SRIVENKATESWARAUNIVERSITY

S.V.U COLLEGE OF SCIENCES

TIRUPATI - 517 502

DEPARTMENT OF BIO-CHEMISTRY

Re-Structured P.G. Programme (CBCS) as per NEP2020,NHEQFandGuidelinesofAPSCHE

(With effect from the batch of Students admitted from the academic year 2024-25)

M.Sc Bio-chemistry

SRIVENKATESWARAUNIVERSITY::TIRUPATI
SVUCOLLEGEOFSCIENCES,DepartmentofBIOCHEMISTRY
Re-StructuredP.G.Programme(CBCS)asperNEP2020,NationalHigherEducationQualificationFrameWork (NHEQF) and Guidelines of APSCHE
(Witheffectfromthe batchofStudentsadmitted fromthe academic year2024-25) M.Sc
Branch II (A): M.Sc. Bio-chemistry

SEMESTER-I								
S. No	**Course**	**BCH Code**	**TitleoftheCourse**	**H/W**	**C**	**SEE**	**IA**	**Total Marks**
1	CC	101	CoreCourse-1:IntermediaryMetabolismI	4	4	70	30	100
2		102	CC–2(A):BiochemicalandBiophysical Techniques	4	3	50	25	75
			CC–2(B): Foodsafetyandqualitymanagement					
3		103	CC–3(A):BiomolecularChemistry	4	3	50	25	75
			CC–3(B): Plant Biochemistry					
4	*P	104	PracticalI(relatedtoCC2&3)	6	2	35	15	50
5	SOC	105	SkillOrientedCourse–1(A): Microbiology	4	3	50	25	75
			SkillOrientedCourse–1(B):InheritanceBiology					
6		106	SkillOrientedCourse–2(A):MolecularBiology	4	3	50	25	75
			SOC–2(B):Biotechnologyand Nanotechnology					
7	*P	107	PracticalII(relatedtoSOC1&2)	6	2	35	15	50
			Total	**36**	**20**	**340**	**160**	**500**
8	Audit Course	109	IndianKnowledgeSystems-1	4	0	0	100	0

- **CC(CoreCourses)-1stCoreCourseismandatoryand2nd&3rdCoreCoursesStudentcanchooseonefromeachcode**
- ***SOC(SkillOrientedCourses) –Studentcanchooseonefromeachcode**
- ***Practical –Irelatingto2nd&3rdCore CoursesandPractical-IIrelatingto1st&2ndSkillOrientedCourses(SOC)**
- **AuditCourse–ZeroCreditsbutmandatorywithonlyaPass.**

SEMESTER-II								
S. No	**Course**	**BCH Code**	**TitleoftheCourse**	**H/W**	**C**	**SEE**	**IA**	**Total Marks**
1	CC	201	CoreCourse-4:IntermediaryMetabolismII	4	4	70	30	100
2		202	CC–5(A):MolecularPhysiology	4	3	50	25	75
			CC–5(B):MolecularSignaling&Immuno-technology					
3		203	CC–6(A:Enzymology	4	3	50	25	75
			CC–6(B):EcologicalPrinciples					
4	P	204	PracticalIII(relatedtoCC5 &6)	6	2	35	15	50
5	SOC	205	SkillOrientedCourse–3(A):NutritionalBiochemistry	4	3	50	25	75
			SkillOrientedCourse–3(B):Nutraceuticals					
6		206	SkillOrientedCourse–4(A):GeneticEngineering	4	3	50	25	75
			SkillOrientedCourse–4(B):Metabolomics					
7	P	207	PracticalIV(relatedtoSOC3&4)	6	2	35	15	50
8	OOTC	208	OpenOnlineTransdisciplinaryCourse-1	-	2	-	100	100
			Total	**36**	**22**	**340**	**260**	**600**
9	Audit Course	209	IndianKnowledgeSystems-2	4	0	0	100	0

- **CC(CoreCourses)–4thCoreCourseismandatoryand5th&6thCoreCoursesStudentcanchooseonefromeachcode**
- ***SOC(SkillOrientedCourses) –Studentcanchooseonefromeachcode**
- ***Practical-IIIrelatingto5th&6thCoreCoursesandPractical-IVrelatingto3rd&4thSkillOrientedCourses(SOC)**
- ***Open Online Trans disciplinary Course (OOTC) - Students can choose any relevant course of his / her choice from theonline courses offered by governmental agencies like SWAYAM, NPTEL, etc.,**
- **AuditCourse–ZeroCreditsbutmandatorywithonlyaPass**

SEMESTER-III								
S. No	**Course**	**BCH Code**	**TitleoftheCourse**	**H/W**	**C**	**SEE**	**IA**	**Total Marks**
1	CC	301	Corecourse-7:EndocrineBiochemistry	4	4	70	30	100
2		302	CoreCourse–8(A): Immunology CoreCourse–8(B): Neuro-Biochemistry	4	3	50	25	75
3		303	CoreCourse–9(A):DevelopmentalBiology CoreCourse–9(B): CancerBiology	4	3	50	25	75
4	P	304	PracticalV(relatedtoCC8&9)	6	2	35	15	50
5	SOC	305	SkillOrientedCourse–5(A):TechnicalWriting, Biostatistics,BioinformaticsandOmics SOC– 5(B): Research Methodology Tools Techniques,ResearchPublicationandEthics	4	3	50	25	75
6		306	SkillOrientedCourse–6(A):Clinical Biochemistry SOC–6(B):InSilicoDrugDesignandDiscovery	4	3	50	25	75
7	P	307	PracticalVI(relatedtoSOC5&6)	6	2	35	15	50
8	OOTC	308	OpenOnlineTransdisciplinaryCourse-2	-	2	-	100	100
*	Seminar/tutorials/remedialclassesandQuizaspartofinternal assessment			4				
			Total	**36**	**22**	**340**	**260**	**600**

- **CC(CoreCourses)–7thCoreCourseismandatoryand8th&9thCoreCoursesStudentcanchooseonefromeachcode**
- ***SOC(SkillOrientedCourses) –Studentcanchooseonefromeachcode**
- ***Open Online Trans disciplinary Course (OOTC) - Students can choose any relevant course of his / her choice from theonline courses offered by governmental agencies like SWAYAM, NPTEL, etc.,**
- ***Practical -Vrelatingto5th&6thCoreCoursesandPractical-VIrelatingto5th&6thSkillOrientedCourses(SOC)'**

SEMESTER-IV								
S. No	**Course**	**BCH Code**	**TitleoftheCourse**	**H/W**	**C**	**SEE**	**IA**	**Total Marks**
1	OOSDC	401	OpenOnlineSkillDevelopmentCourses	-	8	-	200	200
2	PW	402	ProjectWork–Orientationclasses	24	12	300	0	300
*	Conductingclassesforcompetitiveexams,communicationskills,UGC/ CSIRandNET/SLETexaminations			12	-	-	-	-
			Total	**36**	**20**	**300**	**200**	**500**
TotalSemesters				**144**	**84**	**1320**	**880**	**2200**

- Open OnlineSkill DevelopmentCourse(OOSDC)- Studentscan chooseany**Two**relevantcoursesofhis/her choicefromthe online courses offered bygovernmental agencies like SWAYAM, NPTEL, etc., **to get 8 credits (with 4 credits from each course)**

SEMESTER-I

BCH101CoreCourse1:IntermediaryMetabolismI(Credits4)

CourseObjectives:

Themainobjectivesofthiscourseareto:

1. Tounderstandthemetabolismofcarbohydrates,andlipids.
2. Toimpartknowledgeoftheconceptsofregulationofmetabolicpathways.
3. Tooffer basicknowledgeonapplicationsinthemetabolicpathways

UnitI

Outlineof intermediarymetabolism, methods of studying metabolism. Glycolysis – Reactions, energy yield and regulation. Entry of other carbohydrates into glycolytic sequence, fermentation, TCA cycle – Reactions, Energetics and Regulation.

Organization of electron carriers and enzymes in mitochondria, mitochondrial respiratory chain, Classes of electron transferring enzyme, inhibitors of electron transport, oxidative phosphorylation, Mechanism of oxidative phosphorylation.

UnitII

Glyoxylate cycle, pentose phosphatepathway-regulation and significance. Glucuronicacid cycle, Breakdown of glycogen, starch and disaccharides, glycogenolysis and its regulation, Biosynthesis of glucose (gluconeogenesis), Futile cycle, glycogen synthesis and its regulation, Regulation of blood glucose homeostasis

UnitIII

Bioenergetics - Thermodynamic principles: free energy, enthalpy (H), entropy (S), Free energy change in biological transformations in living systems; high energycompounds, exergonic and endergonic reaction, oxidation – reduction reactions.

Microsomal electron transport –utilization of oxygen byoxygenases, superoxide dismutase, and catalase.Photosynthesis – dark andlightreaction Photophosphorylation,andPhotorespiration, cyclicandnon –cyclicreactions; photochemical eventsassociated with photo system – I and II. C3 and C4 plants.

UnitIV

Lipidmetabolism:lipidsasenergyreserves.Oxidationoffattyacids,Oxidationofoddchainfattyacids,Energyyieldand regulation.

Ketonebodies, Fattyacid biosynthesis- control of fattyacid synthesis. Formation of monoenoic and polyenoic acids. Biosynthesis of cholesterol, triacyl glycerols, phospholipids, bile acids. Formation of prostaglandins, leukotrienes, prostacyclins. Metabolism of lipoproteins.

RecommendedBooks:

1) PrinciplesofBiochemistry,white.A,Handler,PandSmith
2) Biochemistry,LehningerA.L.
3) Biochemistry,DavidE.Metzler.
4) Biochemistry,LubertStryer.
5) ReviewofPhysiologicalchemistry,HaroldA.Harper.
6) TextofBiochemistry,WestandTood.
7) OutlinesofBiochemistry,ConnandStump
8) Metabolicpathways–Greenberg.
9) Mitochondria,Munn.
10) Biochemistry,2nd Edition,G.Zubay.

ExpectedCourseOutcomes: Onthesuccessfulcompletionofthecourse,studentswillbeableto:

1. Understandtheconceptsofcarbohydratemetabolismanditsregulation (K2)
2. Understandtheconceptsofnucleicacidmetabolismanditsregulation(K2)
3. ApplytheknowledgeMetabolicPathways (K3)

K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate;K6–Create

BCH102CoreCourse2(A):BiochemicalandBiophysicalTechniques (Credits3)

Course Objectives: The main objectives of this course are to:

1. The main objective of the course is qualitative and quantitative analysisof different molecules taking place in a biochemicalreaction.
2. Itincludesthedevelopment ofdifferent toolsandmethodsfor identification,analysisand examination ofphysical propertiesof different biochemical compositions to provide better chemical information.
3. Ithelpsthebiochemistrystudentsin understandingthebasicsciencein avarietyofapplications.

Unit I

Safetyand good labpractices, Solutions –Percentage, Molarity, Molality, Normality, pH, Measurement of pH, pKa of functional group in biopolymers such as proteins and nucleic acids.

Microscopy:basicprinciplesoflightmicroscopy,phasecontrastmicroscopyandelectronmicroscopy.

Sedimentationmethods:principlesofcentrifugation,analyticalandUltra-centrifugation/Gradientcentrifugation.

Unit II

Concept of half – life and decay constant, units of radioactivity, Radioactivity measuring techniques and correction factors. Application of isotopes in biochemical analysis, isotope dilution techniques and autoradiography.Radioisotopes in biochemistry and medicine. Measurement of radioactivity - GM counter, Liquid Scintillation Counter, γ-Counter, Radioactive disposal, RIA, Chemi luminescence.

Separation methods: principle, methodology and application of counter current distribution, paper, thin layer, ion-exchange, gas chromatography, affinity chromatography, gel filtration, HPLC.

UnitIII

Electrophoresis - paper, agar, high voltage electrophoresis, iso-electrophoresis, iso-tachophoresis, Northern blot, southern blot, western blot analyses. *In situ* hybridization.

UnitIV

Spectroscopy methods – Concepts of spectroscopy, electromagnetic spectrum, Beer– Lamberts law, principles and applicationsofcolorimetry, UV-VIS spectrophotometry. Concepts of fluorimetry, flame photometry, AAS, AES, Infrared, ESR, NMR, CD & ORD and X – ray Diffraction. Flowcytometry and cell sorting and their applications.

RecommendedBooks:

1) PrinciplesandTechniquesofPracticalBiochemistry,Ed.WilliamsandWilson.
2) TechniquesinMolecularBiologyEd.Walker&Gastra,CroomHelm.
3) PrinciplesofInstrumentalAnalysis,2nd Ed.Holt-Sanders.
4) AnIntroductiontoSpectroscopyforBiochemistry,Ed.BrownSn.,AcademicPress.
5) AnalyticalBiochemistry,HolmesandHazelPeck,Longman.
6) AnIntroductiontoPracticalBiochemistry.Davidt.Plummer,TataMacgrew–Hill.
7) BiophysicalChemistry,Ed.Shall&Wyman,AcademicPressVolII&I.
8) Atextbookofquantitativeinorganicanalysisincludingelementaryinstrumentalanalysis,VogelELBS.
9) BiochemicalCalculationsSeigel,IH,2nd Ed.JohnWiley&SonsInc.
10) AnalyticalBiochemistrybyDavidFriefelder.

