SYLLABUS

for

B.Sc. (Honors)ZOOLOGY

Under ChoiceBased Credit System (CBCS)

BERHAMPUR UNIVERSITY
BHANJA BIHAR

SCHEME FOR CHOICE BASED CREDIT SYSTEMIN B.Sc. ZOOLOGY HONORS

Semester-I		Credits
Core Course-1	Biology of Non-Chordata-I Protista to Pseudo coelomates	4
Core Course-2	Principles and Ethics of Ecology	4
Lab Works	CC1 and CC2 (Practical)	2+2=4
GE-1 (Generic Elective)	<From Other Subject>	6
AECC-1 (Ability Enhancement Compulsory	Environmental Science	2
Semester-II		**Credits**
Core Course-3	Biology of Non-Chordata-II Coelomate Nonchordates	4
Core Course-4	Physiology: Life Sustaining Systems	4
Lab Works	CC3 and CC4 (Practical)	2+2=4
GE-2 (Generic Elective)	<From Other Subject>	6
AECC-2 (Ability Enhancement Compulsory	MIL Communication	2
Semester-III		**Credits**
Core Course-5	Biology of Chordata	4
Core Course-6	Physiology: Controlling and Coordinating System	4
Core Course-7	Comparative Anatomy of Vertebrates	4
Lab Works	CC5, CC6 and CC7 (Practical)	2+2+2=6
GE-3 (Generic Elective)	Environment and Public health	4
Lab Work	GE-3(Practical)	2
SEC-1 (Skill Enhancement Course)	Economic Zoology	2
Semester-IV		**Credits**

Core Course-8	Biochemistry of Metabolic Processes	4
Core Course-9	Cell Biology	4
Core Course-10	Principles of Genetics	4
Lab Works	CC8, CC9 and CC10 (Practical)	2+2+2=6
GE-4 (Generic Elective)	<From Other Subject>	4
Lab Work	GE-4 (Practical)	2
SEC-2 (Skill Enhancement Course)	Public Health and Hygiene	2
Semester-V		**Credits**
Core Course-11	Developmental Biology	4
Core Course-12	Molecular Biology	4
Lab Works	CC11 and C12 (Practical)	2+2=4
DSE-1 (Discipline Specific Elective) Any one	Animal Behaviour	4
DSE-2 (Discipline Specific Elective) Any one	Animal Biotechnology	4
Lab Works	DSE-I and DSE II (Practical)	2+2=4
Semester-VI		**Credits**
Core Course-13	Immunology	4
Core Course-14	Evolutionary Biology	4
Lab Works	CC13 and C14 (Practical)	2+2=4
DSE-3 (Discipline Specific Elective) Any one	Microbiology	4
Lab Work	DSE-3 (Practical)	2
DSE-4 (Discipline Specific Elective) Any one	Project	6

CORE COURSE: ZOOLOGY
PaperI

Biology of Non-Chordata-I Protista to Pseudo coelomates

(CREDITS: THEORY-4, PRACTICALS-2)

THEORY

Unit 1:PhylumProtozoa, Parazoa andMetazoa

Generalcharacteristicsandclassificationuptoclasses; Lifecycle,pathogenicityand prophylaxisof*Plasmodiumvivax,Trypanosomagambiense*and*Entamoebahistolytica;* Locomotion and reproduction in Protozoa, origin of Metazoa.

Unit 2:PhylumPorifera and Ctenophora

Generalcharacteristicsandclassificationuptoclasses;Canal systeminsponges;General characteristics andevolutionarysignificance of Ctenophora

Unit 3:PhylumCnidaria

Generalcharacteristicsandclassificationuptoclasses;Metagenesisin*Obelia*; Polymorphism in Cnidaria; Corals andcoral reefs.

Unit 4:PhylumHelminthes

Generalcharacteristicsandclassificationuptoclasses; Lifecycle,pathogenicityand prophylaxis of *Fasciola hepatica* and *Ascarislumbricoides;*Parasiticadaptations.

Note: Classification to befollowed from"BarnesRD (1982)InvertebrateZoology. 5th Edition."

PRACTICALS

PhylumProtozoa

1. Morphologyof*Paramecium,*Binaryfission andConjugation in *Paramecium.*
2. Lifestagesof*Plasmodiumvivax,Trypanosmagambiense*and*Entamoebahistolytica* (Slides/Micro-photographs).
3. Examination of pond waterfor protists.

PhylumPorifera

4. Studyof*Sycon*(includingT.S. andL.S.),*Hyalonema,* and *Euplectella.*
5. Temporarymounts of spicules, gemmulesand sponginfibres.

PhylumCnidaria

6. Studyof*Obelia,Physalia,Millepora,Aurelia,*Ephyralarva,*Tubipora,Corallium, Alcyonium, Gorgonia*and *Metridium*(includingT.S.andL.S.).

PhylumCtenophora

7. Anyonespecimen/slide.

PhylumHelminthes

8. Study of adult *Fasciolahepatica, Taeniasolium*and their life stages (Slides/ microphotographs).Studyof adult*Ascarislumbricoides,Wuchereriabancrofti*andtheirlifestages(Slides/ microphotographs).

Note: Classification to be followed from"BarnesRD (1982)InvertebrateZoology. 5th Edition."

SUGGESTED READINGS

1. AroraMP (2006) Non-Chordata-I. 1st edition. HimalayaPublishing House,New Delhi.
2. AroraMP (2008)Non-Chordata-II.1st edition. HimalayaPublishingHouse,New Delhi.
3. Barnes RD(1982)InvertebrateZoology.6th Edition. Holt SaundersInternational Edition.
4. BarnesRSK,CalowP,OlivePJW,GoldingDW& SpicerJI(2002)TheInvertebrates:A NewSynthesis. 3rd Edition. Blackwell Science,USA.
5. Barrington EJW(1979)Invertebrate Structure andFunctions. 2nd Edition.ELBS and Nelson.
6. BoradaleLAand Potts EA (1961)Invertebrates:AManual fortheuseofStudents. Asia PublishingHome.
7. Jordan ELandVermaPS(1963)InvertebrateZoology.RevisedEdition.S.Chand,New Delhi.
8. MohantyPK(2000)Illustrated DictionaryofBiology. Kalyani Publishers,Ludhiana.
9. Kotpal R.L Modern Text Book of Zoology, Invertebrates. RastogiPublication,Meerut.
10. Singh.H.S. &Rastogi.P., Parasitology,RastogiPublication,Meerut.

CORE COURSE: ZOOLOGY
PAPER II
Principles and Ethics of Ecology
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY

Unit 1:Introduction to Ecology

Relevanceofstudyingecology;Historyofecology;Autecologyandsynecology;Levels oforganization;Lawsoflimitingfactors;Detailedstudyoftemperatureandlightas physicalfactors.

Unit 2:Population

Unitaryandmodularpopulations;Uniqueandgroupattributesofpopulation:Density, natality,mortality,lifetables,fecunditytables,survivorshipcurves,ageratio,sexratio, dispersalanddispersion;Exponentialandlogisticgrowth,equationandpatterns,randK strategies,Populationregulation-density-dependentandindependentfactors;Population interactions,Gause'sPrinciplewithlaboratoryandfieldexamples

Unit3:Community

Communitycharacteristics:dominance,diversity,speciesrichness,abundance, stratification;Ecotoneandedgeeffect;Ecosystemdevelopment(succession)with exampleand Theories pertainingto climaxcommunity.

Unit 4:Ecosystem

Typesofecosystem;Foodchain,Detritusandgrazingfoodchains,LinearandY-shaped foodchains;Foodweb;Energyflowthroughtheecosystem;Ecologicalpyramidsand Ecologicalefficiencies;Nutrientandbiogeochemicalcycle,NitrogencycleandSulphur cycle.

PRACTICALS

1. Studyoflifetables andplottingof survivorship curves ofdifferent types from the hypothetical/real dataprovided.
2. Determinationofpopulationdensityinanatural/hypotheticalcommunitybyquadrate method and calculation ofShannon-Weinerdiversityindexfor thesamecommunity.

3. Studyofanaquaticecosystem:faunaandfloraMeasurementofarea, temperature,turbidity/penetrationoflight,determinationofpH,andDissolvedOxygen content(Winkler's method), Chemical OxygenDemandand freeCO_2.

SUGGESTED READINGS

1. ColinvauxPA(1993)*Ecology*.IIEdition. JohnWileyand Sons,Inc., USA.
2. Dash MC(1993)Fundamentals of Ecology. McGraw Hill Book Company,New Delhi.
3. JoshiNandJoshiPC(2012)EcologyandEnvironment.1st Edition.HimalayaPublishing House, NewDelhi.
4. MohantyPK(2000)Illustrated DictionaryofBiology. Kalyani Publishers,Ludhiana.
5. Odum EP (2008)*Fundamentals of Ecology*.Indian Edition. Brooks/Cole.
6. Ricklefs, R.E., (2000). *Ecology*. 5th Edition. Chiron Press.
7. RobertLeo Smith EcologyandfieldbiologyHarperand Row.
8. SinghJS, Gupta SR and Singh SP (2014) Ecology, Environmental Science and Conservation. S. Chand, New Delhi.
9. Sharma P.D (2011) : Ecology and Environment. RastogiPublication,Meerut.

CORE COURSE: ZOOLOGY
PAPER III

Biology of Non-Chordata-II
Coelomate Nonchordates

(CREDITS: THEORY-4, PRACTICALS-2)

THEORY

Unit 1:PhylumAnnelida

Generalcharacteristicsandclassificationuptoclasses;EvolutionofCoelom; Metamerism and Excretion in Annelida.

