-HZ64m
5. https://openstax.org/books/microbiology/pages/1-3-types-of-microorganisms
6. https://openstax.org/books/microbiology/pages/4-1-prokaryote-habitats-relationships-and-microbiomes
7. https://swayam.gov.in/explorer?searchText=microbiology

अनुशंसित समकक्ष ऑनलाइन पाठ्यक्रम:

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Anil Pitale

भाग द - अनुशंसित मूल्यांकन विधियां		
अनुशंसित सतत मूल्यांकन विधियां: अधिकतम अंक: 100 सतत व्यापक मूल्यांकन (CCE) अंक : 25 विश्वविद्यालयीन परीक्षा (UE): 75		
<u>आंतरिक मूल्यांकन:</u> सतत् व्यापक मूल्यांकन (सीसीई): 25	क्लास टेस्ट	15
	असाइनमेंट/ प्रस्तुतीकरण (प्रेजेंटेशन)	10
	कुल अंक	25
<u>बाह्य मूल्यांकन-</u> विश्वविद्यालयीन परीक्षा: 75 समय- 02.00 घंटे	खण्ड (अ) तीन अति लघु उत्तरीय प्रश्न (प्रत्येक 50 शब्दों में)	3×3=9
	खण्ड (ब) चार लघु उत्तरीय प्रश्न (प्रत्येक 200 शब्दों में)	4×9=36
	खण्ड (स) दो दीर्घ उत्तरीय प्रश्न (प्रत्येक 500 शब्दों में)	2×15=30
	कुल अंक	75
कोई टिप्पणी/सुझाव:		

29/8/24

(Anil Borkar)

Part A - Introduction			
Programme: Certificate	**Class: B.Sc.**	**First Year**	**Session: 2021-22**

Subject: Microbiology

1	**Course Code-**	**S1-MBIO1T**	
2	**Course Title**	General Microbiology and Cell Structure (Paper I)	
3	**Course Type**	Core Course	
4	**Pre-requisition**	To study this course a student must have had the subject Biology in class 12^{th}	
5	**Course Learning Outcomes (CLO)**	After completing this course in Microbiology, a student shall have understanding of - • Indian traditional knowledge and historical background of Microbiology. • Structure and transmission of Viruses. • Cell structures and cell organization of bacteria. • Different kinds of unicellular prokaryotic and eukaryotic microorganisms based on specific characteristics. • General characteristics of important Eubacteria..	
6	**Credit Value**	**4**	
7	**Total Marks**	Max. Marks: **25+75**	Min. Passing Marks: **33**

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Part B – Content of the Course		
Total No. of Lectures-**60** Lectures-Tutorials-Practical (in hours per week): **L-T-P: 4-0-0**		
Unit	**Topics**	**No. of Lectures**
1	**The Microbial World** 1.1 Indian traditional knowledge and global historical background of Microbiology. 1.2 Theory of Biogenesis, Germ theory of disease, Fermentation. 1.3 **Significance of microbiology-** (a) Branches of microbiology (b)Thrust area of microbiology- Genetic engineering and Biotechnology. 1.4 **Contribution** of following scientists in the field of microbiology - Louis Pasteur, Robert Koch, Edward Jenner, Alexander Fleming, Joseph Lister, Serge N. Winogradsky, Martinus Willem Beijerink, Dmitrii Ivanowsky, Wendell M. Stanley and Hans Christian Gram. **Key words:** *History of Microbiology, Renowned microbiologists, Genetic Engineering, Biotechnology*	**15**
2	**Acellular and Prokaryotic Microorganisms** 2.1 Virus – General characters of following viruses – Bacteriophage (T4 and λ phage), Plant viruses (TMV), Prions and Viroids. 2.2 **Whittaker's System** of Five Kingdom Classification: Monera, Protista, Fungi, Plantae and Animalia. 2.3 **Carl Woese's** Three Domain System of Classification: Archaea, Eubacteria, and Eukaryotes. 2.4 **Bacteria** -Study of *Spirochete, Rickettsia, Chlamydia, Mycoplasma* and Actinomycetes. 2.5 **Cyanobacteria** –Study of *Anabaena* and *Spirulina.* **Key words**: *Prokaryotes, Whittaker, Carl Woese, Bacteria, Cyanobacteria*	**15**
3	**Eukaryotic Microorganisms** **3.1 Basic knowledge** of Eukaryotic organisms and their evolutionary pattern. **3.2 Fungi** –Study of *Saccharomyces cerevisiae, Mucor, Aspergillus, Rhizopus* and *Penicillium* . **3.3 Protozoa** –Study of *Euglena, Trypanosoma, Leishmania, Amoeba, Entamoeba* and *Plasmodium.* **Key words:** *Eukaryotes, Fungi, Protozoa*	**15**

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4	**Introduction to Microbial Cell Structure** **4.1 Study of Bacteria** - Size, shape and arrangement of bacterial cells. **4.2 Structures External to Plasma Membrane** – Glycocalyx (capsule, slime layer), flagella, fimbrae, stalk, prostheca and cell wall of Gram +ve and Gram –ve bacteria. **4.3Structures Internal to Cell wall** – Cell membrane, cytoplasm, cytoplasmic inclusions, genome, spores and cysts. **4.4 Reproduction in Bacteria**–Binary fission, budding and fragmentation. **Key words:** *Bacterial cells, Gram Positive Bacteria, Gram Negative Bacteria, Binary fission*	**15**

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Part C - Learning Resources
Text Books, Reference Books and Other Resources

Suggested Readings:

1. Pelczar, M.J., Chan, E.C.S. and Krieg, N.R., "Microbiology". Tata McGraw-Hill, New Delhi. (2001).

2. Tortora G.J., Funke B.R., and Case C.L., "Microbiology: An Introduction." 9th edition Pearson Education. (2008).

3. Willey J.M., Sherwood L.M., and Woolverton C.J., "Prescott's Microbiology". 9th edition. McGraw Hill Higher Education. (2013).

4. Madigan, M.T., Martinko,J.M., Dunlap, P.V. and Clark D.P., "Brock Biology of Microorganisms, 12th Edition. Pearson Benjamin Cummings, San Francisco. (2009).

5. Sumbali, Geeta and Mehrotra, R.S., "Principles of Microbiology". McGraw Hill Edition. (2017).

6. Ananthanarayana, R. and Panicker, C.K.S., "Text Book of Microbiology", 6th Edition. Oriental Longman Publications, USA. (2000).

7. Dubey, R.C. and Maheshwari,D.K., "A Textbook of Microbiology". S. Chand & Company Ltd., New Delhi. (2008).

8. Sharma, P.D.,"Microbiology". Rastogi Publications, Meerut. (2014).

9. Singh, R.P., "Applied Microbiology". Kalyani Publishers, New Delhi. (2007).

10. Shammi, Q.J., "Microbiology-I" . Kailash Pustak Sadan, Bhopal. ISBN: 978-81-89900-43-4.

11. Shammi, Q.J. and Uike, J., "Cell Biology and Immunology". Kailash Pustak Sadan, Bhopal. ISBN : 978-81-89900-95-3.

Suggested equivalent online courses:

1. https://www.mooc-list.com/course/small-and-mighty-introduction-microbiology-futurelearn
2. https://www.mooc-list.com/course/microbiology-saylororg
3. https://www.mooc-list.com/course/bacteria-and-chronic-infections-coursera
4. https://www.coursera.org/lecture/bacterial-infections/1-1-introduction-to-bacteria-by-bioinformatician-phd-peder-worning-HZ64m
5. https://openstax.org/books/microbiology/pages/1-3-types-of-microorganisms
6. https://openstax.org/books/microbiology/pages/4-1-prokaryote-habitats-relationships-and-microbiomes
7. https://swayam.gov.in/explorer?searchText=microbiology

