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UNIVERSITY OF MUMBAI
No. UG/144 of 2017

CIRCULAR:-

A reference is invited to the Syllabi relating to the Bachelor of Science (B.Sc) degree course, vide this office Circular No. UG/01 of 2013-14, dated 2nd April, 2013, and Principals of the affiliated Colleges in Science are hereby informed that the recommendation made by the Board of Studies in Life Science at its meeting held on 9th May, 2017, has been accepted by the Academic Council at its meeting held on 11th May 2017 vide item No. 4.226 and that in accordance therewith, in revised syllabus as per the (CBCS) for S.Y.B.Sc (Life Science) (Sem III & IV). Which is available on the University's website (www.mu.ac.in) and that the same has been brought into force with effect from the academic year 2017-18.

MUMBAI – 400 032
31st July, 2017

(Signature)
REGISTRAR

To,

The Principal of the affiliated Colleges in Science.

A.C/4.226/11.05.2017

No. UG/144-A of 2017

MUMBAI-400 032

31st July, 2017

Copy forwarded with compliments for information to :-

- 1) The Co-ordinator, Faculty of Science,
- 2) The Offg. Director, Board of Examinations and Evaluation,
- 3) The Chairman, Ad-hoc Board of Studies in Life Science,
- 4) The Director, Board of Students Development,
- 5) The Professor-cum-Director, Institute of Distance and Open Learning.
- 6) The Co-Ordinator, University Computerization Centre.

(Signature)
REGISTRAR

....PTO

NEW SYLLABUS OF S.Y.B.SC. LIFE SCIENCES
(SEMESTER BASED CREDIT AND GRADING SYSTEM)
TO BE IMPLEMENTED FROM ACADEMIC YEAR 2017-18

SEMESTER III

USLSC 301- Paper I

THEORY

Comparative Physiology (Total Lectures: 45)

(The number of periods for each topic is given in brackets)

PREAMBLE:

Comparative approach to Physiology should indicate and remind students that in isolated, narrow sub disciplines there is also a wealth of information that can be obtained from unrelated and distant organisms. Thus comparing and contrasting diverse mechanisms provides a cohesive understanding of physiology. Further understanding normal physiology also helps in treatment of diseases which leads to its alteration.

THEORY

Control and Coordination

Unit I. Homeostasis

(15)

A. Homeostatic mechanisms and cellular communication

1. Control systems in homeostasis and components of homeostatic control (1)
2. An overview of cell signalling and biochemical basis of cell signalling - Release and transport of chemical messengers, communication of signal to target cell (3)
3. Cell signalling in the nervous system and endocrine system
[eg. Amines (catecholamine and thyroid hormones)] -- Regulation of receptors (up and down regulation) --- Regulation of cell signalling: 1st, 2nd and 3rd order feedback mechanisms. (3)

B. Neuro Endocrine glands and their hormones (5)

1. Pineal, Hypothalamus, PituitaryThyroid, Parathyroid, Pancreas,Adrenal cortex, Testis and Ovary.
2. Steroid hormone: Ecdysone.

C. Structure and functions of Plant Growth Regulators(3)

Auxins, Giberillic acid,Cytokinin, Abscisic acid, Ethylene

Unit II:Control and Coordination in plants and animals (15)

A. Animals:

1. Phylogenetic development of the Nervous System – nerve net, nerve plexus and ganglionated nervous system in hydra, starfish and earthworm.(1)
2. Human Nervous System – CNS and PNS overview (2)
3. Nature of the Nerve Impulse – Resting potential, Action Potential (2)
4. Transmission of Nerve impulses and synapses (3)
- 5.a. Behaviour and behavioural adaptations (Neuronal)– Innate and learned behaviour (Habituation) with an example of Alysia (2)
5. b. Behavioral Strategies in Bird Migration (Physiological aspect-Accumulation of body fat and thermoregulation) (2)

B. Plants:

1. Plant movements – Tropisms, Taxes, Nasties and Kinesis – discuss with suitable examples with reference to physiology (3)

Unit III : Developmental Biology (15)

A. Reproduction and Development

1. Basis of Sex Determination (4)
 - (a) Plants: Maize
 - (b) Animals: Role of SRY gene and Aromatase
 - (c) Role of environmental factors – Temperature and Parthenogenesis in insects
Eg. Wasp/Honey bee/Ants
 - (d) Plant-animal interaction for reproduction Fig wasp / Gall wasp
 - (e) Sex reversal
2. Alternation of generations in plants Eg. *Adiantum* (1)

3. Sex differentiation of gonads, internal and external genitalia. (1)

4. Ovarian and testicular functions, puberty and regulation of uterine changes in menstrual cycle, menopause, pregnancy, parturition, lactation. (2)

5. Artificial regulation of reproduction: Use of contraceptive methods (1)

B. Gametogenesis and early development:

(a) Plants (4)

1. Microsporogenesis and megasporogenesis.

2. Types of ovules and fertilization.

3. Development of embryo in monocot and dicot plants

(b) Animals: (2)

Cleavage and development of embryo in frog.

