Estd. 1962
"A++" Accredited by NAAC (2021)
With CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR - 416004, MAHARASHTRA
PHONE:EPABX-2609000, www.unishivaji.ac.in, bos@unishivaji.ac.in
शिवाजी विद्यापीठ, कोल्हापूर -४१६००४,महाराष्ट्र
दूरध्वनी-ईपीएबीएक्स -२६०९०००, अभ्याससमंडळे विभाग दुरध्वनी ०२३१—२६०९०९४
०२३१—२६०९४८७

SU/BOS/Science/350 **Date: 24/06/2024**

To,

The Principal,
All Concerned Affiliated Colleges/Institutions
Shivaji University, Kolhapur

Subject: Regarding Minor Change syllabi of B.Sc. Part-I (Sem.I & II) as per NEP-2020 (2.0) degree programme under the Faculty of Science and Technology.

Ref: SU/BOS/Science/876/ Date: 26/12/2023 Letter.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the Minor Change syllabi, nature of question paper of B.Sc. Part-I (Sem.I & II) as per NEP-2020 (2.0) degree programme under the Faculty of Science and Technology.

B.Sc.Part-I (Sem. I & II) as per NEP-2020 (2.0)			
1.	Botany	9.	Geology
2.	Physics	10.	Zoology
3.	Statistics	11.	Chemistry
4.	Astrophysics	12.	Geography
5.	Mathematics	13.	Electronics
6.	Microbiology	14.	Drug Chemistry
7.	Plant Protection	15.	Industrial Microbiology
8.	Astrophysics and Space Science	16.	Sugar Technology (Entire)

This syllabus, nature of question and equivalence shall be implemented from the academic year 2024-2025 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in NEP-2020@suk(Online Syllabus)

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2024 & March/April 2025. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Dy Registrar
Dr. S. M. Kubal

Copy to:

1	The Dean, Faculty of Science & Technology	4	B.Sc. Exam/ Appointment Section
2	Director, Board of Examinations and Evaluation	5	Computer Centre/ Eligibility Section
3	The Chairman, Respective Board of Studies	6	Affiliation Section (U.G.) (P.G.)

SHIVAJI UNIVERSITY, KOLHAPUR

Established: 1962

A^{++} Accredited by NAAC (2021) with CGPA 3.52

Structure and Syllabus in Accordance with

National Education Policy - 2020

with Multiple Entry and Multiple Exit

Syllabus For

B.Sc.Part–I

MICROBIOLOGY

(Faculty of Science and Technology)

SEMESTER I AND II

(To Be Implemented From Academic Year 2024-25)

Shivaji University, Kolhapur

Bachelor of Science, Credit Framework

First Year

Level	Semester				3-OE	4-SEC	5-AEC, VEC, IKS			6-OJT, FP, CEP, CC, RP			Total Credits
					IDC/MDC/ OE/GE	SEC	AEC (Language)	Value Education Courses (VEC)	IKS	CC	Summer Internship/Field Project/OJT	Research Project / Dissertation	
		Subject-1	Subject-1I	Subject-1II	OE								
4.5	I	DSC-I (2) DSC-II (2) DSC Pract. -I (2)	DSC-I (2) DSC-II (2) DSC Pract. -I (2)	DSC-I (2) DSC-II (2) DSC Pract. -I (2)	OE -I (T/P) (2)				IKS-I (2) Introduction to IKS			-	
	Credits	4+2=6	4+2=6	4+2=6	2+0=2	-	-	-	2	-	-	-	22
	II	DSC-III (2) DSC-IV (2) DSC Pract.-II (2)	DSC-III (2) DSC-IV (2) DSC Pract.-II (2)	DSC-III (2) DSC-IV (2) DSC Pract.-II (2)	OE-II (T/P) (2)			VEC- I (2) Democracy				-	
	Credits	4+2=6	4+2=6	4+2=6	0+2=2	-	-	2	-	-	-	-	22
1st Year Cum. Credits		12	12	12	4	-	-	2	2				44