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Part D - Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **100** Continuous Comprehensive Evaluation (CCE): **25** University Exam (UE): **75**		
Internal Assessment Continuous Comprehensive Evaluation (CCE): 25	Class Test	15
	Assignment/ Presentation	10
	Total	**25**
External Assessment: University Exam Section:25 Time : 02.00 Hours	Section (A): Three Very Short Questions (50 Words Each)	3×3=9
	Section (B): Four Short Questions (200 Words Each)	4×9=36
	Section (C): Two Long Questions (500 Words Each)	2×15=30
	Total	**75**
Any remarks/ suggestions: Nil		

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भाग अ - परिचय			
कार्यक्रम- प्रमाण पत्र	कक्षा: बी.एस-सी.	वर्ष: प्रथम वर्ष	सत्र: 2021-22

विषय: सूक्ष्मजीवविज्ञान			
1	पाठ्यक्रम का कोड	S1-MBIO1P	
2	पाठ्यक्रम का शीर्षक	सूक्ष्म जीवों का अध्ययन (प्रायोगिक 1)	
3	पाठ्यक्रम का प्रकार	कोर कोर्स	
4	पूर्वापेक्षा (Prerequisite) (यदि कोई हो)	इस कोर्स का अध्ययन करने के लिए, छात्र ने कक्षा 12 वीं में विषय जीवविज्ञान में अध्ययन किया हो।	
5	पाठ्यक्रम अध्धयन की परिलब्धियां (कोर्स लर्निंग आउटकम) (CLO)	बी.एस-सी. प्रथम वर्ष सूक्ष्मजीवविज्ञान प्रमाण-पत्र पाठ्यक्रम पूर्ण करने के पश्चात विद्यार्थी निम्नलिखित ज्ञान प्राप्त कर सकेंगें - • विभिन्न प्रकार के जीवाणुओं एवं यीस्ट का पृथक्करण करना सीख सकेंगे। • कुछ महत्वपूर्ण जीवाणुओं, कवकों तथा प्रोटोजोआ सदस्यों का स्लाइड बनाकर सूक्ष्मदर्शी की सहायता से अध्ययन करना सीख सकेंगे। • इलेक्ट्रन माइक्रोग्राफ की सहायता से महत्वपूर्ण जन्तु, पादप एवं जीवाणु विषाणुओं की संरचना का ज्ञान प्राप्त होगा।	
6	क्रेडिट मान	2	
7	कुल अंक	अधिकतम अंक: 25+75	न्यूनतम उत्तीर्ण अंक: 33

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Anil Prakash

भाग ब- पाठ्यक्रम की विषयवस्तु		
व्याख्यान की कुल संख्या: 30 व्याख्यान -ट्यूटोरियल- प्रायोगिक (प्रति सप्ताह घंटे में): L-T-P: 0-0-2		
सरल क्रमांक	प्रायोगिक कार्य का नाम	प्रायोगिक कार्य में व्यतित घंटे
1	स्वपोषित जीवाणु , सायनोबैक्टिरिआ तथा राइजोबिया (मूल ग्रंथियों से) का पृथक्करण करना ।	9
2	दहीं से लैक्टोबैसिलस का पृथक्करण करना ।	3
3	पके फलों से यीस्ट का पृथक्करण करना ।	3
4	म्यूकर, एस्परजिलस, राइजोपस, पेनिसिलियम की अस्थायी स्लाइड बनाकर सूक्ष्मदर्शी की सहायता से अध्ययन करना ।	4
5	स्टेफिलोकाकस, लैक्टोबैसिलस, इश्चिरिशिया कोलाई, विब्रियो तथा लेप्टोस्पाइरा के स्मियर बनाकर सूक्ष्मदर्शी की सहायता से अध्ययन करना ।	3
6	अमीबा, यूग्लिना, पेरामेशियम तथा क्लेमाइडोमोनास की अस्थायी स्लाइड बनाकर सूक्ष्मदर्शी की सहायता से अध्ययन करना ।	4
7	इलेक्ट्न माइक्रोग्राफ की सहायता से महत्वपूर्ण जन्तु विषाणुओं (रेब्डो, इन्फलुएंजा, पेरामिक्सो, हेपेटाइटिस बी तथा रिट्वाइरस) का अध्ययन करना।	1
8	इलेक्ट्न माइक्रोग्राफ की सहायता से महत्वपूर्ण पादप विषाणुओं (कालिमो, जैमिनी, टाबेको रिंग स्पाट, कुकूम्बर मोजेइक तथा अल्फा-अल्फा मोजेइक) का अध्ययन करना।	1
9	इलेक्ट्न माइक्रोग्राफ की सहायता से महत्वपूर्ण जीवाणु विषाणुओं (ϕX 174,T4 तथा λ फेज) का अध्ययन करना।	1
10	सैद्धांतिक पहलूओं के आधार पर अन्य कोई प्रयोग ।	1

सार बिंदु (की वर्ड)/टैग: *Isolation of bacteria, Bacteria cell structure, Fungi cell structure, Protozoa cell structure, Virus .*

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Anil Bakesh

भाग स- अनुशंसित अध्ययन संसाधन
पाठ्य पुस्तकें, संदर्भ पुस्तकें, अन्य संसाधन
अनुशंसित सहायक पुस्तकें /ग्रन्थ/अन्य पाठ्य संसाधन/पाठ्य सामग्री: 1. Cappuccino, J. and Sherman, N., "Microbiology: A Laboratory Manual", 9th edition. Pearson Education Limited. (2010). 2. Dubey, R.C. and Maheswari, D.K., "Practical Microbiology", S. Chand & Co. Ltd., New Delhi. (2002). 3. M. Gopal Reddy,M., Reddy, M.N., Saigopal, D.V.R. and Mallaiah K.V., "Laboratory Experiments in Microbiology",. Himalaya Publishing House, Mumbai. (2007). 4. Aneja, K.R., "Laboratory Manual of Microbiology and Biotechnology. 2n Edition", Meditech Scientific International. (2018). 5. Patel, Rakesh J. and Patel Kiran, R., "Experimental Microbiology Vol. I and Vol. II", Aditya Prakashan, Ahmadabad. (2009). 6. Varghese, Naveena and Joy, V, "Microbiology Laboratory Manual" Ed.1, Aromatic and Medicinal Plants Research Station, Odakkali, Ernakulam, Kerala. (2014). 7. Shammi, Q.J.,"Microbiology - Tools and Techniques", Kailash Pustak Sadan, Bhopal. ISBN: 978-81-89900-38-0 (In Hindi also). 8. Grainger.John, Hurst. Janet and Burdass. Dariel, "Basic Practical Microbiology: A Manual",. The Society for General Microbiology. (2001). अनुशंसित डिजिटल प्लेटफॉर्म वेब लिंक: 1.https://www.mooc-list.com/course/introduction-practical-microbiology-futurelearn 2.https://study.com/articles/List_of_Free_Online_Microbiology_Courses_and_Training_Options.html

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भाग द - अनुशंसित मूल्यांकन विधियां			
अनुशंसित सतत मूल्यांकन विधियां:			
आतंरिक मूल्यांकन	अंक	बाह्य मूल्यांकन	अंक
कक्षा में संवाद / प्रश्नोत्तरी	10	प्रायोगिक मौखिकी (वायवा)	15
उपस्थिति	5	प्रायोगिक रिकॉर्ड फाइल	10
असाइनमेंट (चार्ट/मॉडल/सेमिनार/ग्रामीणसेवा/प्रौद्योगिकी प्रसार/भ्रमण (एक्सकर्सन) की रिपोर्ट/ सर्वेक्षण/प्रयोगशाला भ्रमण (लैब विजिट)/औद्योगिक यात्रा	10	टेबल वर्क/ प्रयोग	50
कुल अंक	25	कुल अंक	75
कोई टिप्पणी/सुझाव:			