ExpectedCourseOutcomes: Onthesuccessfulcompletionofthecourse,studentwillbeableto:

1. Obtaintheknowledgeaboutthemicroscopehandlingandthebasicdifferencebetweentheordinarymicroscopeand electron microscope (K2).
2. Learn the chromatographic techniques, for the separation of the individual compound from the mixture of compound (K3 & K5).
3. Studytheinteraction between matterandelectromagneticradiationandvisible light dispersedaccordingtoitswavelength, by a prism (K4& K5).
4. Understandthecharacterizationofsurfacesusingradioisotopesgenerallyinvolvesobservingthemannerinwhichthe radioactive species interact with the surface (K1, K2 & K3).
5. Obtain knowledgeabout theseparationandanalysisofmacromoleculesand their fragments,basedon theirsizeandcharge (K2 & K3).

K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6–Create

Practical:BiochemicalandBiophysicalTechniques(Credits1)

1. PreparationofbuffersandpHmeasurement.
2. Separationofaminoacidsbypaper chromatography
3. SeparationofsugarsbyTLC
4. SeparationofproteinsbySDS-PAGE.
5. Absorptionspectraofphenolred,aminoacidsandnucleicacid.
6. IsolationandSpectrophotometriccharacterizationofplantpigments.
7. VerificationofBeer'slawanddeterminationofmolarextinctioncoefficientusingp-nitrophenol.
8. Separationofaminoacidsbyion-exchangechromatography.
9. Isolationofstarchfrompotatoes.
10. Isolationofcholesterolfrombrain.

BCH102CoreCourse2(B):Foodsafetyandqualitymanagement(Credits-3) Course

Objectives: Students will be able to

1. Acquireanunderstandingofrelevanceoffoodcomponents,
2. Acquireanunderstandingofapplicationanddetectiontechniquesinfood.
3. Applyregulatorytechniquesinrealtimescenarios
4. Acquireanunderstandinginindustrialoperationsinfood,roleofmicrobes
5. Foodbornediseases

Unit–I

Microbiology of foods and food safety. Factors affecting the growth of microorganisms in food. Role of microorganisms in fermented foods and food industry. Economically important fermentation products.

Food safety and importance of safe food. Factors affecting food safety – Physical, Chemical andBiological.Recent concerns of food safety. Food safety and food service establishments – food safety measures – hygiene and sanitation infood service establishments, licensing and sale.

Unit–II

Food adulteration – common adulterants, classification of adulterants –harmful effects of adulterants– methods for detection of adulterants.

Unit–III

Food packaging – significance and function – classification of packaging material – packing methods – interaction between packaging and food – toxicity hazards. Packaging laws and regulations. Biodegradable materials and environmental issues – labeling requirements, nutritional labeling and coding of foods.

Unit–IV

Risk analysis Risk analysis – HACCP – A food safety assurance system. Food regulations, standards and quality control. Prevention of food adulteration. Consumer protection Act, 1986 – Regulations related to geneticallymodified foods.

ExpectedCourseOutcomes:Onthesuccessfulcompletionofthecourse,studentswillbeableto:

1. Understandtheconceptsofcarbohydratemetabolismanditsregulation (K2)
2. Understandtheconceptsoflipidmetabolismanditsregulation(K2)
3. ApplytheknowledgeaboutBig Dataanalytics in MetabolicPathwayAnalysis(K3)
4. K1-Remember;K2-Understand;K3-Apply;K4-Analyze; K5-Evaluate;K6–Create

RecommendedBooks:

1) FoodMicrobiology(5ed.)2017.byW.C. Frazier&D.C.Tata McGrawHillpublishinghouse, NewDelhi.
2) Adams,MR.FoodMicrobiologyFundamentals&Frontiers2018AmericanSocietyforMicrobiology5th.
3) JamesM.Jay.5thed.2006.ModernfoodMicrobiology.FoodSciencetextseries.Springerpublication,US.

Practicals:Foodsafetyandqualitymanagementsignaling(Credits-1)

1. Determinationoffungalandyeastcountinagiven foodsample.
2. Determinationofcoliformsinthegivenfoodsamplesbypresumptivetesting.
3. Determinationofqualityofmilksampleofmethylenebluereductasetest
4. Detectionofnumberofbacteriainmilk
5. Analysisofairofprocessingfacilityformicrobialload.
6. CheckthePresenceofRhodamineBingivenfoodsample.
7. Testthepresenceofsugarinhoney
8. DetectionofNaHCO3(chalk)inFlour.
9. ChecktherepresenceofVanaspatiandRanciditythe ghee
10. Checkthemilkforthepresenceofproteins,urea,sugarandstarch.

BCH103CoreCourse3(A):BiomolecularChemistry(Credits3)

Course Objectives: The main objectives of this course are to:
1. Emphasizesonvariousbiologicalmacromoleculesanditssignificanceinbiologicalsystems.
2. Learnthebasicfunctions,structuresandbiologicalimportanceoflifelesschemicalcompoundsinlife.
3. Upon successful completion, students should have understood the significance of the complex biomolecules, polysaccharides, lipids, proteins, nucleic acids and porphyrins.

UnitI

Molecular logicofLife – Major constituents ofcells, Biomolecules. Carbohydrates:Classification, structure, Chemicalproperties of carbohydrates, reactions of monosaccharides, formation of glycosidic bond, oligosaccharides, chemistryand biological role of homo and heteropolysaccharides; Structural polysaccharides (Cellulose and Chitin), storage polysaccharides (Starch, Glycogen and Inulin), Mucopolysaccharides, Blood group substances, Peptidoglycons.

UnitII

Amino acids and Proteins: Classification, structure and physico chemical properties of amino acids, Essential and non-essential amino acids, Acid base properties and general reactions of amino acids, Non-protein or unusual amino acids, Peptide bond formation and stability.

Classificationofproteins,Purificationandisolationofproteins,criteriaofpurity,structuralorganizationofproteins-Primary, Secondary, Tertiary and Quaternary structure, confirmation of proteins-Ramachandran plot, Denaturation of proteins.

UnitIII

LipidsandPorphyrins:ClassficationandStructure,propertiesandclassificationoflipids,fattyacids,waxes,phospholipids, cerebrosides and gangliosides, lipoproteins, prostaglandins, leukotrienes, thromboxanes, steroids and bile acids.
StructureofPorphyrins,Structureandfunction ofHeme,CytochromesandChlorophyll.

Unit IV

Nucleic acids: Purine and Pyrimidine Bases, Nucleosides, Nucleotides, Formation of phosphodiester bond and its stability, Structure of DNA-Watson and Crick model, different forms of DNA, types of RNA, Structure of t-RNA, Denaturation and Renaturation of DNA, melting curves.

Recommended Books:

1) GlycoproteinsbyHughesR.C.,Chapman&Holl.
2) Biochemistry–MechanismsofmetabolismCunningham,E.B..,McGrew–Hill.
3) Nucleicacid–Chargaff&Davidson Vol.II
4) TheBiochemistryofNucleicacids;Adamsetal.,ChapmanandHall.
5) Proteins: AguidetostudybyPhysical&Chemical
6) Proteins:Structure,functionandevolution.DickersonGeis,2ndEdn,Benjamin/Cummings,MenloPark.
7) Theproteins:NeurathandHill,3rdEd.AcademicNewYork.
8) Biochemistry–ZubayC, Addison–Wesley.
9) Biochemistry,AProblemApproach,2ndEd.Wood,W.B.AddisonWesley.
10) BiochemistryofLipidsandMembranes–VanceD,Addison–Wesley.
11) Biochemistry,LehningerA.H.
12) TextbookofBiochemistryWest,E.S.,Todd,Manson&Vanbruggen,Macmillian&co.

13) PrinciplesofBiochemistrywhite-A.HandlerandSmithE.L.McGrawHill.
14) Thecarbohydrates:Pigman&HartmanVol.II–A&II-B.
15) ComprehensiveBiochemistry–Florkin&stotz,AcademicPress.
16) Organicchemistry,I.L.Finar,ELBS.
17) OrganicchemistrybyJ.P. Cohen.Vol.3Edward Arnold.
18) BasicPrinciplesofOrganicChemistrybyRoberts&Cashino(Benjamin)
19) FundamentalsofBiochemistrybyVoetand Voet.
20) OrganicchemistrybyMorrisonandBoydPrenticeHall.

ExpectedCourseOutcomes: Onthesuccessfulcompletionofthecourse,studentswillbeableto:

1. Helpstounderstandaboutthepolysaccharidesanditstypes(K1&K2).
2. Givesaclearunderstandingaboutthelipidsanditsrole(K1&K2).
3. AClearKnowledgeregardingaminoacidsandproteincharacterization(K2&K3).
4. ProvidesthestructureandpropertiesofNucleicacids(K2&K3)
5. Givesanideaaboutenergylevelanditssynthesis(K1,K2&K3).

K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6–Create

Practicals:BiomolecularChemistry(Credits1)

1. Generaltestsofcarbohydrates.Specificreactionsofselectedsugars–Osazones,sucrose,pentoses.
2. Generalreactionsofaminoacidsandproteins.Precipitationofproteins.
3. Qualitativetestsoflipidsandsteroids.
4. Estimationofaminoacidsbyformaltitration.
5. EstimationoftyrosinebyMillons–reaction.
6. EstimationofaminoacidbyNinhydrin method.
7. EffectofsolventsystemontheRfvalueoftwosolutes.
8. EstimationofproteinsbyLowrymethods.
9. EstimationofproteinsbyBiuretmethods.
10. IsolationofmitochondriafromRatliverbyDensitygradientcentrifugation(Demonstration)

BCH103CoreCourse3(B):PlantBiochemistry(Credits-3)

CourseObjectives:

1. Toillustratesknowledgeofstressadaptationsinbiologicalsystems.
2. Todelivermolecularunderstandingofprimaryandsecondarymetabolicprocess.
3. Topresentperspectivesofthecurrenttoolsforapplicationinbiologicalsystemforbiotechnologicalresearch.
4. Demonstratetheconceptusingdifferentactivitiesforbuildingcapacity.

Unit-I

Plant hormones – Types of Plant Hormones and their Functions. Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.

Unit-II

Sensoryphotobiology- Structure, function andmechanismsofaction ofphytochromes, cryptochromesandphototropins;stomatal movement; photoperiodism and biological clocks.

Unit-III

Solute transport and photo assimilate translocation – uptake, transport and translocation of water, ions, solutes and macromolecules from soil,through cells,acrossmembranes,throughxylem andphloem;transpiration; mechanismsofloadingand unloading of photo-assimilates.

Secondary metabolites - Introduction to primary and secondary plant metabolites. Classification of secondary metabolites. Functions of secondary metabolites Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.

UNIT-IV

Stress physiology – Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses. Stress and determined hormones ABA as a signaling molecule Cytokinin as a negative signal. Oxidative stress:RelativeOxygen Species (ROS), role of scavenging systems (SOD catalase etc.).

ExpectedCourseOutcomes: Onthesuccessfulcompletionofthecourse,studentswillbeableto:

1. Helpstounderstandaboutplanthormonessynthesis,transportandphysiologicalfunctions(K1&K2).
2. Givesaclearunderstandingabouttheroleofplanthormoneongrowthandabscissionofplantgrowthwiththeir mechanism of action at molecular level (K1 & K2).
3. AClearKnowledgeregardingplanttransportthroughcellsmembranesandpith(K2&K3).
4. Helpstounderstandaboutthestructureandfunctionsofsecondarymetabolites(K2&K3)
5. Givesanideaaboutofbioticandabioticstressadaptations(K1,K2&K3).

Practical:PlantBiochemistry(Credits1)

1. ThistleFunnelExperiment
2. DeterminationofOsmoticPressure
3. Effectofcarbondioxideconcentration ontherateofphotosynthesis
4. EstimationofSugar
5. EstimationofChlorophyll
6. Demonstrationofanaerobicrespiration

RecommendedBooks:

1) Biochemistry& Molecular Biology of Plants. Authors: Buchanan BB, Gruissem W and JonesRL(2000), American Society of Plant Physiologists.
2) LehningerPrinciplesofBiochemistry,Authors:DavidL.NelsonandMichaelM.Cox.
3) PlantPhysiology.Authors:TaizL,andZeizerE,(2006),SinauerAssociates,Inc.Biochemistry. Authors:BergJM, Tymoczko, JL, and Stryer L (2006). W. H. Freeman.
4) PlantPathology.Authors:AgriosGN5ed;2005,ElsevierAcademicPress.

BCH 1051(A)SkillOrientedCourse 1(A):Microbiology(Credits3)

Course Objectives: The main objectives of this course are to:

1. Provideknowledgeaboutmicrobialculturetechniques.
2. Learntheconceptsofdifferentenergysources.
3. Understandthebasicconceptsoffoodfermentationanditsindustrialapplications.
4. Understandtheconceptsfordiagnosinginfectiousdiseasesandassessmentofantimicrobialactivity.

UnitI

Microorganisms and theirplace inthe living World; Historical developmentsof microbiology (Spontaneousgeneration,Germ theoryofdiseaseandKoch'spostulates).Nomenclatureandbroadclassificationofbacteriaasper Bergey'smanualofsystematic acteriology; General characteristics of Actinomycetes, Rickettsiae, Mycoplasms, Spirochetes. Difference between prokaryotic and eukaryotic cells. Ultra structure of bacterium and endospore.