SEMESTER III
PRACTICALS
USLSCP3
(Based on paper I)

1. Good Laboratory Practices. (1)
 2. Demonstration of reproductive system and location of endocrine glands in Albino Mouse Male and Female (Virtual Lab). (1)
 3. Microtome and preparation of Endocrine gland slides from above dissected specimen or any suitable plant specimen (4)
 4. Study of Histological features of Endocrine glands. (1)
 5. A complete study of Frog Embryology (Egg to Tadpole to Adult). (1)
 6. Study of Floral parts from the given flower (*Hibiscus* and *Pancretium*) study of microscopic structure of anthers , ovules. Seed structure (1)
(Maize and Okra).
 7. Study of pollen germination Using *Vinca* flower (*in vitro*) (1)
 8. a. Study of pollen germination in *Vinca* (*in Vivo*) (1)
b. Tracing the path of the pollen tube along the stylar canal using Aniline blue stain
 9. Detection of activity of plant hormones (Dose dependent response). (1)
 10. Observation and Study of locally collected Leaf Gall and any other one plant disease. (1)
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SEMESTER III
USLSC302 Paper II
Life processes at the tissue, organ and organism levels
A Biochemical Approach

(Total Lectures: 45)

PREAMBLE:

To understand the detailed functioning of a cell it is necessary to study it at the molecular level. Basic biochemical processes in cells and tissues and their regulation and integration are the mainstay of a normal functional cell.

UNIT I Enzymes and their environment (15)

A. Enzymes (15)

1. Extraction, purification and Specific activity
Enzyme example (Plant :RUBISCO, Animal: LDH)
(Mention Techniques: Dialysis, Gel-filtration, Ion-exchange, Affinity chromatography and Spectrophotometry)
2. Classification (With an example of each)
3. Effect of pH and Temperature
4. Co-enzymes and co-factors : NAD, FAD, Mn, Mg, Zn and Cu
(one reaction each)
5. Kinetics (MM, LB)
6. Enzyme Inhibitors, Activators and feed-back
7. Allosteric enzymes (Kinases in Glycolysis) and their significance in metabolic regulation

UNIT II Metabolism - Energy from Carbohydrates : (15)

A. Carbohydrates – Catabolism) (9)

Glycolysis – **Brief Historical background**

process and metabolic regulation

Citric Acid Cycle – **Brief Historical background**

- a) Process and regulation.
- b) Importance as a central amphibolic pathway unifying all primary biological processes.
- c) Anaplerosis

B. Bioenergetics :

- 1. Electron Transport System (2)
 - (i) Localisation and
 - (ii) Sequence of electron transporters
- 2. Oxidative Phosphorylation (4)
 - i. Mitchell's Chemiosmotic Hypothesis
 - ii. ATP synthesis
 - iii. Control of respiration, uncoupling and metabolic poisons

UNIT III Metabolism - Energy from Lipids and Proteins :(15)

A. Lipids - Catabolism : (7)

- 1. Lipolysis
 - 2. Role of Carnitine in mitochondrial permeability
 - 3. Beta– Oxidation of fatty acids and integration into Krebs's cycle
 - 4. Ketone bodies and their significance

A. Amino Acids - Catabolism : (8)1.Protein

Degradation liberating amino-acids'

- 2. Deamination, Transamination & ammonia disposal by Urea cycle.
- 3. Decarboxylation & integration into Krebs's cycle

SEMESTER III
PRACTICALS
USLSC2
(Based on paper II)

This practical involves the following points relevant to Biochemistry:

A. Instrumentation / Technique (I / T) (1)

- pH metry
- Colorimetry
- Titration

B- Process / Concept and immediate Relevance (C ,R) (1)

- Extraction, Purification
 - Analysis / Estimation
 - GLP(Good Laboratory practices) incorporated into every practical
- Acid, bases and buffers

1. pH meter - (I, C, T) (1)