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Part A - Introduction				
Programme : Certificate Course		**Class: B.Sc.**	**Year: First Year**	**Session: 2021-22**
Subject: Microbiolog				
1	**Course Code-**	**S1-MBIO1P**		
2	**Course Title**	Study of Microorganisms (**Paper 1**)		
3	**Course Type**	Core Course		
4	**Pre-requisition**	To study this course a student must have had the subject Biology in class 12^{th}		
5	**Course Learning Outcomes (CLO)**	**On completion of this course, learners will be able to understand:** • Isolation of various types of bacteria and yeasts • Microscopic examination of various types of bacteria, fungi and protozoa. • Structure of important animal, plant and bacterial viruses using electron micrographs.		
6	**Credit Value**	**2**		
7	**Total Marks**	Maximum Marks : **25+75**		Min. Passing Marks: **33**

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Part B - Content of Practical Course		
Total No. of Lectures-30 **Tutorials-Practical (in hours per week): L-T-P: 0-0-2**		
S. No.	**Name of the Exercise**	**No. of Lab Hours**
1	Isolation of autotrophic bacteria and Cyanobacteria, Rhizobia from root nodules	**9**
2	Isolation of lactobacillus from curd.	**3**
3	Isolation of yeast from ripened fruits.	**3**
4	Preparation of temporary wet mount and microscopic examination of *Mucor, Aspergillus, Rhizopus* and *Penicillium.*	**4**
5	Preparation of smear and microscopic examination of *Staphylococcus, Lactobacillus, Escherichia, Vibrio* and *Leptospira.*	**3**
6	Preparation of temporary wet mount and microscopic examination of *Amoeba, Euglena, Paramaecium* and *Chlamydomonas.*	**4**
7	Study of the structure of important animal viruses (rhabdo, influenza, paramyxo , hepatitis B and retroviruses) using electron micrographs .	**1**
8	Study of the structure of important plant viruses (caulimo, Gemini, tobacco ring spot, cucumber mosaic and alpha-alpha mosaic viruses) using electron micrographs .	**1**
9	Study of the structure of important bacterial viruses (ϕX174, T4, λ phage) using electron micrograph.	**1**
10	Any other experiment may be designed on the basis of theoretical aspects.	**1**
Key words: *Isolation of bacteria, Bacteria cell structure, Fungi cell structure, Protozoa cell structure, Virus.*		

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Part C - Learning Resources
Text Books, Reference Books and Other Resources

Suggested Reading:

1. Cappuccino, J. and Sherman, N., "Microbiology: A Laboratory Manual", 9th edition. Pearson Education Limited. (2010).

2. Dubey, R.C. and Maheswari, D.K., "Practical Microbiology", S. Chand & Co. Ltd., New Delhi. (2002).

3. M. Gopal Reddy,M., Reddy, M.N., Saigopal, D.V.R. and Mallaiah K.V., "Laboratory Experiments in Microbiology",. Himalaya Publishing House, Mumbai. (2007).

4. Aneja, K.R., "Laboratory Manual of Microbiology and Biotechnology. 2^{n} Edition", Meditech Scientific International. (2018).

5. Patel, Rakesh J. and Patel Kiran, R.,"Experimental Microbiology Vol. I and Vol. II",. Aditya Prakashan, Ahmedabad. (2009).

6. Varghese, Naveena and Joy, V, "Microbiology Laboratory Manual" Ed.1, Aromatic and Medicinal Plants Research Station, Odakkali, Ernakulam, Kerala. (2014).

7. Shammi, Q.J.,"Microbiology - Tools and Techniques", Kailash Pustak Sadan, Bhopal. ISBN: 978-81-89900-38-0 (In Hindi also).

8. Grainger.John, Hurst. Janet and Burdass. Dariel, "Basic Practical Microbiology: A Manual",. The Society for General Microbiology. (2001).

Suggested Digital Platforms/Web Links:

1. https://www.mooc-list.com/course/introduction-practical-microbiology-futurelearn

2. https://study.com/articles/List_of_Free_Online_Microbiology_Courses_and_Training_Options.html

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Part D - Assessment and Evaluation			
Suggested Continuous Evaluation Methods:			
Internal Assessment	**Marks**	**External Assessment**	**Marks**
Class Interaction/Quiz	10	*Viva voce* on Practical	15
Attendance	5	Practical Record File	10
Assignments (Charts/ Model/ Seminar/ Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey/ Industrial Visit)	10	Table work/ Experiments	50
Total	**25**		**75**
Any remarks/ Suggestions: Nil			

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भाग अ - परिचय			
कार्यक्रम- प्रमाण पत्र	क्षा- बी.एस-सी.	प्रथम वर्ष	सत्र-2021-22

विषय- सूक्ष्मजीवविज्ञान			
1	पाठ्यक्रम का कोड	S1-MBIO2T	
2	पाठ्यक्रम का शीर्षक	सूक्ष्मजैविक तकनीकें (प्रश्न पत्र 2)	
3	पाठ्यक्रम का प्रकार	कोर कोर्स	
4	पूर्वापेक्षा (यदि कोई हो)	इस पाठ्यक्रम का अध्ययन करने हेतु विद्यार्थी का कक्षा 12 वीं में जीवविज्ञान विषय होना अनिवार्य है।	
5	पाठ्यक्रम अध्ययन की परिलब्धियां (कोर्स लर्निंग आउटकम) (CLO)	बी.एस-सी. प्रथम वर्ष सूक्ष्मजीवविज्ञान प्रमाण-पत्र पाठ्यक्रम पूर्ण करने के पश्चात विद्यार्थी निम्नलिखित ज्ञान प्राप्त कर सकेंगें - • प्रयोगशाला में प्रयुक्त होने वाले विभिन्न प्रकार के कांच के उपादानों की समझ विकसित होगी । • निर्जर्मीकरण तथा शुद्ध संवर्धन की विभिन्न विधियों की समझ विकसित होगी । • विभिन्न प्रकार के उपकरणों तथा सूक्ष्मदर्शियों की कार्य प्रणाली की समझ विकसित होगी । • क्रमानुक्रम तनुता तकनीक द्वारा जीवाणुओं का पृथक्करण करने का व्यवहारिक ज्ञान प्राप्त होगा। • जीवाणुओं के संवर्धन की विभिन्न विधियों का अभ्यास कर सकेंगें। ग्राम धनात्मक एवं ग्राम ऋणात्मक जीवाणुओं में विभेदन करने की विधि का ज्ञान प्राप्त होगा।	
6	क्रेडिट मान	4	
7	कुल अंक	कुल अंक अधिकतम अंक: 25+75	न्यूनतम उत्तीर्ण अंक: 33

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भाग ब- पाठ्यक्रम की विषयवस्तु		
व्याख्यान की कुल संख्या- 60 व्याख्यान - ट्यूटोरियल- प्रायोगिक (प्रति सप्ताह घंटे में): L-T-P: 4-0-0		
इकाई	विषयवस्तु	व्याख्यान की संख्या
1	**सूक्ष्मदर्शिकी तथा अभिरंजन** 1.1 सूक्ष्मदर्शिकी: साधारण तथा संयुक्त प्रकाश सूक्ष्मदर्शी, डार्क फील्ड सूक्ष्मदर्शी, फ्लारोसेंस सूक्ष्मदर्शी, फेज कान्ट्स्ट सूक्ष्मदर्शी, ट्रांसमिशन इलेक्ट्न सूक्ष्मदर्शी तथा स्केनिंग इलेक्ट्न सूक्ष्मदर्शी के सिद्धांत एवं अनुप्रयोग। 1.2 साधारण तथा संयुक्त प्रकाश सूक्ष्मदर्शी द्वारा वेट माउन्ट तथा हेंगिंग ड्प का अध्ययन करना। 1.3 स्मियर बनाना तथा स्थिरिकृत करना। 1.4 अभिरंजन के सिद्धांत; ऋणात्मक अभिरंजन, साधारण अभिरंजन, विभेदक अभिरंजन (ग्राम एवं एसीड फास्ट) , कशाभिका का अभिरंजन, सम्पुट तथा एण्डोस्पोर का अभिरंजन। **सार बिंदु (की वर्ड)/टैग:** *Microscopy, Light microscope, Wet mount, Hanging drop method, Bacterial staining.*	15
2	**उपकरण** इलेक्ट्निक तराजु, आटोक्लेव, सेंट्फ्यूज, कालोनी काउन्टर, डीप फ्रीजर, होमोजिनाइजर, हाट एअर ओवन, इंक्यूबेटर, लेमिनर एअर फ्लो, मैग्नेटिक स्टिरर, पी-एच मीटर, स्पेक्ट्फोटोमीटर, वार्टेक्स मिक्सचर, वाटर बाथ, वाटर डिस्टिलर, क्रोमेटोग्राफी चैंबर, एनेराबिक चैंबर तथा इलेक्ट्फोरेसिस चैंबर। **सार बिंदु (की वर्ड)/टैग:** *Instruments in microbiology laboratory.*	15
3	**निर्जर्मीकरण तथा संवर्धन माध्यम** 3.1 निर्जर्मीकरण की भौतिक विधियां - सूखा गर्म करना, आर्द्र वायु में गर्म करना, विकिरण, छानना तथा भस्मीकरण। 3.2 निर्जर्मीकरण की रासायनिक विधियां - फिनाल तथा फिनालिक यौगिक, एल्कोहाल, हेलोजन्स तथा डिटर्जेंट्स। 3.3 संवर्धन माध्यम के प्रकार - प्राकृतिक, संश्लेषित, जटिल, समृद्धित तथा चयनित	15

