AC/I(19-20).2.RPS9

S.P. Mandali's

Ramnarain Ruia Autonomous College

(Affiliated to University of Mumbai)

RUIA COLLEGE
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Syllabus for MSc Part II

Program: MSc (Microbiology)

Program Code: RPSMIC

(Credit Based Semester and Grading System for the academic year 2019-2020)

SEMESTER III

Course Code	Unit	TITLE	Credits	L / Week
		Immunology and Clinical Research	04	04
RPSMIC 301	I	Immune System and Health : Part I	01	
	II	Recent advances in Immunology :Immunobiology	01	
	III	Recent advances in immune tolerance	01	
	IV	Clinical Research and Clinical Microbiology	01	
		Food Microbiology	04	04
RPSMIC 302	I	Microbes In Food	01	
	II	Uses Of Microbes In Food	01	
	III	Control Of Microbes In Food	01	
	IV	Microbial Detection And Food Safety	01	
		Advances In Biotechnology	04	04
RPSMIC 303	I	Plant And Agricultural Biotechnology	01	
	II	Animal Biotechnology	01	
	III	Nano Biotechnology	01	
	IV	Medical Biotechnology	01	
		Applied and Environmental Microbiology	04	04
RPSMIC 304	I	Microbial Diversity	01	
	II	Techniques In Microbial Ecology	01	
	III	Soil, Marine & Agricultural Microbiology	01	
	IV	Advanced Food & Water Microbiology	01	
RPSMIC 3P1, 3P2, 3P3, 3P4	Practicals based on above four courses		8	16

SEMESTER IV

Course Code	Unit	TITLE	Credits	L / Week
		Medical Microbiology and Epidemiology	04	04
RPSMIC 401	I	Study of Infections – I	01	
	II	Study of Infections- II	01	
	III	Role of Biofilms in diseases	01	
	IV	Epidemiology and Microbiome studies	01	
		Pharmaceutical Microbiology	04	04
RPSMIC 402	I	Principles And Applications Of GMP In Pharmaceuticals And Cosmetics	01	
	II	Quality Management And Regulatory Aspects	01	
	III	Analytical Aspects of Cosmetic Products	01	
	IV	Drug Discovery	01	
		Advances in Biotechnology	04	04
RPSMIC 403	I	Pharmaceutical Biotechnology	01	
	II	IPR and ethics in Biotechnology	01	
	III	Environmental & natural resources management and safety standards	01	
	IV	Advances in Molecular Biotechnology	01	
RPSMIC 404		INTERNSHIP	04	04
RPSMIC 4P1, 4P2, 4P3, 4P4		Practicals based on above four courses	10	16

Course Code: RPSMIC 301

Course Title: Immunology and Clinical Research

Academic year 2019-20

Learning Objectives:

The course will help students to build on the basic information regarding Innate Immunity and Host Defence mechanisms that they have gained in B.Sc. Immunology is an integral part of Medical Microbiology and this course is designed to help students understand the ability of our immune system to defend against invading pathogens in a logical fashion. Immune responses to viral, bacterial diseases. This includes our innate ability to defend against microorganisms (innate immunity); should this first line of defense fail, how we can fight infections (acquired immunity). The course elaborates on the mechanisms of acquired defense after an introduction on the molecular nature of antigens and antibodies along with the role of different cells and their surface molecules in acquired immunity.
After a basic introduction to cells of immune mechanisms the other units include mechanisms of immune tolerance. Also cancer immunology will allow students to gain insights into interaction between immune system and cancer.

Learning outcomes:

Students should be able to-

- Conceptualize how the innate and adaptive immune responses coordinate to fight invading pathogens
- Discuss the role of antigen in initiating the immune response
- Understand immune response developed against viral and bacterial infections.
- Understand molecular basis of generating immunoglobulin diversity
- Discuss various types of immune tolerances
- Understanding mechanisms to generate immune tolerance
- Understand various aspects of clinical research

Detail Syllabus

Course Code	Unit	Topics	Credits	Lectures
RPSMIC 301		**Immunology and Clinical Research**	**04**	**60**
	I	Immune system and health part I; Immune response to infectious diseases:-- a) Immune response to Prions, b) Immune response to viral infections- HIV/AIDS-HIV and the immune system-Influenza-Avian H5N1. c) Immune response to Bacterial diseases- Difference in the Immune response to extracellular andintracellular bacteria : Diphtheria, Tuberculosis d) Microbial ways of evading immune system.	01	**15**
	II	Recent advances in immunology: Immuno biology 2.1 Recent advances in Innate immunity including receptors involved and signaling system. Physiological & immunological barriers. 2.2 the cellular players :Phagocytic cells, Lymphocytic cells, DCs. 2.3 The innate immune response: Inflammation, Acute Phase Reaction 2.4 Molecular basis of diversity of immunoglobulin molecules. 2.5 Multigene organization of Ig genes. 2.6 Variable-Region Gene Rearrangements. 2.7 Mechanism of Variable-Region DNA Rearrangements. 2.8 Generation of antibody diversity. 2.9 Manipulations of the immune response	01	**15**
	III	3.1 Recent advances in immune tolerance a) -Central Tolerance b) -Peripheral Tolerance c) -Tolerance Induction d) -T-cell Tolerance e) -B-cell Tolerance f) -Incomplete Tolerance g) -Duration of Tolerance 3.2 Recent advances in autoimmunity a) -Interplaying Factors b) -Triggering Factors c) -Mechanisms of Damage d) -Organ Specific Autoimmune Diseases e) -Systemic Autoimmune Diseases f) -Animal Models for Autoimmune Diseases g) -Proposed Mechanisms for Induction of Autoimmunity h) -Treatment of Autoimmune Diseases 3.3 Cancer immunology. a) -Cancer:Origin & Terminology b) -Malignant Transformation of Cells c) -Oncogenes & Cancer Induction d) -Tumors of the Immune System 37 e) -Tumor Antigens f) -Tumor Evasion of the Immune System g) -Cancer Immunotherapy	01	**15**

	IV	Clinical Research and Clinical Microbiology 4.1 Introduction to Clinical Research. a. Good Clinical practice Guidelines b. Ethical aspects of Clinical Research c. Regulatory Requirements in clinical research d. Clinical Research Methodologies and Management e. Clinical Data Management and Statistics in Clinical Research 4.2 a. Revision of Antimicrobial Susceptibility Testing b. Test for determination of bactericidal activity c. Testing of antibiotic combinations d. Test of therapeutic efficacy and avoidance of toxicity	01	**08** **07**

References:

RPSMIC 301

1. Clinics in laboratory medicine, Emerging Infections and their causative agents. September 2004 vol. 24 no. 3
2. Immunology – Essential and Fundamental, Sulabha Pathak and Urmi Palan. 3rd edition Capital publishing company.
3. Immunology- Kuby 6th edition W. H. Freeman and company- New York.
4. The Elements of immunology- Fahim Halim Khan- Pearson Education.
5. Immunology an introduction- 4th edition- Ian R. Tizard-Thomson.
6. Immunobiology –the immune system in health and disease 6th ed.- Janeway.Travers.GS
7. Color Atlas and Textbook of Diagnostic Microbiology By Konaman *et al* 5th Edition Volume 2 Lipincott

