Shiv Chhatrapati Shikshan Sanstha's

Rajarshi Shahu Mahavidyalaya, Latur (Autonomous)

Department of Microbiology

SYLLABUS

(2023-2024)

Under CBCS

B. Sc. SECOND YEAR

Semester III and IV

CORE COURSE: MICROBIOLOGY

UNDER ACADEMIC AUTONOMOUS STATUS 2013-2024

With effect progressively from June 2023

RAJARSHI SHAHU MAHAVIDYALAYA (AUTONOMOUS), LATUR

PROGRAMME: B. Sc. GENERAL

CORE COURSE: MICROBIOLOGY

INTRODUCTION

Microbiology is study of microorganisms and is one of the significant branches of sciences to understand the principles of life which has roots in the study of various microbial systems. Microbiology has been at the forefront of research in industry, environment, agriculture, food, dairy, medicine and biology. It is one of the rapidly growing and applied areas of the science. Many job opportunities available for student in this stream. Trained manpower is required in industrial production of microbial products. Considering rural and agro based life background and awareness about the general health and hygiene, our curriculum is designed to educate our pupil in various important microbiological domains, as well as to promote and develop skills and competencies that have great value .

Microbiology is one of the optional subjects for B.Sc. degree course of three years . Students passed 10+2 with biology as one of the subject are eligible for admission

The pattern of question paper, standard of passing is as per norms given by BOE of Rajarshi Shahu Mahavidhyalaya, Latur (Autonomous) .The admission procedure for course is as per college norms. Teacher's qualifications are as per UGC norms.

PROGRAMME SPECIFIC OUTCOMES/ PROGRAMME OUTCOMES:

- . Students of microbiology promoted for self employment such as industrial production of biofertilizers, biopesticides, single cell protein bio fuel etc. Knowledge gained through the program is useful for making carrier in related fields.

LEARNING OBJECTIVES OF THE COURSE

- The syllabus of course is designed to provide knowledge which is useful for making carrier in related fields.
- To promote students for self employment.
- To provide basic knowledge and skills to promote students in research and social scientific awareness.

MICROBIOLOGY COURSE OUTCOMES:

Becoming a graduate, The Microbiology students acquire a meticulous knowledge and understanding of the basic concepts of different Microbiology disciplines and will develop an ability to:

i. Understand and use methods of visualizing microorganisms, controlling growth of microorganisms, isolation of microorganisms from different sources and their maintenance.
ii. Describe the importance of existence, beneficial and harmful role of microorganisms in air, water, food and waste.

iii. Understand, describe and apply various methods of microbiological analysis and controlling microbial growth and activities for making these life governing factors safe.

iv. Describe the immunological concepts with reference to infection, immunity, immunological reactions ,diagnostic methods.

Demonstrate that microorganisms have an indispensable role in the environment, including elemental cycles, environmental cleanup, etc. and the role of microorganisms in plant growth promotion and disease management.

v. Describe the basic concepts of bacterial mutations, damage of DNA and its repair mechanisms, the recombination, transposition and genetic exchange processes.

vi. Describe the gene and its expression, exploit the highly advanced molecular and gene cloning techniques

vii. Cite examples of the crucial role of microorganisms in agriculture, biotechnology, fermentation, medicine, and other industries important to human well being.

2. **Laboratory-Skills**

   A student successfully completing practical's in B. Sc. microbiology will exhibit ability to: Appropriately prepare slides for microbiological analysis; Use a light microscope to observe and interpret smears; Appropriately use aseptic techniques for the transfer and handling of microorganisms and instruments; Prepare and use appropriate microbiological culture media and test systems; Estimate the number of microbes in a sample using serial dilution and other related techniques; Use standard microbiology laboratory equipments properly

3. **Laboratory Safety Skills:**

   A student successfully completing basic microbiology will exhibit ability to demonstrate and follow the standard and safe laboratory practices with respect to Microbiological procedures.

Rajarshi ShahuMahavidyalaya (Autonomous),Latur
Department of Microbiology
B. Sc. Second year
Syllabus (C.B.C.S.)