UnitII

Nutritional requirements in microorganisms: Modes of nutrition – phototrophy, chemotrophy, methylotrophy, organotrophy, mixotrophy, saprophytic, symbiotic and parastitic modes of nutrition. Isolation of microorganisms – Direct and indirect Methods of maintenance of culture. Growth and kinetics of bacterial cells; Normal and biphasic growth curve, batch and continuous cultures, chemostats. Preservation of cultures (glycerol stocks, freeze drying), Culture collection centers in India.

UnitIII

Control of microorganisms: Fundamentals of control, control by physical and chemical agents. Antibiotics and other chemotherapeuticagents. MicrobiologyofFood, Water, SewageandBiogas. Water andSewagetreatment.Foodandwater-borne infections. Estimation of BOD and COD and their importance. Outlines of the Ames Test.

UnitIV

Introduction to Virology: Classification, Morphology, size, ultra structure and life cycle of some representative viruses (ØX 174, T4, SV40, λ-Phase, M13 and HIV). Methods of culturing of viruses, Isolation, purification and characterization. Biology of sub viral agents – Viroids, Prions, Satellite viruses.

RecommendedBooks:

1) MicrobiologybyPelczar,ChanandKreig5th Ed. McGrew–Hill
2) GeneralMicrobiology:Boyd,R.F.,TimesMirror/MosbyCollege.
3) ReviewofMedicalMicrobiology:Jawetzetal.,16th Ed.MaruzenAsian.
4) AtextbookofMicrobiology,R.C.DubeyandD.K.Maheswari,S.ChandCo.
5) PharmaceuticalMicrobiology,ByHugoandRussell,BlackwellScientific
6) AnIntroductiontoVirusesbyS.B.Biswas,VikasPublishingHouse.
7) Microbialworld(5th Ed.)RY.Stainer,Hamshire–MacmillanPress.
8) Microbiology4th Ed.Prescott,Harley,Klein(McGrewHill)
9) DiseasesofCropPlants–G.Rangaswamy.
10) PlantPathology–J.C.Walker.
11) FundamentalsofMicrobiology-M.Frebisher.
12) TextbookofMicrobiology–WilliamBurrows
13) BiologyofMicroorganisms–SandesT. Lyles
14) InstantnotesinMicrobiology–Nicklinetal
15) Microbial Ecology – Atlas

ExpectedCourseOutcomes: Onthesuccessfulcompletionofthecourse,studentswillbeableto:

1. Studentswillbeabletoapplyculturetechniquesfor isolationofmicrobesfromvarioussourcesandpreserveisolates(K3).
2. Students will gain knowledge about different energysources such as inorganic compounds, organic compounds and visible radiation for organisms (K2).
3. Studentswilllearnaboutfermentationinfoodindustry(K2).
4. Studentswilllearnabout theisolationandidentificationofmicrobes from textiles(K3). K1 -

Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;

Practical:Microbiology(Credits1)

1. Structure,HandlingandcalibrationofMicroscope.
2. MethodsofSterilization:Autoclave(Moistened–heatsterilization),Oven(dryheatsterilization).
3. PreparationofMediaforBacteria.
4. Methodsforisolationandcultivationofpurecultures:serialdilution,pourplate,spreadplateandstreakplate.
5. Bacterialgrowthcurve:*E.coli*.
6. Methodsofstaining:Gram,acidfastandbacterialspore.
7. Determinationofantibioticsensitivitywithselectedantibiotics
8. Starchhydrolysisassayfortheidentificationamylase–producingmicroorganisms.
9. Wateranalysisforbacteriaanddeterminationof B.O.D.ofwater.
10. Isolationandquantificationofphagesfromsewagebyplaqueassay.

RecommendedBooks:

1) MicrobiologylaboratoryManual4th Ed.ByCappuccino
2) MicrobiologylaboratoryManual(2001)byAnejaK.M.
3) LaboratoryManualinMicrobiologybyP.Gunasekaran(1996),NewAgePubl.
4) MolecularCloningbySam Brook.

BCH105SkillOrientedCourse1(B):InheritanceBiology(Credits-3)

CourseObjectives:

1. Identifyand describetheprocessandpurposesofthecell cycle,meiosis, andmitosis,aswell aspredicttheoutcomesof these processes.
2. Transmission genetics problems, make accurate predictionsabout inheritance ofgenetic traits,andmapthelocationsof genes
3. Toidentifytheparts,structure,anddimensionsofDNAmolecules,RNAmolecules,andchromosomes, and beable to categorize DNA as well as describe how DNA is stored
4. To describe what causes and consequences of DNA sequence changes and how cells preventthesechanges,aswell as make predictions about the causes and effects of changes in DNA
5. Todescribeapplicationsandtechniquesofmoderngenetictechnology,aswellasselectthecorrecttechniquestosolve practical genetic problems

Unit-1

Introduction to Genetics Brief history/basic concepts of genetics, Cell division and chromosomes. Mendelian genetics/monohybrid, dihybrid cross. Mendelian genetics/trihybrid cross, probability. Modification of Mendelianratios/incomplete and codominance. Modification ofMendelianratios/incompleteandcodominance. StructureofGene. Atavism. (https://www.slideshare.net/vanessaceline/intorduction-to-genetics).

Unit–II

Chromosome abnormalities Diploid chromosomes number- Sex differentiation and sex determination. The X chromosomes, Barr bodies, theLyon hypothesis. Aneuploidyandpolyploidy: Genedeletion,duplication,inversionsandtranslocation.Sex Linkagein Drosophila and Man, Sex Influenced and Sex Limited Genes - Non-Disjunction and Gynandromorphs - Cytoplasmic Inheritance. Kappa particles in Paramecium, Milk Factor in Mice.(Blended mode of teaching)

Unit-III

Blood groups and Crossing over Blood Groups and their Inheritance in Human - Linkage and Crossing Over: Drosophila - Morgans' Experiments - Complete and Incomplete Linkage, Linkage Groups, Crossing Over types, Mechanisms - Cytological Evidence for Crossing Over, Mapping of Chromosomes - Interference and Coincidence.

Unit–IV

Nature and Function of Genetic Material Fine Structure of the Gene - Cistron, Recon, Muton - Mutation - Molecular Basis of Mutation, Types of Mutation, Mutagens, Mutable and Mutator Genes. Chromosomal Aberrations - Numerical and Structural Examples from Human.

ExpectedCourseOutcomes: Onthesuccessfulcompletionofthecourse,studentswillbeableto:

1. Studentswillbeabletogainknowledgeonclassicalgeneticsand Mendelianlawsandstructureandfunctionofgene.
2. Studentswillgainknowledgeaboutdominanceandco-dominanceandcompetenceandothercharactersdeviatedfrom Mendelian laws
3. Studentswilllearnaboutchromosomeabnormalitiesandsexlinkedandsexinfluencedgenes (K2).
4. Studentswilllearnaboutthenondisjunctionofchromosomesandgynandromorphs(K3).
5. Conceptofbenzersexperimentontheconceptoflinkageandmechanismofcrossingover.(K3)

RecommendedBooks:

1) GeneticsbyVerma,P.S.andV. K.Aggarwal.
2) GeneticsbyRussellP.J.
3) GeneticsanalysisandprinciplesbyBrookerR.JandMcGrawHill.
4) BasicGeneticsmyMiglani G.S.
5) Genetics:AnalysisofgenesandgenomesbyHartlD.LandJonesE.W.

Practicals:InheritanceBiology(Credit-1)

1. Studyofmicroscope.
2. Studyofcellstructure
3. MitosisandMeiosiscelldivision.
4. Experimentsonepistaticinteractionsincludingtestcrossandbackcross.
5. ExperimentsonprobabilityandChi-squaretest.
6. StudyofmodelsonDNAandRNAstructures.

Courseoutcome

1. Identifyand describetheprocessandpurposesofthecell cycle,meiosis, andmitosis,aswell aspredict theoutcomesof these processes.
2. Transmission geneticsproblems, makeaccuratepredictionsabout inheritanceofgenetictraits,andmapthelocationsof genes.
3. Toidentifytheparts, structure,anddimensionsofDNAmolecules, RNAmolecules, and chromosomes, andbeableto categorize DNA as well as describe how DNA is stored.
4. Todescribewhatcauses andconsequences ofDNA sequencechanges andhowcells prevent thesechanges,as well as make predictions about the causes and effects of changes in DNA.
5. Todescribeapplicationsandtechniquesofmoderngenetictechnology, aswell asselect the correcttechniquestosolve practical genetic problems.

BCH 106 SkillOrientedCourse 2(A):MolecularBiology(Credits3)

Course Objectives: The main objectives of this course are to:

1. Familiarize the students withspecific characteristics of MolecularBiology,know the analytical methodscommonly usedin Molecular Biology.
2. Obtainhandsonexperienceinsomeoftheimportantmolecularbiologytechniquesandtolearnthebasicprinciplesof recombinant DNA technology.

UnitI

Central dogma in molecular biology and its verification. Conservative, semi conservative and dispersive mode of DNA replication, Uni and bidirectional DNAreplication, discontinuous synthesis of DNA, DNA primers, DNA polymerase I, II & III, DNA ligase, AP endonuclease, Topoisomerases and telomerase.

Inhibitorsof DNA synthesis, fidelityof replication. Mechanism of replication of *E.coli* DNA. 'θ' and 'σ'replication, Replication of 'ʎ' Phage DNA, Phage $T_7$and single stranded DNA. DNA repair and recombination. Bidirectional and unidirectional replication.

UnitII

StructureandfunctionsofprokaryoticandeukaryoticRNApolymerase.InhibitorsofTranscription.DNAbindingmotifs. Biosynthesis of prokaryotic and Eukaryotic m-RNA, r-RNA, and t-RNA.

Posttranscriptionalmodificationsof RNA-capping,adenylationandsplicing.Roleof*hn*RNA,*sn*RNAand*sn*RNPin processing of RNA.

Geneexpressionmodelsinprokaryotes:operon,operator,promoter,attenuator,repressor,co-repressor,inducer,apoinducer, gratuitous inducer, induction and repression. Lac operon, His- operon, Trp- operon of *E. coli*.

UnitIII

General features of the genetic code, Deciphering of the genetic code - Nirenberg and Khorana's work. Co-linearity of gene and protein. Wobble hypothesis and deviation from wobble hypothesis. Mitochondrial genetic code and evolution of genetic code.

UnitIV

CompositionofProkaryoticandeukaryoticribosomes.Polysomesandorganellesribosomes.

Amino acid activation, protein chain initiation, elongation, and termination. Mechanism of protein synthesis in relation to gene action. Inhibitors of protein synthesis. Post translation modification of proteins. Synthesis of secretory and membrane proteins – signal sequence hypothesis. Mi and Si RNA mediated translation control.

RecommendedBooks:

1) MolecularBiologyoftheGenebyWatson
2) GeneticsbyG.Zubay
3) MolecularBiologyoftheCell byAlbertBruce*et al*.,5th Ed.
4) CellMolecularBiologybyBaltimore
5) Molecular BiologybyDFriefelder
6) MolecularGeneticsbyDFriefelder
7) GenesVIIIbyBenjaminLewin.OxfordUniv.Press.London.
8) CellandMolecularBiology2nd Ed.ByP.K. Gupta,RastogiPubl.
9) CellandMolecular biologybyDe RobertisandDeRobertis.8Th Ed.
10) Molecular Genetics by Sambamurty

11)CellandMolecularBiology2nd Ed.BySC. Rastogi.

OnlineContent:

1) https://bio.libretexts.org/Bookshelves/Cell_and_Molecular_Biology/Book%3A_Cells_-Molecules_and_Mechanisms_(Wong)
2) https://nptel.ac.in/courses/102/106/102106025/#
3) https://www.easybiologyclass.com/molecular-biology-online-tutorials-lecture-notes-study-materials/
4) https://www.mooc-list.com/tags/molecularbiology?title=MOLECULAR+PHYSIOLOGY

ExpectedCourseOutcomes: Onthesuccessfulcompletionofthecourse,studentswillbeableto:

1. IttrainsthestudentstogaintheconceptsofCentralDogmaofMolecularBiology(K2).
2. Helps the students to understand, evaluate and analysis the cellular processes Replication, Transcription and Translation (K2, K3 & K5)
3. Aids in thetechnical understanding ofthe cellular mechanisms ofheredity, gene expression and protein synthesis(K2,K3 & K5).
4. Understandandfamiliarizeinthemodernmolecular biologicaltechniques anditsapplications(K2, K3,K4&K5). K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Practicals:MolecularBiology(Credit1)

1. IsolationofDNAandRNAfrombacteria.
2. Isolationanddeterminationof DNAfrombacteria,plantandanimalcells.
3. DNAestimationbyDiphenylaminemethod.
4. DeterminationofDNAandpuritybyUVabsorptionmethod.
5. Isolationanddeterminationof RNAcontentfromyeast.
6. RNAestimationbyOrcinolmethod
7. Determinationandanalysisofmeltingcurveof DNA(TmofDNA)
8. Isolationandconcentrationdeterminationofplasmid DNAfrom*E.coli*

BCH 106 SkillOrientedCourse 2(B):BiotechnologyandNanotechnology(Credit3)

Course Objectives: The main objectives of this course are to:

1. Emphasizestolearnabouttheprinciplesinvolvedinfermentationtechnology,fermentors.
2. Exposuretolearntheconceptsinvolvedinmakingimmobilizedenzymesandtheiruseinvariousproductsynthesis.
3. Providesbasicconceptsaboutvaccinesandinvitroculturing.
4. Providesknowledgeabout transgenicplantsandanimalsandtheirapplications.