Exit option: Award of UG Certificate with 44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor

Learning Outcomes:

A candidate who wish to graduate in B.Sc. (Microbiology Course) needs to have acquired/developed following competencies:

1. Acquired knowledge and understanding of the microbiology concepts as applicable to diverse areas such as medical, industrial, environment, genetics, agriculture, food and others.
2. Demonstrate key practical skills/competencies in working with microbes for study and use in the laboratory as well as outside, including the use of good microbiological practices.
3. Competent enough to use microbiology knowledge and skills to analyze problems involving microbes, articulate these with peers/ team members/ other stake holders, and undertake remedial measures/studies etc.
4. Developed a broader perspective of the discipline of Microbiology to enable him to identify challenging societal problems and plan his professional career to develop innovative solutions for such problems.

SEMESTER- I

F. Y. B. Sc. (MICROBIOLOGY) SEMESTER I

DSC- I : Introduction to Microbiology

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK - 02]

Learning Objectives:

1. To develop a good knowledge of the development of the discipline of Microbiology and the contributions made by prominent scientists in this field.
2. To develop a very good understanding of the characteristics of different types of microorganisms, methods to organize/classify these into and basic tools to study these in the laboratory.
3. To explain the useful and harmful activities of the microorganisms and scope of different branches of Microbiology.
4. To describe characteristics of bacterial cells, cell organelles and various appendages like capsules, flagella or pili.

Unit I /Credit I	**History and Scope of Microbiology**	**No. of hours: 15**
	A. History of Microbiology 1. Spontaneous generation *vs*. biogenesis. 2. Contributions of - a. Antony von Leeuwenhoek, b. Edward Jenner , c. Louis Pasteur , d. Robert Koch , e. Ivanowsky , f. Joseph Lister , g. Alexander Fleming , h. Martinus W. Beijerinck and i. Sergei N. Winogradsky. B. Introduction to types of Microorganisms : 1. General characteristics of different groups: a. Acellular microorganisms-Viruses, Viroids and Prions b. Cellular microorganisms- Bacteria, Algae, Fungi and Protozoa – General Characteristics c. Ultra structure of Prokaryotic and eukaryotic cell, difference between prokaryotic and eukaryotic microorganisms.	

	C. Bacterial Nomenclature and Classification : a. Taxonomic ranks b. Common or Vernacular name c. Scientific or International name d. Carl Woese's three domain classification systems. D. An overview of Scope of Microbiology: 1. Beneficial and harmful activities of microorganisms. Introduction to applied branches of Microbiology: a. Air, b. Water ,c. Sewage , d. Soil , e. Dairy , f. Food , g. Medical ,h. Industrial , i. Biotechnology and j. Geomicrobiology.	
Unit II /Credit II	**Bacterial Cell Structure and Functions**	**No. of hours: 15**
	A. Cell size, shape and arrangement B. Cytology of Bacteria : i) Cell wall :Composition and detailed structure of Gram-positive and Gram-negative bacterial cell walls ii) Cell Membrane: Structure, function & chemical composition of bacterial cell membranes. iii) Structure and functions of Capsule and slime layer. iv) Structure and functions of Flagella v) Structure and functions of Pilli. C. Structure and functions of Cytoplasmic Components: a. Ribosomes b. Mesosomes c. Nucleoid d. Plasmids e. Endospore: Structure, stages of sporulation f. Reserve food materials - Nitrogenous and non-nitrogenous	

SEMESTER- I

F. Y. B. Sc. (MICROBIOLOGY) SEMESTER I

DSC- II : Basic Techniques in Microbiology

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK - 02]

Learning Objectives :

1. To study the staining techniques for the observation of bacteria and bacterial cell components
2. To study the working principle, handling and use of microscopes for the study of microorganisms
3. To understand the principles of sterilization and disinfection of culture media, glassware and plastic ware and other objects to be used for microbiological work.