Unit 2:PhylumArthropoda and Onychophora

Generalcharacteristicsandclassificationuptoclasses;VisioninArthropoda;Resp iration inArthropoda,Larvalforms in Crustacea, Generalcharacteristics and affinities of*Peripatus.*

Unit 3:PhylumMollusca

Generalcharacteristicsandclassificationuptoclasses;RespirationinMollusca;Torsion inGastropoda, Evolutionarysignificance of trochophorelarva.

Unit 4:PhylumEchinodermata

Generalcharacteristicsandclassificationuptoclasses;Water-vascularsystemin Asteroidea;LarvalformsinEchinodermataandits Evolutionarysignificance

Note: Classification tobefollowed from "Barnes, R.D. (1982). *InvertebrateZoology*, 5th Edition, Holt SaundersInternational Edition."

PRACTICAL

PhylumAnnelida

1. Studyof*Aphrodite,Nereis,Heteronereis,Sabella, Terebella,Serpula,Chaetopterus, Pheretimaand Hirudinaria.*
2. T.S. through pharynx, gizzard,and typhlosolarintestineofearthworm.
3. T.S. through cropof leech.

PhylumArthropoda

4. Study of *Limulus, Palamnaeus, Palaemon, Daphnia, Balanus, Sacculina, Cancer, Eupagurus, Scolopendra, Julus*, termite, louse, honeybee, silk moth, waspand dragon fly.

PhylumOnychophora

5. Anyonespecimen/slide.

PhylumMollusca

6. Study of *Chiton, Dentalium, Pila, Doris, Helix, Unio, Ostrea, Mytilus, Loligo, Sepia,Octopus*and *Nautilus* and *Cypraea*(cowrie).

PhylumEchinodermata

7. Studyof echinodermlarvae.
8. Study of *Pentaceros, Asterias, Ophiura, Clypeaster, Echinus, Echinocardium, Cucumaria*and *Antedon.*

Note: Classification tobe followed from "Barnes, R.D. (1982). *InvertebrateZoology*, 5th Edition, Holt SaundersInternational Edition".

SUGGESTED READINGS

1. AroraMP (2006)Non-Chordata-I. 1st edition. HimalayaPublishingHouse, New Delhi.
2. AroraMP (2008)Non-Chordata-II.1st edition.HimalayaPublishing House, New Delhi.
3. Barnes RD(1982)InvertebrateZoology. 6th Edition. Holt SaundersInternational Edition.
4. BarnesRSK,CalowP,OlivePJW,GoldingDW&SpicerJI(2002)TheInvertebrates:A NewSynthesis. 3rd Edition. Blackwell Science,USA.
5. Barrington EJW(1979)*Invertebrate Structure and Functions*. 2nd Edition.ELBSand Nelson.
6. BoradaleLAand Potts EA (1961)*Invertebrates:A Manual for theuseof Students*. Asia PublishingHome.
7. Jordan ELandVermaPS(1963)InvertebrateZoology.RevisedEdition.S.Chand,New Delhi.
8. MohantyPK(2000)Illustrated DictionaryofBiology. Kalyani Publishers,Ludhiana.
9. Kotpal R.L Modern Text Book of Zoology, Invertebrates. RastogiPublication,Meerut.

CORE COURSE: ZOOLOGY
PAPER IV
PHYSIOLOGY:LIFESUSTAININGSYSTEMS
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY

Unit 1:DigestiveSystem

Structuralorganization,histologyandfunctionsofgastrointestinaltractanditsassociated glands;Mechanicalandchemicaldigestionoffood;Absorptionsofcarbohydrates,lipids, proteins,water,mineralsandvitamins;Roleofgastrointestinalhormonesonthesecretion and control of enzymes ofgastrointestinal tract.

Unit 2: Respiratory System

Mechanismofrespiration,Pulmonaryventilation; Respiratoryvolumeandcapacity; Transport ofoxygenintheblood;Oxygen-hemoglobin andmyoglobin,dissociationcurveandthefactorsinfluencingit;Carbonmonoxide poisoning;Carbondioxidetransportintheblood;bufferingactionofbloodand haemoglobinand Control of respiration.

Unit 3:Excretory System

Structureofkidneyanditshistologicaldetails;Renalbloodsupply;Mechanismofurine formation and its regulation and Regulation ofacid-basebalance.

Unit 4:Circulatory System

Componentsofbloodandtheirfunctions;Haemopoiesis; Haemostasisand Coagulation ofblood,Structureofheart,Cardiaccycle, Bloodpressureanditsregulation, Electrocardiogram

PRACTICAL

1. Enumeration of red blood cells usinghaemocytometer.
2. Estimation of haemoglobin usingSahli'shaemoglobinometer.
3. Preparation ofhaeminand haemochromogencrystals.
4. Recordingof blood pressureusingaSphygmomanometer.
5. Examinationofsectionsofmammalianoesophagus,stomach,duodenum,ileum,rectum liver, trachea, lungand kidney.

SUGGESTED READINGS

1. AreyLB (1974)HumanHistology. 4th Edition.W.B. Saunders, USA.
2. ChatterjeeCC (2008)Human Physiology.Vol.IandII. MedicalAllied Agency, Kolkata.
3. GuytonAC andHall JE(2006) Textbook of Medical Physiology. 9th Edition. W.B. Saunders Company, Philadelphia.
4. MohantyPK(2000)Illustrated DictionaryofBiology. Kalyani Publishers,Ludhiana.
5. TortoraGJand Derrickson B(2012) Principles ofAnatomy&Physiology.13th Edition JohnWileyand sons, USA.
6. Victor PE (2008)diFiore'sAtlas of Histologywith Functional Correlations. 12th Edition. Lippincott W. &Wilkins, USA.
7. Goyal K.A. &Shastri K.V. Animal Physiology, RastogiPublication.Meerut.

CORE COURSE: ZOOLOGY
PAPER V
BIOLOGY OFCHORDATA
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY

Unit 1:Protochordataand Cyclostomata

GeneralcharactersofHemichordata,UrochordataandCephalochordata;Retrogressivemetamorphosisin Urochordata;Generalcharactersand classificationofcyclostomesuptoclass;Structuralpeculiaritiesandaffinitiesof *Petromyzon* and *Myxine.*

Unit 2:Pisces and Amphibia

GeneralcharactersofChondrichthyesandOsteichthyesandclassificationuptoorder; Migration;Osmoregulationinfishes;Scalesinfishes;Originof *Tetrapoda*(Evolutionofterrestrialectotherms);Generalcharactersandclassificationup to orderand Parentalcarein Amphibians.

Unit 3:Reptilia and Aves

Generalcharactersandclassificationuptoorder;Affinitiesof *Sphenodon*;PoisonapparatusandBitingmechanisminsnakes;Generalcharactersand classificationuptoorder;Flightadaptations; *Archaeopteryx*-a connectinglink and Migration in birds.

Unit 4:Mammals

Generalcharactersandclassificationuptoorder;Affinitiesof PrototheriaandMetatheria;Dentitioninmammals;Adaptiveradiationwithreferencetolocomotoryappendages;

PRACTICAL

1. Protochordata

1. *Balanoglossus, Herdmania, Branchiostoma*and Colonial Urochordata.
2. Sections of*Balanoglossus*through proboscis andbranchiogenitalregions.
3. Sections of*Amphioxus* through pharyngeal, intestinal and caudal regions.
4. Permanent slide ofspicules of*Herdmania*.

2.Agnatha

5. Petromyzon and *Myxine.*

3. Fishes

6. *Sphyrna, Pristis, Trygon, Torpedo, Chimaera, Notopterus, Mystus, Heteropneustes, Hippocampus, Exocoetus, Echeneis, Anguilla, Tetrodon,Diodon, Anabas* and Flat fish.

4.Amphibia

7. Ichthyophis/Ureotyphlus, Necturus, Duttaphrynus, Polypedates, Hyla, Alytes and *Salamandra.*

5. Reptiles

*8. Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Draco, Ophiosaurus, Bungarus, Vipera, Naja, Hydrophis, Zamenis*and *Crocodylus.*
9. KeyforIdentificationofpoisonous and non-poisonous snakes.

6. Aves

10. Studyof sixcommon birds from different orders.
11. Types of beaksand claws.
12. Types offeathers.

7. Mammalia

13.Sorex, Bat (Insectivorous and Frugivorous), *Funambulus, Loris, Herpestes*and *Hemiechenis.*

SUGGESTED READINGS

1. Agarwal VK (2011)Zoologyfor degreestudents.S. Chand, New Delhi.
2. AroraMP (2006) Chordata-1. 1st Edition. HimalayaPublishingHouse, NewDelhi.
3. Hall BKand Hallgrimsson B(2008)*Strickberger's Evolution*. 4th Edition.Jones and Bartlett PublishersInc.,USA.
4. Jordan ELand VermaPS(1963)ChordateZoology.RevisedEdition.S.Chand,New Delhi.
5. MohantyPK(2000)Illustrated DictionaryofBiology. Kalyani Publishers,Ludhiana.
6. YoungJZ(2004)*TheLifeof Vertebrates*. 3rd Edition. OxfordUniversityPress, USA.
7. Kotpal R.L. (2015) Modern Text Book of Zoology, Vertebrates, RastogiPublication,Meerut.

CORE COURSE: ZOOLOGY
PAPER VI
PHYSIOLOGY – CONTROLLINGAND COORDINATINGSYSTEM
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY

Unit 1:Tissues and Glands, Boneand cartilage

Structure,location,functionandclassificationofEpithelialtissue,Connectivetissue, Musculartissue,Nervoustissue;Typesofglandsandtheirfunctions;Structureandtypes of bones and cartilages;Ossification, bonegrowth and resorption.

Unit 2: Nervous System

Structureofneuron,restingmembranepotential;Originofactionpotentialandits propagationacrossthemyelinatedandunmyelinatednervefibers;typesofsynapsis, Synaptictransmission;Neuromuscularjunction;Reflexactionanditstypes,Reflexarc and Physiologyof hearingandvision.