Unit I

Immobilized enzymes and their applications. Protein engineering. Production ofglucose from starch, use ofglucose isomerase in confectionaryindustry, use of lactase in diaryindustry, production of invert sugar from Glucose and sucrose. Useofproteaseinfood, detergentandleatherIndustries,Biosensors(glucoseoxidaseinenzymeelectrodes).

Unit II

Isolation, preservation and maintenance of industrial microorganisms, batch, continuous culture techniques, Types of fermenters. Industrialproductionofalcohol,acids(LacticandAcetic),solvents(acetoneandButanol),antibiotics(penicillin),Vitamins (Riboflavin), amino acids (glutamic acid) and single cell protein (SCP).

UnitIII

Animalandplantcell/tissueculturetechniques:Micropropagation,somaticcellculture,somaclonalvariations,somaticcell hybridization, protoplast fusion, genetic transformation.
Methodsofgenetransfer,vectorandvector lessmethods, production oftransgenicplantsandanimalsandtheirapplications.

Unit IV

Nano technology**:** Green Synthesis and characterization of metallic nanoparticles using plants and microorganisms Structural analysisandtheirapplicationsinagri biotechnology. Nanofertilizers-Awayforwardforgreen economy**.** Nanobiosensors–Next generation diagnostic tools in Agriculture. Development of Nano formulations for crop improvement.

RecommendedBooks:

1. FermentationTechnology(2nd Ed.)Standury(PergmanPress).
2. Biotechnology:TextbookofIndustrialMicrobiology2nd Ed.byWulfCruegerandAnnelieseCrueger(2000).
3. MolecularBiotechnology: PrinciplesandApplicationsofRecombinationDNA(1996)BernardR.GlickandJack. J. Pasternak (Panima Publishing Corporation)
4. PrinciplesofGeneManipulation:AnIntroductiontoGeneticEngineering(5th Ed.)
5. PrinciplesofBiotechnology(1985)AlenWeisman(SurreyUniversityPress)
6. ConceptsinBiotechnology(1996)Ed.D.Balasubramanian,K.Dharmalingam,J.GreenandK.Jayaraman(UniversityPress)
7. IndustrialMicrobiology,MillerandLitsky,McGraw–Hill,1976.
8. IndustrialMicrobiology,L.E.Casida,JRNewAgeInternational(1995)
9. IndustrialMicrobiology(Prescott&Dunn),EdbyG.Reed,CBSPublishers.
10. ImmobilizedEnzymes(1978)byIchiroChibata,HalstedPressBook.

ExpectedCourseOutcomes: Onthesuccessfulcompletionofthecourse,studentwillbeableto:

1. Learntheimmobilizationprocessofcellsandenzymes,andtypes(K1&K2).
2. Understandaboutindustrialproductionofvariousproductsusedforhumanwelfare(K1&K2).
3. Understand about plant tissue culture, plant secondary metabolites,elicitation and methods involvedingene transferof plants and machine learning in the analysis of plant (K2, K3 & K4).
4. Studentswilllearnabouttransgenicanimalsandplants(K2,K3&K4).

K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate;K6–Create

Practicals:BiotechnologyandNanotechnology(Credits1)

1. Lacticacidfermentationby*Lactobacillus*
2. Productionofenzymesbymicroorganisms–Amylase,protease
3. Fermentationprocessduringcurdling,estimationoflactose,lacticacid,protein,bacterialcount
4. Synthesisandcharacteristicsofnanoparticles
5. Callus propagation,organogenesis,transferofplantstosoil
6. Syntheticseedpreparation
7. Protoplastisolationandculture

Auditcourse 109:IndianKnowledgeSystemI:IndianHealthSciences(AuditCourse)

SEMESTER II

BCH201CoreCourse4:IntermediaryMetabolismII(Credits4)

CourseObjectives: Themainobjectivesofthiscourseareto:

1. Tounderstandthe,lipids,nucleicacidsandproteinsmetabolism.
2. Toimpartknowledgeoftheconceptsofregulation ofmetabolism.
3. Tooffer basicknowledgeabout an overviewofmetabolicpathwaysandtheirregulationsanalysis.

Unit I

Nucleic acid metabolism. Synthesis of nucleotides and its regulation, Biosynthesis and degradation of purines and pyrimidinesand its regulation. Salvage pathway, Lesch-Nyhan Syndrome, Synthesis of ribonucleotides, deoxy-ribonucleotides and its regulation. Inter-conversion of nucleotides. Nucleotides as metabolic regulators.

UnitII

Nitrogencycle,BiologicalNitrogenfixation.Nitrateandammoniautilization,ammoniaexcretion,synthesisofglutamine. Formation of nitrogenous excretion products.
Urea cycle. Aminoacidsasprecursors–formationofPolyamines,Creatine,Histamine.

Unit III

Amino acid degradation, transamination, oxidative deamination, pathways of degradation of different amino acids, biosynthesisof essential and non-essential amino acids. Regulation of amino acid biosynthesis.

UnitIV

Inborn errors of amino acid metabolism – Phenylketonuria, Alkaptonuria, Maple-Syrup urine disease. Biosynthesis and degradation of Heme, Glutathione, γ- glutamyl cycle, gramicidin.Disorders of lipid metabolism – Gauchers disease, Tay-Sachs disease, Hypo and Hyper lipoproteinemia.

RecommendedBooks:

1. PrinciplesofBiochemistry,White.A,Handler,PandSmith
2. Biochemistry,LehningerA.L.
3. Biochemistry,DavidE.Metzler.
4. Biochemistry,LubertStryer.
5. ReviewofPhysiologicalchemistry,HaroldA.Harper.
6. TextofBiochemistry,WestandTodd.
7. OutlinesofBiochemistry,ConnandStump
8. MetabolicPathways–Greenberg.
9. Mitochondria,Munn.
10. Biochemistry,2nd Ed,G.Zubay.

ExpectedCourseOutcomes: Onthesuccessfulcompletionofthecourse,studentswillbeableto:

1. Understandtheconceptsofmetabolismofaminoacidsandureacycle(K2)
2. Understandtheconceptsofnucleotidemetabolismandregulationmechanism (K2)
3. Applytheknowledgeabout overviewofMetabolicPathwaysandtheirregulationAnalysis(K3) K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

BCH202CoreCourse5(A):MolecularPhysiology(Credits3) Course

Objectives: The main objectives of this course are to:

1. Knowthevariousaspectsofbrainandneurotransmitters.
2. Understandthefunctioningofneurotransmittersanddrugsonbrain.
3. Knowtheaspectsrelatedtobiochemistryofvision.
4. Assimilatetheconceptsofmusclecontractionandmusclefunctioning.

Unit1

Bio-membranes - composition of Membranes. Membrane lipids, proteins and carbohydrates. Molecular structure of membranes, fluid mosaic model of biological membranes. Membrane transport: Active transport, Active transport of Na+ K+ (sodium potassiumATPase) Ca^{2+}(Ca^{2+}- ATPase). Basic conceptsof cell signalingand transduction, different signalingmolecules, second messengers, calcium, calmodulin, inositol phosphate, cAMP, cGMP, NO. Signal cascades. Homeostasis.

UnitII

Presynaptic events at the neuromuscular junction: cholinergic and non-cholinergic synapses. Chemical composition of brain, formation, structure and biochemistry of myelin, chemistry of major brain lipids, lipid composition, Special nervous system proteins. Drugs acting on brain - antidepressants and benzodiazepines.

Biochemistry of vision: Structure, Composition, Metabolism and blood supply to the eye, lens and retina, rods and cones. Photochemistry of vision. Role of vitamin A in vision. Processing of visual information.

UnitIII

Neurotransmitters- chemistry, synthesis, storageandreleaseofneurotransmitters, transmitter action,chemical eventsat synapses, post synaptic events. Various classes of neurotransmitters-Glutamate, GABA, catecholamines (Epinephrine, norepinephrine and dopamine), serotonin, acetyl choline.

Structure and function of muscle – skeletal muscle structure, Biochemical characterization and extracellular matrix.Plasmalemma,sarcoplasmicreticulumandmyofibrils,actin,myosin,streptomycin,troponin,muscularcontraction,sliding filament mechanism, oxidative and anaerobic metabolism.

UnitIV

Circulatory System:Bloodcomposition,Heart-Structure.Electricalactivity,Heartbeat,Arterialsystem,microcirculationand lymphatics, cardiac cycle and cardiac output, control of circulation.

Respiratorysystem:Mechanicsofrespiration,gasexchangeinthelungs,controlofbreathing.

ExcretorySystem:Kidneys–Glomerularfiltration,tubularfunction,formationofurine,regulationofwaterandmineralbalance.

RecommendedBooks:

1. BasicNeurochemistry5th Ed.BySiegel.
2. EssentialsofNeuralScienceandBehaviorbyKandel.
3. Neurobiologymolecules,CellsandSystemsbyMathews.

CourseOutcomes:Onthesuccessfulcompletionofthecourse,studentswillbeableto:

1. Givesanideaaboutthebrainanditsorganization(K1&K2).
2. Helpstocollectinformationaboutneurotransmittersanddrugs,andtheirroleinbrain(K1&K2).
3. Givesaclear understandingaboutthebiochemistryofvisionandagingrelatedproblems(K1&K2).
4. AClearKnowledgeondisordersofbrain,eyeandmuscle(K2&K3).
5. Provides clear understanding of muscle types and muscular disorders (K2 & K3).

K1-Remember;K2 -Understand;K3-Apply; K4 -Analyze; K5 -Evaluate; K6-Create

Practicals:MolecularPhysiology(Credit1)

1. Completebloodpicture:RBCcount.
2. Completebloodpicture:TLC.
3. WBCdifferentialcount.
4. ErythrocytesedimentationRate(ESR).
5. Packedcellvolume(PCV)
6. DeterminationofHaemoglobin(Hb).
7. MeancellHaemoglobinandMeancellRBCvolume.
8. OsmoticfragilityofRBC

BCH202CoreCourse5(B):MolecularSignaling&Immuno-Technology(Credits 3)

CourseObjective:

1. Stagesofmitosisandmeiosis,highlightingsimilaritiesanddifferences,understandthecancerandcellcycle.
2. Understandthebasicprinciplesofsignaltransductionmechanisms,inparticulartheconceptsofresponse specificity, signal amplitude and duration, signal integration and intracellular location
3. Understand the structure and function at the molecular and cellular level of the immune defence, provide the knowledge about thetransfusionandtransplantationimmunologicalreactionsabletoprovidean overviewfor polyclonal,monoclonal and humanized antibodies and production of hybridoma
4. Togainadeepknowledgeabouttheimmunization/vaccination,immunologicaldiseaseandimmunotherapy.
5. Discussimmunologicaltechniquesandtheirapplicationsinbiotechnicalindustry, the keyrolesofmitosisandmeiosis during the life cycle. Compare and contrast different life cycle strategies, focusing on thehuman life cycle.

UnitI

Cell cycle andCancer biology: Mitosisandmeiosis, theirregulation, stepsin cell cycle, andcontrol ofcell cycle. Checkpoints in cell cycle, regulation andcontrol ofcell cycle, inhibitorsGeneticrearrangementsin progenitorcells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, Angiogenesis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.

UnitII

Cell signaling Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component signaling systems.

Quorum sensing in bacteria- Chemotaxis, Role of acyl homolactone serine in quorum sensing,types of quorum sensing, regulation of quorum sensing.

UnitIII

Hybridoma technology: Production, purification and characterization of monoclonal antibodies. Application of monoclonals in biomedical research, clinical diagnosis, treatment and drug targeting.

Transplantation immunology –relationship between donor and recipient, immune response to graft rejection, clinical characteristics of allograft rejection. Transplantation antigens. MHC class I & II as targets of graft rejection, Tests for histocompatability antigens, prolongation of allografts, graft versus host disease.

UnitIV

Immunoprophylaxis: Types of vaccines – Conventional (BCG, Salk, Influenza, DPT) DNA vaccines, Glycoconjugate vanccines, Deletion vaccines, DCbased vaccines, basis ofattenuation. Recent developmentsin vaccine technology, Vaccinedeliverysystem and approaches to enhanceimmunogenicity, immuno modulators and immunomodulation, adjuvant, cytokines / interleukins based immune therapy.

