CBCS SYLLABUS

FOR

THREE YEARS UNDER-GRADUATE COURSE

IN

Physiology (PROGRAMME)

(*w.e.f. 2017*)

BANKURA UNIVERSITY

BANKURA

WEST BENGAL

PIN 722155

CONTENTS

1. Scheme for CBCS Curriculum

1.1 Credit Distribution across Courses

		Credits	
Course Type	**Total Papers**	**Theory + Practical**	**Theory***
Core Courses	12	12*4 =48 12*2 =24	14*5 =70 14*1=14
Discipline Specific Electives	6	6*4=24 6*2=12	4*5=20 4*1=4
Ability Enhancement Language Courses	2	1*2=2 (ENG / MIL) 1*4=4 (ENVS)	1*2=2 (ENG / MIL) 1*4=4 (ENVS)
Skill Enhancement Courses	4	4*2=8	4*2=8
Totals	24	122	122

1.2 Scheme for CBCS Curriculum in Physiology (Programme)

SEMESTER –I

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SP/PHY/101/ C-1A	**CT-1: Physiological Aspect of Community Health** **CP-1: Physiological Aspect of Community Health Lab**	4 2	10	25 15	50	4	N.A.	4
SP/102/ C-2A	Discipline-2 From another discipline	6	10	40	50			
SP/103/ C-3A	Discipline-3 From another discipline	6	10	40	50			
ACSHP/ 104/ AECC-1	Environmental Studies	4	10	40	50	4	N.A.	N.A.
Total in Semester – I		**22**	**40**	**160**	**200**	**8**		**4**

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

SEMESTER –II

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SP/PHY/ 201/C-1B	**CT-2: Developmental Aspect of Embryo and Foetus** **CP-2: Developmental Aspect of Embryo and Foetus Lab**	4 2	10	25 15	50	4	N.A.	4
SP/202/ C-2B	Discipline – 2 From another discipline	6	10	40	50			
SP/ 203/C- 3B	Discipline – 3 From another discipline	6	10	40	50			
ACSHP/204/ AECC-2	English/MIL	2	10	40	50	4	N.A.	N.A.
Total in Semester – II		**20**	**40**	**160**	**200**	**8**		**4**

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

SEMESTER –III

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SP/PHY/ 301/C-1C	**CT-3: Environmental Hazards and Human Physiology** **CP-3: Environmental Hazards and Human Physiology Lab**	4 2	10	25 15	50	4	N.A.	4
SP/302/C-2C	Discipline – 2 From another discipline	6	10	40	50			
SP/ 303/ C-3C	Discipline – 3 From another discipline	6	10	40	50			
SP/PHY/ 304/ SEC-1	**SECP-1: Food Pollutants Lab**	2	10	40	50	N.A.	N.A.	4
Total in Semester – III		**20**	**40**	**160**	**200**	**4**		**8**

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

SEMESTER –IV

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SP/PHY/ 401/C-1D	**CT-4: Bio-engineering** **CP-4: Bio-engineering Lab**	4 2	10	25 15	50	4	N.A.	4
SP/ 402/C-2D	Discipline-2	6	10	40	50			
SP/ 403/C-3D	Discipline-3	6	10	40	50			
SP/PHY/ 404/ SEC-2	**SECP-2: Methods in Hematology Lab**	2	10	40	50	N.A.	N.A.	4
Total in Semester – IV		**20**	**40**	**160**	**200**	**4**		**8**

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

SEMESTER – V

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SP/PHY/ 501/DSE-1A	Any one of the following **DSET-1: Clinical Microbiology and Immunology** **DSEP-1: Clinical Microbiology and Immunology Lab**	4 2	10	25 15	50	4	N.A.	4
SP/502/DSE-2A	Discipline – 2 From another discipline	6	10	40	50			
SP/503/DSE-3A	Discipline – 3 From another discipline	6	10	40	50			
SP/PHY/ 504/SEC-3	**SECT-1: Clinical Microbiology and Laboratory Medicine**	2	10	40	50	2	N.A.	N.A.
Total in Semester – V		**20**	**40**	**160**	**200**	**6**		**4**