Semester	**Paper No. & Title, Course code**	**Lectures** **Practicals**	**Marks**		
			In Sem. Evaluation	End Sem. Evaluation	Total
Semester III	**Theory Paper-V:** Applied Microbiology (U-MIB-359)	45	20	30	50
	Theory Paper-VI: Fundamentals of immunology (U-MIB 360)	45	20	30	50
	Skill Enhancement Course MB-I Microbiology Laboratory Techniques and Biosafety SEC.U-MIB I		20	30	50
	Lab Course-MB-III: Practical's based on theory papers-V	12	----	---	50
	Lab Course-MB-IV: Practical'sbased on theory papers-VI	12	----	---	50
Semester IV	**Theory Paper-VII:** Environmental Microbiology (U-MIB-459)	45	20	30	50
	Theory Paper-VIII: Medical microbiology(U-MIB-460)	45	20	30	50
	Skill Enhancement Course MB-II Production of Bio fertilizers SEC.U-MIB II		20	30	50
	Lab Course-MB-V: Practical's based on theory papers –VII	12	----	---	50
	Lab Course-MB-VI: Practical'sbased on theory papers –VIII	12	----	---	50

Note: B.Sc. I, II, III year practical's includes Studies of growth and life activities of microorganisms.

These Studies needs two consecutive days for completion of practical

Workload:

1. Theory: Per paper per week three periods

2. Practical: Per batch per week one practical (Four periods) for two consecutive days (04+04= 08 periods)

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B. Sc. Second year (Semester -III)
MICROBIOLOGY
Course Code: U-MIB-359

Maximum Marks: 50 Lectures: 45

PAPER V – Applied microbiology

Learning Objectives:

1 To study presence of microorganisms in air and Microbiological Analysis of Air.
2 To learn the subject in perspective of public health and hygiene.
3 To know techniques to control microbial contamination in air, water and food.
4 To study Bacteriological evidence of pollution and water borne diseases.

Course Outcomes:

Students will be able to:

1 Describe the importance of existence of microorganisms.
2 Know beneficial and harmful role of microorganisms.
3 Understand and describe various methods of microbiological analysis and microbial control.
4 Apply sewage treatment in domestic, municipal and industrial sectors.

UNIT I: Air Microbiology 10L

1.1 Definition, composition and quality of air.

1.2 Sources of microorganisms in air: Indoor and outdoor microflora.

1.3 Importance of state of suspension- Bioaerosols: droplet, droplet nuclei and droplet infection

1.4 Significance of microorganisms present in air: With respect to human health (list of air borne diseases).

1.5 Microbiological Analysis of Air: Solid and liquid impingement, Anderson air sampler

1.6 Control of microorganisms in air: Dust control, UV radiation, laminar airflow system, masks, Bactericidal vapours.

UNIT II: Water Microbiology 12L

2.1 Natural waters: Atmospheric, surface, stored and ground water.

Definitions: Fresh water (ponds, lakes, streams) and Marine water (estuaries, the sea).

2.2 Aquatic environment: Temperature, hydrostatic pressure, light, salinity,turbidity, Planktons and other microorganisms

2.3 Domestic water: water borne diseases, nuisance microorganisms

2.4 Bacteriological evidence of pollution: Fecal pollution, significance ofindex microorganisms.

2.5 Microbiological examination of water: Membrane filter technique, Tests for presence of coliforms (quantitative and qualitative), IMVC test, Elevated temperature test.

2.6 Safety of drinking water: Boiling, chlorination, radiation and ozonization.

UNIT III: Waste water microbiology 08L

3.1 Sewage: Definition, composition and strength: BOD, COD.
3.2 Sewage treatment: (physical, biological and chemical Oxidation ponds, solids processing, Composting.)
3.3 Domestic sewage treatment
3.4 Municipal sewage treatment
3.5 Industrial waste treatment

UNIT IV: Food and milk microbiology 15L

4.1 Sources of microorganisms in foods and milk

4.2 Milk as a nutrient medium for microbial growth

4.3 Common food borne bacteria-Starter culture-Lactic acid bacteria

4.4 Microbiological examination of food: DMC, SPC, Differential enumeration, MBRT, Resazurin test,

4.5 Food Spoilage: Classification of foods depending upon ease of spoilage, Different types of spoilages with suitable examples, biochemical types of microorganisms in milk.