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	संवर्धन माध्यम। अवायवीय (थायोग्लाइकोलेट ब्राथ, राबर्टसन मीडिया, माइक्रोएरोफिलिक), वायवीय बैक्टिरिया का ब्राथ कल्चर। **सार बिंदु (की वर्ड)/टैग:** *Physical sterilization, Chemical sterilization, Microbial culture media.*	
4	**पृथक्करण, संवर्धन तथा संरक्षण** 4.1 प्राकृतिक सूक्ष्मजीव जनसंख्या - शुद्ध संवर्धन। 4.2 सूक्ष्मजीव जनसंख्या का पृथक्करण - वायु, जल तथा मृदा से पृथक्करण। 4.3 पृथक्करण की विधियां - स्ट्रिक प्लेट, पोर प्लेट एवं स्प्रेड प्लेट, क्रमानुक्रम तनुता विधि तथा माइक्रोमेनिपुलेटर द्वारा। तरल एवं ठोस मीडिया पर संवर्धन। आलू की चिप्स एवं ब्रेड पर पृथक्करण। 4.4 रखरखाव तथा संरक्षण - लंबी अवधि तथा छोटी अवधि के लिये। 4.5 अवायवीय बैक्टिरिया का संवर्धन तथा गैर संवर्धन योग्य सूक्ष्मजीवों की जानकारी प्राप्त करना। **सार बिंदु (की वर्ड)/टैग:** *Pure culture, Isolation of microbes, Preservation of culture.*	15

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भाग स- अनुशंसित अध्ययन संसाधन

पाठ्य पुस्तकें, संदर्भ पुस्तकें, अन्य संसाधन

अनुशंसित सहायक पुस्तकें /ग्रन्थ/अन्य पाठ्य संसाधन/पाठ्य सामग्री:

1. Pelczar, M.J., Chan, E.C.S. and Krieg, N.R., "Microbiology". Tata McGraw-Hill, New Delhi. (2001).

2. Tortora G.J., Funke B.R., and Case C.L., "Microbiology: An Introduction." 9th edition Pearson Education. (2008).

3. Willey J.M., Sherwood L.M., and Woolverton C.J., "Prescott's Microbiology". 9th edition. McGraw Hill Higher Education. (2013).

4. Madigan, M.T., Martinko, J.M., Dunlap, P.V. and Clark D.P., "Brock Biology of Microorganisms, 12th Edition. Pearson Benjamin Cummings, San Francisco. (2009).

5. Sumbali, Geeta and Mehrotra, R.S., "Principles of Microbiology". McGraw Hill Edition. (2017).

6. Ananthanarayana, R. and Panicker, C.K.S., "Text Book of Microbiology", 6th Edition. Oriental Longman Publications, USA. (2000).

7. Dubey, R.C. and Maheshwari,D.K., "A Textbook of Microbiology". S. Chand & Company Ltd., New Delhi. (2008).

8. Sharma, P.D.,"Microbiology". Rastogi Publications, Meerut. (2014).

9. Singh, R.P., "Applied Microbiology". Kalyani Publishers, New Delhi. (2007).

10. Shammi, Q.J., "Microbiology-I" . Kailash Pustak Sadan, Bhopal. ISBN: 978-81-89900-43-4.

11. Shammi, Q.J. and Uike, J., "Cell Biology and Immunology". Kailash Pustak Sadan, Bhopal. ISBN: 978-81-89900-95-3.

अनुशंसित डिजिटल प्लेटफॉर्म वेब लिंक:

1. https://www.mooc-list.com/course/small-and-mighty-introduction-microbiology-future learn

2. https://www.mooc-list.com/course/microbiology-saylororg

3. https://www.mooc-list.com/course/bacteria-and-chronic-infections-coursera

4. https://www.coursera.org/lecture/bacterial-infections/1-1-introduction-to-bacteria-by-bioinformatician-phd-peder-worning-HZ64m

5. https://openstax.org/books/microbiology/pages/1-3-types-of-microorganisms

6. https://openstax.org/books/microbiology/pages/4-1-prokaryote-habitats-relationships-and-microbiomes

7. https://swayam.gov.in/explorer?searchText=microbiology

अनुशंसित समकक्ष ऑनलाइन पाठ्यक्रम:

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भाग द - अनुशंसित मूल्यांकन विधियां		
अनुशंसित सतत मूल्यांकन विधियां: अधिकतम अंक: 100 सतत व्यापक मूल्यांकन (CCE) अंक : 25 विश्वविद्यालयीन परीक्षा (UE): 75		
<u>आंतरिक मूल्यांकन:</u> सतत् व्यापक मूल्यांकन (सीसीई): 25	क्लास टेस्ट	15
	असाइनमेंट/ प्रस्तुतीकरण (प्रेजेंटेशन)	10
	कुल अंक	25
<u>बाह्य मूल्यांकन-</u> विश्वविद्यालयीन परीक्षा: 75 समय- 02.00 घंटे	खण्ड (अ) तीन अति लघु उत्तरीय प्रश्न (प्रत्येक 50 शब्दों में)	3×3=9
	खण्ड (ब) चार लघु उत्तरीय प्रश्न (प्रत्येक 200 शब्दों में)	4×9=36
	खण्ड (स) दो दीर्घ उत्तरीय प्रश्न (प्रत्येक 500 शब्दों में)	2×15=30
	कुल अंक	75
कोई टिप्पणी/सुझाव:		

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Part A - Introduction			
Programme: Certificate Course	**Class: B.Sc.**	**First Year**	**Session: 2021-22**
Subject : Microbiology			

1	**Course Code-**	**S1-MBIO2T**	
2	**Course Title**	Microbial Techniques (**Paper II**)	
3	**Course Type**	Core Course	
4	**Pre-requisition**	To study this course a student must have had the subject Biology in class 12^{th}	
5	**Course Learning Outcomes (CLO)**	After completing this course in Microbiology, a student shall have understanding of – • Recall the basic lab glassware to be used in the laboratory. • Summarize different methods of sterilization and isolation of pure cultures. • Understand the working of different kinds of instruments and microscopes. • Apply serial dilution technique to isolate the bacteria. • Practice different methods to culture bacteria in the laboratory • Illustrate a method to differentiate between Gram positive and Gram negative bacteria.	
6	**Credit Value**	**4**	
7	**Total Marks**	Max. Marks: **25+75**	Min. Passing Marks: **33**

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B – Content of the Course
Total No. of Lectures- **60** Lectures-Tutorials-Practical (in hours per week): **L-T-P: 4-0-0**