Unit I / Credit I	**Staining Techniques and Microscopy**	**No. of hours: 15**
	1. **Stains and staining procedures** A. Definition and Classification of stains - Acidic, Basic and Neutral B. Principles, Procedure, Mechanism and applications of staining procedures i) Simple staining ii) Negative staining iii) Differential staining: Gram staining and Acid fast staining C. Special staining methods i) Cell wall (Chance's method) ii) Capsule (Maneval's method) iii) Volutin granule (Albert's method) 2.**General Principles of Microscopy:** a. Types of microscopes: light and electron microscopes b. Light microscopy: Parts, Image formation, Magnification, Numerical aperture (uses of oil immersion objective), Resolving power and Working distance. c. Ray diagram, special features, applications and comparative study of : i) Compound Microscope ii) Electron Microscope iii)	

Unit II / Credit II	Control of Microorganisms	No. of hours: 15
	A. Definitions of - Sterilization, Disinfection, Antiseptic, Germicide, Microbiostasis, Antisepsis and Sanitization. B. Physical agents for control of microorganisms: a. Temperature – a) Dry heat b) Moist heat b. Desiccation c. Osmotic pressure d. Radiations - U.V. Ray, Gamma rays, e. Filtration – Asbestos and Membrane filter C. Chemical Agents for control of microorganisms: Mode of action, application and advantages of - a. Phenol and Phenolic compounds b. Alcohols (Ethyl alcohol) c. Halogen compounds (chlorine and iodine) d. Heavy metals (Cu and Hg) e. Gaseous Agents – Ethylene oxide, Beta-propiolactone and formaldehyde	

DSC Pract. -I: PRACTICALS BASED ON DSC I & II

[CREDITS - 02; PRACTICALS - 60 hours , Practicals /week - 04]

Paper I &II: Introduction to Microbiology And Basic Techniques In Microbiology Learning Objectives:

1. To understand the basic techniques in Microbiology laboratory
2. To study the working principle, handling and use of compound microscope for the study of microorganisms
3. To study the simple and special staining techniques for the observation of bacteria and bacterial cell components
4. To understand the working principles and applications various equipment's in Microbiology laboratory
5. To study the preparation, sterilization and use of various culture media.

Unit I / Credit I	**Basic Techniques**	**No. of hours: 15**
	1. Biosafety- a. Aseptic techniques b. Table disinfection c. Hand wash d. Use of aprons e. Proper disposal of used material f. Cleaning and sterilization of glassware 2. Study of parts of light compound microscope, its use and care. 3. Staining Techniques - a. Monochrome staining b. Negative staining c. Gram's staining d. Cell wall staining (Chance's method), e. Capsule staining (Maneval's method), f. Volutine granule staining (Albert's method) 4. Motility by Hanging drop method. 5. Study of the principle and applications of instruments a. Biological safety cabinets – Laminar Air Flow Device b. Autoclave c. Incubator	

	d. Hot air oven e. Colorimeter, f. Colony counter	
Unit II / Credit II	**Preparation of Culture Media**	**No. of hours: 15**
	1. Preparation of culture media and their sterilization - agar plates, buts and slants 2. Simple media: a. Peptone water – 1% & 2 % b. Nutrient broth c. Nutrient agar 3. Biochemical test media : a. Glucose phosphate broth b. Koser's citrate broth c. Milk agar d. Starch agar 4. Selective media - Sabouraud's agar, Potato Dextrose Agar 5. Selective & Differential Media -MacConkey's agar.	