- (i) principle & instrumentation and
- (ii) determination of pH (titration of Acids/Bases/Buffers/ 'chameleon balls').
(in FY the student were introduced to the concept of pH measurement of familiar liquids-here tech & details are given- practically understanding buffering using Glycine / titration curve)

2. Protein precipitation by pH manipulation (Casein from Milk/ Curds)(1)
(From previous experiment and pH manipulation, proteins can be precipitated)(C, R)

3. Enzymology & localization :

- i. Study of Enzyme activity and Kinetics : Determination of KM of an enzyme Urease (from Jack beans)/Lipase/Protease(from detergents) **(I,C,T) (1)**
(Enzyme activity can be detected and estimated - using colorimetry)
- ii. Histochemical localization of Enzymes (Acid Phosphatase)**(C, T) (1)**
(Enzyme activity can be localized)

4. Estimation / Quantitation :

- i. Colorimetric Protein Estimation by Biuret Method (1)
(Enzyme extract / Casein from previous expts.). **I, C, T**
*(Proteins, such as the isolate from experiment 2 can be estimated by colour reaction)**C,T,R***
- ii. Colorimetric Cholesterol Estimation / total Lipid Estimation from egg. *(lipid metabolism is an important component of our systems, content can be estimated by colour reaction)* (1)

iii. Colorimetric estimation of Inorganic Phosphates by Stannous chloride method. **C,T,R**
(Estimation of biologically relevant inorganic ions by colorimetric method) (1)

iv. Titrimetric estimation of Ascorbic acid (Vit C). **C, T, R**
(Estimation of biological materials by non-colorimetric method) (1)

SEMESTER III
USLSC 303- Paper III
THEORY

Population approach: population and communities as regulatory unit
(Total Lectures: 45)

PREAMBLE:

Population dynamics of human population are not only dependent on biological forces but also social forces. Unit I focuses on Evolutionary concepts and Population studies. Quantification is an important aspect of modern biology. A clear understanding of how to handle measurements and biological variation in a variety of experimental setups is obligatory. Unit II and III include fundamentals of biostatistics and bioinformatics. Further elementary bioinformatics has been added to introduce students to ‘*in silico*’ laboratories available.

UNIT I: Concepts in Evolution and Population Genetics (15)

1. Darwinism: Conceptual arguments for evolution by Natural Selection given by Charles Darwin and Alfred Wallace. (1)
2. Evidences for evolution: Comparative anatomy and embryology, Fossil records and living fossils, Artificial selection. (2)
3. Study of Evolution in context of human genetic diseases (BRCA –I / Huntington’s/ Thalassemia) (3)
4. Populations and allelic frequencies, Hardy Weinberg Equilibrium, change in gene frequencies due to selection, mutation, migration and genetic drift (founders effect) (5)
5. Origin of variability, polymorphism, kinds of selection – directional, stabilizing and disruptive, selectionist vs neutralist (4)

UNIT II : BIostatistics (15)

1. Probability definition, addition law, random variable, probability mass function (3)
2. Binomial, Poisson and Normal distribution (5)
3. Bivariate data, scatter diagram and its uses, Karl Pearson’s correlation coefficient, Spearman’s Rank correlation coefficient (4)
4. Regression equations and their uses (3)

Unit III: Bioinformatics

(15)

1. Introduction to bioinformatics: Concept of information net work:

internet, IP address, TCP/IP, FTP, HTTP, HTML and URLs (2)

2. Virtual libraries - The European Molecular Biology Network (EMBnet),
The National Center for Biotechnological Information (NCBI), Pub Med
and its applications. (4)

3. Concept of databases and their use in Biology (2)

Primary, Secondary and composite databases

4. Types of Databases (7)

(a) Nucleotide Database (Prokaryotic and Eukaryotic Gene to be discussed)

(b) Protein Database (PDB/ExPaSy)

(c) Species Database (Yeast, Arabidopsis and Human)

SEMESTER III
PRACTICALS
USLSC3
(Based on paper III)

1. Correlation (Using serial dilution and OD, Data from Paper II and Using MS EXCEL / Population genetics data) (1)
 2. Regression Analysis (Using serial dilution and OD, Data from Paper II and Using MS EXCEL / Population genetics data) (1)
 3. Probability testing using suitable example (1)
 4. Normal Distribution using suitable example (1)
 5. Database searching: Nucleotide, Protein, Species (2)
 6. Introduction to ORF- 6 reading frames and sequence annotation- 6 frame translation using suitable software (ex. Bioline) (1)
 7. Testing of Hardy-Weinberg law using suitable examples of gene and allelic frequencies -Sex linked (One each) (1)
 8. Project proposal based on Bioinformatics/Biostatistics/ Population Genetics / Evolution (2)
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SEMESTER IV