Course Code: RPSMIC 302

Course Title: Food Microbiology

Academic year 2019-20

Learning Objectives:

This course will give the learners a thorough background on food microbiology. The microbes associated with our food tend to have a bad name – food poisoning is often in the news. Yet while some make us ill and others can be a nuisance by spoiling our food, without the activities of microbes there would no bread, cheese, beer or chocolate. The course begins with the importance and sources of microorganism in food.It then moves on to give an overview of different factors that influence the growth of different organisms in food. Fermented foods are an integral part of diet in all civilizations. Understanding the roles of different microorganisms in cheese, meat, vegetables, cereal fermented foods is therefore essential for a microbiologist. Since food is a highly nutritious medium for the growth of microorganisms, excessive growth of microorganisms will lead to spoiling of food. Students will be then given a thorough insight into different physical, chemical methods for preservation as well newer techniques of food preservation. Food borne infections and food poisoning are an inseparable from Food Microbiology. Different quantitative,qualitative, microbiological and rapid methods for detecting the organisms in foods and also quality control and good lab manufacturing practice and HACCP to ensure food safety at different levels of processing and production of foods.is included in this course to equip the learner with skills required by the industry and make them job ready.

Learning outcomes:
Students will realise the importance of microorganisms in foods and how the microbiological quality of food is of great significance.Students will appreciate the roles of good microorganism in giving them fermented foods with the desirable texture, taste and appearance. Students can also try making those foods at home keeping in mind all the conditions required for a well-directed fermentation, e.gwine
,cheese , idli. Exposure to preservation techniques will help to understand the ways to increase the shelf life of the food while still maintaining its quality. It will also make them aware how the foods are wasted or can become toxic for us if not stored properly at a desirable condition.Students will be able to enumerate and detect different pathogenic microorganism by applying the different method which they have studied. Students will learn different ways to ensure the safety of food by keeping the good manufacturing practices in mind. HAACP will help them understand the different points of contamination during production and processing of foods and the measures to be taken to avoid it. A systematic and in depth study of this course will make the learners entry into food industry much easier and will also make it easier for them to adopt to working condition in food microbiological laboratory.

Detail Syllabus

Course Code	Unit	Topics	Credits	Lectures
RPSMIC 302		**Food Microbiology**	**04**	**60**
RPSMIC 302	I	**Microbes in foods** 1.1 Importance of microbes in food 1.2 Sources of microbes in food 1.3 Normal microbiological quality of food 1.4 Factors influencing microbial growth in food	01	**02** **03** **04** **06**
	II	**Uses of microbes in food** 2.1 Microbial stress response in food 2.2 Starter cultures 2.3 Microbiology of fermented foods General method of production 2.3.a Cheese – Swiss and Blue cheese 2.3.b.Fermented meat product – Sausage 2.3.c Fermented vegetable products – Pickles, soy product Sauerkraut 2.3.d Fermented cereal product - Bread and Idli	01	**04** **02** **09**
	III	**Control of microbes in food** 3.1 Control of access: Control by physical removal, heat, low temperature, reduced aw, low pH and organic acids, modified atmosphere, antimicrobial preservatives, irradiation 3.2 Novel emerging techniques of food preservation 3.3 Control by combination of methods (Hurdle concept)	01	**05** **04** **06**
	IV	**Microbial Detection and Food Safety** 4.1.a. Conventional Methods. Methods used, Sampling for microbial analysis 4.1.b.Quantitative microbial enumeration in food 4.1.c.Qualitative methods of microbial detection 4.1.d.Bacterial Toxins 4.1.e.Rapid methods 4.1.f.Biosensors 4.2 Controlling the Microbiological Quality of food. 4.2.a Quality and Criteria 4.2.b.Sampling Schemes 4.2.c.QC using microbiological control	01	**06** **09**

		4.2.d.Control at source 4.2.e.Codes of GMP 4.2.f. HACCP 4.2.g. Laboratory Accreditation		

References:

RPSMIC 302

1. Bibek Ray and Arun Bhunia(2008) Fundamental Food Microbiology 4th Ed. CRC Press.

2. Srilakshami B (2010) Food Science. 5th Ed. New Age International Publishers.

3. James Jay , M Loessner and D Golden (2005) Modern Food Microbiology 7th Ed.

4. Adams M R and Moss M O (2008) Food Microbiology 3rd Ed. RSC Publishing.

5. J Maud Kordylas(1991) Processing and Preservation of tropical and subtropical foods. ELBS Macmillan

6. Gerald Reed (2004) Prescott and Dunn's Industrial Microbiology 4th Ed. CBS Publishers.

7. N Shakuntala Manay and Shadaksharaswamy M (1985) Foods Facts and Principles. New Age International

8. Harrigan W F and McCance M F (1976) Laboratory methods in food and dairy microbiology. Academic Press.

9. Aylward F (2001) Food Technology Processing and Laboratory Control. Agrobios (India)

Course Code: RPSMIC 303

Course Title: Advances in Biotechnology

Academic year 2019-20

Learning Objectives:

Biotechnological advancement is important for making use of principles of biology for human benefit. Biotechnology involves cultivation and manipulation of plant and animal cell under in vitro conditions. Plants are cultivated under laboratory conditions for the purpose of conservation, to get virus free plants, to be used for production of certain biopharmaceuticals on large scale. Studying the principles and practices of plant tissue culture will enable students to understand all these aspects. Animal cells are also cultivated in vitro for various purposes like cultivation of virus for research studies and vaccine preparation, evaluation of drugs on cells, production of pharmaceutical products like monoclonal antibodies. Hence in this course, basics of animal cell culture which includes terminology, media used for cell culture, types of cell cultures has been included. Since the learner needs to widen his knowledge base in techniques used in biotechnology, development of transgenic animals is discussed in details here. Nanotechnology is an emerging field in science and truly an interdisciplinary field bringing together physics, chemistry, biology and engineering fields. Students will be introduced to terminology in nanobiotechnology alongwith principle and methods of synthesis of nanomaterials and their applications. Medical biotechnology is again an allied field of biotechnology which deals with techniques involving clinical significance. Diagnosis of various genetic disorders, concept, methods and applications of gene therapy is introduced to equip the learner in this allied field. In this course students will get introduced to modern pharmaceutical concepts like pharmacogenomics, pharmacokinetics. Topics of social interest like sex determination, human cloning are also introduced.