SEMESTER- II

DSC- III: : Bacteriology

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK - 02]

Learning Objectives:

1. To describe the nutritional requirements of bacteria and other microbes which grow under extreme environments.
2. To understand the basic laboratory experiments to isolate, cultivate and differentiate bacteria
3. To study the preservation of bacteria in the laboratory

Learning Outcomes:

1. Capable of design the nutritional media of bacteria and other microbes which grow under extreme environments.
2. Able to isolate, cultivate and differentiate bacteria
3. Able to preserve of bacteria in the laboratory

Unit I / Credit I	Microbial Nutrition and Culture Media	No. of hours: 15
	A. Nutritional requirements of microorganisms: a. Water b. Micronutriments c. Macronutrients d. Carbon e. Energy source f. Oxygen g. Hydrogen h. Nitrogen i. Sulphur j. Phosphorous k. growth factors – auxotroph, prototroph and fastidious organisms. B. Nutritional types of microorganism based on carbon and energy sources: a. Autotrophs b. Heterotrophs c. Phototrophs d. Chemotrophs e. Photoautotrophs f. Chemoautorphos g. Photoheterotrophs h. Chemoheterotrophs C. Types of Culture Media: a. Components of media b. Natural and Synthetic media c. Chemically defined media d. Complex media, Selective e. Differential f. Enriched g. Enrichment media. D. Cultivation of microorganisms: a. Use of culture media for cultivation b. Conditions required for growth of the microorganisms.	

Unit II / Credit II	**Isolation, Cultivation and Preservation of Microorganisms.**	**No. of hours: 15**
	A. Isolation of Microorganisms from natural habitats : a. Pure culture techniques – Streak plate, Spread plate, Pour Plate and micromanipulator b. Isolation and cultivation of anaerobic organisms by using media components and by exclusion of air/O2 B. Preservation of microbial cultures : a. Subculturing b. overlaying of cultures with mineral oils c. storage at low temperature d. lyophilization C. Systematic study of pure cultures: a. Morphological characteristics. b. Cultural characteristics : i. Colony characteristics on solid media ii. growth in liquid media iii. growth on agar slants D. Biochemical Characteristics – a. Sugar fermentation b. Production of metabolites - H_2S gas c. Production of enzymes - Amylase, Caseinase and Catalase.	

DSC-IV: Applied Microbiology

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK - 02]

Learning Objectives:

1. To develop a very good understanding of applied branches of Microbiology.
2. To develop the knowledge of how the microorganisms play role in Water microbiology
3. To make well conversant about food preservation techniques
4. To develop knowledge of milk processing and milk testing.

Unit I / Credit I	**Air and Water Microbiology**	**No. of hours: 15**
	1.Air Microbiology: **A.** Sources of microorganisms in air. **B.** Definitions of - Infectious dust, Droplets & Droplet nuclei **C.** Sampling methods for microbial examination of air 1. Solid impaction - Sieve device **D.** Liquid Impingement – Bead-bubbler device 2. Water Microbiology: a. Sources of microorganisms in water. b. Fecal pollution of water, Indictors of fecal pollution of water – *E. coli* c. Routine Bacteriological analysis of water. ii. SPC iii. Tests for coliforms - 1. Qualitative-Detection of coliforms - Presumptive test, Confirmed Test, Completed test. Differentiation between coliforms - IMViC test, Eijkman test. 2. Quantitative – MPN, Membrane filter technique d. Municipal water purification process and its significance.	

Unit II / Credit II	Food and Dairy Microbiology	No. of hours: 15
	1. Food Microbiology _ a. Introduction b. Microbial spoilage of food c. Food Preservation : General Principle and methods and Application Asepsis, Removal of Microorganisms, Dehydration, Use of Heat, Irradiation, Anaerobiosis, Chemicals 2. Milk Microbiology: A. Sources of microorganisms in milk B. General composition of Milk. C. Microbiological examination of Milk – DMC, SPC and dyereduction test- MBRT test D. Pasteurization - Definition, Methods – LTH , HTST ,UHT, Efficiency of Pasteurization– Phosphatase test (Qualitative)	