Unit 3: Muscle

Histology ofdifferenttypesofmuscle;Ultrastructureofskeletalmuscle;Molecularand chemicalbasisofmusclecontraction;Characteristicsofmuscletwitch;MotorUnit, summation and tetanus.

Unit 4:EndocrineSystem

FunctionalHistologyofendocrine glands-pineal,pituitary,thyroid,parathyroid,thymus, pancreas,adrenals;Hormonessecretedbythemandtheirmechanismofaction;Classificationofh ormones;Regulationoftheirsecretion;Modeofhormone action Hypothalamus(neuroendocrinegland),

PRACTICALS

1. Demonstrationoftheunconditionedreflexaction(Deeptendonreflexsuchaskneejerk reflex).
2. Preparation oftemporarymounts: Squamousepithelium, Striatedmusclefibresandnerve cells.
3. Examinationofsectionsofmammalianskin,Cartilage,Bone,Spinalcord,Nervecell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid.

SUGGESTED BOOKS

1. AreyLB (1974)HumanHistology. 4th Edition.W.B. Saunders, USA.
2. ChatterjeeCC (2008)Human Physiology.Vol.IandII. MedicalAllied Agency, Kolkata.
3. GuytonAC andHall JE(2006) Textbook of Medical Physiology. 9th Edition. W.B. Saunders Company, Philadelphia.
4. MohantyPK(2000)Illustrated DictionaryofBiology. Kalyani Publishers,Ludhiana.
5. TortoraGJand Derrickson B(2012) Principles ofAnatomy&Physiology.13th Edition JohnWileyand sons, USA.
6. Victor PE (2008)diFiore'sAtlas of Histologywith Functional Correlations. 12th Edition. Lippincott W. and Wilkins, USA.
7. Goyal K.A. &Shastri K.V. Animal Physiology, RastogiPublication.Meerut.
8. Pocock G.&Rechards C. The Human Body, Oxfort University Press,U.K.

CORE COURSE: ZOOLOGY
PAPER VII
COMPARATIVE ANATOMYOFVERTEBRATES
(CREDITS:THEORY-4, PRACTICALS-2)

THEORY

Unit 1:IntegumentarySystemandSkeletal System

Structure,functionsandderivativesofintegument;Axial andappendicularskeletons; Jaw suspensorium in vertebrates.

Unit 2:DigestiveandRespiratory System

Alimentarycanalandassociatedglands;Skin,gills,lungsandairsacsandAccessory respiratoryorgansin fishes.

Unit 3:Circulatory Systemand Urinogenital System

General plan ofcirculation; Evolution of heartandaortic arches. Succession ofkidney; Evolution of urinogenitalducts and Types of mammalian uteri.

Unit 4:Nervous SystemandSenseOrgans

Comparativeaccountofbrain;Autonomicnervoussystem;SpinalNerves;Spinalcord; CranialnervesinMammals;Classificationofreceptors;visualreceptors,chemo- receptorsand mechanoreceptors.

PRACTICAL

1. Studyof placoid,cycloidand ctenoid scales through permanent slides/photographs.
2. Disarticulated skeleton of Frog, *Varanus*,Fowl and Rabbit.
3. Carapace and plastron ofturtleor tortoise.
4. Mammalian skulls(Oneherbivorous and one carnivorous animal).

SUGGESTED READINGS

1. Hilderbrand Mand Gaslow GE. Analysis of Vertebrate Structure. John Wileyand Sons., USA.
2. KardongKV(2005) Vertebrates'Comparative Anatomy,Function and Evolution. 4th Edition. McGraw-Hill Higher Education, New York.
3. Kent GC and CarrRK (2000)Comparative Anatomyof theVertebrates. 9th Edition. The McGraw-Hill Companies, New York.
4. MohantyPK(2000)Illustrated DictionaryofBiology. Kalyani Publishers,Ludhiana.
5. Weichert CK and William Presch (1970) Elements of Chordate Anatomy.TataMcGraw Hill, New York.

CORE COURSE: ZOOLOGY

PAPER VIII
BIOCHEMISTRYOFMETABOLIC PROCESSES
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY

Unit 1:Carbohydrate Metabolism

Glycolysis;Citricacidcycle;pentosephosphatepathway;Gluconeogenesis;Shuttle systems(Malate-aspartateshuttle,Glycerol3-phosphateshuttle);Glycogenolysis; Glycogenesis.

Unit 2:Lipid Metabolism

β-oxidationofsaturatedfattyacidswithevenandoddnumberofcarbonatoms; Biosynthesis of palmiticacid andKetogenesisandits regulation.

Unit 3:ProteinMetabolism

Catabolismofaminoacids:Transamination,Deamination;Ureacycle;FateofC-skeleton ofGlucogenic andKetogenicamino acids.

Unit 4: Enzymes andOxidative Phosphorylation

KineticsandMechanismofactionofenzymes;Inhibitionofenzymeaction;Allosteric enzymes;Oxidativephosphorylationinmitochondria;Respiratorychain,ATPsynthase, Inhibitors andUncouplers.

PRACTICALS

1. Identificationofunknowncarbohydratesingivensolutions(Starch,Sucrose,Lactose, Galactose, Glucose, Fructose).
2. Colour tests offunctionalgroups in protein solutions.
3. Action ofsalivaryamylaseunder optimum conditions.
4. Effect of pHon theaction ofsalivaryamylase.
5. Effect of temperatureontheaction ofsalivaryamylase.
6. Estimation of total protein in given solutionsbyLowry's method.

SUGGESTED READINGS

1. BergJM, TymoczkoJLand StryerL(2007)Biochemistry. 6th Edition, W.H. Freeman and Co., New York.

2. CoxMM and Nelson DL(2008)Lehninger Principles of Biochemistry. 5th Edition. W.H. Freeman and Co.,NewYork.
3. DevesenaT (2014) Enzymology.2nd Edition. OxfordUniversityPress, UK.
4. HamesBD and HooperNM (2000)Instant Notesin Biochemistry. 2nd Edition. BIOS ScientificPublishersLtd., U.K.
5. MohantyPK(2000)Illustrated DictionaryofBiology. Kalyani Publishers,Ludhiana.
6. MurrayRK,BenderDA,Botham KM, KennellyPJ,RodwellVWand WellPA(2009) Harper'sIllustratedBiochemistry. 28th Edition.International Edition. TheMcGraw-Hill CompaniesInc.,New York.
7. Trudy Mckee, & James Mckee5th Edition,Biochemistry, Oxpord University Press,U.K.
8. Gupta S.N., A Text Book of Bio-Chemistry, RastogiPublication,Meerut.

CORE COURSE: ZOOLOGY
PAPER IX
CELL BIOLOGY
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY

Unit 1:Cells andPlasma Membrane

Prokaryotic andEukaryotic cells;Mycoplasma;Virus,Viroids,VirionsandPrions;Various models ofplasmamembrane;Transportacrossmembranes; Celljunctions:Occluding junctions(Tightjunctions),Anchoringjunctions(desmosomes),Communicating junctions (gap junctions)and Plasmodesmata.

Unit 2: EndomembraneSystem, Mitochondria and Peroxisomes

TheEndoplasmicReticulum;Golgiapparatus;Mechanismofvesiculartransport; Lysosomes;Structureandfunctionofmitochondria:Chemi-osmotichypothesis; Semiautonomousnatureof mitochondria; Endosymbiotichypothesis and Peroxisomes.

Unit3: Cell CycleandCell Signaling

Cell cycleand its Regulation ofcell cycle; Signalingmoleculesand their receptors.

Unit4:Apoptosis andCancer

Extrinsic(DeathReceptor)PathwayandIntrinsic(Mitochondrial)Pathway;Growthand development of tumors and Metastasis.

PRACTICAL

1. Gram's stainingtechniqueforvisualization ofprokaryotic cells.
2. Studyvarious stages ofmitosis from permanent slides.
3. Studyvarious stages ofmeiosis from permanentslides.
4. StudythepresenceofBarrbodyinhumanfemalebloodcells/cheekcells.(Preparationof permanent slides).
5. Cytochemical demonstration (Preparation ofpermanent slides).
    i. DNAbyFeulgen reaction.
    ii. MucopolysaccharidesbyPAS reaction.
    iii. ProteinsbyMercurobromophenol blue.
    iv. DNAand RNAbyMethylGreenPyronin.

(In practical examination, 05 marks should be of permanent slide submission; one markeachfor DNA,PAS, Proteins, MGPandBarrbody slide.)

SUGGESTED READINGS

1. Becker WM, KleinsmithLJ,Hardin Jand Bertoni G P (2009)TheWorld ofthe Cell. 7th Edition. Pearson Benjamin CummingsPublishing,San Francisco.
2. BruceAlbert, BrayDennis,Levis Julian, RaffMartin, Roberts Keith and Watson James (2008)MolecularBiologyof theCell. 5th Edition.Garland publishingInc.,New York.
3. CooperGM and Hausman RE (2009)TheCell: AMolecularApproach. 5th Edition. ASM Press, Washington D.C.
4. DeRobertis EDP and DeRobertis EMF(2006)Cell and MolecularBiology. 8th Edition. Lippincott Williams andWilkins,Philadelphia.
5. Karp G(2010)Cell and Molecular Biology: Concepts and Experiments. 6th Edition.John Wileyand Sons.Inc.,USA.
6. MohantyPK(2000)Illustrated DictionaryofBiology. Kalyani Publishers,Ludhiana.
7. Debasena.T. Cell Biology,Oxford University Press,U.K.
8. Gupta.P.K., Cell & Molecular Biology, RastogiPublication,Meerut.

CORE COURSE: ZOOLOGY
PAPER X
PRINCIPLES OF GENETICS
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY

Unit 1:Mendelian Genetics andits Extension

Principlesofinheritance;Incompletedominanceandco-dominance;Multiplealleles, Lethalalleles; Epistasis;Pleiotropy; Sex-linked inheritance.