RecommendedBooks:

1) BasicImmunology: FunctionsandDisordersoftheImmuneSystem 6thEdition byAbul K. Abbas, AndrewH. Lichtman, Shiv Pillai, Publisher : Elsevier; 6th edition (April 24, 2019)
2) Roitt'sEssential Immunology (Essentials)13th Edition by Peter J. Delves,SeamusJ.Martin,DennisR. Burton,IvanM. Roitt, Publisher: Wiley-Blackwell; 13th edition (January 17, 2017).
3) IntroductoryImmunology, 2nd:BasicConceptsforInterdisciplinaryApplications2nd Edition, Publisher:Academic Press; 2nd edition (February 27, 2019)
4) ClinicalImmunology:PrinciplesandPractice5thEditionbyRobertR.Rich,Thomas AFleisher, WilliamT. Shearer, HarrySchroeder, AnthonyJ. Frew , Cornelia M. Weyand: Elsevier; 5th edition (March 27, 2018)
5) Hancock,J.T.Cellsignalling.2aed.OxfordUniversityPress,2005.
6) Lodish, H., Berk, A., Zipursky, S.,Matsudaira, P.,Baltimore, D.andDarnell, J.EMolecular CellBiology, W.H.Freeman and Company, 2000.
7) Alberts,B.,Bray, D.,Lewis,J.,Raff,M.,Roberts,K.andWatson,J.D.MolecularBiologyoftheCell,Garland Publishing, 2002.
8) MolecularCellBiologybyHarveyLodish,ArnoldBerk,ChrisA.KaiserandMontyKrieger,2012.
9) Becker'sWorldofthe Cell(8thEdition)byJeffHardin,GregoryPaulBertoniandLewisJ.Kleinsmith2011.
10) CellandMolecularBiology:ConceptsandExperimentsbyGeraldKarp,2009
11) PhysicalBiologyoftheCellbyRobPhillips,JaneKondev,JulieTheriot andHernanGarcia,2012
12) TheCell:AMolecular Approach,FifthEditionbyGeoffreyM.CooperandRobertE.Hausman,2009.
13) Molecularbiologyofcell-BruceAlberts,CellBiology–Karp,CellsignalingbyJohnTHancock(Oxford).
14) AtlasofImmunology,J.M.Cruse,R.E.Lewis.2000.CRCPress,NewYork.
15) ClinicalImmunologybyChaper,Harvey,Shah,Snowden.2006.BlackwellPublishers,NewYork

ExpectedCourseOutcomes: Onthesuccessfulcompletionofthecourse,studentswillbeableto:

1. Understandingofdetailedmechanismincellcycleanditsregulationcellcyclecheckpoints(K1,K2&K3).
2. Coursematerialwillhelpinunderstandingofvariouscellsignalingmechanismsin cell(K2)
3. Thecoursewilladvancetheknowledgeofhybridomatechnologyandmonoclonalantibodiesproduction(K2&K3).
4. Studentswillthoroughlyunderstandtheconceptsofimmuno-prophylaxisandimmuno-modulators(K2&K4).
5. Studentswillgainadvanceknowledgeonvaccineproductions.

Practicals:MolecularSignaling&ImmunoTechnology(Credits1)

1. Isolationofcellorganelles
2. Normalandcancercells-cytotoxicityassay(Trypanbluedyeexclusion)
3. AgglutinationWidal(slide&tube)testfortyphoidfeverVDRLtestforsyphilis
4. PurificationofIgGbySephadexGcolumnchromatography
5. Purificationofantibodiesbyammoniumsulfateprecipitationanddialysis
6. DotELISA
7. SandwichELISA
8. AntigencaptureELISA
9. AntibodycaptureELISA
10. RocketImmunoelectrophoresis

BCH203CoreCourse6(A):Enzymology(Credits3) Course

Objectives: The main objectives of this course are to:

1. To understand the classificationof enzymesand fundamentals of enzymeassay.Also,understanding of kineticsofenzyme catalyzed reactions and derivation of Michaelis Menten equation.
2. Toadvancetheknowledgeonmechanismofenzymeactionaswellasregulationofenzymeactionwithrelevantexamples.

UnitI

Classification of enzymes, protein confirmation, specificity and active site. Units of enzyme activity, enzyme coupled kinetic assay. Compartmentation of enzymes. Factors affecting velocity of enzyme catalyzed reactions – effect of pH, temperature, enzyme concentration and substrate concentration. Kinetics of enzyme catalyzed reactions.

Enzyme kinetics of single substrate reactions, study state assumption, Michalis – Menten, LineweaverBurk, Eadie Hofstee, Hanes plots.

UnitII

Enzymeinhibition:irreversible,reversible,competitive,non-competitive,un–competitiveandpartialinhibition. DeterminationofK$_I$values,substrateinhibition,feedbackinhibitionandallostericinhibition.Kineticsofenzymaticreactions having two or more substrates – single displacement reactions, double displacement reactions (Ping-Pong).

UnitIII

Typesofenzymecatalysismechanisms,acid-basecatalysis,electrostaticcatalysis,covalentcatalysis,metalioncatalysis, proximity and orientation. Effects, preferential transition state binding.
Catalyticmechanisms of chymotrypsin, Trypsin,Carboxypeptidase,Ribonucleaseand Lysozyme.CatalyticRNA(Ribozyme), abzymes, synzymes.
Mechanismofcatalysiswithcoenzymes–Pyridoxalphosphate,flavinnucleotides,thiaminepyrophosphate,biotin, tetrahydrofolate, lipoic acid.

UnitIV

Enzyme Regulation: General mechanisms, allostericenzymes –AT case, cooperativityphenomenon, Sigmoidal kineticsandtheir physiological significance, Symmetric and sequentialmodels for action of allosteric enzymes and their significance.
Feedback inhibition. Reversible and irreversible covalent modifications of enzymes, cyclic and cascade systems, Zymogens, Isoenzymes, multienzyme systems – pyruvate dehydrogenase, fatty acid synthase complex.

RecommendedBooks:

1. TheenzymesDixon &Webb,3rded.Longman.
2. Understandingenzymes:PalmerT.,EllisHarwoodLtd.
3. EnzymeKinetics:RobertsD.V.,CambridgeUniv.Press.
4. Enzymestructureandmechanism.AlanFersht,Freeman&Co.
5. PrinciplesofEnzymologyforFoodSciences:WhitakerMarcDekker.
6. TheenzymeBoyer3rdEd.AcademicPress.
7. MethodsinEnzymologyEd.ColowickandKaplan,AcademicPress(continuingseries)
8. TextbookofBiochemistrywithClinicalCorrelations(4thedition)–ThomasM.Devlin.
9. Fundamentalsofenzymology3rd edi.NicholasC.PriceandLewisStevens.
10. Biologicalchemistry;H.R.Mehler&E.HCordesHarper&Rev.
11. EnzymesandMetabolicInhibitorsVol.I&IIJ.WebbAcada.Press
12. EnzymeKineticSiegelInterScience–Wiley.
13. BiochemistryChemicalreactionsoflivingcellsbyDavidE.Matzler.Vol.I.
14. EnzymeCatalyzedReactionsbyG.H. Gray.

OnlineContent:

1) IntroductiontoDataMining,Pang-NingTan(2018)PearsonEducationIndia
2) https://books.google.co.in/books?id=64GVEjpTWIAC
3) https://www.udemy.com/course/enzymology/
4) https://www.classcentral.com/course/swayam-enzymology-19860
5) https://www.mooc-list.com/course/biochemistry-biomolecules-methods-and-mechanisms-edx

ExpectedCourseOutcomes: Onthesuccessfulcompletionofthecourse,studentswillbeableto:

1. Understandingofdetailedmechanisminenzymeregulationwithrelevantexamples(K1,K2&K3).
2. Coursematerialwillhelpin understanding ofnomenclatureandclassification ofenzymesandalsothefundamentalsof enzyme assay (K2)
3. Thecoursewilladvancetheknowledgeofstudentsonthemechanismofenzymeaction(K2&K3).
4. StudentswillthoroughlyunderstandtheKineticsofenzymeessayandderivationofvelocityequations(K2&K4).
5. Studentswillgainknowledgeinvariousimmobilizationtechniquesandindustrialapplicationofenzymes(K2,K3&K5) K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Practicals:Enzymology(Credits1)

1. AssayofAmylasefrom saliva
2. AssayofUreasefromHorse–gram
3. AssayofAcidphosphatase
4. Assayofserumalkalinephosphatase
5. AssayofSDHfrom Liver
6. AssayofInvertasefrom Yeast
7. AssayofTrypsin
8. AssayofLDHfrom serum (Isoenzymes)
9. EnzymeKinetics(DeterminationofV-max,KmandKi).
10. EffectofpH,Temperature,Activators,Inhibitors,Immobilizationofenzymes(demonstrationonly).

RecommendedBooks:

1. Hawk'sPhysiologicalChemistry
2. PracticalBiochemistrybyTPlummer
3. PracticalBiochemistrybyJJayaraman
4. Klemirandothers:PracticalBiologicalChemistry
5. PracticalBiochemistry-KochandHankDunnandDrell
6. PracticalBiochemistry-Sawheny.
7. Varley'sPracticalClinicalBiochemistry–Ed.AlanW.Gowenlock(HeinemannMedicalBooks,London).

BCH203CoreCourse6(B):EcologicalPrinciples(Credits-3) Course

Objectives: The main objectives of this course are to:

1. Tounderstandthecomponentsofenvironment.:Ecosystemstructure,energyflow
2. ToadvancetheknowledgeoncommunityEcologyandEcologicalSuccession
3. ToadvancetheknowledgeonPopulationecologyofrandKselections
4. TostudytheEnvironmentalpollutionandbiodiversitymanagement.

Unit-I

The Environment: Physical environment; biotic environment; biotic and abiotic interactions.Habitat and Niche: Conceptof habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement Ecosystem Ecology: Ecosystem structure;ecosystem function; energyflowandmineral cycling (C,N,andP); primaryproduction and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).

Unit-II

Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement;edgesandecotones. Ecological Succession:Types;mechanisms;changesinvolvedin succession;conceptof climax

Unit-III

PopulationEcology: Characteristicsofa population;populationgrowth curves; populationregulation;lifehistory strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations.

Unit-IV

AppliedEcology:Environmentalpollution;globalenvironmentalchange;biodiversity:status, monitoringanddocumentation; major drivers of biodiversity change; biodiversity management approaches

RecommendedBooks:

1) Goldstein, M. &D. Dellasala, 2020.Encyclopedia ofWorld'sBiomes. Elsevier. 3500p.5vols. Sher,A.A&M.C. Molles. Jr. 2022. Ecology: Concepts and Applications, 9th Edition. Mc Graw Hill. ISBN10:
2) Archibold, O.W. 1995. Ecology of World Vegetation. Chapman & Hall, London. Reference Books: Friday, A & D.S. Ingram (Gen.Eds.)1985.TheCambridgeEncyclopedia ofLifeSciences, CambridgeUniv. Press, Cambridge.Ecosystems of the World Series - Nos.1,2,3,4,5,6,7,8,12,13, & 14 Elsevier, Amsterdam.
3) Singh,J.S., Singh, S.P. &Gupta,S.R. 2014.Ecology, Environmental ScienceandConservation. S.Chand&Company Pvt. Ltd., New Delhi. 929p.

4) Malcolm L. Hunter,Jr., JamesP.Gibbs, Viorel D.Popescu. (2021). FundamentalsofConservation biology(4th edition). Wiley.
5) FredVan Dyke,Rachel L. Lamb(2020). Conservation Biology: Foundations,Concepts,Applications.Springer International Publishing 6
6) AnnaA.Sher,RichardB.Primack·(2019) anIntroductiontoConservationBiology.OxfordUniversityPress
7) Krishnamurthy KV (2018) an Advanced Textbook onBiodiversity – Principles and Practice,OxfordandIBH Publishing, New Delhi.
8) Singh JS, Singh SP and Gupta SR(2014) Ecology, Environmental Science and Conservation.4thEdition.S.Chand& Company Pvt. Ltd.
9) PeterStiling(2015).Ecology:GlobalInsights&Investigations2ndEdition.McGraw-Hillinternationaledition

ExpectedCourseOutcomes:

Onthesuccessfulcompletionofthecourse,studentswillbeableto:

1. UnderstandingecosystemandCONPcyclesinEcosystems(K1,K2&K3).
2. Coursematerialwillhelpinunderstandingofmajoraspectsin CommunityEcology,PopulationEcology(K2)
3. ThecoursewilladvancetheknowledgeofEnvironmentalPollutionanditshazards(K2&K3).
4. Studentswillthoroughlyunderstandtheconceptsofbiodiversity.

Practicals:EcologicalPrinciples(Credit-1)

1. Isolationofmicrobialnucleicacids
2. ExtractionofmicrobialDNAfromaquaticsources
3. ExtractionofmicrobialDNAfromsoil
4. GelpurificationofsoilDNAextracts
5. ExtractionofDNAfromRhizosphere
6. Preparationofradioactiveprobesandnon-radioactiveprobes(Demonstration)

BCH205SkillOrientedCourse 3(A):NutritionalBiochemistry (Credits3) Course

Objectives: The main objectives of this course are to:

1. The mainobjectiveof thiscourse is to introduceaboutDietary requirements and energy content infoodsneededforhuman body
2. The course aims to give exposure to learn about malnutrition, starvation, protein metabolism in prolonged fasting and diseases that occur due to malnutrition.
3. Thiscourseteaches about inheritedmetabolicdisordersandnaturallybornefood toxicantsandallergycausingfoods

Unit I

Principle food components, Balanced diet, Nutritional Requirement, recommended daily requirements, Recommended dietary allowances (RDA), Body composition and energy requirements, Measurement of energy expenditure, direct and indirect calorimetry, BMR

UnitII

Nitrogen balance and muscle protein turnover, essential and non-essential amino acids, Protein requirement, Biological value of proteins, Protein calorie deficiency state, Kwashiorkor and Marasmus.