Learning Objectives:

Students will understand basics of plant tissue culture with respect to terminologies and techniques involved. Students will know production of secondary metabolites using plant tissue culture. Students will understand genetic engineering involved in plant biotechnology. Students will realise use of plant cells for production of secondary metabolites. Students will understand concepts associated with animal tissue culture. Students will understand the techniques involved in development of transgenic animals. Students will be introduced to the emerging field of nanobiotechnology. They will understand the synthesis of nanomaterials and their applications in the field of biology and medicines. Students will appreciate the technological advances in the field of nanobiotechnology. Students will know genetic disorders and should understand their diagnosis at pre-implantation and pre-natal stage. Students will be sensitized to the importance of genetic counselling in the process of diagnosis and treatment of genetic disorders. Students will understand the concept of gene therapy. They will also learn the meaning, applications and significance in the modern scenario of terms like pharmacogenetics, toxicogenomics, tissue engineering and biomolecular engineering.

Detail Syllabus

Course Code	Unit	Topics	Credits	Lectures
RPSMIC 303		**Advances in Biotechnology**	**04**	**60**
	I	**Plant and Agricultural Biotechnology** 1.1 Plant Tissue Culture for crop improvement--Initiation and maintenance of Callus and Suspension culture, Direct and Indirect Organogenesis, Micropropagation, Artificial seeds, Anther culture and dihaploids, Protoplast isolation culture and fusion, Production of haploids, Somaclonal variations, Germplasm conservation, Somatic hybrids, Cybrids. 1.2 Production of secondary metabolites from plant cell cultures, Technology of plant cell culture for production of chemicals, Bioreactor systems and models for mass cultivation of plant cells. 1.3 Plant Transformation Technology – Agrobacterium mediated gene transfer, Agrobacterium based vectors, viral vectors, Direct gene transfer methods, chemical methods, electroporation, microinjection, particle bombardment, Molecular breeding, plant selectable markers, Reporter genes, Positive selection, Selectable marker elimination, Transgene silencing, Strategies to avoid transgene silencing. 1.4 Plant Genetic Engineering for Productivity and Performance– Biotic Stress Tolerance- Herbicide resistance, Glyphosate, Insect Resistance, Bt toxin, Disease Resistance, Virus resistance Abiotic Stress Tolerance-- Drought, Flooding, Salt and temperature. By manipulation of–Photosynthesis, Nitrogen fixation, Nutrient uptake efficiency For Quality Improvement-Protein, Lipids, carbohydrates, vitamins and minerals. Biosafety concerns of transgenic plants 1.5 Plants as bioreactors	01	**05** **04** **02** **03** **01**

	II	**Animal Biotechnology** 2.1 Animal Tissue Culture: Primary culture, Organ culture, Embryo Culture, Established Cell lines 2.2 Scale up, Cryopreservation, Culture Collections 2.3 Risks and Safety, Bioethics. 2.4 Stem Cell Technology, Cloning techniques Applications. 2.5 Transgenics and knockouts: Transgenic cattle, Transgenic birds, Transgenic fish 2.6 Applications: Transgenic mice: i) Retroviral method ii) DNA microinjection method iii) Engineered Embryonic Stem cell method	01	**03** **02** **01** **02** **04** **03**
	III	**Nanobiotechnology** 3.1 Nanoscale systems, nanoparticles, nanowires,thin films and multilayers; Properties of nanomaterials. 3.2 Synthesis of nanostuctures - physical, chemical and biological,microbiological methods a. Biomolecules as nanostructures. b.Nanoparticular carrier systems, Micro and Nanofluidics. c. Applications: Biosensors, drug and gene delivery systems, chip technologies, nano imaging, Nanomedicine and Cancer diagnostics and treatment.	01	**07** **08**
	IV	**Medical Biotechnology** 4.1 Genetic Testing of diseases and disorders, Cancer genetics., Immunogenetics; prenatal diagnosis-chorionic villus sampling, amniocentesis, Pre-implantation diagnosis., Genetic counselling. 4.2 Gene therapy-concept, vectors, gene targeting and tissue-specific expression, Anti- sense Technology 4.3 Introduction to pharmacogenomics, Pharmacogenetics and toxicogenomics	01	**04** **05** **02**

		4.4 Social- genetic discrimination: insurance and employment, human cloning, foeticide, Sex determination 4.5 Tissue Engineering, Methods of Synthesis, Biomolecular Engineering		**02** **02**

References:

RPSMIC 303

1. Plant Biotechnology: The genetic manipulation of plants,2005,A.Slater ,N.Scott&M.Fowler, Oxford Univ Press, Oxford.

2.Introduction to Plant Biotechnology(3rd Edtn), H.S. Chawla

3. Roberta Smith, Plant Tissue Culture: Techniques and Experiments,2nd Edtn,Academic Press,2000

4. H.K.Das(ed),Textbook of Biotechnology,Wiley India,2004

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6. B.B.Buchanan, W.Gruissen and R.L.Jones(eds), Biochemistry and Molecular Biology of Plants,American Society of Plant Biology,Rockville,USA,2000.

7. Plant Biotechnology and Agriculture:Prospects for the 21st Century, Arie altman ,Paul Michael Hasegawa,

8. Plant Biotechnology and Genetics:Principles, Techniques & Applications, Stewart, C.Neal,June 2008,John Wiley &Son

9. Animal Cell Culture by IanFreshney

10. Basic Cell Culture. Ed.J.M.Davis 2nd.Ed 2007. Oxford press

11. Animal Cell Culture Sudha Gangal

12. Principles of biotechnology and applications-Glick and Pasternack

13.Nanobiotechnology by David Goodsell. John Wiley

14. Handbook of Nanostructured biomaterials and their applications in nanobiotechnology by Nalwa HS 2005. American scientific publishers

15. Nanobiotechnology by Niemeyer CM & Mirkin CA 2005 .Wiley Interscience

16. Jogdand S. N., Medical Biotechnology, Himalaya Publishing House, Mumbai, (2008)

17. Judit Pongracz, Mary Keen, Medical Biotechnology, Churchill Livingstone, Elsevier (2009)

18. Pratibha Nallari & V. Venugopal Rao, Medical Biotechnology, Oxford University Press, India (2010)

Course Code: RPSMIC 304

Course Title: APPLIED AND ENVIRONMENTAL MICROBIOLOGY

Academic year 2019-20

Learning Objectives:

Environment is the surrounding in which we live. It is very important to understand the components of environment along with the factors that affects the environmental system. One of the important factors that influences environment are microorganisms. Microorganisms due to their metabolism bring about interconversion of many elements in nature into different forms by changing their oxidation state. In this course students will get introduced to basic concepts of microbial ecology. They will get introduced to microbial diversity. Organisms that can grow under extreme conditions of environment like temperature, pressure, pH, radiations etc. are called as extremophiles. Proteins obtained from extremophiles have potential biotechnological applications. Thus students should learn about different kinds of extremophiles and their applications. Study of microorganisms in environment involves various steps like sample collection, cultural and non cultural methods. Students will be introduced to modern methods of studying environmental microorganisms like genomics, proteomics, immunological and nucleic acid based methods. In order to understand microbes in environment, it is important to understand various habitats in the environment with respect to their composition and properties. Studying soil, marine and agricultural ecosystems will give the students an insight into the microcosmos. Role of microorganisms in maintaining a balance in nature is undisputed. Understanding these roles in interconversion of elements into various compounds through biogeochemical cycles is essential for a microbiologist. Microbiological analysis of food and water involves various processes like sampling, sample processing and methods of analysis. There are methods of analysis and standards established by various regulatory authorities for the microorganisms which students should know. Students should know use of biosensors for rapid toxicological and microbiological analysis of food. A very new branch in which microbiologists can play a significant role is the branch of nutraceuticals. The learner is also introduced to this branch in this course.