Unit 2:Linkage, Crossing Overand Chromosomal Mapping

Linkageandcrossingover;Cytologicalbasisofcrossingover;Molecularmechanismsof crossingover;Recombinationfrequencyasameasureoflinkageintensity;Twofactor and threefactorcrosses;Interference andcoincidence and Somatic cellhybridization.

Unit 3:Mutations

Genemutations;Chromosomalmutations:Deletion,duplication,inversion, translocation;Aneuploidyandpolyploidy;Inducedversusspontaneousmutations; Backwardandforwardmutations;Suppressormutations;Molecularbasisofmutationsin relationtoUVlightandchemicalmutagens;Detectionofmutations:CLBmethod, attached *X*methodand DNA repair mechanisms.

Unit 4:Sex DeterminationandQuantitativeGenetics

Chromosomalmechanismsofsexdetermination;Sex-linked,sex-influencedandsex limited characters; Polygenic inheritance and Transgressivevariation.

PRACTICAL

1. TostudytheMendelianlawsandgeneinteractionsandtheirverificationbyChisquareanalyses usingseeds/beads/*Drosophila*.
2. Identification ofvariousmutants of *Drosophila*.
3. Tocalculate allelic frequenciesbyHardy-WeinbergLaw.
4. Linkagemaps based on datafrom crosses of*Drosophila*.
5. Studyof human karyotype(normal andabnormal).
6. Pedigree analysis of somehuman inherited traits.
7. Preparation ofpolytenechromosomes from larvaof*Chironomous*/*Drosophila*.
8. To studyMutagenicityin*Salmonella/E. coli*byAmes test.

SUGGESTED READINGS

1. Gardner EJ, SimmonsMJ,Snustad DP (2008)Principles of Genetics. 8th Edition. Wiley India.
2. Griffiths AJF, WesslerSR,Lewontin RC and Carroll SB.Introduction toGenetic Analysis. 9th Edition. W.H. Freeman and Co.,New York.
3. KlugWS, CummingsMR, Spencer CA and Palladino MA (2012)Concepts of Genetics. 10th Edition. Pearson Edsucation,Inc., USA.
4. MohantyPK(2000)Illustrated DictionaryofBiology.Kalyani Publishers,Ludhiana.
5. Russell PJ(2009) Genetics-A MolecularApproach. 3rd Edition. BenjaminCummings, USA.
6. Snustad DP and Simmons MJ(2012)Principles of Genetics. 6th Edition.John Wileyand SonsInc., USA.
7. VermaPS and AgarwalVK(2010) Genetics. 9th Edition. S. Chand, New Delhi.

CORE COURSE: ZOOLOGY
PAPER XI
DEVELOPMENTALBIOLOGY
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY

Unit 1:Early Embryonic Development

Gametogenesis(Spermatogenesis,Oogenesis);Typesofeggs;Eggmembranes; Fertilization:Changesingametes,monospermyandpolyspermy;Planesandpatternsof cleavage;earlydevelopmentoffrogandchickuptogastrulation;Fatemaps;embryonic induction andorganizers.

Unit 2:LateEmbryonicDevelopment

Fateofgermlayers;Extra-embryonicmembranesinbirds;Implantationofembryoin humansand Placenta(Structure, types andfunctions of placenta).

Unit 3:PostEmbryonicDevelopment

Metamorphosis:Changes,hormonalregulationsinamphibians;Regeneration:Modesof regeneration(epimorphosis,morphallaxisandcompensatoryregeneration);Ageing: Concepts and models.

Unit 4:Implications ofDevelopmental Biology

Teratogenesis:Teratogenicagentsandtheireffectsonembryonicdevelopment;*invitro* Fertilization;Stem cell cultureandAmniocentesis.

PRACTICAL

1. Studyofwholemountsandsectionsofdevelopmentalstagesoffrogthroughpermanent slides:Cleavagestages,blastula,gastrula,neurula,tail-budstage,tadpole(externaland internal gill stages).
2. Studyofwholemountsofdevelopmentalstagesofchickthroughpermanent slides:Primitivestreak(13and18hours),21,24,28,33,36,48,72,and96hoursof incubation(HamiltonandHamburger stages).
3. Studyofdevelopmentalstages(abovementioned)byraisingchickembryointhe laboratory.
4. Studyof thedevelopmental stages and lifecycleof*Drosophila* from stock culture.
5. Studyof differenttypes ofplacenta.

6. Project report on*Drosophila* culture/chick embryo development.

SUGGESTED READINGS

1. BalinskyBIandFabianBC (1981)AnIntroduction to Embryology.5th Edition. International ThompsonComputerPress.
2. Gilbert SF(2010)Developmental Biology. 9th Edition. SinauerAssociates,Inc.,USA.
3. Kalthoff(2008) Analysis of Biological Development. 2nd Edition. McGraw-Hill, New York.
4. MohantyPK(2000)Illustrated DictionaryofBiology. Kalyani Publishers,Ludhiana.
5. WolpertL, BeddingtonR,Jessell T, LawrenceP,MeyerowitzEand Smith J(2002) Principles of Development. 1st Edition, Oxford UniversityPress,NewYork.
6. Sastry K.V & Shukla Vinita, Developmental Biology, RastogiPublication,Meerut.

CORE COURSE: ZOOLOGY
PAPER XII
MOLECULARBIOLOGY
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY

Unit 1:Nucleic Acids andDNA Replication

SalientfeaturesofDNAdoublehelix;WatsonandCrickmodelofDNA;DNA denaturationandrenaturation;DNAtopology-linkingnumberandDNAtopo-isomerases;StructureofRNA,tRNAandDNAandRNAassociated proteins;DNAReplicationinprokaryotesandeukaryotes;MechanismofDNA replication;

Unit 2: Transcriptionand Translation

RNApolymeraseandtranscriptionUnit;Mechanismoftranscriptioninprokaryotesand Eukaryotes;SynthesisofrRNAandmRNA; Transcriptionfactorsandregulationof transcription.Geneticcode,Wobble Hypothesis;Processofprotein synthesisinprokaryotes and Eukaryotes

Unit 3:Post Transcriptional Modifications andProcessing ofEukaryoticRNA

StructureofglobinmRNA;Splitgenes:conceptofintronsandexons,splicing mechanism, alternativesplicing, exon shuffling,and RNA editing,

Unit 4: GeneRegulationandRegulatory RNAs

Transcriptionregulationinprokaryotes:Principlesoftranscriptionalregulationwith examplesfrom*lac*operonand*trp*operon;Transcriptionregulationineukaryotes: Activators,repressors,enhancers,silencerselements;Genesilencing,Geneticimprinting; Ribo-switches, RNAinterference, miRNAandsiRNA.

PRACTICAL

1. StudyofDNAreplicationusingPhotographsorslidesandspecialcases,e.g.,Polyteny usingpermanent slides of polytene chromosomes.
2. Preparation ofliquid culturemedium (LB)andraise cultureof*E. coli*.
3. Estimation of the growthkinetics of*E.coli* byturbiditymethod.

4. Preparation of solid culture medium (LB) and growth of *E. coli* byspreading and streaking.
5. Demonstrationofantibioticsensitivity/resistanceof*E.coli*toantibioticpressureand interpretation of results.
6. Quantitative estimation of salmon sperm/calf thymus DNA using colorimeter(Diphenylamine reagent) orspectrophotometer(A260 measurement).
7. Quantitativeestimation of RNA usingOrcinol reaction.

SUGGESTED READINGS

1. Becker WM, KleinsmithLJ,Hardin Jand Bertoni GP (2009)TheWorld ofthe Cell. 7th Edition. Pearson Benjamin CummingsPublishing,San Francisco.
2. BruceAlberts, AlexanderJohnson,Julian Lewis,Martin Raff, Keith Roberts, Peter Walter(2008)MolecularBiologyof theCell, 4th Edition. Garland publishingInc.,New York.
3. CooperGM and Hausman RE (2007)TheCell: AMolecularApproach**.** 4th Edition, ASM Press, USA.
4. DeRobertis EDP and DeRobertis EMF(2006)Cell and MolecularBiology. 8th Edition. Lippincott Williams andWilkins,Philadelphia.
5. Karp G(2010)Cell and Molecular Biology: Concepts and Experiments. 6th Edition.John Wileyand Sons.Inc., USA.
6. MohantyPK(2000)Illustrated DictionaryofBiology. KalyaniPublishers,Ludhiana.
7. Craig N. & Cohen-fix.O., Molecular Biology, Oxford UniversityPress,U.K.
8. Pal.J.K. &Ghaskadbi S.S., Fundamentals Of MolecularBiology,OxfortUniversity,U.K.

CORE COURSE:
ZOOLOGYPAPER XIII
IMMUNOLOGY
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY

Unit 1:ImmuneSystemand Immunity

Innateimmunity,Adaptiveimmunity. Cellmediatedandhumoral responses Cell and Organs of the Immune system

Unit 2:Antigens

Antigenicity andimmunogenicity,Immunogens,Adjuvantsandhaptens,Factors influencingimmunogenicity, Band T-Cell epitopes.

Unit 3: Immunoglobulins

Antibody structure and function, antibody isotypes, Applications Monoclonalantibodies.

Unit4:Hypersensitivity

Type-I hypersensitivity- allergens, mast cell degranulation, mediators of type-I reaction, Type-II-antibody mediated cytotoxic, Type-III and Type IV hypersensitivity.

PRACTICAL

1. Demonstration of lymphoid organs.
2. Ouchterlony's doubleimmuno-diffusion method.
3. Determination of ABOblood group.
4. Preparationofsinglecellsuspensionofsplenocytesfromchickspleen,cellcountingand viabilitytest.
5. ELISA/ dot Elisa (usingkit).
6. Principles, experimental set up andapplications of immuno-electrophoresis,RIA,F.