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

SEMESTER – VI

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
SP/PHY/ 601/DSE-1B	Any one of the following **DSET-2: Exercise and Sports Physiology** **DSEP-2: Exercise and Sports Physiology Lab**	4 2	10	25 15	50	4	N.A.	4
SP/602/DSE-2B	Discipline – 2 From another discipline	6	10	40	50			
SP/603/DSE-3B	Discipline – 3 From another discipline	6	10	40	50			
SP/PHY/ 604/SEC-4	**SECT-2: Applied Biochemistry**	2	10	40	50	4	N.A.	N.A.
Total in Semester – VI		**20**	**40**	**160**	**200**	**8**		**4**

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

SP= Science programme/Pass, PHY= Physiology, ACSHP= Arts Commerce Science Honours Pass, C= Core Course, MIL= Modern Indian Language, AECC = Ability Enhancement Compulsory Course, SEC= Skill Enhancement Course, DSE= Discipline Specific Elective IA= Internal Assessment, ESE= End-Semester Examination, Lec.= Lecture, Tu.= Tutorial, and Pr.=Practical

1.3 Choices for Discipline Specific Electives

DSET-1: Clinical Microbiology and Immunology

DSEP-1: Clinical Microbiology and Immunology Lab

DSET-2: Exercise and Sports Physiology

DSEP-2: Exercise and Sports Physiology Lab

1.4 Choices of Skill Enhancement Courses

SEC P1 – Food Pollutants Lab

SEC P2 – Methods in Hematology Lab

SEC T1 – Clinical Microbiology and Laboratory Medicine

SEC T2 - Applied Biochemistry

2. Core Courses

SEMESTER - I

2.1 CC-1A T1– Physiological Aspect of Community Health

[Theory: Credits 4 (4 Lectures/Week)/Marks 25] 4 Credits

Concepts in theory

1. Basic idea about community health and public health issues, Malnutrition in a community, over nutrition, issues of obesity; possible remedial measures.
2. Composition and nutritional value of common Indian foodstuffs, rice, wheat, pulses, egg, meat, fish and milk.
3. Dietary fibers. Calorie requirement.
4. Concept of ACU.
5. Principles of formulation of balanced diets for growing child, adult man and woman, pregnant and lactating woman.
6. Diet management of obese, diabetic, hypertensive person and athlete.
7. Basic idea on PCM, marasmus, kwashiorkor and their prevention. Iron and iodine deficiency.
8. Sound pollution as a community health issue; definition, concept of noise, source of extraordinary sound, effects of sound pollution on human health, noise index (noise standards).
9. General concept on communicable and non-communicable diseases - Agents of communicable diseases, food borne, water borne and vector borne communicable diseases.

2.2 CC –1A P1– Physiological Aspect of Community Health Lab

(Practical: Credits 2/ Marks 20) 2 Credits

List of Practical

1. Qualitative assessment of noise.
2. Survey on the status of dietary intake in the surrounding area through visits, etc.
3. Field survey on: Immunization.
4. Role of ICDS/AnganwadiandMid-day meal programme.

Or

2.1 CC-1A T1– Instruments in Physiology

[Theory: Credits 4 (4 Lectures/Week)/Marks 25] 4 Credits

Concepts in theory

1. Microscopy, Spectrophotometry and Spectrofluorometric. Principles and uses of paper and thin layer chromatography.
2. Electrophoresis: Principles and method, uses of agarose gel electrophoresis, SDS – PAGE.
3. Staining of DNA/RNA gel by ethidium bromide, Ultracentrifugation: moving boundary and density gradient ultracentrifugation.
4. ELISA and immunoblotting.

2.2 CC –1A P1– Instruments in Physiology Lab

(Practical: Credits 2/ Marks 20) 2 Credits

1. Handling of compound microscope.
2. Measurement of protein concentration of a sample using spectrophotometer and separation of amino acids through paper chromatography (demonstration).