Learning outcomes:

Through this course, students will understand basic concepts of microbial ecology. They will realise and appreciate microbial diversity in environment and also know characteristics of various extremophiles. They will know the potential biotechnological applications of proteins from extremophiles. Students will understand techniques in microbial ecology with respect to sampling, sample processing and cultural methods. They will also know physiological methods of analysis of ecological samples. Students will realise the use of modern approaches of studying microbial ecology like genomics, proteomics, immunological and nucleic acid -based methods. Students will understand soil and marine ecosystems with respect to their structures and properties. Students will know agricultural microbiology and interactions between microorganisms and plant structures. Students will get an in depth understanding of role of microbes in biogeochemical cycles for various elements. The background knowledge of the learner about

sampling and sample processing approaches for food and water samples, standards used for analysis of food and water laid by regulatory authorities will strengthen his/her knowledge base. Exposure to modern methods of food analysis like use of biosensors, and to nutraceuticals as a class of compounds used for nutritional and pharmaceutical purposes, will trigger the innovative minds; while knowledge on microbiological analysis methods and regulations for drinking water will strengthen skills of the job seekers

Detail Syllabus

Course Code	Unit	Topics	Credits	Lectures
RPSMIC 304		**APPLIED AND ENVIRONMENTAL MICROBIOLOGY**		
	I	**Microbial Diversity** 1.1 Microbial ecology: concepts, niche, habitat, ecosystem. 1.2 Introduction to microbial diversity: Types of microorganisms- bacteria, Archaebacteria, Eucarya interactions between microorganisms , ecological Succession 1.3 Extremophiles: Habitat, effect of extreme conditions on cellular components- membrane structure, nucleic acids and proteins, adaptation mechanism in microorganisms in diverse environments 1.4 Study of Thermophiles, Psychrophiles, halophiles, Piezophiles, Acidophiles, Alkaliphiles, Xerophiles, Radiation resistant organisms, Methanogens. 1.5 Biotechnological Applications of extreme proteins from the above groups Geomicrobiology: Biofouling, biocorrosion, bioleaching.	01	**02** **04** **04** **03** **02**
	II	**Techniques in Microbial Ecology** 2.1: Environmental sample collection and processing.: Soils and Sediment, Water, Air, Detection of Micro organisms on fomites 2.2: Cultural Methods:Cultural methods for isolation & enumeration of Bacteria 2.3: Physiological Methods:Measuring microbial activity in pure culture; Carbon respiration, Stable isotope probing, Use of radioisotopes as tracers Adenylate energy charge, Enzyme assays, 2.4 Functional genomics &proteomics based approach	01	**02** **02** **03** **01**

		2.5:Immunological methods: Immunoassays. 2.6 Nucleic acid based methods of analysis:Obtaining Nucleic acids from Environment, Use of Gene probes, PCR, 2.7 Recombinant DNA Techniques, RFLP, Denaturing /Temperature gradient, Plasmid analysis, Reporter genes. Rep PCR fingerprinting and microbial diversity 2.8 Molecular Techniques to Assess Microbial Community Structure, Function, and Dynamics in the Environment: culturable and unculturable bacteria		**01** **02** **02** **02**
	III	**Soil, Marine & Agricultural Microbiology** 3.1 Soil Microbiology: The litho ecosphere: Soil formation, Properties (physical and chemical) Soil communities. Link to microbial interactions. Soil sampling for surface, subsurface soils .Processing and storage of samples. 3.2 Marine microbiology: Marine and estuarine habitats. Characterization and stratification of the oceans Vertical and horizontal zones of marine habitats Marine microbes characteristics, distribution, composition & activity. 3.3 Agricultural microbiology: Factors affecting microbial load of soils. Relationship between plants and microbes rhizosphere, phyllosphere. Beneficial uses of microorganisms for plant growth and development, Interactions with aerial plant structures. 3.4 Microbial contribution to animal nutrition Special reference to Rumen flora 3.5: Biogeochemical cycles for Carbon Nitrogen and Oxygen. Degradation of recalcitrant polymers and xenobiotics eg cellulose, lignin .lignocellulose. Combating Greenhouse effect using microbes. Concept of carbon credits	01	**04** **04** **03** **02** **02**

	IV	**Advanced Food & Water Microbiology** 4.1 Use of enzymatic/ thermal techniques for food analysis 4.2 Food additives and ingredients :Food additives-definitions, classification and functions, (Preservatives, antioxidants, colors, emulsifiers, natural and microbial flavors) 4.3 Toxicological evaluation of food additives. 4.4 Applications of fibres from food sources, microbial fructooligosaccharides. 4.5 Nutraceuticals and health foods: Introduction to nutraceuticals: definitions, basis of claims for a compound as a nutraceutical, regulatory issues for nutraceuticals .Microbes and production of nutraceuticals like lycopene, isoflavonoids, prebiotics and probiotics, glucosamine, phytosterols.Formulation of functional foods containing nutraceuticals – stability and analytical issues,labelling issues. 4.6 Drinking water risk assessment & its safety: Bottled water-legislation: Types of bottled water.BIS Regulations regarding the production of bottled waters wrt final quality of the product. Potential chemical and microbiological hazards in the bottles depending on the type of water, the type of bottle and the bottling procedure. The application of HACCP in the bottling plants: Water Quality attained from point of use water purifier units , Types of water purifiers.: Microbiological specifications and methods used certify water purifiers International standards regulating quality of water purifiers .	01	**02** **03** **01** **01** **04** **04**

References:

RPSMIC 304

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2. R. M. Atlas and R. Bartha - 1998 - Microbial Ecology - Fundamentals and Applications. Addison Wesley Longman, Inc.

3. Microbial Diversity- Current Perspective and Potential Application--Johri and Satyanarayana

4. Methods in Microbiology Vol 35- Extremophiles (2006) Edited by Fred Rainey, Aharon Oren (Academic press)

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7. A K Bej and M H Mahbubani, Applications of the polymerase chain reaction in environmental .Microbiology. Genome Res. 1992 1: 151-159

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11. Marine Microbiology: Ecology and Applications. Colin Munn. Garland publishing. ISBN: 0815365179

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13. Agricultural Microbiology. G. Rangaswami, D. J. Bagyaraj, D.G. Bagyaraj. PHI Learning Pvt. Ltd., 2004

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19. Macleod AJ. 1973. Instrumental Methods of Food Analysis. ElekSci.Marcel Dekker

20. Nielsen S. (Eds.). 1994. Introduction to Chemical Analysis of Foods. Jones & Bartlett

21. Branen AL, Davidson PM & Salminen S. 2001. Food Additives. 2nd Ed. Marcel Dekker.

22. Gerorge AB. 2004. Fenaroli's Handbook of Flavor Ingredients. 5th Ed. CRC Press.

23. Madhavi DL, Deshpande SS & Salunkhe DK. 1996. Food Antioxidants: Technological, Toxicological and Health Perspective. Marcel Dekker.