4.6 Principles and applications of food Preservation techniques: Asepsis, use of high temperatures (milk pasteurization and phosphatase test, canning), freezing, dehydration, radiation (UV and Gamma rays), osmotic pressure; use of chemicals-Vinegar, Benzoic acid

4.7 Food borne diseases: Staphylococcal poisoning and Salmonellosis

REFERENCES

1) Fundamental principles of bacteriology by A. J. Salle.
2) Fundamentals of Microbiology by Martin Frobisher.
3) General microbiology by Stanier, Ingraham,Wheelis,Pinter: Macmillan press Ltd. London.
4) General Microbiology Vol. II by Power C.H and H.F. Daginawala. Himalaya Publishing House, Mumbai.
5) Microbiology by Pelczar and Crick.
6) Text book of Microbiology by Dubey and Maheshwari.
7) Text book of Applied Microbiology by Dr. B. M. Sandikar

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B. Sc. Second year (Semester -III)
MICROBIOLOGY
Course Code: U-MIB-360

Maximum Marks: 50 Lectures: 45

PAPER VI – FUNDAMENTALS OF IMMUNOLOGY

Learning Objectives

1 To understand basic principles of immunology and microbial interactions with relationshi
2 To understand antigen, antibody and complement system.
3 Get an overview of Immunity and immune responses.
4 To understand antigen antibody reaction and their applications.

Course Outcomes:

After the completion of this course, students will be able to:
1 Understand the host microbe interactions.
2 Describe the immunological concepts with reference to infection
3 Describe the immunological concepts with reference to immunity.
4 Apply serological reactions for diagnosis of the diseases.

UNIT I: Humans Microbial interactions 10 L

1.1 Definition –contamination, infection and disease, pathogen, pathogenicity and virulence.
1.2 Overview of human microbial interactions.
1.3 Virulence factors of pathogen.
1.4 Normal (indigenous) micro flora.

UNIT II: Antigen and Antibody 12 L

Antigen

2.1 Definition, Immunogenicity versus antigenicity
2.2 General properties of antigen.
2.3 Antigen specificity.
2.4 Bacterial antigens with special reference to antigens of *Salmonella typhi.*

Antibody

2.5 Definition, basic structure of immunoglobulin.
2.6 Immunoglobulin classes, properties of immunoglobulin classes

UNIT III: Immunity and Immunization 11 L

3.1 Definition and classification of immunity with suitable examples.

3.2 Immune response: Humoral and cellular

3.3 Theories of antibody production

3.4 Hypersensitivity: types of hypersensitivity in brief

3.5 Immunization-Active and passive immunization.

3.6 Designing vaccines for active immunization

a. Live attenuated vaccines.
b. Inactivated or killed vaccine.
c. Subunit vaccine.
d. Toxoid.
e. Recombinant DNA vaccine

3.7 Immunesera

UNIT IV: Antigen antibody reactions 12L

4.1General features of antigen antibody reactions

4.2 Mechanism and applications of the following reaction

a. Precipitation
b. Immunodiffusion
c. Immunoelectrophoresis
d. Agglutination.
e. Complement fixation.
f. Neutralization: toxin and virus neutralization
g. Enzyme linked immunosorbent assay.

References:

1) Basic Immunology by Joshi and Osarano. Agrobotanical publishers Ltd. Bikaner.
2) Elementary Microbiology Vol. I and II Dr. A. H Modi. Akta Prakashan. Nadiad.
3) Medical Microbiology. N. C. Dey and T. K. Dey. Allied agency, Culcutta.
4) Microbiology by Davis, Dulbecco, Eisen Harper and Row Maryland.
5) Molecular biology by David Frifelder, Narosa Publishing house, New Delhi.
6) Immunology by B. S. Nagoba and D. V. Vedpathak. BI publications, New Delhi.
7) Text book of Microbiology by R. Anantharayanan, C.K. Jayaram Panikar, Orient Longman, Mumt
8) Kuby's Immunology by Goldsby RA, Kindt TJ, Osborne BA. W.H. Freemanand Company, New York.