Unit	Topics	No. of Lectures
1	**Microscopy and Staining** 1.1 **Microscopy** - Principles and applications of simple and compound Bright-field microscopy, Dark-field microscopy, Fluorescence microscopy, Phase-contrast microscopy, Transmission electron microscopy and Scanning electron microscopy . 1.2 **Preparation for Light Microscope Examination** - Wet-mount and hanging-drop techniques. (iii). Preparation for smear and fixation. 1.3 **Staining** - Principles of staining, negative staining, simple staining, differential staining (Gram and acid fast staining), flagella staining, capsule and endospore staining. **Key words:** *Microscopy, Light microscope, Wet mount, Hanging drop method, Bacterial staining.*	**15**
2	**Instruments** Electronic Balance, Autoclave, Centrifuge, Colony counter, Deep freezer, Homogenizer, Hot air Oven, Incubator, Laminar air flow, Magnetic stirrer, pH Meter, Spectrophotometer, Vortex mixture, Water bath, Water distiller, Chromatography Chambers, Anaerobic chamber and Electrophoresis apparatus . **Key words:** *Instruments in microbiology laboratory.*	**15**
3	**Sterilization and Culture Medium** 3.1 **Physical methods of sterilization -** Dry heat, Moist heat, Radiation, Filtration and Incineration. 3.2 **Chemical methods of sterilization** – Phenol and phenolic compounds, Alcohol, Halogens and Detergents. 3.3 **Types of culture media** –Natural, synthetic, complex, enriched and selective. Anaerobic (Thioglycolate broth, Robertson's media, Microaerophilic), broth culture of aerobic bacteria. **Key words:** *Physical sterilization, Chemical sterilization, Microbial culture media.*	**15**
4	**Isolation, Cultivation and Preservation** 4.1 **Natural microbial population** - Pure culture. 4.2 **Isolation of microbial population** - From air, water and soil.	**15**

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	4.3 **Methods for isolation** - Streak plate, Pour plate and Spread plate. Serial dilution and Micromanipulator methods. Cultivation on liquid and solid media. Isolation of microorganisms on potato slice and bread. 4.4 **Maintenance and preservation** for short term and long term. 4.5 **Cultivation** of anaerobic bacteria and accessing non-cultivable microorganisms. **Key words:** *Pure culture, Isolation of microbes, Preservation of culture.*	

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Part C - Learning Resources

Text Books, Reference Books and Other Resources

1. Pelczar, M.J., Chan, E.C.S. and Krieg, N.R., "Microbiology". Tata McGraw-Hill, New Delhi. (2001).

2. Tortora G.J., Funke B.R., and Case C.L., "Microbiology: An Introduction." 9th edition Pearson Education. (2008).

3. Willey J.M., Sherwood L.M., and Woolverton C.J., "Prescott's Microbiology". 9th edition. McGraw Hill Higher Education. (2013).

4. Madigan, M.T., Martinko, J.M., Dunlap, P.V. and Clark D.P., "Brock Biology of Microorganisms, 12th Edition. Pearson Benjamin Cummings, San Francisco. (2009).

5. Sumbali, Geeta and Mehrotra, R.S., "Principles of Microbiology". McGraw Hill Edition. (2017).

6. Ananthanarayana, R. and Panicker, C.K.S., "Text Book of Microbiology", 6th Edition. Oriental Longman Publications, USA. (2000).

7. Dubey, R.C. and Maheshwari,D.K., "A Textbook of Microbiology". S. Chand & Company Ltd., New Delhi. (2008).

8. Sharma, P.D.,"Microbiology". Rastogi Publications, Meerut. (2014).

9. Singh, R.P., "Applied Microbiology". Kalyani Publishers, New Delhi. (2007).

10. Shammi, Q.J., "Microbiology-I" . Kailash Pustak Sadan, Bhopal. ISBN: 978-81-89900-43-4.

11. Shammi, Q.J. and Uike, J., "Cell Biology and Immunology". Kailash Pustak Sadan, Bhopal. ISBN: 978-81-89900-95-3.

Suggested equivalent online courses:

1. https://www.mooc-list.com/course/small-and-mighty-introduction-microbiology-futurelearn
2. https://www.mooc-list.com/course/microbiology-saylororg
3. https://www.mooc-list.com/course/bacteria-and-chronic-infections-coursera
4. https://www.coursera.org/lecture/bacterial-infections/1-1-introduction-to-bacteria-by-bioinformatician-phd-peder-worning-HZ64m
5. https://openstax.org/books/microbiology/pages/1-3-types-of-microorganisms
6. https://openstax.org/books/microbiology/pages/4-1-prokaryote-habitats-relationships-and-microbiomes
7. https://swayam.gov.in/explorer?searchText=microbiology

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Part D - Assessment and Evaluation		
Suggested Continuous Evaluation Methods: **Maximum Marks:** **100** Continuous Comprehensive Evaluation (CCE): **25** University Exam (UE): **75**		
Internal Assessment Continuous Comprehensive Evaluation (CCE): 25	Class Test	15
	Assignment/ Presentation	10
	Total	**25**
External Assessment: University Exam Section:25 Time : 02.00 Hours	Section (A): Three Very Short Questions (50 Words Each)	3×3=9
	Section (B): Four Short Questions (200 Words Each)	4×9=36
	Section (C): Two Long Questions (500 Words Each)	2×15=30
	Total	**75**
Any remarks/ suggestions: Nil		

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भाग अ - परिचय			
कार्यक्रम- प्रमाण पत्र	क्षा- बी.एस-सी.	वर्ष: प्रथम वर्ष	सत्र-2021-22

विषय- सूक्ष्मजीवविज्ञान			
1	पाठ्यक्रम कोड	S1-MBIO2P	
2	पाठ्यक्रम का शीर्षक	सूक्ष्मजैविक उपकरण एवं तकनीक (प्रायोगिक 2)	
3	पाठ्यक्रम का प्रकार	कोर कोर्स	
4	पूर्वापेक्षा (Prerequisite) (यदि कोई हो)	इस कोर्स का अध्ययन करने के लिए, छात्र ने कक्षा 12 वीं में विषय जीवविज्ञान में अध्ययन किया हो।	
5	पाठ्यक्रम के पश्चात उपलब्धियां	बी.एस-सी. प्रथम वर्ष सूक्ष्मजीवविज्ञान प्रमाण-पत्र पाठ्यक्रम पूर्ण करने के पश्चात विद्यार्थी निम्नलिखित ज्ञान प्राप्त कर सकेंगें - • प्रयोगशाला में प्रयुक्त होने वाले विभिन्न प्रकार के कांच के उपादानों की समझ विकसित होगी। • निर्जर्मीकरण तथा शुद्ध संवर्धन की विभिन्न विधियों की समझ विकसित होगी। • विभिन्न प्रकार के उपकरणों तथा सूक्ष्मदर्शियों की कार्य प्रणाली की समझ विकसित होगी। • क्रमानुक्रम तनुता तकनीक द्वारा जीवाणुओं का पृथक्करण करने का व्यवहारिक ज्ञान प्राप्त होगा। • जीवाणुओं के संवर्धन की विभिन्न विधियों का अभ्यास कर सकेंगें। ग्राम धनात्मक एवं ग्राम ऋणात्मक जीवाणुओं में विभेदन करने की विधि का ज्ञान प्राप्त होगा।	
6	क्रेडिट मान	2	
7	कुल अंक	अधिकतम अंक: 25+75	न्यूनतम उत्तीर्ण अंक: 33