SUGGESTED READINGS

1. Abbas KA andLechtmanHA(2003) Cellular andMolecularImmunology.5th Edition. Saunders Publication, Philadelphia.
2. David M, Jonathan B, David RBandIvan R (2006)Immunology. 7th Edition. Elsevier Publication,USA .
3. Kindt TJ, GoldsbyRA,OsborneBAand KubyJ(2006)Immunology.6th Edition. W.H. Freeman and Company,New York.
4. MohantyPK(2000)Illustrated DictionaryofBiology. Kalyani Publishers,Ludhiana.
5. Khanna R. Immunology,OxfordUniversity,U.K.
6. Lal.S.S& Kumar Sanjeev, Immunology,RastogiPublication,Meerut.

CORE COURSE: ZOOLOGY
PAPER XIV
EVOLUTIONARYBIOLOGY
(CREDITS:THEORY-4, PRACTICALS-2)

THEORY

Unit 1:History ofLife,theories ofEvolution and Extinction

Chemogeny,Biogeny,RNAWorld,MajorEventsinHistoryofLife;Lamarckism; Darwinism;Neo-Darwinism;Backgroundofextinction,Massextinction(Causes,Names offive major extinctions, K-T extinction in detail) and Role ofextinction inevolution.

Unit 2: Evidences ofEvolution

Fossilsanditstypes;Datingoffossils,Phylogenyofhorseandhuman;Molecular evidences(Globingenefamilies as an example) and Moleculerclock concept.

Unit 3:Processes ofEvolutionary Change

Organicvariations;Isolatingmechanisms;Naturalselection(Industrialmelanism, Pesticide/Antibioticresistance);Typesofnaturalselection(Directional,Stabilizing, Disruptive), Sexual Selection and Artificial selection.

Unit 4:Principles ofpopulation genetics

Conceptofgenepool,Genefrequencies–equilibriumfrequency(Hardy-Weinberg equilibrium),Shiftingenefrequencywithoutselection–Geneticdrift,Mutationpressure and Geneflow and Shiftsin gene frequencies with selection, species concept

PRACTICAL

1. Studyoffossil evidencesfrom plaster cast models and pictures.
2. Studyof homologyandanalogyfrom suitable specimens/ pictures.
3. Demonstration of changingallele frequencieswith and without selection.
4. Construction of cladogram based on morphological characteristics.
5. Construction ofphylogenetictreewith bioinformatics tools (Clustal X and Phylip).
6. Interpretation ofphylogenetictrees.

SUGGESTED READINGS

1. Barton NH,Briggs DEG,EisenJA, Goldstein DBand Patel NH(2007)Evolution. Cold SpringHarbourLaboratoryPress.
2. Campbell NAand ReeceJB(2011)Biology. 9th Edition. Pearson EducationInc., New York.
3. Douglas JF(1997) EvolutionaryBiology. SinauerAssociates, USA.
4. Hall BKand Hallgrimsson B(2008)Evolution. 4th Edition.Jones and Bartlett Publishers, USA.
5. MohantyPK(2000)Illustrated DictionaryofBiology.Kalyani Publishers,Ludhiana.
6. Pevsner J(2009) BioinformaticsandFunctional Genomics. 2nd Edition. Wiley-Blackwell, USA.
7. RidleyM (2004) Evolution. 3rd Edition. Blackwell Publishing, USA.
8. Tomar B.S & Singh S.P. Evolutionary Biology,RastogiPublication,Meerut.

DISCIPLINE SPECIFIC ELECTIVE-I

ANIMAL BEHAVIOUR
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY

Unit 1: Introduction and Mechanisms of Behaviour

Origin and history of Ethology; Brief profiles of Karl von Frisch, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen; Proximate and ultimate behavior; Objective of behaviour, Behaviour as a basis of evolution; Behaviour as a discipline of science; Innate behaviour, Instinct, Stimulus filtering, Sign stimuli and Codebreakers.

Unit 2: Patterns of Behaviour

Reflexes: Types of reflexes, reflex path, characteristics of reflexes (latency, after discharge, summation, fatigue, inhibition) and its comparison with complex behavior.

Orientation: Primary and secondary orientation; kinesis-orthokinesis, klinokinesis; taxis tropotaxis and klinotaxis and menotaxis (light compass orientation) and mnemotaxis.

Learning: Associative learning, classical and operant conditioning, Habituation and Imprinting.

Unit 3: Social Behaviour

Insects' society; Honeybee: Society organization, polyethism, foraging, round dance, waggle dance, Experiments to prove distance and direction component of dance, learning ability in honeybee, formation of new hive/queen; Reciprocal altruism, Hamilton's rule and inclusive fitness with suitable examples.

Unit 4: Sexual Behaviour

Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Infanticide, Consequences of mate choice for female fitness, Sexual conflict for male versus female parental care and Courtship behaviour in three spine stickleback.

PRACTICAL

1. To study different types of animal behaviour such as habituation, social life, courtship behaviour in insects, and parental care from short videos/movies and prepare a short report.
2. To study nests and nesting habits of the birds and social insects.
3. To study the behavioural responses of woodlice to dry condition.
4. To study behavioural responses of wood lice in response to humid condition.
5. To study geotaxis behaviour in earthworm.
6. To study the phototaxis behaviour in insect larvae.
7. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study

behaviouralactivities of animals and prepareashort report.

SUGGESTED READINGS

1. David McF. Animal Behaviour. Pitman PublishingLimited,London, UK.
2. John A(2001)Animal Behaviour. 7th Edition.SinauerAssociateInc., USA.
3. ManningA and Dawkins MS. AnIntroduction toAnimal Behaviour. Cambridge UniversityPress, USA.
4. MohantyPK(2000)Illustrated DictionaryofBiology. Kalyani Publishers,Ludhiana.
5. Paul WS andJohn A (2013)ExploringAnimal Behaviour. 6th Edition.SinauerAssociate Inc., Massachusetts, USA.
6. Mathur R. Animal Behaviour, RastogiPublication,Meerut.

DISCIPLINE SPECIFIC ELECTIVE II

ANIMAL BIOTECHNOLOGY
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY

Unit 1: Concept and scope of Biotechnology, Cloning vectors (Types and characteristics), Restriction enzymes: Nomenclature, detailed study of Type-II.

Unit 2: Transformation techniques: Calcium chloride method and electroporation, Construction of genomic and cDNA libraries and screening, Bloting techniques, DNA sequencing, Polymerase Chain Reaction, DNA finger printing and DNA microarray

Unit3: Production of cloned and transgenic animals: Nuclear transplantation, retroviral method, DNA microinjection, Applications of Transgenic animals: production of pharmaceuticals, knock out mice, donor organs, production of transgenic plants: Agrobacterium mediated transformation, Application of Transgenic plants: insect and herbicide resistant plants.

Unit4: Animal cell culture, Expression of cloned genes, molecular diagnosis of genetic diseases (Cystic fibrosis/Sickle cell anemia), Recombinant DNA in medicine: insulin/growth hormone, Gene therapy.

PRACTICAL

1. Genomic DNA isolation from E. Coli.
2. Plasmid DNA isolation.
3. Restriction digestion
4. Construction of circular and linear restriction map
5. Calculation of transformation efficiency from the data provided
6. To study the following technique through photographs
   Southern Bloting
   NothernBloting
   DNA sequencing
   PCR
   DNA fingerprinting
7. Project report on animal cell culture

SUGGESTED READINGS

1. Brown, T. A. Molecular Biology, LabfaxII: Gene cloning and DNA Analysis, II Edition
2. Glick, B. R. and Pasternak, JJ, Molecular Biotechnology-Principles and Application of Recombinant DNA, IV Edition
3. Griffiths, AJF etal. (2009): An Introduction to Genetic Analysis, IX Edition
4. Snustad, DP and Simmons MJ, Principles of Genetics, V Edition
5. Watson JD, Myers RM, Caudy A and Witkowski JK (2007): Recombinant DNA-Genes and Genomes-A short Course, III Edition
6. Beauchamp TI and Childress JF (2008): Principles of Biomedical Ethics, VI Edition

DISCIPLINE SPECIFIC ELECTIVE III
MICROBIOLOGY
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY

Unit 1: Historyof Microbiology; Microbial World– Characterization, Classification and identification ofmicrobes.

Unit 2: Prokaryotes: General morphologyandclassification ofbacteria, theircharactersand economicimportance; Gram-positive and Gram-negativebacteria.Eukaryotes: General morphologyof Protista and Fungi– classification and economic importance.

Unit3: Viruses:structure,genome,replicationcycle;Epidemiologyofinfectiousdiseaseswith referenceofhumanhosts–Bacterial(Tuberculosis),Viral(Hepatitis),Protozoan (Amoebiasis) and Fungal(anyone)disease.

Unit4: Microbeinteractions-ImmuneResponses-Antibioticsandotherchemotherapeutic agents; Appliedmicrobiologyinthefields of food, agriculture, industryand environment.

PRACTICAL

1. Cleaningofglasswares,sterilisationprincipleandmethods-moistheat-dryheatand filtration methods.
2. Mediapreparation:Liquidmedia,Solidmedia,Agarslants,Agarplates.Basal,enriched, selectivemediapreparation-qualitycontrolofmedia,growthsupportingproperties, sterilitycheck of media.
3. Pureculturetechniques:Streak plate, pourplateand decimal dilution.
4. Culturalcharacteristicsofmicroorganisms:Growthondifferentmedia,growth characteristics and description and demonstration ofpigment production.
5. Stainingtechniques:Smearpreparation,simplestaining,Gram'sstaining,Acidfast stainingand stainingformetachromaticgranules.
6. Morphologyof microorganisms.
7. Antibioticsensitivitytesting: Discdiffusion test- Qualitycontrol with standard strains
8. Physiology characteristics:IMViCtest,H_2S,Oxidase,catalase,ureasetest,Carbohydrate fermentation,Maintenanceofpureculture,Paraffinmethod,Stabcultureand maintenanceof mold culture.