Suggested Readings:

1. Park K. (2017). Park's Text Book of Preventive and Social Medicine.24th Edition.M/s. BanarsidasBhanot Publishers.
2. Cromwell , L. Weibell, F.J. Pfeiffer, E.A. Biomedical Instrumentation and Measurements, by, & Prentice-Hall of India Pvt Ltd.
3. Ananthi, S. (2005). A Textbook of Medical Instruments.New Age International Private Limited.
4. Joseph J. K. Joseph L. G. (1997).Practical HPLC Method Development. 2nd Edition.Wiley-Interscience.
5.Harold M. M. James M. M.(2009). Basic Gas Chromatography.2nd Edition.Wiley-Interscience.
6. Katz, D. L. and Wild, D. (2013). Jekel's Epidemiology, Biostatistics, Preventive Medicine, and Public Health: With STUDENT CONSULT Online Access, 4e (Jekel's Epidemiology, Biostatistics, Preventive Medicine, Public Health.Fourth edition.Saunders.
7. Wallace, R.B. (2007). Maxey-Rosenau-Last Public Health and Preventive Medicine. Fifteen Edition. McGraw-Hill Education.
8. Heymann , D.L. (2008).Control of Communicable Diseases Manual.19th Edition.American Public Health Association.
9. Magnus, M. (2007). Essentials Of Infectious Disease Epidemiology (Essential Public Health).1st Edition.Jones & Bartlett Learning.
10. BabaharikSharirBigyan. Jogen Debnath (2008). Shreedhar Prokashani, Kolkata.
11.Note Books on Practical Histology. Published by The Physiological Society of India.Kolkata.
12. Manna, M.K. (2005). Practical Physiology.1st Edition.SritaraPrakasani.
13. Ghai, P.O. Gupta, P. (2000). Essential Preventive Medicine. Vikas Publishing Pvt. Ltd.

SEMESTER - II

2.3 CC-1B T2 -Developmental Aspect of Embryo and Foetus

[Theory: Credits 4 (4 Lectures/Week)/Marks 25] 4 Credits

Concepts in theory

1.General concept of reproductive system
2. Gametogenesis: Spermatogenesis and Oogenesis, Ultra-structure: sperm and ovum in mammals.
3. Egg Membranes, Fertilization: In mammals Cleavage: Cleavage types, cleavage process in mammals.
4. Blastula formation: mammals, Morphogenetic movements: Types and examples.
5. Gastrulation: General Concept, determination, and differentiation.
6. Organogenesis: development of eye as an example of reciprocal and repeated inductive events.

2.4 CC-1B P2 – Developmental Aspect of Embryo and FoetusLab

(Practical: Credits 2/ Marks 20) 2 Credits

List of Practical

1. Hematoxylin and Eosin staining of testicular, ovarian tissue sections.
2. Identification of spermatocytes, spermatids, Graafian follicle, Corpus Luteum.
3. Demonstration of preserved mammalian embryo.

Suggested Readings:

1. Sadler, T.W. (2014). Langman's Medical Embryology. Thirteen Edition.Lippincott Williams and Wilkins.
2. Singh, I, (2014).Human Embryology.Tenth Edition.Jaypee Brothers Medical Publishers(P) LTD.
3. Datta.A.K.Essentials of Human Embryology.6th Edition.Current Books International

   Hoar, W.S. Hall P.General and Comparative Physiology.Prentice-Hall of India Pvt.Ltd.

4. Note Books on Practical Histology. Published by The Physiological Society of India.Kolkata.
5. BabaharikSharirBigyan. Jogen Debnath (2008). Shreedhar Prokashani, Kolkata.
6. Mukherjee, K.L. (2004). Medical Laboratory Technology.Vol.I, Vol. II and Vol. III. Tata McGraw-Hill.
7. Manna, M.K. (2005). Practical Physiology.1st Edition.SritaraPrakasani.

SEMESTER - III

2.5 CC-1C T3– Environmental Hazards and Human Physiology

[Theory: Credits 4 (4 Lectures/Week)/Marks 25] 4 Credits

Air Pollution

Definition, sources, air pollutants, effects of air pollution on human health, concept of ozone hole, green house effects and global warming.