Essential fattyacids, energyvalueoffood, phospholipidsinnutrition,Starvation.

Unit III

Mineral Nutrients, Micro nutrients and Macro nutrients, dietary sources, deficiency symptoms and recommended dietary allowances of trace elements andmacro minerals (Calcium, Phosphorus, Magnesium, Iron, Sodium, Potassium, Iodine, Zinc).
Nutrition for infants, children, pregnant and lactating women and in old age. Role of nutrition in colorectal cancer. Nutrition and diseases: Cancer, obesity, diabetes, stress, etc.

UnitIV

NutraceuticalsandFunctional Foods: SourcesofNutraceuticals.Properties, structureandfunctionsofvariousPhytonutraceuticals (Glucosamine, Lycopene, Carnitine, grape products, flaxseed oil asnutraceuticals). Anti-nutrientsand Dietary fibers in nutrition. Nutraceutical remedies for common disorders like Bronchitis, circulatory problems, hypoglycemia, Nephrological disorders,Liver disorders, Osteoporosis.

RecommendedBooks:

1. Harper'sBiochemistry
2. TraceElementsbyUnderwood
3. TheBookofHumanNutritionbyMS.BamjiN.PrahladRaoandV.Reddy.
4. Essentialsoffoodandnutrition,Vol. 1and2,byM.S.Swaminathan
5. NutritionalBiochemistryby Truemen.
6. CasarettandDoull'sToxicology.TheBasicScienceofPrisons5th Ed.ByKlaasen.

OnlineContent:

1. https://nptel.ac.in/content/storage2/courses/126104004/LectureNotes/Week-5_03-Balanced%20diet%20and%20food%20groups.pdf
2. https://nptel.ac.in/content/storage2/courses/126104004/LectureNotes/Week-1_01-Relationship%20between%20Food,%20Nutrition%20and%20Health%201-A.pdf

ExpectedCourseOutcomes: Onthesuccessfulcompletionofthecourse,studentswillbeableto:

1. Tolearnenergycontentinfoods.Thetechniquesinvolvedinthemeasurementofenergyexpenditure,Dietary requirements of carbohydrates, dietary fiber and dietary lipids (K1 & K2).
2. To learn essential andnon-essential aminoacids, protein reserves in human body, Protein malnutrition, techniques for the study of starvation, concepts for weight reduction diets (K1, K2 & K4).
3. Toknowabout nutritionalrequirement duringpregnancy, lactation,infantsandchildren, Nutritionalsignificanceofdietary calcium, phosphorus, magnesium, iron, iodine, zinc and copper (K1, K2 & K4).
4. To learn aboutthe role of diet and nutritionin the preventionand treatment of diseases,learn aboutinherited metabolic disorders (K1, K2 & K4).
5. Tolearnnaturallyoccurring food bornetoxicants,Allergycausing foodsandmanagement(K1,K2). K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Practical:NutritionalBiochemistry(Credits1)

1. Isolationofcaseinfrommilkandestimation.
2. Determinationofmoisturecontentoffoods/foodgrainpowders
3. Isolationoflactosefromskimmedmilkanditsestimation.
4. DeterminationofreducedAscorbicacidbyDCPIPmethod.
5. Determinationofcalciuminfood.
6. DeterminationofIodinevalueofedibleoilbyTitrimetry.
7. Estimationoffructoseinthefruitjuiceandhoney.
8. DeterminationofacidvaluebyTitrimetry.
9. Determinationofavailablelysineinfood.
10. Estimationofcopperin food.

BCH205SkillOrientedCourse 3(B):Nutraceuticals(Credits3) Course

Objectives: The main objectives of this course are to:

1. Theobjectiveofthiscourselearnaboutmacroandmicronutrientsin Dietaryrequirementsandtheirdeficiencydiseases.
2. Thecourseaimstogiveexposuremalnutrition,starvation,andlifestylediseases
3. Thiscourseteachesnutraceurticalsasfunctionalfoodsandtheirimportanceinhealth
4. ThecourseteachesNutraceuticalremediesforvariouslifestylediseases.

Unit-I:

Macronutrients: Water balance, Diet and composition, nutritive values of food. Carbohydrates, protein and lipids- Physiological function, energy values of foods,basal metabolism, nutritive evaluation of proteins and nitrogen balance, energy requirementsand nutritional requirements for all age groups. Dietry fiber and its significance.

Micronutrients (Vitamins and trace elements): Vitamins- fat and water soluble, sources, requirements, physiological role deficiency and toxicity symptoms. Minerals and trace elements- physiological role, requirements andtoxicity symptoms of calcium, copper, iron, iodine, zinc, cobalt, selenium, fluorine, manganese, magnesium and molybdinum.

Unit-II:

Nutraceuticals or Functional foods: Nutraceuticals and phytochemicals- definition, nutraceuticals in controlling diseases, natural occurrence and physiological importance of phytochemicals, antioxidants, flavanoids, carotinoids, saponins, tanins, phenols, omega 3-fatty acids, glucosides, organosulphur compounds.

Unit-III:

Nutritional dissorders: Disorders due malnutrition, Protein energy malnutrition, Marasmus, Kwashiorkor. Hyper tension, cardiovascular diseases, diabetes, obesity, eating disorders- anorexia and bulimia

Unit-IV:

Phytonutraceuticals (Glucosamine, Lycopene, Carnitine, grape products, flaxseed oil as nutraceuticals). Anti-nutrients andDietary fibers in nutrition. Nutraceutical remedies for common disorders like Bronchitis, circulatory problems, hypoglycemia, Nephrological disorders, Liver disorders, Osteoporosis.

ExpectedCourseOutcomes: Onthesuccessfulcompletionofthecourse,studentswillbeableto:

1. Nutritivevalueoffunctional foodsnutritionalrequirementsfor allagedgrouppersonsinthesociety.
2. Knowledgeon macroandmicroelementsandtheirroleinmetabolicpathwaysanddeficiencydiseases.
3. Roleofphyto-chemicalsandneutraceuticalsasremediesforcommon disorders

Practical:Nutraceuticals(Credits1)

1) Isolationofcaseinfrommilkandestimation.
2) Determinationofmoisturecontentoffoods/foodgrainpowders
3) Isolationoflactosefromskimmedmilkanditsestimation.
4) DeterminationofreducedAscorbicacidbyDCPIPmethod.
5) Determinationofcalciuminfood.
6) DeterminationofIodinevalueofedibleoilbyTitrimetry.
7) Estimationoffructoseinthefruitjuiceandhoney.
8) DeterminationofacidvaluebyTitrimetry.
9) Determinationofavailablelysineinfood.
10) Estimation of copper in food.

RecommendedBooks:

1) Phytochemicalsasbioactiveagents-WayneR.Bidlack(CRCpress)
2) TextBookofBiochemistrywithclinicalcorrelation-ThomasM.Devlin(JohnWiley)2nd&4thEdition
3) PrinciplesofhumannutritionandditicsVolume-I&IIbyM.Swaminathan
4) PrinciplesofBiochemsitry-Lehninger,NelsonandCox,CBSpublishers.

BCH206SkillOrientedCourse 4(A):GeneticEngineering(Credits3)

Course Objectives: The main objectives of this course are to:

1. TostudyabouttheDNAmodifyingenzymesandVectorsusedinrecombinantDNAtechnology
2. Understanding the cloning strategies andpreparation of probes. In addition, acquiring thorough knowledge about confirmation of rDNA expression by various techniques, including blotting and immunological screening.
3. Uponcompletionof the course,students might also be thorough aboutvarioustypesof sequencing techniques aswell ason biotechnological applications of rDNA technology.

UnitI

Introductiontogeneticengineering,cloning,cloningvectors-plasmids,phagevectors,shuttlevectorsandcosmids. Enzymesingeneticengineering:Restrictionendonucleases,types,propertyandapplications,RNAandDNApolymerases, nucleases, kinases, phosphatases, ligases, topoisomerases, methylases and gyrases. Linkers and adaptors.

UnitII

RNA isolation, preparation and use of cDNAs. Screening and determination of nucleotide sequences. Construction of cDNA and genomic library, site-directed mutagenesis. Polymerase chain reaction (PCR) in recombinant DNA technology, Chromosome walking

UnitIII

Maxim and Gilbert chemical degradation and Sanger's dideoxy chain termination methods of nucleotide sequencing, Restriction mapping, restriction fragment length polymorphisms (RFLP) linkage and recombination between molecular and phenotypic markers, Random amplified polymorphic DNA (RAPDs) Using PCR. Human genome project, Microarray.
Cloning ofspecific genes andtheir expression in bacteria and eukaryotic system. GeneticEngineering-ApplicationsinMedicine, Agriculture and Industry.

UnitIV

RNAitechnology forgene knock outstudies,Socialand moralimplications, national and internationalguidelines/regulations. RNA technology for gene knockout mechanism. CRISPER CAS 9 technology. Next generation sequencing.

RecommendedBooks:

1. Genesandprobes,APracticalApproachseries(1995)byBD.HamesandSJHiggins,OxfordUniv.Press.
2. GelElectrophoresisofNucleicacids,APracticalApproach(1990)byDRickwoodandBDHames.OxfordUniv.Press. Refer the books already mentioned for other Molecular Biology course.
3. RecombinantDNA–JamesDWatson etal.
4. GeneCloning–T.A.Brown.
5. FromGenestoGenomes–J.W.DalaandSchantz
6. GeneBiotechnology–S.N.Jogdand
7. MedicalBiotechnology-S.N.Jogdand
8. Principlesofgenemanipulations–R.W.OldandS.B.Primerose
9. Genes–LewinB.
10. PCR-Technology:PrinciplesandapplicationofDNAamplification–H.A.Erlich.

ExpectedCourseOutcomes: Onthesuccessfulcompletionofthecourse,studentswillbeableto:

1. Thecoursematerialwillprovidea clearunderstandingabout DNAmodifyingenzymesandtheirusesin RDNA technology (K1 & K2).
2. Studentswilladvancetheir knowledgeofhost cellsandvectorsthatarehighlysuitablefor rDNA-based expression of desirable genes (K1 & K2).
3. Thecoursewillprovidea detailedunderstandingofcloningstrategiesandvariousmethodsadoptedfor confirmation of rDNA expression (K1 & K2).
4. Studentswilllearnaboutadvancesin sequencingtechniquesandtheiradvantages(K1&K2).
5. CoursematerialprovidesdetailedunderstandingofBiotechnological applicationsofrDNAtechnology(K1, K3&K4). K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Practicals:GeneticEngineering(Credit1)

1. Agarosegelelectrophoresisforisolationofvariousformsofplasmid.
2. DeterminationofrestrictionactivityonDNA.
3. Amp^{r}plasmidtransformationin*E.coli.*
4. Isolationofphage M_{13}.
5. IsolationofsingleanddoublestandardM_{13}DNA.
6. TransfectionofM$_{13}$DNAinto*E.coli* JM103.

BCH206 SkillOrientedCourse 4(B):Metabolomics

CourseObjectives:

Themainobjectivesofthiscourseareto:

1. TostudyaboutBiomoleculesmetabolism(Catabolism,Anabolism)andtheirregulatorypathways.
2. TolearnaboutcarbonfixationinC3andC4plants.Photosynthesisprocess
3. TostudyaboutLipidsandoilsbiosynthesisandtransportdifferentoxidationandregulationoffattyacids
4. Tostudydetailaccountonnitrogencycle,Nitrogenaseenzyme
5. Tostudyabout the ketogenicandglucogenicaminoacidsandtheir metabolicdisorders

Unit I

Catabolism, Anabolism - Glucose as fuel-Major and Minor metabolicpathways-Glycolysis. Regulation of glycolysis. Fermentation. Metabolism of maltose, lactose, sucrose, fructose, mannose and galactose. Pentose phosphate pathway and its significance. Glucuronicacid pathwayand ascorbic acidpathway. TCAcycle:pyruvatedehydrogenasecomplex,Reactionsof theTCAcycleand regulation. Amphibolic pathway. Anapleortic reaction. Gluconeogenesis and regulation. Futile cyclesin carbohydrate metabolism.Glycogen metabolismandregulation.

Biosynthesis of Starch. CO_2 Fixation, C3 and C4 pathways (Hatch-Slackpathway).Disordersofcarbohydrate metabolism-glycogen, lactose, galactose and fructose.

UnitII

Lipid digestion, absorption and transport. Fatty acid oxidation- Fatty acid activation, Transport across the mitochondrial membrane. Oxidation: oxidation of unsaturated, odd-chain fatty acid, peroxisomalβ-oxidation. Regulation of fatty acidoxidation ά,-oxidation and ω-oxidation. Degradation of triacylglycerol and phospholipids, ketone bodies-formation andutilization. Biosynthesis of Fattyacids- Transfer of Mitochondrial acetyl Co-A to cytosol, formation of malonyl Co-A, Fattyacid synthasecomplex, biosynthesis and regulation of fatty acid synthesis.