24. Stephen AM. (Ed.). 2006. Food Polysaccharides and Their Applications. Marcel Dekker.Brigelius-Flohé, J & Joost HG. 2006. Nutritional Genomics: Impact on Health and Disease. Wiley VCH.

25. Gibson GR & William CM. 2000. Functional Foods - Concept to Product.

26. Losso JN. 2007. Angi-angiogenic Functional and Medicinal Foods. CRC Press.

27. Manson P.2001. Dietary Supplements. 2nd Ed. Pharmaceutical Press.

28. Shi J. (Ed.). 2006. Functional Food Ingredients and Nutraceuticals: Processing Technologies. CRC Press.

PRACTICALS: RPSMIC 3P1 (60 Contact Hrs)

1. Study of virulence factors-Phagocytosis & Phagocytic index
2. Collection of human blood & separation of mononuclear cells by ficoll hypaque density gradient centrifugation,
3. Counting of viable cells by trypan blue.
4. Checkerboard assay
5. Dissertation

PRACTICALS: RPSMIC 3P2 (60 Contact Hrs)

1. Microbiological study of fermented foods (Idli batter and sauerkraut)
2. Microbiological load in carrot and apple juice, salad, mayonnaise
3. Quality Assessment and Analysis of food
   i) Milk (Raw and Packed)
   ii) Ice cream
   iii) Yoghurt
   iv) Seafood

4. Dissertation

PRACTICALS: RPSMIC 3P3 (60 Contact Hrs)

1. Preparation of Nanosilver By Wet reduction Method(Chemical),using Neem Extract (plants) & fungi (Microbiological)

2. Characterization of Nanosilver by UV spectrometry and microscopic methods

3. Antimicrobial effect of Ionic silver and Nanosilver prepared by above methods.

4. Study of Nanosilver coated Gauze/textiles for antimicrobial effect on different bacteria

5. Dissertation

PRACTICALS: RPSMIC 3P4 (60 Contact Hrs)

1. Enrichment & isolation of thermophiles from hot springs/compost heaps & extraction of thermophilic enzymes & determination of its specific activity..

2. Assessment of point of use water purifiers (Zero B) for removal of bacteria.

3. Soil analysis-comparison of arid and fertile soil on the bases of

i) presence of cellulose, lignin & xylan degraders

ii) levels of organic matter

4. Dissertation

Course Code: RPSMIC 401

Course Title: Medical Microbiology and Epidemiology

Academic year 2019-20

Learning objectives:

Classical medical microbiology is the study of aetiology, transmission, pathogenesis, clinical manifestations, laboratory diagnosis, prophylaxis and treatment of various bacterial, viral, fungal and parasitic infections. The course on Medical Microbiology introduces the students to all these parameters of representative diseases from each category. The course also includes one of the most important areas of modern medical microbiology that is -understanding genetic modification and pathogen evolution.

As a part of understanding chemotherapeutic agents for destruction of pathogens, the students are introduced to different classes of chemotherapeutic agents and their mechanisms of action. As development of resistance to antibiotics is a very burning issue in the field of clinical microbiology, the syllabus also includes mechanisms of resistance to drugs.

Learning outcomes: Students should be able to:

- Study pathogenesis and clinical features of different diseases
- Comment on the mode of transmission, epidemiology and therefore modes of prophylaxis of these diseases
- Given a few key clinical features, identify the likely causative agent.
- Comment on the methods of diagnosis of the disease.
- Correlate classes of antibiotics with their mechanism of action
- Comment on drug resistance mechanisms
- Evaluate drugs and antibiotics for their efficacy
- Understand nature of biofilms and its association with human diseases
- Understand methods of eradication of biofilms
- Understand definitions associated with epidemiology
- Understand the concept of microbiome. Know the positive effects of microbiota on human health

Detail Syllabus

Course Code	Unit	Topics	Credits	Lectures
RPSMIC 401		**Medical Microbiology and Epidemiology**	**04**	**60**
RPSMIC 401	I	**Study of Infections – I** Detailed Study of following infections including Etiology, Transmission, Pathogenesis, Clinical Manifestations, Lab.diagnosis, Prophylaxis, and Treatment:-- AIDS, MOTT (mycobacteria other than TB) Legionellosis, Chikungunya, Cholera caused by *V. cholerae* 0139,Swine flu.	01	**15**
	II	**Study of Infections- II** Detailed Study of following infections including Etiology, Transmission, Pathogenesis, Clinical Manifestations, Lab.diagnosis, Prophylaxis, and Treatment:-- Conditions caused by *Helicobactor pylori,* Campylobacter, Dengue, SARS, Listeriosis, VRE (Vancomycin Resistant enterococci), Leptospirosis, Hepatitis non A, prions	01	**15**
	III	**Role of Biofilms in diseases** 3.1 Structure and properties of biofilms: 3.2 Formation of biofilm , Regulation of Initial Attachment, Biofilm Formation Proceeds via Multiple Convergent Genetic Pathways, Early Attachment Events, Maturation of the Biofilm , Detachment and Return to the Planktonic Growth Mode 3.3 Biofilm erradication :Methods and commonly used biocides such as surfactants, enzymes, triclosan, chlorhexidine, quarternary ammonium compounds. 3.4 Use of other biofilm management methods such as probiotic organisms and prebiotics to restore disrupted beneficial biofilms to a ¯normal state‖. Correction of environmental conditions for enhanced bioremediation of biofilms (eg dental plaque) Disadvantages of biofilm management strategies- development of resistant strains-cross resistance induction 3.5 Biofilms from different environments,Impact of environment on biofilm development and its composition and implications of each on biofilms in water bodies, biofouling associated microbial biofilms prosthetics associated biofilms,human associated biofilms eg. Gut	01	**15**
	IV	**Epidemiology and Microbiome studies**	01	

		A] Epidemiology of infectious diseases : 4.1 Historical aspects-definition 4.2 Descriptive Epidemiology-aims and uses 4.3 Host parasite interactions in the cause of diseases 4.4 Epidemiological principles in prevention and control of Diseases 4.5 Measures of risks: frequency measures, morbidity frequency measures, mortality frequency measures natality(birth) measures, measures of association, measures of public health impact. 4.6 Public health surveillance: purpose and characteristics, identifying health problems for surveillance, collecting data for surveillance, analyzing and interpreting data, disseminating data and interpretation, evaluating and improving surveillance. B] Microbiome studies a. Stomach, small and large intestinal microbiome b. Function of the Human Gut Microbiota b. Gut Microbiota in health and disease		**08** **07**