USLSC 401- Paper I

THEORY

Comparative Physiology

(Total Lectures: 45)

Altered Homeostasis due to stress and infections:

Unit I Homeostasis to stress: (15)

A. Thermal physiology: (10)

1. Plant adaptation in extreme thermal conditions
2. Thermal strategies in poikilotherms and homeotherms, ecto and endotherms.
3. Temperature regulating reflexes, acclimatization
4. Fever, Hyperthermia, heat exhaustion and heat stroke.
5. Thermogenesis: shivering and nonshivering thermogenesis, Hyperthermia induced by pyrogens
6. Antifreeze proteins.

B. Fuel Homeostasis during exercise and Stress: (5)

1. Regulation of energy stores: control of food intake
2. Role of Leptin, Ghrelin and Kisspeptin
3. Eating disorders: Anorexia and Bulimia Nervosa
4. Overweight and obesity
5. Type I and Type II Diabetes

Unit II. Homeostasis during infections (15)

A. Host Parasite Relationship

1. Virulence factors and toxins: virulence factors, exotoxins, enterotoxins, endotoxins (2)
2. Host factors in infection: host risk factors, innate resistance (2)
3. Parasite escape mechanisms (2)

B. Defence mechanisms in plants

(2)

Biomolecules such as secondary metabolites, surface protectants and enzymes

C. Defence mechanisms in animals

1. Innate and Adaptive Immunity (1)
2. Introduction to primary and secondary lymphoid organs and Lymphatic systems (1)
3. Mechanisms of Innate Immunity – In invertebrates (hemocytes) and in Vertebrates (physical and physiological barriers, phagocytosis and inflammation) (3)
4. Mechanisms of Adaptive Immunity – T and B cells

(Mode of Recognition of Antigen) (2)

Unit III. Infectious Diseases (15)

(to be discussed with respect to epidemiology, aetiology, pathology (of target tissue only), diagnosis, therapy, preventive measures and vaccines)

A. Vector borne Diseases– Malaria (2)

B. Viral Disease-AIDS, Herpes (3)

C. Bacterial Diseases- Tuberculosis, Leprosy, Typhoid (4)

D. Fungal Diseases– Ringworm, Candidiasis (2)

E. Helminthic Diseases– Filariasis (1)

F. Infections in Plants (3)

- Tobacco mosaic virus,
- Crown gall bacterial infection
- Puccinia fungal infection

SEMESTER- IV

PRACTICALS **USLSCP4**

1. Extraction and detection of Plant alkaloids, saponines, tannins and volatile oils from suitable plant source. (1)
 2. Alkaloid separation by TLC (1)
 3. ABO blood typing (1)
 4. Principle and working of home pregnancy test slide. (1)
 5. Widal Test- Qualitative. (1)
 6. Streak plating (T , Pentagon and Quadrant –Any 2) to isolate microorganisms from a mixed culture using differential media. (1)
 7. Antibiotic sensitivity of microorganisms (Plant extract, Tetracycline/ Gentamycin) (2)
 8. Study of effect of temperature and caffeine on heart beat of Daphnia. (1)
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Semester IV

USLSC 402- Paper II

THEORY

Life processes at the tissue, organ and organism levels **A Biochemical Approach**

(Total Lectures: 45)

UNIT I Metabolism - Anabolism of biomolecules: (15)

A. Carbohydrate Anabolism : (4)

1. Gluconeogenesis
2. Pentose phosphate pathway
3. Short account of polysaccharide (Glycogen) synthesis

B. Lipids Anabolism :

- (3)1. Fatty acid biosynthesis
2. Cholesterol (4 Stages –Condensation, Conversion, Polymerization and Cyclization) and prostaglandin biosynthesis

C. Amino-acid Anabolism : (2)

1. Transamination and its significance
2. Glutamine synthesis

D. Photosynthesis (6)

1. Photophosphorylation, Hill reaction
2. C3 and C4 cycles
3. Photorespiration

UNIT II Nucleic acids : (15)

Chemistry of nucleic acids – (8)

1. Existence of two pathways for purine & pyrimidine synthesis and Significance of the 'salvage pathway'.
2. DNA replication system in prokaryotes – process and enzymes (with domains of DNA polymerase)

3. Transcription (7)
- (a) Prokaryotes - binding, initiation, elongation & termination
 - (b) Eukaryotes - only in terms of different RNA polymerase along with promoters RNA processing – of rRNA, tRNA and mRNA (5'cap, polyA tail and intron splicing (snRNPs only).
4. Concept of Reverse transcription.