DSC Pract. -II

: PRACTICALS BASED ON DSC III & IV

Bacteriology and Applied Microbiology

: [CREDITS - 02; PRACTICALS - 60 hours , Practicals /week - 04]

Learning Objectives:

1. To understand the basic laboratory experiments to isolate and cultivate
2. To study various biochemical tests used to differentiate bacteria

Unit I / Credit I	**Study of Bacteria**	**No. of hours: 15**
	1. Demonstration of presence of micro flora in / on – 1. Air by solid impaction technique on nutrient agar plates 2. Water by direct cultivation method 3. Hand, nails, teeth and skin (swabbing) by direct cultivation methods. 2. Isolation of pure cultures of bacteria by four quadrant streaking method and study of Colony characteristics, Gram staining and motility of – 1. *Escherichia coli* 2. *Bacillus species* 3. *Staphylococcus aureus* 3. Enumeration of bacteria from water and milk by SPC method.	
Unit II / Credit II	Biochemical Tests	No. of hours: 15
	1. IMViC Test 2. MBRT Test 3. H_2S production test 4. Sugar fermentation - glucose and lactose 5. Enzyme production - Amylase Catalase Caseinase	

Books recommended for Theory

1. Microbiology by Pelczar, M.J.Jr., Chan E.C.S., Krieq, N.R. 5th edition, 1986 (McGraw Hills Publication).
2. Fundamental Principles of bacteriology by A. J. Salle, Tata McGraw Hill.
3. Fundamentals of Microbiology by Frobisher, Hindsdill, Crabtree, Good Heart, W.B. Saunders

Company, 7th edition.

4. Medical Microbiology Vol. I and II by Cruick Shank R., Duguid J.P., Marmion B.P., Swain R.H.A., XIIth edition, Churchill Livingston, New York.
5. A textbook of Microbiology by Ananthnarayan – Orient Longman, Bombay
6. General Microbiology by Stanier R. Y. Vth edition, McMilan, London.
7. General Microbiology Vol I and II by Powar and Daginawala, Himalaya Publications.
8. Medical Bacteriology by Dey and Dey – Allied Agency, Calcutta.
9. Food Microbiology by W. C. Frazier.
10. Basic Experimental Microbiology by Ronal M. Atlas, Alfred E. Brown, Kenneth W. Dobra, Wonas Miller (1986) Pren-tice Hall.
11. General Microbiology by Robert F. Boyd (1984), Times, Mirror/Mosby College.
12. A Biologics guide to principles, techniques of Practical Biochemistry by K. Wilson and K. H. Goulding, Edward Arnold Publication.
13. Introduction to Practical Biochemistry by D. Plummer, J. Willey and Sons.
14. Microbiology by Prescott, Herley and Klein, IInd edition.
15. Bacteriological Techniques by F. K. Baker
16. Introduction to Microbial Techniques by Gunasekaran.
17. Biochemical methods by Sadasivam& Manickam
18. Elementary Microbiology Vol. I by Dr. H.A. Modi, Akta Prakashan, Nadiad, Gujrat.
19. Principles of Biochemistry by Nelson and Cox (Lehninger) – Fifth edition

Books recommended for Practical

1) Medical Microbiology by Cruickshank Vol. II.

2) Stains and Staining procedures by Desai and Desai.

3) Introduction to Practical Biochemistry by D. Plummer, J Wiley and Sons.

4) Bacteriological techniques by F. J. Baker.

5) Introduction to Microbial techniques by Gunasekaran.

6) Biochemical methods by Sadasivam and D. Manickam.

7) Laboratory methods in Biochemistry by J. Jayaraman.