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भाग ब- पाठ्यक्रम की विषयवस्तु		
व्याख्यान की कुल संख्या: 30 व्याख्यान -ट्यूटोरियल- प्रायोगिक (प्रति सप्ताह घंटे में): L-T-P: 0-0-2		
सरल क्रमांक	प्रायोगिक कार्य का नाम	प्रायोगिक कार्य में व्यतित घंटे
1	प्रयोगशाला में उपलब्ध विभिन्न प्रकार के उपकरणों के सिद्धांत एवं कार्य प्रणाली को समझना।	4
2	संवर्धन माध्यम तैयार करने की आधारभूत तकनीक, आटोक्लेविंग, क्लिनिंग एवं कांच के उपादानों का निर्जर्मीकरण।	6
3	तरल संवर्धन माध्यम - पेप्टोन वाटर, न्यूट्एिन्ट ब्रोथ तैयार करना।	2
4	ठोस संवर्धन माध्यम - न्यूट्एिन्ट अगार (अगार स्लांट/अगार प्लेट)तैयार करना।	2
5	क्रमानुक्रम तनुता अगार प्लेटिंग विधि द्वारा जल, मृदा एवं वायु में उपस्थित सूक्ष्मजीवों का पृथक्करण करना।	3
6	क्रमानुक्रम तनुता अगार प्लेटिंग विधि द्वारा जल, मृदा एवं वायु में उपस्थित कवकों का पृथक्करण करना।	3
7	पोर प्लेट विधि द्वारा सूक्ष्मजीवों का पृथक्करण करना।	3
8	स्ट्रिक प्लेट विधि द्वारा सूक्ष्मजीवों का पृथक्करण करना।	3
9	स्प्रेड प्लेट विधि द्वारा सूक्ष्मजीवों का पृथक्करण करना।	3
10	सैद्धांतिक पहलूओं के आधार पर अन्य कोई प्रयोग ।	1

सार बिंदु (की वर्ड)/टैग: : *Basic instruments, Culture media ,Pour plate, Streak plate, Spread plate.*

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भाग स- अनुशंसित अध्ययन संसाधन
पाठ्य पुस्तकें, संदर्भ पुस्तकें, अन्य संसाधन

अनुशंसित सहायक पुस्तकें /ग्रन्थ/अन्य पाठ्य संसाधन/पाठ्य सामग्री:

1. Cappuccino, J. and Sherman, N., "Microbiology: A Laboratory Manual", , 9th edition. Pearson Education Limited. (2010).

2. Dubey, R.C. and Maheswari, D.K. , "Practical Microbiology",. S. Chand & Co. Ltd., New Delhi. (2002).

3. M. Gopal Reddy, M., Reddy, M.N., Saigopal, D.V.R. and Mallaiah K.V., "Laboratory Experiments in Microbiology",. Himalaya Publishing House, Mumbai. (2007).

4. Aneja, K.R., "Laboratory Manual of Microbiology and Biotechnology. 2^{n} Edition", Meditech Scientific International. (2018).

5. Patel, Rakesh J. and Patel Kiran, R.,"Experimental Microbiology Vol. I and Vol. II",. Aditya Prakashan, Ahmadabad. (2009).

6. Varghese, Naveena and Joy, V, "Microbiology Laboratory Manual" Ed.1, Aromatic and Medicinal Plants Research Station, Odakkali, Ernakulam, Kerala. (2014).

7. Shammi, Q.J.,"Microbiology - Tools and Techniques", Kailash Pustak Sadan, Bhopal. ISBN: 978-81-89900-38-0 (In Hindi also).

8. Grainger.John, Hurst. Janet and Burdass. Dariel, "Basic Practical Microbiology: A Manual", The Society for General Microbiology. (2001).

अनुशंसित डिजिटल प्लेटफॉर्म वेब लिंक:

1. https://www.mooc-list.com/course/introduction-practical-microbiology-futurelearn

2.https://study.com/articles/List_of_Free_Online_Microbiology_Courses_and_Training_Options.html

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भाग द - अनुशंसित मूल्यांकन विधियां			
अनुशंसित सतत मूल्यांकन विधियां:			
आतंरिक मूल्यांकन	अंक	बाह्य मूल्यांकन	अंक
कक्षा में संवाद / प्रश्नोत्तरी	10	प्रायोगिक मौखिकी (वायवा)	15
उपस्थिति	5	प्रायोगिक रिकॉर्ड फाइल	10
असाइनमेंट (चार्ट/मॉडल/सेमिनार/ग्रामीणसेवा/प्रौद्योगिकी प्रसार/भ्रमण (एक्सकर्सन) की रिपोर्ट/ सर्वेक्षण/प्रयोगशाला भ्रमण (लैब विजिट)/औद्योगिक यात्रा	10	टेबल वर्क/ प्रयोग	50
कुल अंक	25	कुल अंक	75
कोई टिप्पणी/सुझाव:			

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Part A - Introduction				
Programme : Certificate Course		**Class: B.Sc.**	**Year: First Year**	**Session: 2021-22**
Subject: Microbiology				
1	**Course Code-**	**S1-MBIO2P**		
2	**Course Title**	Microbial Tools and Techniques (Paper 2)		
3	**Course Type**	Core Course		
4	**Pre-requisite (if any)**	To study this course a student must have had the subject Biology in class 12th		
5	**Course Learning Outcomes (CLO)**	**On completion of this course, learners will be able to understand:** • Basic knowledge of glassware, microscopes and different kinds of instruments used in the microbiology laboratory. • Basic media preparation technique, autoclaving, cleaning and sterilization of glassware. • Preparation of liquid and solid culture media. • Isolation of microorganisms by different plating methods.		
6	**Credit Value**	**2**		
7	**Total Marks**	Maximum Marks : **25+75**		Min. Passing Marks: **33**

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Part B - Content of the Course		
Total No. of Lectures- **30** Lectures-Tutorials-Practical (in hours per week): **L-T-P: 0-0-2**		
S. No.	**Name of the Exercise**	**No. of Lab Hours**
1	Demonstration and briefing about principles and working of basic instruments.	**4**
2	Basic media preparation technique, autoclaving, cleaning and sterilization of glassware.	**6**
3	Preparation of liquid culture media - Peptone water, nutrient broth	**2**
4	Preparation of solid culture media - Nutrient agar (agar slant/ agar plate)	**2**
5	Isolation of microbes from water, soil and air by serial dilution agar plating method.	**3**
6	Isolation of fungi from water, soil and air by serial dilution agar plating method.	**3**
7	Isolation of microorganisms by pour plate method.	**3**
8	Isolation of microorganisms by streak plate method.	**3**
9	Isolation of microorganisms by spread plate method.	**3**
10	Any other experiment may be designed on the basis of theoretical aspects.	**1**
Key words: *Basic instruments, Culture media , Pour plate, Streak plate, Spread plate.*		

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Part C - Learning Resources
Text Books, Reference Books and Other Resources

Suggested Reading:

1. Cappuccino, J. and Sherman, N., "Microbiology: A Laboratory Manual", , 9th edition. Pearson Education Limited. (2010).

2. Dubey, R.C. and Maheswari, D.K. , "Practical Microbiology",. S. Chand & Co. Ltd., New Delhi. (2002).

3. M. Gopal Reddy,M., Reddy, M.N., Saigopal, D.V.R. and Mallaiah K.V., "Laboratory Experiments in Microbiology",. Himalaya Publishing House, Mumbai. (2007).

4. Aneja, K.R., "Laboratory Manual of Microbiology and Biotechnology. 2^{n} Edition", Meditech Scientific International. (2018).

5. Patel, Rakesh J. and Patel Kiran, R., "Experimental Microbiology Vol. I and Vol. II",. Aditya Prakashan, Ahmadabad. (2009).

6. Varghese, Naveena and Joy, V, "Microbiology Laboratory Manual" Ed.1, Aromatic and Medicinal Plants Research Station, Odakkali, Ernakulam, Kerala. (2014).

7. Shammi, Q.J. "Microbiology - Tools and Techniques", Kailash Pustak Sadan, Bhopal. ISBN: 978-81-89900-38-0 (In Hindi also).

8. Grainger.John, Hurst. Janet and Burdass. Dariel, "Basic Practical Microbiology: A Manual",. The Society for General Microbiology. (2001).