Reference Books

RPSMIC 401

1. Clinics in laboratory medicine, Emerging Infections and their causative agents. September 2004vol. 24 no. 3.

2. Textbook of Microbiology 8th edition 2009-Ananthnarayan & Paniker-University press

3. Davies DG, Parsek MR, Pearson JP,Iglewski BH, Costerton JW, Greenberg EP. 1998. The involvement of cell-to cell signals in thedevelopment of a bacterial biofilm. Science 280 (5361):295-98

4. O'Toole GA, Kolter R. 1998. The initiation of biofilm formation in Pseudomonas aeruginosa WCS365 proceeds via multiple, convergent signaling pathways: a genetic analysis. Mol. Microbiol. 28:449-61

5. Morris, C. E. and Monier, J. M. 2003.The ecological significance of biofilm formation by plant-associated bacteria. Annu. Rev. Phytopathol. 41:429-53

6. Bacterial biofilms: from the Natural environment to infectious diseases. Nature Reviews Microbiology 2, 95-108 (February 2004)

7. Principles of epidemiology in public health practices 3rd edition (www.cdc.gov/training/products/ss1000)

8. Basic lab methods in medical bacteriology, WHO Geniva.

9. Medical laboratory technology by Godkar.

10. Handbook of Epidemiology- W. Ahrens, I. Pigeot Springer- Verlag Berlin Herdelberg (2005).

11 Epidemiology for Public Health Practice- Robert H Friis & Thomas A. Sellers 3rd editionJones & Bartlett publishers.

12. Textbook of preventive and Community medicine- Park & Park.

13. Infectious disease surveillance by Nikuchia Nikanatha Blackwell Publishing 2005.

14. The Human Microbiota and Microbiome by Julian R. Marchesi
CABI

Course Code: RPSMIC 402

Course Title: Pharmaceutical Microbiology

Academic year 2019-20

Learning objectives:

Pharmaceutical industry encounters problems of microbial contamination in their plants as well as products. So they need to have quality control and assessment to prevent contamination. In this course students will learn basic concepts associated with regulatory factors in pharmaceutical industry like QC, A and GMP. They will also get introduced to design of premises of pharmaceutical industry with respect to structure, layout, cleaning. It is important to understand documentation in this industry. It is important to understand testing done for checking preservation efficacy of preservative used in pharmaceutical product. Nowadays, rational drug designing is evolving as an important branch in science which involves studying of 3 D structures of drug molecule and target molecule. Students will be introduced to techniques involved in drug discovery like proteomics, bioinformatics.

In this course students will get introduced to regulatory affairs of pharmaceuticals industry and some basics of drug discovery.

Learning outcomes: Students should be able to:

- Get introduced to terminology used in pharmaceutical microbiology.
- Understand regulatory aspects in pharmaceutical industry, QC, GCLP.
- Understand design of pharmaceutical industry.
- Understand principle behind microbial testing carried out in pharmaceutical industry.
- Understand concept of validation and apply it to pharmaceutical industry.
- Get introduced to modern methods of drug discovery.
- Understand methods used for proteomic and bioinformatics studies.
- Understand the process of lead identification.
- Get introduced to various softwares used for studying 3D structures of drug and target molecule.

Detail Syllabus

Course Code	Unit	Topics	Credits	Lectures
RPSMIC 402		**Pharmaceutical Microbiology**	**04**	**60**
RPSMIC 402	I	**Principles and applications of GMP in pharmaceuticals** 1.1 Principles – Applications and Definitions 1.2 The concept of Quality 1.3 The regulatory factors 1.4 QC, QA and GMP 1.5 Quality assurance beyond GMP 1.6 ISO	01	**02** **02** **02** **02** **02** **02**
	II	**Quality management,regulatory aspects and Analytical aspects for pharmaceutical products** 2.1 Premises and contamination control, location, design, structure, layout, services and cleaning. 2.2 Personnel management, training, Hygiene and health. 2.3Documentation 2.4 Quality control and GCLP 2.5 Sterile and other products.	01	**04** **02** **01** **02** **02** **04**
	III	**Analytical aspects of cosmetic Products** 3.1 Sanitary practices in cosmetic manufacturing 3.2 Global regulatory and toxicological aspects of cosmetic preservation 3.3 Cosmetics microbiology- testing methods and preservation 3.4 Antimicrobial preservation efficacy and microbial content testing 3.5 Validation method for cosmetics 3.6 Preservation strategy 3.7 Evaluation of antimicrobial mechanism	01	**02** **02** **02** **02** **02** **02** **02** **01**
	IV	**Drug Discovery** 4.1 Modern Methods of Drug Discovery 4.2 Proteomics 4.3 Bioinformatics 4.4 High throughput screening technology 4.5 Natural products for lead identification 4.6 The role of protein 3D structures in the drug discovery process	01	**02** **03** **02** **03** **02** **03**

References:

RPSMIC402

1. Sharp John (2000) Quality in the manufacture of medicines and other healthcare products. Pharmaceutical Press.

2. Iyer S. (2003) Guidelines on cGMP and quality of Pharmaceutical products. D K Publishers Mumbai.

3. Philip A , Taylor and Francis (2006) Cosmetic Microbiology a practical approach.2nd Ed.

4. Denyer S p, Hodges N A and Gorman S P (2005) Hugo and Russell's Pharmaceutical Microbiology. Blackwell Publishing.

5. Bhatia R and Ichhapujani R L (1995) Quality Assurance in Microbiology. CBS publishers and distributors.

6. Hillisch A and Hilgenfeld R (2009) Modern Methods of drug discovery. Springer International Edition.

7. Kadam s s, Mahadik K R and Bothara K G (2009). Principles of medicinal Chemistry. Vol II NiraliPrakashan Pune.

8. Lemke T L and Williams D A (2008) Foye's Principles of medicinal Chemistry. 6th Ed. Wolter Luwer, Lippincott Williams and Wilkins. N Delhi

Course Code: RPSMIC 403

Course Title: Advances in Biotechnology

Academic year 2019-20

Learning objectives:

Many of the pharmaceutical products are manufactured at commercial scale. It is important to understand upstream and downstream production of biopharmaceuticals. In this course students will get introduced to industrial scale production of biopharmaceuticals like cytokines, interferons, insulin etc. Drug discovery tools high throughput screening, chemiinformatics etc. will also be discussed in this course. Intellectual property right (IPR) is an important concept related to securing ownership on your creation. In this course students will be taught about basics of IPR. In biological sciences, ethical issues arise when there is use of animal models, genetically modified organisms (GMOs), humans for experiments. Students should have knowledge and they should be sensitized towards the issue of bioethics. Also they should be made aware of agencies dealing with the issue of bioethics and how to assess whether the given research work is ethical, these things are taught in this course. There is lot of diversity found in marine microorganisms. It is important to explore these organisms for useful products like antibiotics, enzymes, polymers etc. This course thus discusses microbial diversity in marine ecosystem and products that are obtained from them. Genetic engineering is used to manipulate the organism to produce protein of our interest. In this course students will be taught various techniques involved in protein production from not only prokaryotes but also from eukaryotic models. Chemical synthesis of DNA is discussed which is used for synthesis of oligonucleotides like pimers etc. Directed mutagenesis is a method of introducing mutation at specific site in the genome, techniques for which will be discussed in this course. It is important to introduce students to modern field like synthetic biology, which will be done in this course.