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B. Sc. Second year (Semester – III)

Practical

Microbiology

Maximum Marks: 50

Lab Course-MB-03, Course code U-MIB-361

Learning objectives:

1 To study methods used for bacteriological analysis of water,
2 To study methods used for bacteriological analysis of air ,
3 To study methods used for bacteriological analysis of soil, food and milk**.**

Course outcomes: A student will exhibit ability to:

1 Perform microbiological analysis Air
2 Perform microbiological analysis of Water.
3 Perform microbiological analysis of Milk
4 Perform quantitative microbiological analysis of food.

Experiments

1) Microbial analysis of air from –hospital environment , public places and industrial Area.
2) Microbial sampling of air for fungi by solid impingement techniques
3) Bacteriological examination of water for potability - Quantitative analysis: MPN
4) Bacteriological examination of water for potability –Qualitative: Presumptive, confirmed, completed test
5) Test for fecal coliforms: IMViC tests
6) Test for fecal coliforms: Elevated temperature tests
7) Bacteriological analysis of milk: Reductase test

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B. Sc. Second year (Semester – III)

Practical

Microbiology

Maximum Marks: 50

Lab Course-MB-04, Course code U-MIB-362

Learning objectives:

1 To study host microbe interaction and virulence factors of pathogens.
2 To study isolation and identification of pathogens
3 To study serological test used for diagnosis of diseases
4 To study staining for WBC and total count.

Course outcomes: A student will be able to:

1 Perform haematological procedures for detection of blood groups.
2 Perform diagnosis of diseases.
3 Perform differentiate blood staining
4 Perform experiment to determine presence of virulence factors of pathogens

Experiments

1) Isolation of normal bacterial flora of human body.
2) Study of virulence factors of pathogen
3) Determination of iso antigens on human RBC: Blood grouping
4) Serodiagnosis of Typhoid fever : Widal test.
5) RPR test.
6) Immuno diffusion test.
7) Differential blood staining for WBC
8) Differential count of leucocytes.
9) Western blot test (Demonstration)

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B. Sc. Second Year (Semester -IV)
MICROBIOLOGY
Course Code: U-MIB-459

Maximum Marks: 50 Lectures: 45

PAPER VII – Environmental microbiology

Learning Objectives:

1 To study interrelationship and influence of microorganisms on each other and on environment.
2 To learn eco-friendly and sustainable microbial techniques to resolve agro-environmental problems .
3 To study role of microorganisms in turnover of elements in the environment.
4 To study role of microorganisms in plant growth promotion and plant disease management.

Course Outcomes:

After the completion of this course, students will be able to:

1 Explain why microorganisms are ubiquitous in nature
2 Understand the influence of interactions among different microorganisms and with environment a on development of an ecosystem.
3 Demonstrate that microorganisms have an indispensable role in turnover of elements in the environment.
4 Understand and advocate the role of microorganisms in plant growth promotion and plant disease management

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UNIT I: Microbial Ecology and interactions 11L

1.1 Microbial ecology: Ecosystem, Synecology, Autecology, population, community (Autochthonous, Allochthonous), Dispersal (Center, Active, Passive), Community succession (Pioneer, Successive, Climax), Adaptation (Phenotypic, Genotypic)

1.2 Symbiosis: Definition and functions
Types of associations: neutralism, Commensalism, Mutualism (Lichens, Mycorrhiza) Competition, Antibiosis, Synergism, and Parasitism. (Definition and example of each)

UNIT II: Plant growth promoting rhizobacteria 11L

2.1 Rhizosphere

2.2 Direct plant growth promotion:

i) Microbial plant growth promoting substances: Indoleacetic acid, gibberellic acid.

2.2 Indirect plant growth promotion –Biocontrol:

i) Competition for an ecological niche,
ii) Suppression of growth of soil-born phytopathogens byproducing allelochemicals
iii) Induction of systemic resistance (ISR)

UNIT III: Soil microbiology : Microbial transformation of C N,S,P in soil

3.1 Soil environment :Structure and texture of soil,Organic fraction of soil (Humus),Soil a growth medium for microorganisms.
3.2 Carbon cycle: Cycle, Mineralization- cellulose, Starch (Microbiology andenzymology) Carbon assimilation.
3.3 Nitrogen cycle: Cycle, Nitrogen fixation(Symbiotic, Non symbiotic, Nitrogenase), Mineralization of proteins, Ammonification, Nitrification,Denitrification,.
3.4 Sulfur cycle Phosphorus cycle.