Suggested Digital Platforms/Web Links:

1. https://www.mooc-list.com/course/introduction-practical-microbiology-futurelearn

2. https://study.com/articles/List_of_Free_Online_Microbiology_Courses_and_Training_Options.html

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Part D - Assessment and Evaluation			
Suggested Continuous Evaluation Methods:			
Internal Assessment	**Marks**	**External Assessment**	**Marks**
Class Interaction/Quiz	10	*Viva voce* on Practical	15
Attendance	5	Practical Record File	10
Assignments (Charts/ Model/ Seminar/ Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey/ Industrial Visit)	10	Table work/ Experiments	50
Total	**25**		**75**
Any remarks/ Suggestions: Nil			

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Department of Higher Education, Madhya Pradesh Bhopal
Syllabus approved by Central Board of Studies in Microbiology
SYLLABUS FOR THE DEGREE OF THE BACHELOR OF SCIENCE
(From 2021-22 onwards)
B.Sc. SECOND YEAR - MICROBIOLOGY
Paper-I Biochemistry and Microbial Physiology

MM - 42.5

Unit I

General properties, classification and function of carbohydrates, lipids, proteins and amino acids. General properties, classification and nomenclature of enzymes. Factors affecting enzyme activity, mechanism of enzyme action, regulations of enzyme activity, applications of enzymes.

Unit II

Growth and measurement of growth, mathematical expression of growth, growth curve, growth yield, factors affecting growth effect of nutrients, temperature, oxygen, pH, osmotic pressure. Cell count, direct and indirect method, dry weight and wet weight method, synchronous cultures, continuous culture, and batch cultures.

Unit III

Energy production in anaerobic and aerobic process, glycolysis, Pentose phosphate pathway, Entner Duodoroff pathway, fermentation, glucose fermentation by *E. coli*, TCA cycle, heterotrophic carbon dioxide fixation, Glyoxylate cycle, catabolism of lipids, α and β-oxidation, catabolism of proteins, aerobic respiration. Principles of Bioenergetics, oxidation-reduction reaction, Redox-potential, oxidative phosphorylation hypothesis.

Unit IV

Utilization of Energy, Methods of studying Microbial biosynthesis, assimilation of Ammonia, Nitrogen and Sulphate Utilization of energy in non-biosynthetic and biosynthetic process, Diffusion, gaseous exchange, osmosis, plasmolysis, transport of nutrients in bacteria- active transport, passive diffusion, facilitated diffusion, group translocation.

Unit V

Energy production by photosynthesis, photochemical reaction, cyclic and non cyclic photophosphorylation, role of ATP in metabolism, role of reducing power in metabolism, role of precursors of metabolism, component of electron transport chain and arrangement of ETC in cell membrane.

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Department of Higher Education, Madhya Pradesh Bhopal
Syllabus approved by Central Board of Studies in Microbiology
SYLLABUS FOR THE DEGREE OF THE BACHELOR OF SCIENCE
(From **2021-22** onwards)
B.Sc. SECOND YEAR - MICROBIOLOGY
Paper-II Microbial Genetics and Molecular Biology

MM - 42.5

UNIT I

Structure and genetic material of microbes, Nucleic acid as genetic material, Physical and chemical structure and different forms of DNA. Melting curve of DNA and Tm value determination, Buoyant density of DNA and its relationship with mole (G+C) content in DNA, Types of RNA, mRNA, rRNA, tRNA. Gene structure and functions.

UNIT II

Types of DNA replication, Replication of DNA in prokaryotes and eukaryotes, Conservative, Semi-conservative and Dispersive mode of replication, mechanism of replication, Messelson and Stahl experiment, DNA topology, Supercoiling of DNA and linking number, Enzymes involved in replication of DNA.

Molecular Mechanism of chromosomal replication, Models of chromosomal replication, Cairns model, Rolling Circle model. Translation and transcription in prokaryotes and eukaryotes.

UNIT III

Basic features of genetic code, Biological significance of degeneracy, Wobble hypothesis, Poly cistronic RNA, Overlapping genes, deciphering of genetic code, gene translocation, Ribosomes, and role in protein synthesis, tRNAs, initiation, elongation and termination of protein synthesis in prokaryotes, post translational modification of polypeptides, regulation of protein synthesis, Lac operon, Repressible operon.

UNIT IV

Genetic recombination in bacteria, transformation, conjugation, F factor, Hfr strains, transduction in microbes, plasmids and binary vectors, transposons, transformation techniques, use of bacteria and viruses in genetic engineering.

UNIT V

DNA mutation and repair, types of mutation, evidence of spontaneous nature of mutation, fluctuation test, new comb's experiment and replica testing, mode of action of physical, chemical and biological mutagens-UV rays, nitrous acid, 5-bromouracil, 2-aminopurin, EMS, Reversion in mutation, true reversion, suppression and types of suppressor mutation, DNA repair mechanism, Photo reactivation, excision, mismatch, SOS repair and dealkylation repair.

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List of recommended books:

- Microbiology-Pelczar MJ, Chan ECS & Kreig NR, 5th edition (Tata McGraw-Hill, New Delhi).
- Fundamentals of Microbiology-Frobisher M, Hinsdill RD, Crabtree KT & Goodheart CR, 9th edition (W.B. Saunders Co.).
- Fundamental Principles of Bacteriology -Salle AJ, 7th edition (Tata McGraw-Hill, New Delhi).
- Microbiology- Prescott LM, Harley JP &Klein DA, 7th edition (Wm. C. Brown Publishers, USA).
- Elementary Microbiology-Modi, HA (Vol.I), 1st edition (Ekta Pakashan, Nadiad).
- A Handbook of Elementary Microbiology-Modi, HA, 1st edition (Shanti Pakashan, Rohtak).
- A Textbook of Microbiology- Dubey RC & Maheshwari DK, 2nd edition (S Chand & Co. N. Delhi.
- General Microbiology (Vol I, II, III)- Powar CB& Daginawala HF, 2nd edition (Himalaya Publication, Bombay) Lehniger-Principles of Biochemistry- Nelson DL & Cox MM, 4th edition (CBS Publishers, New Delhi).
- Microbial Physiology- Moat AG, Foster JW &Spector MP, 4th edition (John Wiley & Sons).
- Fundamentals of Biochemistry-Jain JL, Jain S & Jain N, 8th edition (SChand & Co. New Delhi).
- Biochemistry- Satyanarayana U, 4th edition (Elsevier, India).
- Genetics- Russel JP, 2nd edition (Scott, Foresman & Company, USA).
- Principles of Genetics- Gardner JE, Simmons JM & Snustad PD, 8th edition (John Wiley & Sons, Canada)..
- Concepts of Genetics- Klug WS&Cummings MR, 10th edition (Bejamin Cummings, USA).
- Microbial Genetics- Freifelder D, 2nd edition (Jones & Bartlett, Boston).
- Molecular Biology & Genetic Engineering- Singh BD, 1st edition (Kalyani Publishers).
- Essentials of Practical Microbiology- Patel B &Phanse N, 1st edition (Print Care, Indore).
- Experiments in Biotechnology- Nighojkar S& Nighojkar A, 1st edition (Satprachar Press, Indore).
- Recombinant DNA Technology- Sardul Singh Sandhu (2008). IK International publisher, New Delhi.

List of Practicals based on paper I and II for B.Sc. II Year (MM, 50)

1. To determine the pH of a given solution.
2. To prepare a buffer solution.
3. Identification of biological compound, Carbohydrates – Molisch's test, Protein - Biuret test, Lipid - Saponification test
4. Qualitative analysis for amino acid- Color reaction for amino acid, Biuret test, Ninhydrine test.
5. Quantitative analysis of fat- Test for oil, Solubility test, Emulsion test, Absorption test.
6. Estimation of glucose by Cole's method

7. Estimation of protein by Folin Lowry method.
8. Estimation of total lipid by dichromate method.
9. Study of enzyme activity and effect of different factors on enzyme activity.
10. Demonstration on isolation of DNA.
11. Quantitative estimation of DNA by DPA method.
12. Quantitative estimation of RNA by Orcinol method.
13. To study conjugation in bacteria.
14. To transfer bacterial colonies by replica plating method.
15. Effect of UV light on growth of bacteria.
16. Effect of mutagen on the growth of bacteria.
17. To study antibiotic resistance in bacteria.
18. Primary screening of amylase/ protease producers.
19. Designing of at least two innovative experiments based on the available facility in the college/ University related to subject

Department of Higher Education, Madhya Pradesh Bhopal

Syllabus approved by Central Board of Studies in Microbiology
SYLLABUS FOR THE DEGREE OF THE BACHELOR OF SCIENCE
(From 2021-22 onwards)
B.SC THIRD YEAR - MICROBIOLOGY
Paper-I Applied and Environmental Microbiology

(MM Theory 42.5)

UNIT I

Design and types of Fermentor, factors affecting fermentation process, Industrial production of alcohol, organic acid economically important enzymes, amino acids, antibiotics, vitamins. Method of immobilization and applications. Strategy for improvement of industrially important microbial strain.