Water Pollution

Definition, types, health hazards, water pollutants, biochemical oxygen demand (BOD), thermal pollution, concept of safe drinking water standards.

Soil Pollution

Causes, health hazards, solid waste managements- bioreme- diation, phytoremediation.

Sound Pollution

Definition, concept of noise, source of sound pollution, effects of sound pollution on human health, noise index (noise standards).

Radionuclide Pollution

Ionizing radiations, effects of ionizing radiation on human health, permissible doses

Arsenic Pollution

Sources, sources of arsenic in ground water, drinking water standard for arsenic (WHO, USEPA), health effects of chronic arsenic poisoning.

2.6 CC-1C P3– Environmental Hazards and Human PhysiologyLab

(Practical: Credits 2/ Marks 20) 2 Credits

Physiological (experimental) Experiments

1. Effect of temperature on cardiac rhythm, degree of contraction - analysis on model graphical record.
2. Determination of particulate matter in air sample
3. Measurement of dissolve oxygen.
4. Measurement of noise by sound level meter
5. Measurement of pH of soil.
6. Demonstration: Presence of arsenic in water sample.

Suggested Readings:

1. Agarwal, K. M. Sikdar, P. K. and Deb. S.C. (2002). A Text Book of Environment. Macmillan India Ltd.
2. Pal G. Paribesh O Dushan.Dasgupta Publisher.
3. William P. Cunningham and Mary Ann. Principles of Environmental Science. Tata Mc GrewHill. Publisher.
4. Tyler, G. Miller & Scott Spoolman. An introduction to Environmental science. Cengage Learning Publisher.
5. Note Books on Experimental Physiology. Published by The Physiological Society of India. Kolkata.
6. Babaharik Sharir Bigyan. Jogen Debnath (2008). Shreedhar Prokashani, Kolkata.
7. Manna, M.K. (2005). Practical Physiology. 1st Edition. Sritara Prakasani.

SEMESTER - IV

2.7 CC-1C T4 – Bio-engineering

[Theory: Credits 4 (4 Lectures/Week)/Marks 25] 4 Credits

Concepts in theory

1. Definition
2. History of biotechnology
3. Importance of biotechnology
4. Cloning - General concept
5. Gene therapy - General concept
6. Transgenic animals -General concept
7. Hybridoma techniques basic concept
8. Monoclonal antibody - General ideal in brief
9. DNA finger printing and its application in forensic science
10. Polymerase chain reaction - A brief concept
11. RT-PCR – A brief concept
12. Enzyme immobilization - A brief concept
13. Basic idea of tissue culture and CO2-incubators. -General concept

2.8 CC-1C P4– Bio-engineering Lab

[Practical: Credits 2/(4 Practical Classes/Week)/Marks 15] 2 Credits

List of Practical

1. General concept of protein identification(molecular weight) from chromatographic record.
2. DNA base pair identification of the unknown from analysis of southern blot record.
3. Demonstration of DNA and RNA quantification.

Suggested Readings:

1. Mount , David W. (2005). Bioinformatics: Sequence and Genome Analysis
2. Francis Ouellette, B.F. Baxevanis, A.D. (2009).Bioinformatics. 3rd Edition.Wiley.
3. Wilson, K. and Walker J. (2010).Principles and Techniques of Biochemistry and Molecular Biology. Seventh Edition.
4. Gardner, E.J. Simmons, M.J, Snustad, D.P. (2006) Principles of Genetics. Eighth Edition. Wiley.

3. Discipline Specific Elective Courses

3.1 DSE T1: Clinical Microbiology and Immunology

[Theory: Credits 4 (4 Lectures/Week)/Marks 25] 4 Credits

Microbes

1. Structure and morphological classification.
2. Gram positive, gram negative, pathogenic and nonpathogenic bacteria. Sterilization, pasteurization, brief idea about antibiotics.
3. Bacterial growth curve.
4. Elementary idea of bacteriostatic and bacteriocidal agents.
5. Viruses- Structure and types, Lytic and lysogenic cycle.