Biosynthesis of prostaglandins. Biosynthesis of Triacylglycerols and its regulation. Biosynthesis of glycerophospholipid sphingophospholipids and sphingoglycolipids. Biosynthesis of cholesterol and its regulation. Lipoprotein metabolism. Chylomicrons-VLDL, LDL, HDL. Integration of carbohydrate andlipid metabolism.

UnitIII

Nitrogen cycle. Non-biological and biological nitrogen fixation. Nitrogenase system. Utilization ofnitrate ion, ammonia incorporation into organic compounds. Synthesis of glutamine and regulatory mechanism of glutamine synthetase. General metabolic reactions of amino acids. Amino acid transamination,deamination. Role of folic acid, vitamin B1, B6, and B12 in amino acid metabolism. Krebs urea cycle, regulation of urea cycle. Ketogenic and glucogenic amino acids. Metabolic defects of amino acid metabolism.

UnitIV

Biosynthesisdegradation andregulation of purineand pyrimidine nucleotides, chemical inhibition ofbiosynthesis of nucleotides. Biosynthesisofdeoxy ribonocleotides, regulation of ribonucleotide reductase.Salvage pathway. Disorders of purine and pyrimidines nucleotide metabolism.

Biosynthesis and degradation of porphyrin (Heme). Porphyrias (Fixation of sulphur and sulphur cycle).Non-ribosomal peptide synthesis-glutathione, Biosynthesis of nucleotide coenzymes – nicotinamide coenzymes, Flavin coenzymes and coenzyme– A.

ExpectedCourseOutcomes:

1. Onthesuccessfulcompletionofthecourse,studentswillbeableto:
2. ThecoursematerialwillprovideaclearunderstandingaboutcarbonfixationandBiomoleculesMetabolism(K1&K2).
3. Studentswilladvancetheir knowledge on lipidsbiosynthesisandtransportandFattyacidsoxidationandregulation pathways in metabolic studies.
4. Thecoursewillprovidea detailedunderstandingofNitrogencycleandammonia formation,nitrificationandincorporation of N2 in aminoacids and proteins
5. Studentswilllearnabout nucleicacidsbiosynthesisanddegradationandmetabolicdisorders(K1&K2). Course

material provides detailed understanding of metabolism and metabolic disorders.

Recommendedbooks:

1) PrinciplesofBiochemistry–A.L.Lehninger(CBSPublishers).
2) Biochemistry–LubertStryer (5th&6THEdition).
3) PrinciplesofBiochemistry–Generalaspects–Smith etal.,(8thedition).
4) Harper'sReviewofBiochemistry–Martinetal.,(Lange).
5) TextBookofBiocehmistrywithclinicalcorrelation–ThomasM.Devlin(JohnWiley)2nd&4thEdition.
6) TextBookofBiochemistry–WestandTodd,1966(MacMillian).
7) Biochemistry2nded.C.K.MathewsandK.E.VanHolde(1995)(Benjamins/Cummings).
8) Biochemistry2nedDonaldVoetandJ.G.Voet(1994)(JohnWiley).
9) Biochemistry–TheChemicalReactionsofLivingCellsVol-II,DavidE.Metzler.
10) Biochemistry – J.L. Zubay
11) Biochemistry– GarrettandGrishameC.M.(SaundesCollegepublication)-2ndEdition.
12) Biochemistry and Molecular biology of plants by Buchanan, Gruissem, and Jones.
13) AmericanSocietyofPlantPhysiologists.Rockville,Maryland.
14) IntroductiontoplantBiochemistry.IIndEd.GoodwinandMercer,CBSPublication,NewDelhi
15) PlantBiochemistrybyDey,PMandHarborneJB,AcademicPress,NewYork.

Practicals:Metabolomics(Credit1)

1. Estimationofbloodglucose.
2. Estimationofbloodurea.
3. Estimationofcreatineinserum.
4. Estimationofcalciumandphosphorusintheserum
5. Estimationofuricacidin serum.
6. Estimationofserumtotal proteins.
7. Estimationofbilirubin
8. Estimationofvitamin-C
9. Estimationofserumalbumin.
10. Estimationofserumtotal cholesterol.

OOTC208OpenOnlineTransDisciplinaryCourse 2(Credits2)

Auditcourse209IndianKnowledgeSystem2:IndianAgriculture;(Credits0)

SEMESTER III

BCH301CoreCourse7:EndocrineBiochemistry(Credits4) Course

Objectives: The main objectives of this course are to:
1. This coursepresentsan introduction and provides a comprehensive, balanced introduction toEndocrineglands,their secretions and functions.
2. Toenablethestudentstolearn or toknowthebiological,physiological activitiesalongwith themechanismofaction of various hormones.

UnitI

Endocrine system – organization of the endocrine system. General features and classification of hormones, mechanism of actionof hormones, hypothalamic hormones, chemistry, biosynthesis, Secretion, physiological functions, regulation and disorders of anterior and posterior pituitary hormones, LH, FSH, Growth hormone, prolactin, oxytocin, Vasopressin. Hormones of the pineal gland – Serotonin and melatonin.

UnitII

Thyroidhormones–chemistry,biosynthesis,secretion,physiologicalfunction,regulationanddisorders,hypoand hyperthyroidism, tests for thyroid function. Antithyroid drugs and calcitonin.
Parathyroid gland – Parathormone and disorders of Parathormone. Role of calcitonin in calcium and phosphate homeostasis in blood.

UnitIII

Pancreatic and gastrointestinal hormones – Biosynthesis, secretion, physiological functions and regulation of insulin andglucagon. Role of insulin and glucagon in carbohydrate, lipid and protein metabolism. Disorders of pancreas. Gastrin, secretin, Cholecystokinin.

UnitIV

Adrenalhormones–Chemistry,biosynthesisandfunctionsofadrenalmedullaryandadrenalcorticalhormones.Cortisol, corticosterone, aldosterone, adrenaline, nor-adrenaline, Disorders of adrenal hormones.
Hormones ofreproduction – Gonadal hormones (testosterone), chemistry, biosynthesisand physiological functions ofandrogens, estrogens and progesterone, inhibin.
Hormonalregulationofmenstrualcycle,placentalhormones,contraception,reproductivedisorders.

RecommendedBooks:

1. TextbookofBiochemistryandHumanBiologybyTalwarG.P.,PrenticeHallIndia.
2. HumanPhysiologyandMechanismofdistance.Guyton 3rd Ed.Igkushoen/Seunders.
3. ClinicalBiochemistry,Vol.1and2,Williams*etal*.,HeinemannMedical,1978.
4. LynchsMedicalLaboratoryTechnologybyRaphael,S.S.,4th Ed.Igkushoen/Seunders.
5. TextBookofEndocrinology,William.
6. GeneralEndocrinology–Turner.
7. BiochemicalEndocrinologyoftheVertebrates–E.FrudenandH.Lines.
8. FoundationofModernBiochemicalSeries,PrenticeHallInc.,1971.
9. MetabolicandEndocrinePhysiology–JayTeppermann.
10. MetabolicPathways–GreenBerg.
11. IntermediaryMetabolismanditsregulation –Larner
12. PrinciplesofBiochemistry–WhiteA.,HandlerPandSmith.
13. ReceptorsandHormoneaction.ReceptorsandRecognitionseries.MedicalphysiologybyA.C.Guytom.

Expected Course Outcomes: Onthesuccessful completionofthecourse, student willbeableto: Obtain a deep knowledge regarding Endocrine glands and their secretions (K1 & K2).
Givesanideaabout structureandfunctionsofendocrineglands(K1&K2) Provides knowledge about Hormone and its regulation (K2, K3 & K4)
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate;K6–Create

BCH302CoreCourse8(A):Immunology(Credits3) Course

Objectives: The main objectives of this course are to:

1. Thestudyofimmunologyhelps thestudents in understanding theimmunesystem in all organisms, especiallythephysiological functioning of the immune system in states of both health and disease.
2. Tounderstandthemalfunctionsoftheimmunesystem in immunologicaldisorderssuch asautoimmunedisease,hypersensitive, immune deficiency and transplant rejection.
3. To understand the physical, chemical and physiological characteristics of the components of the immune system in *in vitro*, *in situ* and *in vivo*.

UnitI

Lymphoid organs (primary and secondary), organization of the immune system, Types ofimmunity – Natural and acquired, specific and non-specific immune response. Cells and organs of the immune system, antigenic determinants/Epitopes.
Haptens, adjuvants, classification, structure and biological functions of immunoglobulins, Isotypes, allotypes and idiotypes. Theories of antibody formation.

UnitII

Active and passive immunity,Humoral and cell mediated immune response, T-Cell and B-Cell activation. Antigenprocessing and presentation.
T-Cell and B-Cell receptors, Complement system, Alternate and classical pathways of complement activation. Complement fixation tests. Types of Interferons and Cytokines. Major Histocompatability Complex: MHC in mice and HLA in man-fine structure and functions.

UnitIII

Transplantation: Terminology, Auto graft, Isograft, Allograft, Xenograft, Immunological basis of transplantation reactions, GVH reaction, Immuno suppression, General mechanisms of Immune suppression, Immune suppression, drugs (azothioprine, methotrexate, cyclophosphamide, cycosporin-A, Steroids). Blood groups:AB, Rh system, Lewis-Luthern systems, significance, practical application of immuno methodology in blood transfusions, Erythoblastosis faetalis.
Disorders of immune response – Autoimmune diseases – Hashimoto's thyroiditis, Rheumatoid arthritis (RA), Systemic lupus erythomatosis (SLE). Immuno deficiencies – Introduction, primary and secondary deficiencies. T-cell, B-cell and combined immune deficiencies, Compliment system deficiency. SCID, AIDS. Cancer immune therapy.

UnitIV

Hypersensitivity reactions: Antibody mediated type II, anaphylactic reactions, Antibody mediated, type II cytotoxic reactions, Immune complex reactions Type – III, T-cell mediated delayed type hypersensitivity Type-IV**.** Immunological tolerance and tolerance induction.
Antigen-antibody interactions, precipitation reactions – immune diffusion, radial immuno diffusion, immuno electrophoresis, immunofluorescence, Western blotting, Radioimmunoassay (RIA) and ELISA – Principle, Methodology and applications. Hybridoma Technology, Production of polyclonal and monoclonal antibodies and their application,

RecommendedBooks:

1) Essentialimmunology–IvanM.Roitt.
2) Immunology–ashortcourseelibezaminiandSidneyLeskowitz,AlanR.LisiInc.NewYork,1988.
3) ImmunologyIII,JosephA.BellantiIgaku–SheinSaundersInternationalEd.1985.
4) ImmunologyataglanceJ.H.L.Playfeir4th Ed.BlackwellScientificPublication1987.
5) AcidstoImmunologyD.M.WierChurchill,Livingtons1986.
6) FundamentalsofImmunology,MyrvikandWeiser,1984.
7) FundamentalsofImmunology,Bier*etal*,Springer1986
8) TextbookofBiochemistryandHumanBiology,TalwarG.P.PrenticeHall,1980.
9) BasicandClinicalImmunology–Stitesetal.,4th Ed.Lange1982.
10) TheImmuno-system, McConnelletal., Blackwell Scientific1981.
11) FundamentalsofImmunology–WilliamC.Boyed(WileyToppan)
12) Introduction to Immunology – John W. Kinball.
13) FundamentalsofImmunology–OttoS.Viewandothers.
14) Immunology – D.M. Weir.
15) Immunology–JanisKuby,

ExpectedCourseOutcomes: Onthesuccessfulcompletionofthecourse,studentswillbeableto:

1. Obtain theknowledgeabout theimmunesystem, asahost defensesystem comprising manybiological structuresand processes within an organism that protects against disease (K1 & K2).
2. Concentrateontheantigenandantibodyreactionsandimmunologicaltechniques(K1&K2).
3. Understandingabout thetwobranchesoftheimmunesystem such ashumoralimmunity and cellular immunity, cytokines and complement system (K1 & K2).
4. Clear about thehypersensitivityreaction or intoleranceundesirablereactionsproduced bythenormal immunesystem, including allergies and autoimmunity (K1 & K2).
5. Obtain theknowledgeabout thehybridomatechnologyis toproducelargenumbers of identicalantibodies (monoclonal antibodies) andarecombinant DNAtechnologythat involves insertingtheDNA encodingan antigen that stimulatesan immune response (K1,K3 & K4).

K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate;K6-Create

Practicals:Immunology(Credit1)

1. Separationofserumandplasma
2. Lymphocyteseparationandidentificationofviablelymphocytes.
3. Fluorescentantibodytechnique
4. Raisingofantibodiestosolubleantigeninrabbits.
5. SingleRadialImmunodiffusion.
6. OuchterlonyDoubleImmunodiffusion.
7. Rocket immunoelectrophoroesis.
8. Crossover Immunoelectrophoresis.
9. GraberandWilliamsImmunoelectrophoresis.
10. Haemeagglutinationtestsforidentificationofhumanbloodgroups.

BCH302CoreCourse8(B):Neuro-Biochemistry(Credits3)

CourseObjectives:

Theobjectiveofthecourseis:

1. Tointroducestudentstothefieldofneurobiology. Neurobiologytouchesupon manydiverseareas --frommolecular organization of the nerve cells to the philosophy of mind.
2. Tounderstandthevariousaspectsofneurotransmitters.
3. Tounderstandthediseasesrelatedtonervoussystem.