UNIT IV:Bioremediation 10L

4.1 Soil contamination- Xenobiotics
4.2 Bioremediation: Definition and principle.
4.3 Microbial Populations for Bioremediation Processes.
4.4 Types of Bioremediation: In situ bioremediation, Ex situ bioremediation.
4.5 Advantages and disadvantages of Bioremediation

References:

1) Introduction to soil Microbiology, Alexander Martin, John Wiley and Sons. N.Y.
2) Soil Microorganisms and plant growth. Subba Rao N.S, Oxford and IBH publishing Co. Pvt. Ltd.
3) Microbiology. Pelczar, Chan and Crieg. TATA MCGRAW- HILL
4) Text book of applied microbiology. Dr. B.M Sandikar, Himalaya Publishing House
5) Microbial biotechnology: fundamentals of applied microbiology. Alexander Glazer, Hiroshi Nikaido. Cambridge university press
6) Review on Bioremediation of Polluted Environment: A Management Tool: Kumar.A, Bisht.B.S, Joshi.V.D, Dhewa.T. International journal of environmental sciences. Volume 1, No 6, 2011
7) Environmental microbiology. Ralph Mitchell, Ji-Dong Gu. Wiley-Blackwell

RAJARSHI SHAHU MAHAVIDYALAY(AUTONOMOUS), LATUR

B. Sc. Second year (Semester- IV)

CORE COURSE: MICROBIOLOGY

Course Code: U-MIB-460

Maximum Marks: 50 Lectures: 45

Paper-VIII- Medical Microbiology

Learning objectives:

1 To gain knowledge about disease process and kinds of diseases
2 To study reservoirs of infection and modes of transmission of infections.
3 To study diseases caused by bacterial pathogens.
4 To study diseases caused by viral pathogens and parasites.

Course outcomes:

Completing fourth semester, the Microbiology students will be able to:

1.Explain an integral role of microorganisms in causation of diseases.
2.Explain reservoirs of infection and modes of transmission of infections
3.Describe antimicrobial, immunological and diagnostic methodologies used in disease treatment and prevention.
4.Execute precautions to avoid the spread of viral diseases

UNIT I: Disease process and kinds of diseases 08 L

1.1 Kinds of diseases –terms used to describe infections.
1.2 Disease process, signs, symptoms and syndrome.
1.3 Epidemiology-epidemic, endemic, pandemic, sporadic
1.4 Reservoirs of infection.
1.5 Modes of disease transmission, carriers and theirtypes.

UNIT II: Study of following diseases 15L

Etiology, pathogenesis, Clinical features, laboratory diagnosis, epidemiology, treatment and prophylaxis of the following

2.1 Typhoid**.**
2.2 Cholera
2.3 Tuberculosis

UNIT III: **Study of the Fungal and mosquito borne diseases** 12L

Etiology, pathogenesis, Clinical features, laboratory diagnosis, epidemiology, treatment and prophylaxis of the following

3.1 Candidiasis
3.2 Malaria
3.3 Dengue

UNIT IV: Study of following viral diseases 10 L

Etiology, pathogenesis, Clinical features, laboratory diagnosis, epidemiology, treatment and prophylaxis of the following diseases

4.1 Hepatitis
4.2 AIDS

REFERENCE BOOKS:

1) Medical Microbiology. N.C.Dey and T.K. Dey. Allied agency, Culcutta.
2) Microbiology by Davis, Dulbecco, Eisen Harper and Row Maryland.
3) Text book of Microbiology by R. Anantharayanan, C.K. Jayaram Panikar, Orient Longman, Mumbai.
4) Medical microbiology by Chakraborthy.
5) Medical Microbiology: Prep Manual for Under Graduates by Nagoba, Elsevier.