UNIT III Regulation of gene expression and Integration of metabolism (15)

1. Translation: Genetic code; Translation system, post translational Modification (Phosphorylation, methylation and Acetylation) (7)
2. Regulation of gene expression and its significance (8)
- (a) Operon model (Lac, Trp).
 - (b) Alternate splicing
 - (c) Concept of RNAi

SEMESTER IV
PRACTICALS
USLSC2
(Based on paper II)

This practical involves the following points relevant to Biochemistry :

A. Instrumentation / Technique (I / T) (1)

PAGE (Demonstration)

Chromatography – Paper, Thin layer, Column

B. Process / Concept and immediate Relevance (C and R) (1)

- Extraction, Purification

- Analysis / Estimation

- GLP(Good Laboratory practices) incorporated into every practical
Separation / Extraction techniques

1. Extraction and Detection of RNA/Ribose Sugars. **C, T** (1)
(Extraction of nucleic acid and detection by colour reaction)

2. Chromatography of Sugars – CircularPaper **C, T** (1)
(Separation of carbohydrates and detection by colour reaction)

3. Thin Layer Chromatography for separation of Plant Pigments (1)
(Slide technique)**C,T,R**
(Separation techniques for charged, uncharged materials based on solvent partition)

4. Solvent Extraction of Lipids. **C, T, R** (1)
(Extraction of lipid and proportional estimation by weight)

5. Column Chromatography of Proteins / Pigments. **I, C, T** (1)
(Separation technique for proteins/ other materials based on charge/size)

6. Protein separation by PAGE (Demonstration) **I, C** (1)
(Separation techniques for charged materials based on electrophoretic mobility)

7&8. Plant enzyme (Qualitative / Quantitative) **I,C,T** (2)

9. Interpretation of pathological reports based on the biochemical analysis. (1)

SEMESTER IV

USLSC 403- Paper III

THEORY

(Total Lectures: 45)

Population approach: population and communities as regulatory unit

UNIT I :Evolution and its consequences (15)

1. Origin of Species: Biological species concept, morphological species, Allopatric and sympatric speciation, Isolating mechanism preventing exchange in populations. Rates of speciation- punctuated or gradual. Life history of a species, Mitochondrial DNA and tracing human phylogeny and extinctions (5)

2. Human evolution: Factors in Human Origin: Bipedalism, improvement in food acquisition , improved predator avoidance and reproductive success, Hunter gatherer societies and evolution of communication –speech and language. Tool making. Altruism and kin selection. (6)

3. Evolution and Society : Cultural vs biological evolution, social Darwinism, eugenics, reproductive technologies and genetic engineering- impact on human culture, gene machine vs intelligent design arguments. (4)

UNIT II:Biostatistics (15)

1. Hypothesis and its types, errors in testing and its types, level of significance (3)

2. Analysis of variance one way classification, F-test (3)

3. Test for equality of two means, Paired and unpaired t-tests. (3)

4. Comparison between Parametric and Non parametric test (3)

5. Chi Square test for independence 2x2 table (3)

Unit III : Bioinformatics (15)

1. DNA sequence Data analysis- (5)

(a) Annotation of putative genes – ORF finding

(b) Genetic code and Frame translation to amino acids, concept of six frame translation

2. Phylogenetic Analysis (10)

(a) Concept of paralogous and orthologous genes

(b) Nucleic acid based phylogenies

(c) Nucleotide sequence comparisons and homologies

(d) Phylogenetic Trees

(e) Parsimony principle and limitations of molecular phylogenetic trees

SEMESTER IV
PRACTICALS
USLSC 4
(Based on paper III)

- 1.a. Comparative Anatomy of Brain (Invertebrate to vertebrate) (1)
b. Study of Fossils (Any two)
 2. Human Karyotyping- Normal and Abnormal (Numerical and Structural) (1)
 3. *Chironomous* Larva- Study of Giant Chromosome from Salivary Glands (1)
 4. Blast search (1)
 5. Bioinformatics- Phylogenetic analysis using Globin gene and Mitochondrial DNA (1)
 6. Applications of t distribution (2)
 7. Analysis of variance one way classification (1)
 8. Chi square distribution (1)
- (In all statistical analysis use of Excel should be introduced)
9. Project report based on Bioinformatics/Biostatistics/ Population Genetics / Evolution (1)
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References

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