SUGGESTED READINGS

1. Ahsan Jand Sinha SP(2010)A Hand book on EconomicZoology. S Chand, NewDelhi.
2. AroraDRandAroraB(2001)MedicalParasitology.2nd Edition.CBSPublicationsand Distributers.
3. AtwalAS(1993)AgriculturalPestsofIndiaandSouthEastAsia.KalyaniPublishers,

Ludhiana.

4. DubeyRCand MaheshwariDK(2013)ATextbookofMicrobiology.S.Chand,New Delhi.
5. Dunham RA(2004) Aquaculture and Fisheries Biotechnology Genetic Approaches. CABIpublications.
6. PelczarMJ,ChanECSandKriegNR(1993)Microbiology.5th Edition,TataMcGraw Hill PublishingCo.Ltd.
7. Pradhan, S (1983)InsectPests of Crops. National Book Trust ofIndia, New Delhi.
8. Shrma P.D. Microbiology, RastogiPublication,Meerut.

GENERIC ELECTIVE -I
ANIMAL DIVERSITY
(THEORY-4, PRACTICALS-2)

THEORY

Unit 1:
General characters of Protozoa; Life cycle of plasmodium
General characters & canal system in Porifera
General characters of Cnidarians & Polymorphism in hydrozoa
General characters of Helminthes **;** Life cycle of *Taeniasolium*
General characters ofNemathelminthes ; Parasitic adaptation

Unit 2:
General characters &Metamerismin Annelida ;
General characters of Arthropoda ; Social life in insects
General characters of Mollusca ; Pearl formation
General characters of Echinoderms ; Water vascular system in Starfish

Unit 3:
Salient features of Protochordates
Osmoregulation , Migration of Fishes
General characters of Amphibians ; Adaptation of Amphibians for terrestrial life
Parental care in Amphibia

Unit 4:
Origin of Reptiles ; Terrestrial adaptations in Reptiles
Origin of Birds ; Flight adaptation in birds
Early evolution of Mammals ; Primates ; Dentition in Mammal

PRACTICALS

1.Study of following specimens :
Non chordates
:*Euglena,Noctiluca,Paramecium,Sycon,Physalia,Tubipora,Metridium,Taenia,Ascaris, Nereis,Aphrodite,Leech,Peripatus,Limulus,*Hermitcrab,*Daphnia,*Millipede,Centipede, *Beetle,Chiton,Dentalium,Octopus, Asterias,Antedon*
Chordates :
Balanoglossus,Amphioxus,Petromyzon,Pristis,Hippocampus,Labeo,Icthyophis,

Salamander,Rhacophorus,Draco,Uromastix,Naja,Viper,Model of Archaeopteryx,
Crow,Duck,Owl,Squirrel,Bat

2. Study of permanent slides :
C.S of Sycon, Sea anemone,Ascaris
T.S of Earthworm passing through pharynx,gizzard,typhlosolar region of intestine
Bipinnaria&Pluteus larva

3. **Temporary mount** of
Septal & Pharyngeal nephridia of Earthworm
Placoid, cycloid,ctenoid scales
4. **Dissection** of
Digestive & Nervous system of Prawn,Cockroach.
Urinogenital system of Rat, Calotes.

SUGGESTED BOOKS

1. Barnes,R.D.(1992). Invertebrate Zoology. Saunders college Pub. USA.
2. Ruppert, Fox & Barnes (2006) Invertebrate Zoology.A functional Evolutionary Approach 7th Edition, Thomson Books/Cole
3. Campbell & Reece (2005). Biology,Pearson Education, (Singapore) Pvt. Ltd.
4. Kardong,K.V.(2002). Vertebrates Comparative Anatomy , Function and Evolution. Tata MeGraw Hill Publishing Company, New Delhi .
5. Raven, P.H. and Johnson, G.B., (2004). Biology, 6th edition, Tata MeGraw Hill Publications.New Delhi.
6. Arora MP (2006) Non-Chordata-I&II,1st edition. Himalaya Publishing House, New Delhi.
7. Arors MP (2006) Chordata- I.1st edition. Himalaya Publishing House, New Delhi.
8. Jordan EL AndVerma PS (1963) Invertebrate Zoology. Revised Edition, S.Chand, New Delhi.
9. Jordan EL And Verma PS (1963) Chordate Zoology. Revised Edition, S.Chand, New Delhi.
10. Agarwal VK (2011) Zoology For Degree students. S.Chand, New Delhi.
11. Kotpal R.L Modern Text Book of Zoology, Invertebrates. RastogiPublication,Meerut.
12. Kotpal R.L. (2015) Modern Text Book of Zoology, Vertebrates, RastogiPublication,Meer

GENERIC ELECTIVE – II

ENVIRONMENT AND PUBLIC HEALTH
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY

Unit 1:Bee-keeping and BeeEconomy (Apiculture)

VarietiesofhoneybeesandBeepasturage;Settingupanapiary:Langstroth's/Newton's hive,beeveil,broodandstoragechambers,ironframesandcombsheets,drone excluder, rearingequipments,handlingofbees,artificialdiet;Diseasesofhoneybee,American andEuropeanFoulbrood,andtheirmanagement;Honeyextractiontechniques;Physico-chemicalanalysisofhoney;Otherbeneficialproductsfrombee;Visittoanapiculture institute and honeyprocessingUnits.

Unit 2:Silk andSilk Production (Sericulture)

DifferenttypesofsilkandsilkwormsinIndia;Rearingof*Bombyxmori*,Rearingracks andtrays,disinfectants,rearingappliances,blackboxing,Chawkirearing,bedcleaning, mountages,harvestingofcocoons;Silkwormdiseases:Pebrine,Flacherie,Grasserie, MuscardineandAspergillosis,andtheirmanagement;Silkwormpestsandparasites:Uzi fly,Dermestidbeetlesandtheirmanagement;SilkreelingtechniquesandQuality assessment ofsilk fibre.

Unit 3:AquacultureI

Broodstockmanagement;Inducedbreedingoffish;Managementofhatcheryoffish; Managementofnursery,rearingandstockingponds;Preparationandmaintenanceoffish aquarium;Preparationofcompounddietsforfish;Roleofwaterqualityinaquaculture; Fishdiseases:Bacterial,viralandparasitic;Preservationandprocessingofharvestedfish; Fisheryby-products.

Unit 4:DairyandPoultryFarming

Introduction;Indigenousandexoticbreeds;Rearing,housing,feedandrationing; Commercialimportanceofdairyandpoultryfarming;Varietalimprovementtechniques; Diseasesandtheirmanagement;Dairyorpoultryfarmmanagementandbusinessplan; Visit to anydairyfarm orPoultryfarm.

* Submission of report on anyone field visits mentioned above.

PRACTICAL

1. Studyof differenttypes ofbees (Queens,Dronesand Worker bees).
2. Studyof differenttypes of silk moths.
3. Studyof differenttypes of pearls.
4. Studyof differenttypes offish diseases.
5. Identification ofdifferent types ofscales in fishes.
6. Studyof differenttypes offins.
7. Studyofdifferentmodifiedstructuresoffishes(Sawofsawfish,Hammerofhammer head fish, tail of sharksetc.)
8. Identification ofvarious types of natural silks.

SUGGESTED READINGS

1.Dhyan Singh Bisht,Apiculture,ICAR Publication.

2.Dunham RA(2004)Aquacultureand Fisheries Biotechnology–GeneticApproaches. CABIpublications, U.K.

3.HafezESE (1962) Reproduction in Farm Animals.Lea and Fabiger Publishers.

4.Knobil E and NeillJD(2006)ThePhysiologyofReproduction.Vol. 2. Elsevier Publishers, USA.

5.MohantyPK(2000)Illustrated DictionaryofBiology. Kalyani Publishers,Ludhiana.

6.Prost PJ(1962)Apiculture. Oxford andIBH,NewDelhi.

7.Singh S. BeekeepinginIndia,Indian council ofAgricultural Research,New Delhi.

8.SrivastavaCBL(1999) FisheryScience andIndian Fisheries. KitabMahalpublications, India.

9.Shukla G.S &UpadhyayV.B(2013) , Economic Zoology, 5th Edition,Rastogi publication, Meerut.

SYLLABUS

for

B.Sc. ZOOLOGY (Regular)

Under ChoiceBased Credit System (CBCS)

BERHAMPUR UNIVERSITY
BHANJA BIHAR

Semester-I		**Credits**
Core A-1	Biology of Non-Chordata	4
	Practical A-1	2
Core B-1	<From Other Subject>	6
Core C-1	<From Other Subject	6
AECC-1 (Ability Enhancement Compulsory	Environmental Studies	2
Semester-II		**Credits**
Core A-2	Biology of Chordata	4
	Practical A-2	2
Core B-2	<From Other Subject>	4
Core C-2	<From Other Subject>	6
AECC-2 (Ability Enhancement Compulsory	MIL Communication	2
Semester-III		**Credits**
Core A-3	Cytogenetics and Molecular Biology	4
	Practical A-3	2
Core B-3	<From Other Subject>	6
Core C-3	<From Other Subject>	6
SEC-1 (Skill Enhancement Course)	From the pool of SEC courses	2
Semester-IV		**Credits**
Core A-4	Physiology and Biochemistry	4
	Practical A-4	2
Core B-4	<From Other Subject>	6

Core C-4	<From Other Subject>	6
SEC-2	From the pool of SEC courses	2
Semester-V		**Credits**
DSE-A1	Developmental Biology	4
	Practical DSE-A1	2
DSE-B1	<From Other Subject>	6
DSE-C1	<From Other Subject>	6
SEC-3	From the pool of SEC courses	2
Semester-VI		**Credits**
DSE-A2	Biotechnology	4
	Practical DSE-A2	2
DSE-B1	<From Other Subject>	6
DSE-C1	<From Other Subject>	6
SEC-4	From the pool of SEC courses	2

CORE COURSE: A1
Biology of Non-Chordata
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY

Unit 1:PhylumProtozoa, Parazoa andMetazoa

Generalcharacteristicsandclassificationuptoclasses; Lifecycle,pathogenicityand prophylaxisof*Plasmodiumvivax,Trypanosomagambiense*and*Entamoebahistolytica;* Locomotion and reproduction in Protozoa, origin of Metazoa.