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B. Sc. Second year (Semester – IV)

Microbiology

LabCourse-MB-05, Course code U- MIB-461 Maximum Marks: 50

Learning objective:

1 To study activities of microorganisms in soil, milk.
2 To study microorganisms present in air.
3 To study method for qualitative and quantitative analysis of water.
4 To study microbial spoilage of food

Course outcomes:

After the completion of this course, students will be able to:

1 Perform microbiological analysis Air
2 Perform microbiological analysis of Water.
3 Perform microbiological analysis of Milk
4 Perform microbiological analysis of food.

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1) Study of microbial succession in raw milk.
2) Study of rhizosphere effect- R: S ratio.
3) Isolation of rhizospheric bacteria showing biocontrol potential.
4) Isolation of starch degrading bacteria.
   Demonstration of Ammonification ,Nitrification and Denitrification .
5) Demonstration of i) Nitrate reduction and ii) Sulfate reduction .
6) Isolation and study of *Rhizobium* species from root nodules of leguminous plants.
7) Isolation and study of *Azotobacter sp.* from soil .
8) Chemical analysis of soil.
9) Determination of BOD and COD of sewage water

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B. Sc. Second year (Semester – IV)

Microbiology

Lectures:45 Maximum Marks: 50

LabCourse-MB-06, Course code U- MIB-462

Learning Objective:

To study Serological test for serodiagnosis of diseases.To study etiological agent of typhoid and cholera

Course outcomes :

1 After the completion of this course, students will be able to:
2 Exercise and describe Ecological developments.
3 Isolate and exploit the plant growth promoting bacteria for agricultural and industrial purpose
4 Identify parasitical and bacterial pathogens diseases using staining procedures, cultural methods a biochemical tests
5 Perform antibiotic sensitivity test.

Experiments

1) Acid fast staining.
2) Staining of blood for malarial parasite.
3) Study of biochemical reactions for identification of pathogen.
4) Study of morphological and cultural characteristics of *Salmonella typhi* species.
5) Study of biochemical characteristics of *Salmonella* species
6) Study of morphological and cultural characteristics of *Vibrio cholera* .
7) Antibiotic sensitivity tests for pathogens by disc diffusion method

RAJARSHI SHAHU MAHAVIDYALAYA, LATUR
Choice Based Credit System
B. Sc. Second year (Semester -IV)
Subject: Microbiology
Skill Enhancement Course: Production of Bio fertilizers
Course Code: SEC.U-MIB II

Maximum marks: 50 **Credits: 2**

Learning objectives:

1 To create awareness about organic farming
2 To inculcate skills for mass production of biofertilizers.
3 To promote self-employment
4 To ecofriendly and sustainable agro practices

Unit I: Organic farming and importance of bio fertilizers

Unit II: Free living nitrogen fixing bacteria

Study of *Azotobacter* and *Azospirillum*

Technique/skill-Isolation, characterization, Mass production and Quality control

Unit III: Study of legume inoculants-Study of Rhizobium
Technique/skill-Isolation, characterization, Mass production and Quality control

Unit IV: Study of Phosphate solubilizing bacteria

Technique/skill- Isolation of PSB and characterization
Formulation of biofertilizers**,**Maintenance of microbes

References:

1) Kannaiyan, S. (2003). Biotechnology of Bio fertilizers, CHIPS, Texas.
2) Mahendra K. Rai (2005). Hand book of Microbial bio fertilizers, The Haworth Press, Inc.New York.
3) Reddy, S.M. (2002). Bio inoculants for sustainable agriculture and forestry, Scientific Publishers.

LIST OF MAJOR INSTRUMENTS

Sr.no.	Equipments / Instruments	Unit
1	Quartz Distillation unit (Bhanu make)	1
2	Lab Fermenter 5 lit capacity make (DYNA biotech)	1
3	Distillation unit (Bhanu make)	1
4	Lab Fermenter 5 lit capacity make (DYNA biotech)	1
5	Orbital shaking incubator (CIS-24)with voltage stabilizer	1
6	Cooling centrifuge (C-24 BL) with voltage stabilizer	1
7	Deluxe laboratory centrifuge (R-8C)	1
8	Laminar air flow microfilt(microfilt make)	1
9	UV visible spectrophotometer	CIC
10	FTIR	CIC