Overview of immune system

1. Idea about innate and acquired immunity. Immuno-competent Cells.
2. Humoral and cellular immunity. Antigen-antibody interaction.
3. Immunoglobulin - classification, basic structure and function.
4. Antigen presentation. Major Histocompatibility Complex (MHC).
6. Cytokines and Lymphokines.
7. Vaccination - principles and importance of immunization.
8. Immunization program - immunization against Polio, Hepatitis-B, Tetanus, Measles, Whooping cough, Tuberculosis, AIDS- causative virus, mode of transmission, effects on human body, preventive measures, principles of diagnostic test for AIDS (ELISA).
10. Immunopathology - basic principles of autoimmune disease.

3.2 DSEP1: – Clinical Microbiology and Immunology Lab

[Practical: Credits 2/(4 Practical Classes/Week)/Marks 15] 2 Credits

List of Practical

1. Gram staining of bacteria and identification of Gram positive and Gram negative bacteria.
2. Demonstration: Spore Staining, Radial immuno-diffusion.

3.3 DSET2 – Exercise and Sports Physiology

[Theory: Credits 4 (4 Lectures/Week)/Marks 25] 4 Credits

Concepts in theory

1. Importance of regular exercise in health and wellbeing.
2. Basic concept of Bioenergetics, Energy sources during exercise (Phosphagen, Anaerobic system and Aerobic system).
3. Cardio-respiratory responses during different grades of exercise.
4. Concept of excess post exercise oxygen consumption (EPOC), physiological fatigue and recovery.
5. Aerobic work Capacity: Measurement, physiological factors and applications.
6. Training: Principles of physical training, Training to improve aerobic and anaerobic power.
7. Nutritional supplements and ergogenic aids.
8. Sports injury and its' management.

3.4 DSEP2– Exercise and Sports PhysiologyLab

[Practical: Credits 2/(4 Practical Classes/Week)/Marks 15] 2 Credits

List of Practical

1. Measurement of blood pressure before and after exercise.
2. Recording of recovery heart-rate after standard exercise.
3. Determination of Physical Fitness Index by Harvard Step Test (Modified).
5. Measurement of body fat percentage.
7. Determination of muscle strength by hand grip dynamometer.
8. Pneumographic recording of effect of talking, laughing, coughing, breath holding and hyperventilation

Suggested Readings:

8. Pelczar, M.J. (2001) Microbiology. 5th edition, Tata McGraw-Hill Co, New Delhi.
9. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
10. Campbell, N.A., Reece J.B., Urry L.A., Cain M.L., Wasserman S.A. Minorsky P.V., Jackson R.B. (2008). Biology. Pearson Benjamin Cummings, USA. 8th edition.
11. Das, D. Handbook of Practical Microbiology, Cell Biology Genetics and Biometry. Academic Publishers.
12. William D. McArdle, Frank I. Katch, Victor L. Katch.Essentials of Exercise Physiology. 5th International edition. Lippincott Williams and Wilkins.
13. Astrand, P.O.Rodhal. K. Dahl, H.A. (2003). Textbook of work Physiology. Forth Edition. Mc Graw-Hill Book Co.
14. Shaver, L.G. Essentials of Exercise Physiology. Surjeet Publications.
15. McCormick, E.O. and Sanders, M. Human Factors in Engineering and Design by Tata Mc Graw Hill.
16. Fox, E.L. (1985). Sports Physiology. Saunders College Publishing Holt-Saunders
17. Fox, E.L. Mathews, D.K. The Physiological Basis of Physical Education and Athletics by and. Saunders College Publishing.
18. Durin, J.V.G.A. and Passmore, R. Energy, Work and Leisure. Heinemann Educational Books.
19. Kindt, J.T. Barbara A. Osborne, B.A. Goldsby, R. (2006)Kuby Immunology. 6th Edition. W. H. Freeman.
20. Doan, T. Melvold, R. , Susan Viselli, S. Waltenbaugh, C. (2012).Immunology. Lippincott Williams and Wilkins. 2nd Edition.
21. Hanningan, B.M. Moore, C.B.T. Quinn, D.G. (2010). Immunology.2nd Edition. Viva Book.