This course will essentially teach students various concepts in the field of biotechnology ranging from biopharmaceuticals to synthetic biology.

Learning outcomes: Students should be able to:

- Understand the process of production of various biopharmaceuticals.
- Know about new vaccines and vaccine designing approaches.
- Get introduced to various drug discovery tools and appreciate use of *in silico* methods in drug designing.
- Understand basic concepts of IPR, understand requirements of patentability.
- Know type and categories of biotechnological patent.
- Get sensitized towards ethics in biological sciences.
- Know about regulatory authorities for dealing with ethical issues.
- Understand methods for chemical synthesis and sequencing of DNA.
- Understand process of genetic manipulation in prokaryotic and eukaryotic models.
- Understand the method of directed mutagenesis.
- Understand various steps involved in protein engineering.
- Get introduced to field of synthetic biology and know its applications in industry.

Detail Syllabus

Course Code	Unit	Topics	Credits	Lectures
RPSMIC 403		**Biotechnology & Environmental Resource Management**	**04**	**60**
RPSMIC 403	I	**Pharmaceutical Biotechnology** 1.1 Biologics, Biopharmaceuticals, 1.2 Protein structure stability, folding, structure prediction, Post translation modifications, Protein Therapeutics – Upstream and Downstream processing, Cytokines, Interferon production, Interleukins production, Therapeutic hormones – Insulin, Human Growth Hormone, Recombinant blood products, Therapeutic Enzymes 1.3 Newer Vaccines, Vaccine Designing Approaches 1.4 Drug Discovery Tools, Combinatorial Chemistry, High Throughput Screening, Chemiinformatics, In silico Modelling, Molecular Modeling, Structure Prediction, Rational Drug Designing, Drug Development, Concept of Pharmacognosy, Pharmacokinetics and Pharmacodynamics	01	**02** **05** **03** **05**
	II	**IPR and Ethics in Biotechnology** 2.1 Biotechnology and Intellectual Property Rights 2.1 a. Intellectual Property Rights (IPR) and Protection (IPP) 2.1 b. Biotechnology and IPR-Rationale of Patent in Research and Scientific Innovations , Biotechnological Patents 2.1 c. Requirements for Patentability- Patentable subject matter, Novelty, Invention in Biotechnological Research, Industrial Applicability, Enablement Requirement. 2.1 d. Patent Specifications and Basic Component of License Agreement, In IP System 2.1 e. Categories of Biotechnological Patents-Patenting in New Era of Genomics, Proteomics and Microbiology, Examples of Patents granted by USPTO, Concerns over Biotechnology Patents. Biotechnology and Bioethics Bioethics and cross-cultural bioethics.- Autonomy, Rights, Beneficience, Do No Harm, Justice,Confidentiality, Animal Rights, Environmental ethics, Decision-Making Perceptions of Ethical Biotechnology.-‗Moral' is not the same as Ethical, Mixed Perception of Benefit & Risk, Reasoning behind Acceptance or Rejection of Genetic Manipulation,Concerns about Consuming	01	**12**

		products of GMOs. Past and Present _Bioethical Conflicts' in Biotechnology- Interference with Nature , Fear of Unknown, Regulatory Concerns, Human Misuse Future _Bioethical Conflicts' in Biotechnology. - Changing perception of Nature, Human Genetic Engineering Bioethics vs Business: A Conflict?- IPP, Global Issues of Technology Transfer, Safety vs Costs, Is New Technology Better Resolution of Conflicts- Who can be trusted?, Public Education, Sufficient Regulations Ethical limits of Biotechnology.-Absolute or Relative, Timeless or Transient 2.2. Criteria to Assess whether Biotech Research is Ethical.		**03**
	III	**Environmental & natural resources management and safety standards** 3.1 Natural resources: Renewable/ non renewable. Land, water, forest, minerals, energy, food. Associated problems and management practices. Environmental Impact Assessment and Sustainable Development 3.2 Solid waste management: Biodegradable waste from kitchen, abattoirs and agricultural fields and their recycling by aerobic composting or biomethanation. Non biodegradable waste like plastics, glass metal scrap and building materials and plastic recycling, metal recycling. 3.3 Hazardous waste management: Hazardous waste from paint, pesticides and chemical industries and their composition, Sewage & Sludge treatment and disposal methods. Probable means to reduce these waste through Common Effluent Treatment Plants. 3.4 Biomedical and electronic waste management, recovery of precious metals from electronic waste resources. 3.5 Biohazards: Introduction, levels of biohazards, Risk assessment, proper cleaning procedures 3.6 Biosafety: Historical background and introduction, need of biosafety levels, biosafety guidelines for GMOs and LMOs. Role of Institutional biosafety committee. RCGM, GEAC, etc. for GMO	01	**06** **03** **04** **02**

		applications in food and agriculture. Environmental release of GMOs. Overview of national regulations and relevant international agreements. Ecolabelling, IS 22000, Generally Recognized as Safe (GRAS)		
	IV	**Advances in Molecular Biotechnology** 4.1 Chemical synthesis and sequencing of DNA: Phosphoramidite method, Uses of synthesized oligonucleotides, Dideoxynucleotide method for sequencing of DNA, Automated DNA sequencing, Using Phage M13 as a sequencing vector 4.2 Manipulation of Gene Expression in Procaryotes: Gene expression from strong and regulatable promoters, Fusion proteins, unidirectional tandem gene arrays, Increasing protein stability, protein folding, DNA integration into host chromosome, 4.3Heterologous protein production production in eukaryotic cells:Expression systems like Saccharomyces cerevisiae, Pichia pastoris, Baculovirus-Insect cell, mammalian cell 4.4 Directed Mutagenesis: Oligonucleotide directed mutagenesis with M13, Oligonucleotide directed mutagenesis with plasmid DNA, PCR amplified oligonucleotide directed mutagenesis, Random mutagenesis with degenerate oligonucleotide primer, Random mutagenesis with nucleotide analogues, Error-prone PCR, DNA shuffling, Mutant proteins with unusual amino acids 4.5Protein Engineering: Adding disulfide bonds, Changing aspargine to other amino acids, Reducing the number of free sulfhydryl residues, Increasing enzymatic activity, Modifying metal cofactor requirement, Decreasing protease sensitivity, Modifying protein specificity, Increasing enzyme stability and specificity, altering multiple properties 4.6 Synthetic Biology: Introduction, types, mechanisms, applications in industry	01	**03** **03** **03** **03** **02** **01**

References:

RPSMIC403

1. Gary Walsh, Pharmaceutical Biotechnology – Concepts and Applications (E-Book), John Wiley & Sons Ltd. (2007)

2. Jogdand S. N., Biopharmaceuticals, Himalaya Publishing House, Mumbai (2006)

3. K. Sambamurthi, Pharmaceutical Biotechnology, New Age International (2006)

4. Daan J. A. Crommelin, Robert D. Sindelar and Bernd Meibohm Pharmaceutical Biotechnology: Fundamentals and Applications, informa healthcare, (Oct 30, 2007)