UNIT II

Physical and microbial spoilage of food and food products, spoilage of stored products, fruits and vegetables, spoilage of milk, milk products and meat. Food born diseases. Food preservation methods, asepsis, pasteurization, canning, desiccation, low temperature, anaerobiosis, filtration, chemical preservation of food- salt and sugar, organic acids, use of sulphur dioxide, ethylene and propylene oxides, wood smoke. Applications and production of SCP.

UNIT III

Physical and chemical characteristics of soil, soil microflora, soil fertility and management of agricultural soil, rhizosphere and phyllosphere. Microbial diseases of crop plants with special reference to wheat, rice. VAM and its importance. Nitrogen fixation by symbiotic and non- symbiotic microbes. Use of microbes as biofertilizers, mass cultivation of Rhizobium and Azotobacter, use of blue green algae as biofertilizer.

UNIT IV

Concept of environment in relation to microbes, physiological adaptation in microbes, nature of microbial population in soil, water and air. Microbial interactions - neutralism, commensalism, synergism.

UNIT V

Bioremediation, biomagnification, bioleaching, biopesticides, Microbial H_2 production. Impact of genetically modified organisms. Biodegradation of plastics. Liquid waste disposal, characteristics of solid and liquid waste, sewage treatment - primary, secondary and tertiary treatment.

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SYLLABUS FOR THE DEGREE OF THE BACHELOR OF SCIENCE
(From 2021-22 onwards)
B.SC THIRD YEAR - MICROBIOLOGY
Paper-II Immunology and Medical Microbiology

(MM Theory 42.5)

Unit I

Structure, composition and types of cells and organs involved in immune system. Innate and acquired immunity. Types, structure and functions of MHC molecules, antigen processing and presentation. Humoral and cell mediated immune responses.

UNIT-II

Antigens – structure, properties and types. Haptens and adjuvants. Immunoglobulins- structure, heterogeneity, types and subtypes, physico-chemical and biological properties. Theories of antibody production. generation of antibody diversity. Antigen-Antibody interactions - agglutination, precipitation, immunofluorescence, ELISA, Radioimmunoassays. Hybridoma technology - Production and applications of monoclonal antibodies.

UNIT-III

Tumor immunology –Cancer, origin, oncogenes, tumor antigens, immune response to tumors, tumor evasion of the immune system, immune diagnosis of tumors.

UNIT-IV

Immunization – Modern methods of vaccine production, autoimmunity, hypersesitivity. Immunohematology, antigens of ABO and Rh blood group systems. Medical importance of blood groups- ABO and Rh incompatibility.

UNIT-V

Host microbe interaction, mechanism of pathogenecity. Laboratory strategies in diagnosis of infective syndrome. Bacterial and viral diseases of human - Syphilis, pox, Hepatitis. Fungal diseases of human- Cryptococcus, Candidiasis, Dermatomycosis, sexually transmitted diseases (STDs).

List of recommended books:

- Introduction to soil microbiology-Alexander M, 2nd edition (John Wiley and Sons NewYork).
- Soil Microbiology- Subba Rao NS, 4th edition (Oxford and IBH, Publishing Co. New Delhi).
- Fundamental Principles of Bacteriology -Salle AJ, 7th edition (Tata McGrawhill,NewDelhi).
- Microbiology-Pelczar MJ, Chan ECS & Kreig NR, 5th edition (Tata McGraw-Hill, New Delhi).
- A Textbook of Microbiology- Dubey RC & Maheshwari DK, 2nd edition (S Chand & Co. NewDelhi.
- Food Microbiology- Frazier CW and Westhoff CD, 4th edition (Tata McGrawhill,NewDelhi).
- Food Microbiology- Adams RM and Moss OM, 3rd edition (RSC publisher).
- Introductory Food Microbiology-Modi HA, 1st edition, (Aavishkar Publishers, Jaipur).
- Modern Food Microbiology- Jay JM, 5th edition (Aspen Publishers, Maryland).
- Introduction to Environmental Microbiology-Michael R, 1st edition (Prentice Hall).
- Bioremediation-Baker KH and Herson DS (Mc Graw Hill, New York).
- Textbook of Industrial Microbiology -Patel AH, 1st edition (Macmillan India Ltd, Madras).
- Industrial Microbiology-Cassida LE, 4th edition (Wiley Eastern Ltd, New Delhi).
- Principles of Fermentation Technology-Stanbary FP, Whitaker A and Hall JS, 2nd edition,
- (Elsevier, Delhi).
- Fermentation Technology- Modi HA, 1st edition (Pointer Publisher, Jaipur).
- Biotechnology -Industrial Microbiology- Crueger W & Crueger A, 2nd edition (Panima Publisher, Delhi).
- Industrial Microbiology- Prescott SC & Dunn CG, 4th edition (Agrobios India, Jodhpur).
- Industrial Microbiology: Fundamentals and Applications- Agarwal AK & Parihar P, 1st edition (Agrobios India, Jodhpur).
- Kuby Immunology- Kindt TJ, Goldsby RA, Osborne BA, 6thedition (WH Freeman & Co. NewYork).
- Text book of Microbiology -Ananthnarayan R and Panikar CKJ, 8th edition, (Univ Press Pvt Ltd, Hyderabad).
- Text book of Microbiology-Chakraborty P, 1st edition (New Central book agency Pvt Ltd).
- Fundamental Immunology- Paul WE, 7th edition (Lippincott Williams & Wilkins, USA).
- Fundamentals of Immunology-Coleman RM, Lombord MF and Sicard RE, 2nd edition (WMC Brown, USA).
- Immunology-Weir DM and Steward J, 8th edition (Topley & Wilson, UK).
- Immunology-Rao CV, 2nd edition (Narosa Publishing House, New Delhi).
- Essentials of Immunology- Roitt IM, 11th edition, (Blackwell Pub, USA).
- Immunology- Elgert KD, 2nd edition (Wiley Blackwell).

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List of Practicals based on paper I and II for B.Sc. III Year (MM, 50)

1. Isolation and enumeration of microorganisms from air.
2. Isolation and enumeration of microorganisms from water.
3. Isolation and enumeration of microorganisms from soil.
4. Total count of bacteria from water.
5. Measurement and confirmation of *E.coli* in water sample.
6. Isolation and identification of bacteria from spoiled food.
7. Heavy metal sensitivity in microbes.
8. Study of *Rhizobium* bacteria from root nodules.
9. Study of symbiotic and non-symbiotic blue green algae.
10. Determination of milk quality by resazurin test through MBRT.
11. Determination of Blood Groups.
12. Estimation of hemoglobin by Sahli's method.
13. Estimation of hemoglobin by Cynamethaemoglobin mehod.
14. Total count of W.B.C.
15. Total count of R.B.C.
16. Differential W.B.C. count.
17. Flocculation reaction- VDRL.
18. Agglutination reaction- Widal test.
19. Examination of urine- chemical, physical, microscopic and bacteriological.
20. Demonstration of ELISA test.
21. Designing of at least two innovative experiments based on the available facility in the college/ University related to subject.

Important Note:

(Visit to any industry / Research industry/ Research laboratory related to Microbial product during III year)

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