8) Experimental Microbiology by Patel & Patel

List of Minimum Equipment's

1. Hot air oven – 1
2. Incubator - 1
3. Autoclave - 1
4. Refrigerator – 1
5. Medical microscopes - 10 nos. for one batch
6. Digital balance - 2
7. pH meter - 1
8. Seitz filter – 1
9. Centrifuge - 1
10. Colorimeter - 1
11. Distilled Water Plant – 1
12. Laminar air flow cabinet - 1
13. Arrangements for gas supply and fitting of two burners per table.
14. One working table of 6' x 2½' for two students.
15. One separate sterilization room attach to the laboratory (10' x 15')
16. At least one wash basin for a group of five students
17. Colony counter
18. Water bath
19. One separate instrument room attached to lab (10' x 15')
20. One laboratory for one batch including working tables (6' x 2½') per two students for one batch
21. Store room (10' x 15')
22. Lactometer

Practical Examination

(A) The practical examination will be conducted at end of each semester on two consecutive days for three hours per day per batch of the practical examination.

(B) There will be at least one external examiner for practical examination.

(C) Each candidate must produce a certificate from the Head of the Department in her/his college, stating that he/she has completed in a satisfactory manner the practical course on lines laid down from time to time by Academic Council on the recommendations of Board of Studies and that the journal has been properly maintained. Every candidate must have recorded his/her observations in the laboratory journal and have written a report on each exercise performed. Every journal is to be checked and signed periodically by a member of teaching staff and certified by the Head of the Department at the end of the year. Candidates must produce their journals at the time of practical examinations.

Theory Examination

Question Paper Pattern (40 Marks) Theory Exam		
Q. No.	**Nature / Type of Question**	**Marks**
1.	Multiple Choice Questions (MCQ) 8 Questions	**8 Marks** (1 Marks for each question)
2.	Write descriptive question Attempt any 2 out of 3 questions	**16 Marks** (8 Marks for each question)
2.	Write Short Notes Attempt any 4 out of 6 questions	**16Marks** (4 Marks for each question)
6.	**Total Marks**	**40**

****

OPEN ELECTIVE COURSE-OE-1

COURSE TITLE: FERMENTED FOODS AND PRESERVATION TECHNOLOGY

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK - 02]

Course Learning objectives
The objective of this course is to; *1.* Demonstrate the role played by microbes in food production and food spoilage *2.* Make student familiar with the traditional and modern fermented foods *3.* Give an overview of food borne illnesses *4.* Make students understand the concepts of food preservation and food safety
Course leraning outcomes
After completion of this course learner will be able to; *1.* Understand the interaction between microbes and food *2.* Know and explore more about Indian fermented foods *3.* Appreciate the science behind food preservation techniques 4.Practice food hygiene and sanitization to overcome food borne illnesses

Credit I	**Introduction to Fermented Foods**	**No. of hours: 15**
	1. Fermented Foods 1.1 Introduction to fermentation 1.2 Classification of fermented foods 1.3 Ethnic and Modern Indian fermented foods 1.4 Overview of other fermented foods 1.5 Pre and Probiotics **2.** Production of Traditional Foods 2.1. Fermented foods-,Bread,Yoghurt. Butter. 2.2. Cottage Cheese, Soy sauce. **2.3.** Pickles- 1.Sauerkraut 2.Cucumber 3.Olives 3. Beverages- 3.1 Non alcoholic-Coffee, tea, 3.2Alcoholic Beverages 1. Wine: - Industrial production of - a) Red Table Wine b) Sparkling Wine-Champagne 2. Beer: - a) Ale b) Lager	

Credit II	**Preservation Technology**	**No. of hours: 15**
	A) Food preservation by removal of microorganisms, low temperature, high temperature irradiation chemical methods. Food borne infection, food borne intoxications B) Newer Preservation &Processing technology- Natural antimicrobials, Hydrostatic pressure, Electric pulse, , High magnetic pulse, Minimally processed foods, Bio preservation, Hurdle technology	

References:

1.Mudambi R and Rajagopal M. V. 2001. Fundamentals of food and nutrition. 4t Edi. New Age International Ltd. Publ.