Unit 2:PhylumPorifera and Ctenophora,Cnidaria, Helminthes

Generalcharacteristicsandclassificationuptoclasses;Canal systeminsponges;Evolutionarysignificance of Ctenophora,Polymorphism in Cnidaria; Corals andcoral reefs,Lifecycle,pathogenicityand prophylaxis of *Fasciola hepatica* and *Ascarislumbricoides;*Parasiticadaptations

Unit 3:PhylumAnnelida, Arthropoda and Onychophora

Generalcharacteristicsandclassificationuptoclasses;EvolutionofCoelom; Metamerism and Excretion in Annelida, VisioninArthropoda;Larvalforms in Crustacea, Generalcharacteristics and affinities of*Peripatus.*

Unit 4:PhylumMollusca and Echinodermata

Generalcharacteristicsandclassificationuptoclasses;Torsion inGastropoda, Evolutionarysignificance of trochophorelarva.Water-vascularsystemin Asteroidea;LarvalformsinEchinodermataand its Evolutionarysignificance

Note: Classification to befollowed from"BarnesRD (1982)InvertebrateZoology. 5th Edition."

PRACTICALS

Phylum Protozoa

9. Morphologyof*Paramecium,*Binaryfission andConjugation in *Paramecium.*
10. Lifestagesof*Plasmodiumvivax,Trypanosmagambiense*and*Entamoebahistolytica* (Slides/Micro-photographs).
11. Examination of pond waterfor protists.

PhylumPorifera

12. Studyof*Sycon*(includingT.S. andL.S.),*Hyalonema*, and *Euplectella.*
13. Temporarymounts of spicules, gemmulesand sponginfibres.

PhylumCnidaria

14. Studyof*Obelia,Physalia,Millepora,Aurelia,*Ephyralarva,*Tubipora,Corallium, Alcyonium, Gorgonia*and *Metridium*(includingT.S.andL.S.).

PhylumCtenophora

15. Anyonespecimen/slide.

Phylum Helminthes

16. Study of adult *Fasciolahepatica*, *Taeniasolium*and their life stages (Slides/ microphotographs).Studyof adult*Ascarislumbricoides,Wuchereriabancrofti*andtheirlifestages(Slides/ microphotographs).

PhylumAnnelida

17. Studyof*Aphrodite,Nereis,Heteronereis,Sabella, Terebella,Serpula,Chaetopterus, Pheretimaand Hirudinaria*.T.S. through pharynx, gizzard,and typhlosolarintestineofearthworm.T.S. through cropof leech

PhylumArthropoda

18. Study of *Limulus, Palamnaeus, Palaemon, Daphnia, Balanus, Sacculina, Cancer, Eupagurus, Scolopendra, Julus*, termite, louse, honeybee, silk moth, waspand dragon fly.

PhylumOnychophora

19. Anyonespecimen/slide.

PhylumMollusca

12. Study of *Chiton, Dentalium, Pila, Doris, Helix, Unio, Ostrea, Mytilus, Loligo, Sepia,Octopus*and *Nautilus* and *Cypraea*(cowrie).

PhylumEchinodermata

13 Studyof echinodermlarvae.

14 Study of *Pentaceros, Asterias, Ophiura, Clypeaster, Echinus, Echinocardium, Cucumaria*and *Antedon.*

Note: Classification to be followed from"BarnesRD (1982)InvertebrateZoology. 5th Edition."

SUGGESTED READINGS

11. AroraMP (2006) Non-Chordata-I. 1st edition. HimalayaPublishing House,New Delhi.
12. AroraMP (2008)Non-Chordata-II.1st edition. HimalayaPublishingHouse,New Delhi.

13. Barnes RD(1982)InvertebrateZoology.6th Edition. Holt SaundersInternational Edition.
14. BarnesRSK,CalowP,OlivePJW,GoldingDW& SpicerJI(2002)TheInvertebrates:A NewSynthesis. 3rd Edition. Blackwell Science,USA.
15. Barrington EJW(1979)Invertebrate Structure andFunctions. 2nd Edition.ELBS and Nelson.
16. BoradaleLAand Potts EA (1961)Invertebrates:AManual fortheuseofStudents. Asia PublishingHome.
17. Jordan ELandVermaPS(1963)InvertebrateZoology.RevisedEdition.S.Chand,New Delhi.
18. MohantyPK(2000)Illustrated DictionaryofBiology. Kalyani Publishers,Ludhiana.
19. Kotpal R.L Modern Text Book of Zoology, Invertebrates. RastogiPublication,Meerut.
20. Singh.H.S. &Rastogi.P., Parasitology,RastogiPublication,Meerut.

CORE COURSE: A2
Biology of Chordata
(CREDITS: THEORY-4, PRACTICALS-2)
THEORY

Unit 1:Protochordataand Cyclostomata

GeneralcharactersofHemichordata,UrochordataandCephalochordata;Retrogressivemetamorphosisin Urochordata;Generalcharactersand classificationofcyclostomesuptoclass;Structuralpeculiaritiesandaffinitiesof *Petromyzon* and *Myxine.*

Unit 2:Pisces and Amphibia

GeneralcharactersofChondrichthyesandOsteichthyesandclassificationuptoorder; Migration;Osmoregulationinfishes;Scalesinfishes;Originof *Tetrapoda*(Evolutionofterrestrialectotherms);Generalcharactersandclassificationup to orderand Parentalcarein Amphibians.

Unit 3:Reptilia and Aves

Generalcharactersandclassificationuptoorder;Affinitiesof *Sphenodon*;PoisonapparatusandBitingmechanisminsnakes;Generalcharactersand classificationuptoorder;Flightadaptations; *Archaeopteryx*-a connectinglink and Migration in birds.

Unit 4:Mammals

Generalcharactersandclassificationuptoorder;Affinitiesof PrototheriaandMetatheria;Dentitioninmammals;Adaptiveradiationwithreferencetolocomotoryappendages;

PRACTICAL

2. Protochordata

1. *Balanoglossus, Herdmania, Branchiostoma*and Colonial Urochordata.
2. Sections of*Balanoglossus*through proboscis andbranchiogenitalregions.
3. Sections of*Amphioxus* through pharyngeal, intestinal and caudal regions.
4. Permanent slide ofspicules of*Herdmania*.

2.Agnatha

5. Petromyzon and *Myxine.*

3. Fishes

6. *Sphyrna, Pristis, Trygon, Torpedo, Chimaera, Notopterus, Mystus, Heteropneustes, Hippocampus, Exocoetus, Echeneis, Anguilla, Tetrodon,Diodon, Anabas* and Flat fish.

4.Amphibia

7. Ichthyophis/Ureotyphlus, Necturus, Duttaphrynus, Polypedates, Hyla, Alytes and *Salamandra.*

8. Reptiles

*8. Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Draco, Ophiosaurus, Bungarus, Vipera, Naja, Hydrophis, Zamenis*and *Crocodylus.*

9. KeyforIdentificationofpoisonous and non-poisonous snakes.

9. Aves

10. Studyof sixcommon birds from different orders.
11. Types of beaksand claws.
12. Types offeathers.

10. Mammalia

13.Sorex, Bat (Insectivorous and Frugivorous), *Funambulus, Loris, Herpestes*and *Hemiechenis.*

SUGGESTED READINGS

8. Agarwal VK (2011)Zoologyfor degreestudents.S. Chand, New Delhi.
9. AroraMP (2006) Chordata-1. 1st Edition. HimalayaPublishingHouse, NewDelhi.
10. Hall BKand Hallgrimsson B(2008)*Strickberger's Evolution*. 4th Edition.Jones and Bartlett PublishersInc.,USA.
11. Jordan ELand VermaPS(1963)ChordateZoology.RevisedEdition.S.Chand,New Delhi.
12. MohantyPK(2000)Illustrated DictionaryofBiology. Kalyani Publishers,Ludhiana.
13. YoungJZ(2004)*TheLifeof Vertebrates*. 3rd Edition. OxfordUniversityPress, USA.
14. Kotpal R.L. (2015) Modern Text Book of Zoology, Vertebrates, RastogiPublication,Meerut.

CORE COURSE: A3
Cytogenetics and Molecular Biology
(CREDITS: THEORY-4, PRACTICALS-2)

.

THEORY

Unit 1: Cytology

Prokaryotic andEukaryotic cells;Plasma Membrane and Fluid Mosaic Model Transport across cell membrane, Cell cycle, Endomembranes: TheEndoplasmicReticulum;Golgiapparatus;Lysosomes;Peroxisomes

Unit 2:Mendelian Genetics andits Extension

Principlesofinheritance;Incompletedominanceandco-dominance;Multiplealleles, Lethalalleles; Epistasis;Pleiotropy; Sex-linked inheritance.Linkageandcrossingover, Sex determination

Unit 3:Molecular Biology-I

Structure of Nucleic Acid, Watson and Crick DNA Model, MechanismofDNA replication (Prokaryote and Eukaryotes),

Unit4: Transcriptionand Translation

RNApolymeraseandtranscriptionUnit;Mechanismoftranscriptioninprokaryotesand Eukaryotes;SynthesisofrRNAandmRNA; Transcriptionfactorsandregulationof transcription, Geneticcode,Wobble Hypothesis;Processofprotein synthesisinprokaryotes and Eukaryotes, Gene Mutation

PRACTICAL

6. Gram's stainingtechniqueforvisualization ofprokaryotic cells.
7. Studyvarious stages ofmitosis from permanent slides.
8. Studyvarious stages ofmeiosis from permanentslides.
9. StudythepresenceofBarrbodyinhumanfemalebloodcells/cheekcells.(Preparationof permanent slides).
10. Cytochemical demonstration (Preparation ofpermanent slides).
    i. DNAbyFeulgen reaction.
    ii. MucopolysaccharidesbyPAS reaction.
    iii. ProteinsbyMercurobromophenol blue.
    iv. DNAand RNAbyMethylGreenPyronin.