4. Skill Enhancement Courses

4.1 SEC P1 – Food Pollutants Lab

[Practical: Credits 2/(4 Practical Classes/Week)/Marks 40] 2 Credits

Qualitative tests for Food Adulteration

Qualitative tests for identifying Food Adulterants in some food samples:
Metanil yellow, Saccharin, Monosodium glutamate, Aluminium foil, Bisphenol A and Bisphenol S, Chocolate Brown HT, Margarine, Pb, Hg, As, etc. in turmeric powder, besan, laddoo, noodles, chocolate and amriti.

4.2 SEC P2 – Methods in Hematology Lab

[Practical: Credits 2/(4 Practical Classes/Week)/Marks 40] 2 Credits

List of practical

1. Preparation of blood smear and identification of blood cells.
2. Determination of hematocrit, MCV, MCH, MCHC, bleeding time, clotting time etc.
3. Measurement of hemoglobin in blood by Sahlis method.
4. Demonstration of SGOT and SGPT.

a. SEC T1 – Clinical MicrobiologyandLaboratory Medicine

[Theory: Credits 2 (2 Lectures/Week)/Marks 25] 2 Credits

Concepts in theory

1. Staining of gram positive and gram negative bacteria.
2. Brief idea of Identification of tubercular bacteria in sputum (with utmost precautionary measure taken before students handle the samples).
4. ECG Machine - Working principle, procedure of recording and applied value.
5. Handling of Doctor's centrifuge.
6. Spectrophotometer colorimeter and colorimeter: - Working principle and application in Biomedical Laboratory.Procedure of recording and applied value.

4.4 SEC T2 – Applied Biochemistry

[Theory: Credits 2 (2 Lectures/Week)/Marks 25] 2 Credits

Concepts in theory

1. Photo-colorimetric estimation of blood constituents.
2. Measurement of blood glucose by Nelson-Somogyi method

3. Measurement of blood inorganic phosphate by Fiske - Subbarow method
4. Measurement of serum total protein by Biuret method.
5. Determination albumin globulin ratio.
6. Determination of serum amylase by iodometric method.

Suggested Readings:

1. Kumar, V. Abbas, A.K. (2014). Robbins &Cotran Pathologic Basis of Disease. Nineth Edition. Elsevier, Saunders.
2. Basu P. Biochemistry Laboratory Manual. Academic Publishers.
3. Jayaraman, J. Laboratory Manual in Biochemistry. 2nd Edition. New Age International Publisher.
4. Note Books on Practical Biochemistry. Published by The Physiological Society of India. Kolkata.
5. Rao, S. Practical Biochemistry in Medicine. Academic Publishers.
6. Pelczar, M.J. (2001) Microbiology. 5th edition, Tata McGraw-Hill Co, New Delhi.
7. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
8. Mukherjee, K.L. (2004). Medical Laboratory Technology.Vol.I, Vol. II and Vol. III. Tata McGraw-Hill.
9. Hinkle, J.L. Kerry H. Cheever, K.H. (2013). Brunner &Suddarth's Handbook of Laboratory and Diagnostic Tests. 2nd Edition. LWW Publisher.
10. Godkar , P.B. Godkar. O.D.(2014). Textbook of Medical Laboratory Technology. 14th Edition.
11. Kirk, R.S.Sawyer, S. Egan, H. (1991)Pearson's Composition and Analysis of Foods. Longman.
12. Swaminathan, M. (2012). Essentials of Food and Nutrition. Vol. I AND Vol. II. Jain Book Agency.
13. Note Books on Practical Biochemistry. Published by The Physiological Society of India.Kolkata.
14. Manna, M.K. (2005). Practical Physiology. 1st Edition. SritaraPrakasani.
15. BabaharikSharirBigyan. Jogen Debnath (2008). Shreedhar Prokashani, Kolkata.