2. Swaminathan M. Principles of Nutrition and Dietetics. 2nd Edi

3. Banerjee G. C. 1998. 8th Edi. Text book of Animal Husbandary.

4. Modern Food Science Jou. 2007.

5.Food Microbiology by Frazier.

6.Food Microbiology by H.A .Modi. (Vol. I&II)

7.Industrial Microbiology by A.H.Patel.

8.Industrial Microbiology by Prescott & Dunn.

9. Indian Food Industry. AFST Jou. 2007

OPEN ELECTIVE COURSE-OE-II

COURSE TITLE: FODD SCIENCE AND FOOD PROCESSING

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK - 02]

Course Learning objectives
The objective of this course is to; 1. Demonstrate the role played by microbes in food production and food spoilage 2. Make student familiar with the traditional and modern fermented foods 3. Give an overview of food borne illnesses 4. Make students understand the concepts of food preservation and food safety
Course leraning outcomes
After completion of this course learner will be able to; 1. Understand the interaction between microbes and food 2. Know and explore more about Indian fermented foods 3. Appreciate the science behind food preservation techniques 4. Practice food hygiene and sanitization to overcome food borne illnesses

OE-II	**(CREDITS:02; TOTAL HOURS : 30)**	**No. of Hours per Credit 15**
Credit-1	**. Food Science and Nutrition** **1.1** Chemical Nature, Sources and Functions of Nutrients. Examples Proteins, Carbohydrates, Fats, Minerals, Vitamins, Water, Fibre, Antioxidants and phytochemicals. **1.2** Food Additives – Intentional / Unintentional, general. Examples : Antioxidants, chelating agents, colouring agents, emulsions, flavours and flavour enhancers, flavour improvers, humectants and anticaking agents, leavening agents, nutrient supplements, non nutritive sweeteners, pH controlling agents **1.3** Energy Value of Foods. Methods of measurement of energy, **1.4** Nutritional Disorders due to deficiency and excess of Nutrients. Vitamin deficiency- pernicious anemia, scurvy, night blindness, rickets. Protein deficiency : Kwashiorkar, Mineral deficiency due to iron, iodine and calcium.	

Credit II	**Pri ciples of Food Processiog** **A) Cereal based foods** Pasta. Macaroni. Semolina Processed Soy bean products- Fermented Soyabean Products – miso, tofu, soy sauce **B)** Nutraceuticals C) Probiotic foods-Production and quality control D) Convenience foods E) Processing of fruits and Vegetables-Jam, Jelly, squash. ketchup **F)** Foods of Microbial Origin-SCP- and Mushrooms **Production of SCP** Introduction Production – Algae(Spirulina) Product quality and safety	**15**

References

1.Glick and Pasternak, 3rd Edi. ASM Press. Molecular Biotechnology- Principles and Applications of Recombinant DNA.

2. Kulkarni S. K. Nanotechnology : Principles and Practices. Capital Publ. Co.

3. Sawhney S. K. And R Singh. 2005. Introductory Practical Biochemistry. Narosa Publ. Pvt Ltd.

4. Mudambi R and Rajagopal M. V. 2001. Fundamentals of food and nutrition. 4t Edi. New Age International Ltd. Publ.

5. Swaminathan M. Principles of Nutrition and Dietetics. 2nd Edi

6. Banerjee G. C. 1998. 8th Edi. Text book of Animal Husbandary.

7. Modern Food Science Jou. 2007.

8. The Hindu Survey of Indian Agriculture. 2007.

9. Van Garde S. J. And Woodburn M. 19909. Food Preservation and Safety- Principles and Practice.

10. Manay N. S., and Shadasaraswamy. 2001. Foods –facts and principles. New Age International Pvt Ltd. 2nd Edi. 11. Clive de Blackburn and Peter Mc Clure. Food Bourne pathogens- Hazards, Risks analysis and Control. CRC Wood Publ. Co.

12. Indian Food Industry. AFST Jou. 2007