5. Biodiversity,Biotechnology&Traditional Knowledge- Understanding Intellectual Property Rights , Aravind Kumar, Govind Das, Narosa

6. A textbook of Biotechnology, R.C.Dubey ,S.Chand

7. Biotechnology,Second Completely Revised Edition-Volume 12-Legal,Economic and Ethical Dimensions.Volume Editor-D.Brauer(A multi- Volume Comprehensive Treatise),H.J.Rehm and G.Reed, A.Puhler ,P Stadler

8. Ethics in Biotechnology-An Executive Guide ,Chris MacDonald &Rahul.K. Dhanda

9. www.BiotechEthics.ca

10. David H.Attway& Oskar R.Zabosky: Marine Biotechnology, Volume 1,2,3, plenum press (1993).

11. Molecular Biotechnology: Principles and Applications of Recombinant DNA Bernard R. Glick, Jack J. Pasternak, 4/e (2010), ASM Press

12. An Introduction to Molecular Biotechnology: Molecular Fundamentals, Methods and Applications in Modern Biotechnologyedited by Michael Wink, (2006)Wiley VCH

13. Molecular biotechnology: principles and practices Channarayappa, (2006), Universities Press

Course Code: RPSMIC 404

Course Title: Internship

Academic year 2019-20

PRACTICALS: RPSMIC 4P1 (60 Contact Hrs)

1. Diagnosis for HIV - Trispot/ ELISA for AIDS (Demonstration)
2. Acid fast staining for MOTT
3. Mono - Spot Test for diagnosis of Chikungunya (Demonstration expt.)
4. Diagnosis for V.c.0139 5.Cholera red test, String test, Oxidase test, Biochemical tests, & isolation on TCBS medium for identification of Vibrio cholerae 0139.
5. Diagnosis for Helicobacter pylori HPSA (Helicobacter pylori) (Demonstration expt.) (kit method)

PRACTICALS: RPSMIC 4P2 (60 Contact Hrs)

1. Sterility testing and reporting (as per Pharmacopia)
2. Microbial load in cosmetic product
3. Efficacy testing of preservatives like parabens
4. Efficacy of preservation and shelf life study.
5. Preparation of cosmetic product and its preservation study

PRACTICALS: RPSMIC 4P3 (60 Contact Hrs)

1. Assignments on IPR-Case studies on different patents granted
2. Report on International Bioethics survey on specific concerned issues
3. Research Project experimental work

PRACTICALS: RPSMIC 4P4 (60 Contact Hrs)

1. Internship – Students will be sent for internship to research nstitute/industry for a period of four months

Modality of Assessment (Semester III) :

Theory

A) Internal Assessment - 40%

40 marks

Sr No	Evaluation type	Marks
1	Presentation & assignment	15
2	One class Test (multiple choice questions / objective)	20
3	Active participation in routine class instructional deliveries	05
4	Overall conduct as a responsible student, manners, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.	

B) External examination- 60 %

Semester End Theory Assessment -60 marks

A. Duration - These examinations shall be of 2.5 hours duration

B. Theory question paper pattern:-

1. There shall be five questions each of 12marks on each unit. Fifth one will be based on all the four units.
2. All questions shall be compulsory with internal choice within the questions. Each question will be of 20 to 23 marks with options.
3. Questions may be subdivided into sub-questions a, b, c, d & e only &the allocation of marks depends on the weightage of the topic.

Questions	Options	Marks	Questions on
Q.1)	Any 2 out of 4	12	Unit I
Q.2)	Any 2 out of 4	12	Unit II
Q.3)	Any 2 out of 4	12	Unit III
Q.4)	Any 2 out of 4	12	Unit IV
Q.5) A	Any 4 out of 8	04	Unit I, II, III, IV
Q.5) B	Any 4 out of 8	04	
Q.5 C	Any 2 out of 4	04	

Practical Examination Pattern (Semester III) :

Particulars	Practical 1	Practical 2	Practical 3	Practical 4
Laboratory work	15	30	20	15
Quiz	-	-	10	-
Viva	05	-	-	05
Project Work presentation	30	20	20	30
Total	**50**	**50**	**50**	**50**

PRACTICAL BOOK/JOURNAL

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head/ Co-ordinator / Incharge of the department; failing which the student will not be allowed to appear for the practical examination.

Research project work: Candidates are required to present duly certified dissertation report based on the topic of research along with the laboratory notebook containing raw data and make the poster presentation of the research work for evaluation by the examiner.

Modality of Assessment (Semester IV) :

Theory

Paper I		Paper II		Paper III		Paper IV	
Theory	**Internal**	**Theory**	**Internal**	**Theory**	**Internal**	**Internship evaluation by mentor**	**Internship evaluation by internal faculty**
60 marks	40 marks	60 marks	40 marks	60 marks	40 marks	60 marks	40 marks

Semester End Theory Assessment -60 marks

B. Duration - These examinations shall be of 2.5 hours duration

C. Theory question paper pattern:-

4. There shall be five questions each of 12marks on each unit. Fifth one will be based on all the four units.
5. All questions shall be compulsory with internal choice within the questions. Each question will be of 20 to 23 marks with options.
6. Questions may be subdivided into sub-questions a, b, c, d & e only &the allocation of marks depends on the weightage of the topic.

Questions	Options	Marks	Questions on
Q.1)	Any 2 out of 4	12	Unit I
Q.2)	Any 2 out of 4	12	Unit II
Q.3)	Any 2 out of 4	12	Unit III
Q.4)	Any 2 out of 4	12	Unit IV
Q.5) A	Any 4 out of 8	04	Unit I, II, III, IV
Q.5) B	Any 4 out of 8	04	
Q.5 C	Any 2 out of 4	04	

Practical Examination Pattern (Semester IV)

Particulars	Practical 1	Practical 2	Practical 3	Practical 4
Practical	50	50	-	-
Internship presentation	-	-	50	-
Internship Report	-	-	-	50
Total	50	50	50	50

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head of the Department/ Co-ordinator of the department ; failing which the student will not be allowed to appear for the practical examination.

Overall Examination Pattern

Semester III

Course	RPSMIC 301			RPSMIC 302			RPSMIC 303			RPSMIC 304			Grand Total
	Internal	External	otal	Internal	External	Total	Internal	External	Total	Internal	xternal	otal	
Theory	40	60	100	40	60	100	40	60	100	40	60	100	400
Practicals	-	50	50	-	50	50	-	50	50	-	50	50	200

Semester IV

Course	RPSMIC 401			RPSMIC 402			RPSMIC 403			RPSMIC 404			Grand Total
	Internal	External	otal	Internal	External	Total	nternal	External	Total	Internship evaluation	nternship evaluation	Total	
Theory	40	60	100	40	60	100	40	60	100	40	60	100	400
Practicals	-	50	50	-	50	50	-	50	50	-	50	50	200

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