8. StudyofDNAreplicationusingPhotographsorslidesandspecialcases,e.g.,Polyteny usingpermanent slides of polytene chromosomes.
9. Preparation ofliquid culturemedium (LB)andraise cultureof*E. coli*.
10. Estimation of the growthkinetics of*E.coli* byturbiditymethod.
9. TostudytheMendelianlawsandgeneinteractionsandtheirverificationbyChisquareanalyses usingseeds/beads/*Drosophila*.
10. Identification ofvariousmutants of *Drosophila*.
11. Tocalculate allelic frequenciesbyHardy-WeinbergLaw.
12. Linkagemaps based on datafrom crosses of*Drosophila*.
13. Studyof human karyotype(normal andabnormal).
14. Pedigree analysis of somehuman inherited traits.
15. Preparation ofpolytenechromosomes from larvaof*Chironomous*/*Drosophila*.
16. To studyMutagenicityin*Salmonella/E. coli*byAmes test.

SUGGESTED READINGS

1. Becker WM, KleinsmithLJ,Hardin Jand Bertoni GP (2009)TheWorld ofthe Cell. 7th Edition. Pearson Benjamin CummingsPublishing,San Francisco.
2. BruceAlberts, AlexanderJohnson,Julian Lewis,Martin Raff, Keith Roberts, Peter Walter(2008)MolecularBiologyof theCell, 4th Edition. Garland publishingInc.,New York.
3. CooperGM and Hausman RE (2007)TheCell: AMolecularApproach**.** 4th Edition, ASM Press, USA.
4. DeRobertis EDP and DeRobertis EMF(2006)Cell and MolecularBiology. 8th Edition. Lippincott Williams andWilkins,Philadelphia.
5. Karp G(2010)Cell and Molecular Biology: Concepts and Experiments. 6th Edition.John Wileyand Sons.Inc., USA.
6. MohantyPK(2000)Illustrated DictionaryofBiology. KalyaniPublishers,Ludhiana.
7. Craig N. & Cohen-fix.O., Molecular Biology, Oxford UniversityPress,U.K.
8. Pal.J.K. &Ghaskadbi S.S., Fundamentals Of MolecularBiology,OxfortUniversity,U.K.

8. Gardner EJ, SimmonsMJ,Snustad DP (2008)Principles of Genetics. 8th Edition. Wiley India.
9. Griffiths AJF, WesslerSR,Lewontin RC and Carroll SB.Introduction toGenetic Analysis. 9th Edition. W.H. Freeman and Co.,New York.
10. KlugWS, CummingsMR, Spencer CA and Palladino MA (2012)Concepts of Genetics. 10th Edition. Pearson Edsucation,Inc., USA.
11. MohantyPK(2000)Illustrated DictionaryofBiology.Kalyani Publishers,Ludhiana.
12. Russell PJ(2009) Genetics-A MolecularApproach. 3rd Edition. BenjaminCummings, USA.
13. Snustad DP and Simmons MJ(2012)Principles of Genetics. 6th Edition.John Wileyand SonsInc., USA.
14. VermaPS and AgarwalVK(2010) Genetics. 9th Edition. S. Chand, New Delhi.

9. Becker WM, KleinsmithLJ,Hardin Jand Bertoni G P (2009):theWorld ofthe Cell. 7th Edition. Pearson Benjamin CummingsPublishing,San Francisco.
10. BruceAlbert, BrayDennis,Levis Julian, RaffMartin, Roberts Keith and Watson James (2008)MolecularBiologyof theCell. 5th Edition.Garland publishingInc.,New York.

11. CooperGM and Hausman RE (2009)TheCell: AMolecularApproach. 5th Edition. ASM Press, Washington D.C.
12. DeRobertis EDP and DeRobertis EMF(2006)Cell and MolecularBiology. 8th Edition. Lippincott Williams andWilkins,Philadelphia.
13. Karp G(2010)Cell and Molecular Biology: Concepts and Experiments. 6th Edition.John Wileyand Sons.Inc.,USA.
14. MohantyPK(2000)Illustrated DictionaryofBiology. Kalyani Publishers,Ludhiana.
15. Debasena.T. Cell Biology,Oxford University Press,U.K.
16. Gupta.P.K., Cell & Molecular Biology, RastogiPublication,Meerut.

DISCIPLINE SPECIFIC ELECTIVE A1

DEVELOPMENTALBIOLOGY

(CREDITS: THEORY-4, PRACTICALS-2)

Unit 1:Early Embryonic Development

Gametogenesis(Spermatogenesis,Oogenesis);Typesofeggs;Eggmembranes; Fertilization:Changesingametes,monospermyandpolyspermy;Planesandpatternsof cleavage;earlydevelopmentoffrogandchickuptogastrulation;Fatemaps;embryonic induction andorganizers.

Unit 2:LateEmbryonicDevelopment

Fateofgermlayers;Extra-embryonicmembranesinbirds;Implantationofembryoin humansand Placenta(Structure, types andfunctions of placenta).

Unit 3:PostEmbryonicDevelopment

Metamorphosis:Changes,hormonalregulationsinamphibians;Regeneration:Modesof regeneration(epimorphosis,morphallaxisandcompensatoryregeneration);Ageing: Concepts and models.

Unit 4:Implications ofDevelopmental Biology

Teratogenesis:Teratogenicagentsandtheireffectsonembryonicdevelopment;*invitro* Fertilization;Stem cell cultureandAmniocentesis.

PRACTICAL

1. Studyofwholemountsandsectionsofdevelopmentalstagesoffrogthroughpermanent slides:Cleavagestages,blastula,gastrula,neurula,tail-budstage,tadpole(externaland internal gill stages).
2. Studyofwholemountsofdevelopmentalstagesofchickthroughpermanent slides:Primitivestreak(13and18hours),21,24,28,33,36,48,72,and96hoursof incubation(HamiltonandHamburger stages).
3. Studyofdevelopmentalstages(abovementioned)byraisingchickembryointhe laboratory.
4. Studyof thedevelopmental stages and lifecycleof*Drosophila* from stock culture.
5. Studyof differenttypes ofplacenta.
6. Project report on*Drosophila* culture/chick embryo development.

SUGGESTED READINGS

1. BalinskyBIandFabianBC (1981)AnIntroduction to Embryology.5th Edition. International ThompsonComputerPress.
2. Gilbert SF(2010)Developmental Biology. 9th Edition. SinauerAssociates,Inc.,USA.
3. Kalthoff(2008) Analysis of Biological Development. 2nd Edition. McGraw-Hill, New York.
4. MohantyPK(2000)Illustrated DictionaryofBiology. Kalyani Publishers,Ludhiana.
5. WolpertL, BeddingtonR,Jessell T, LawrenceP,MeyerowitzEand Smith J(2002) Principles of Development. 1st Edition, Oxford UniversityPress,NewYork.
6. Sastry K.V & Shukla Vinita, Developmental Biology, RastogiPublication,Meerut.

DISCIPLINE SPECIFIC ELECTIVE A2

ANIMAL BIOTECHNOLOGY
(CREDITS: THEORY-4, PRACTICALS-2)

THEORY

Unit 1: Concept and scope of Biotechnology, Cloning vectors (Types and characteristics), Restriction enzymes: Nomenclature, detailed study of Type-II.

Unit 2: Transformation techniques: Calcium chloride method and electroporation, Construction of genomic and cDNA libraries and screening, Bloting techniques, DNA sequencing, Polymerase Chain Reaction, DNA finger printing and DNA microarray

Unit3: Production of cloned and transgenic animals: Nuclear transplantation, retroviral method, DNA microinjection, Applications of Transgenic animals: production of pharmaceuticals, knock out mice, donor organs, production of transgenic plants: Agrobacterium mediated transformation, Application of Transgenic plants: insect and herbicide resistant plants.

Unit4: Animal cell culture, Expression of cloned genes, molecular diagnosis of genetic diseases (Cystic fibrosis/Sickle cell anemia), Recombinant DNA in medicine: insulin/growth hormone, Gene therapy.

PRACTICAL

1. Genomic DNA isolation from E. Coli.
2. Plasmid DNA isolation.
3. Restriction digestion
4. Construction of circular and linear restriction map
5. Calculation of transformation efficiency from the data provided
6. To study the following technique through photographs
   - Southern Bloting
   - NothernBloting
   - DNA sequencing
   - PCR
   - DNA fingerprinting
7. Project report on animal cell culture

SUGGESTED READINGS

1. Brown, T. A. Molecular Biology, LabfaxII: Gene cloning and DNA Analysis, II Edition
2. Glick, B. R. and Pasternak, JJ, Molecular Biotechnology-Principles and Application of Recombinant DNA, IV Edition
3. Griffiths, AJF etal. (2009): An Introduction to Genetic Analysis, IX Edition
4. Snustad, DP and Simmons MJ, Principles of Genetics, V Edition
5. Watson JD, Myers RM, Caudy A and Witkowski JK (2007): Recombinant DNA-Genes and Genomes-A short Course, III Edition
6. Beauchamp TI and Childress JF (2008): Principles of Biomedical Ethics, VI Edition