Unit-I

Developmental Neurobiology: Organogenesis and neuronal multiplication, axonal and dendritic growth, glial multiplication and myelination, growth in size, regeneration and repair mechanisms, plasticity. Neuromorphology and neurocellular anatomy:Central nervous system (CNS) and peripheral nervous system (PNS), autonomous nervous system, somatic nervous system, dendritisand axons,neurofilaments. Sensoryreceptor and effector endings; peripheral nerves, spinal and cranial nerves: Plexuses ganglia, afferent pathways and sense organs.

Unit-II

Neurophysiology: Resting Potential & Action potential, Propagation of Nerve Impulses, Degeneration & regeneration /repair of nerve fibers, Nerve growth factors. Synaptic & neuro-muscular transmission, Muscle tone, posture, Equilibrium & their regulation. Pain production, pathways and analgesics, head ach & referred pain. Vestibular apparatus & motion sickness. Integrative functions of thalamus, cerebellum, basal ganglia & Cerebral cortex. Blood brain barrier, Blood CSF barrier, SpitBrain, EEG.

Unit-III

Neurotransmitters: Acetylcholine, dopamine, norepinephrine, etc., chemistry, synthesis, storage and release of neurotransmitters, transmission, synaptic modulation, receptors involved and mechanism of neuronal integration. Electrical and chemical synapses, temporal and spatial summation, voltagedependent calcium channel and their blockers. Secondary Messengers: Importance of cyclic nucleotides and protein phosphorylation in nervous system. Involvement of protein kinases and calcium in neuronal metabolism. Neuropeptides: classes of neuropeptides, mode of action, role of neuropeptides in obesity and pain neuropeptide receptors.

Unit-IV

Stem cells: Principles in stem cell biology, pluripotency, totipotency, multipotency; Brain stem cells – Embryonic & adult stem cells. Introduction to brain development – evolution of brain – the principles of use it – Nature vs nurture: role of epigenetics – brain cells and functions, Brain morphogenesis – mechanisms involving neural tube formation, neuronal migration etc. Neuronal differentiation – mechanisms involving axonal growth, dendritic spine formation – Growth cones in axonal path finding – Synaptogenesis, Myelinogenesis – Pruning of brain: apoptotic mechanisms involved.

ExpectedCourseOutcomes: Onthesuccessfulcompletionofthecourse,studentswillbeableto:

1. Explain principlesandconceptsofchemicaland functionalorganization ofthenervoussystem atthecellularand molecular levels.
2. Understandabout chemicalneurotransmitters,presynapticproteinsandcell adhesionmolecules, chemicallymediated synaptic transmission, neurotransmitter receptors etc.,
3. Understandaboutneurodegenerativediseases.

Practical:Neuro-Biochemistry(Credit1)

1. Studyofcellsofthenervoussystem usingmicroscope
2. Studyofpermanentslidesofhistologyofnervoussystem
3. Preparationofstainedsectionsofbrain/spinalcordofanyvertebratetissue.
4. Silverstainingofneuronalcell/tissue
5. Wholemountofneuronsofinvertebrates
6. Wholemountofvertebratemedullaryfibres
7. Wholemountofvertebratenon-medullaryfibres
8. Haematoxylinandeosinstainingofneuronal/glialculturedcells
9. Biochemicalestimations/Histo-chemicallocalizationsinbraintissue

Recommendedbooks

1) Siegeletal.,BasicNeurochemistry,6thEdition,Lippincott-Williams-Wilkins,1999
2) Kandeletal.,PrinciplesofNeuralscience,4Edition,McGraw-HillMedical,2000.
3) Zegmond,FundamentalsofNeuroscience,1stEdition,AcademicPress,1999
4) Bear:Neuroscience:ExploringtheBrain,2ndedition,LippincottWilliams&Wilkins,2001.

BCH303CoreCourse9(A):DevelopmentalBiology(Credits-3)

CourseObjectives:

1. Themainobjectivesofthiscourseareto:
2. Understandthemolecularandcellularmechanismsofdevelopmentandlearnaboutbasicembryology.
3. ThemainobjectiveofthiscourseistointroduceconceptsinGeneticsandDevelopmentalBiology.
4. The course aims to give exposure to learn the basic concepts involved in developmental biologysuch as Potency, commitment,specification,induction,competence,determinationand differentiationsandmorphogeneticgradients.
5. Thiscoursealsoprovidesknowledgeabout Celldivisionin cleavage,Rudimentalorgans, GametogenesisandFertilization approaches.

Unit-I

Concepts of development Basic concepts of development: Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.

Unit–II

Fertilisation in animals and plants Gametogenesis, Fertilization and early development: Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilisation in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.

Unit-III

DevelopmentofanimalsMorphogenesisandorganogenesisinanimals:Cellaggregation and differentiationin ictyostelium; axesandpatternformationinDrosophila,organogenesis–vulvaformationin Caenorhabditiselagans;eye lense induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic developmentlarvalformation, metamorphosis; environmental regulation of normal development; sex determination.

Unit-IV

Development of plants Morphogenesis and organogenesis in plants: Organization of shoot and rootapicalmeristem;shootand rootdevelopment; leaddevelopmentand phyllotaxy;transitiontoflowering, floraldevelopmentinArabidopsis and Antirrhinum.

ExpectedCourseOutcomes:

Uponcompletionofthiscourse,studentsshouldbeableto:

1. AcquireknowledgeonbasicconceptsofDevelopmentalBiology.
2. Gaintheproficientknowledgeaboutzygoteformation,blastulaformation,gastrulationandmanyeventsinearlydevelopment of life and seed formation and germination.
3. UnderstandmorphogenesisandOrganogenesisinanimalsandPlants.

Recommendedbooks

1) DevelopmentalBiology(Looseleaf),10thEdition,ScottF.Gilbert,SinauerAssociates,Inc.,2013,ISBN:978- 1605351926.
2) PrinciplesofDevelopment.3rdedition,byL.Wolpert,2006,OxfordUniversitypress,incorporated;ISBN: 9780198709886.
3) DevelopmentalBiology.3rdedition,byLewisWolpert,2006,OxfordUniversityPress,USA;ISBN:1405122161
4) DevelopmentalBiology,6theditionby ScottGillbert,2000,Sunderland(MA):SinauerAssociates; ISBN-10:0-87893- 243-7
5) Evolutionarydevelopmentalbiology,2ndeditionbyBrainK.Hall.1998,Springer;ISBN-10:0412785803

Practical:DevelopmentalBiology(Credit-1)

1. Observationoflivingchickembryo
2. Cultureofearlychickembryo
3. Larvaldevelopmentalstagesofdrosophila(Demonstration).

BCH303CoreCourse9(B):CancerBiology(Credits-3)

CourseObjectives:

Theobjectiveofthiscourseis:

1. Tolearntheprinciplesofcancerbiologyandidentifythemaincellularandmolecularmechanismsunderlyingthe initiation and progression of neoplastic growth.
2. Thefocusofthiscourseisonthedifferencebetween malignantcellsandnormalcells.
3. Itexplorestheanimalmodelsofcancerstudyandthemulti-stepprocessoftumorprogressionleadingtoinvasive metastatic growth.
4. The course will alsoexaminetherole ofstem cells andtheir potential for differentiation in different types ofmalignancies and it includes recent advances in molecular diagnostics and therapy of cancer.

Unit-I

Introduction to Cancer Biology: Definition and classification; evolution of cancer cells; cellular oncogenes; oncogene, viral-oncogene,tumorigenicity,tumor suppressor genes; p53,RbandPTEN.Cancermetastasis,migration&invasion, metastasissteps, epithelial to mesenchymal transition, angiogenesis.

Unit-II

Microenvironment of Tumor cells: Stroma interaction, adipose stromal cells, cancer associated fibroblast, tumor associated macrophages, mesenchymal stem cells, impact of tumor-stroma interaction on tumor development, tumor immunology; interferons, T cells, cancer stem cells; origin, isolation and culture of cancer stemcells, animal models ofcancer study; xenograft and metastasis models.

Unit-III.

Thedifference between Normalcell versusCancer cell. Cellimmortalization andtumorigenesis, Oncogenesandtumorsuppressor genes, Maintenanceof Genomic integrity and development of cancer, Invasion and metastasis- Epithelial to Mesenchymal transition,Cancer stem cells-Basics andhowtotargetingcancer stem cells, Rationaletreatment ofcancer and Special emphasis on few imp cancers which are prevalent in India- Breast cancer, Oral cancer, etc

Unit-IV

Cancer growth and metastasis: Growth factor, receptors and cancer; in vitro testing of stemness property of cancer stem cells; detection and monitoring of metastasis process in animal models; osteoblastic & osteolytic metastasis.

Success and failure of chemotherapy, targeted specific therapy, monoclonal antibody forcancer treatment, micro-RNA mediated cancer treatment and targeted drug delivery, drug resistance, molecular diagnosis and stem cell therapy.

ExpectedCourseOutcomes:

Uponsuccessfulcompletionofthiscoursestudentsshouldbeableto:

1. Identifythe main cellular mechanisms leading to initiation and progression of cancer growth. Describe the characteristics of cancer cells that explain high mortality rate.
2. Definethe roleofoncogenesand mutations incancerand explainwhy severaltypesofcancerhaveheritabletraits and familyhistory.
3. Definethemainfactorscontributingtometastaticgrowth.Identifytheroleofstem-likecells,theirpropertiesand contribution totumor progression. List and describe the main factors controlling the evolution of cancer cell populations.
4. Develop a solid understanding of the main methods used in the modern studies of cellular and molecular mechanisms of cancer.
5. Demonstratecoreknowledgeofthecellulartargetsandmolecularmechanismsoftraditionalandnovelcancertherapies.

Practicals:Cancerbiology(Credit-1)

1. Preparationofculturemedia.
2. Establishmentofprimarycellculture:mousesplenocyteculture.
3. Handlingmammaliancelllines:thawing,culturemaintenanceandcryopreservation.
4. Cellcountingusinghemocytometer.
5. Cell viabilityandproliferationassays: i.Trypan blueexclusiontest,ii.MTTassay, iii.Propidium Iodidestaining,iv.CFSC labeling.
6. Mammaliancelltransfection(transient).
7. Immunofluorescencedetectiontochecktransfectionefficiency(usingfluorescenceandconfocalmicroscopes).

Recommendedbooks:

1. BiologyofCancerbyRobertWeinberg2.PrinciplesOfCancerBiology-LewisJKleinsmith
2. OxfordTextbookofCancerBiology.EditedbyFrancescoPezzella,MahvashTavassoliandDavidKerr.
3. CancerBiologybyRaymondRuddon.

BCH 305SkillOrientedCourse 5(A):Technical writing,Biostatistics,BioinformaticsandOmics Course

Objectives: The main objectives of this course are to:

1. Knowthenuancesoftechnicalwritingofscientificdocumentslikethesis,projectproposalsandjournalarticles.
2. Understandthestatisticaltoolscommonlyusedinbiologicalresearch.
3. Knowtheaspectsfundamentaltoresearchandtounderstandthemethodsofresearch
4. Assimilatetheconceptsofhypothesistestinganditsimportanceinresearch
5. Improvecomputerbasedskillsforanalyzingbiologicaldata.

Unit I

TechnicalWriting:Sentencewriting,paragraphwriting,storywriting,reviewwriting,varioustypesofletterswriting.

Preparation of a research project proposal: Selection of appropriate funding agency, Informal proposal, formal proposal, submission oftechnicalreport (format: title page, introduction, aimsofthe proposal/research, methodology, results, interpretation of results, references, acknowledgments, budgetary allocations), execution of results, submission of progress report (year wise), scientific communications (Articles, papers, reviews etc.,) and critical comments writing.

Unit II

Scope of statistical methods in life sciences. Variables, Measure of central tendency: Mean, median and mode, Measuring Dispersion: Standarddeviation, co-efficient ofvariation, probability, probabilitydistributions, test ofsignificance and estimation, Linear regression and correlation, the chi-square test, ANOVA, t-Test and F-Test.

Unit III

Bioinformatics: Branches of Bioinformatics, scope of bioinformatics, useful sites on the internet: Data bases and search tools: NCBI (http://www.ncbi.nlm.nih.gov/), EMBL serve: (http://www2.ebi.ac.uk/services.html), sequence alignment: gene bee multiple sequence alignment (http://www.genebee.msu.su.), Tree view (http://taxnomy.zoology.gla.ac.uk/rod/treeview.html), Gene doc (http://www.cris.com/ketchup/genedoc.shtml). Sequence analysis, repetitive elements, Image analysis, office applications, logic development. Introduction to Proteomics and genomics.

UnitI V

Genomics, Transcriptomics, proteomics, metabolomics and omic data bases. Sequencing by conventional, automated and next generation sequencing approaches-advantages and limitations. ARDRA, RISA, DGGE/TGGE, Multiple Displacement Amplification (MDA). Whole genome analysis.Advantages and limitation of Metagenomics approach. Culturomics. Proteome, Functional proteomics, metaproteome. Proteome tools – 2-DE Mass spectrometry analysis. Identification of post-translational modifications: Phosphorylation, Glycosylation, Acetylation. Sequence based protein prediction: Homology or comparative modeling, Remote homology (Threading), Protein function prediction. Application of omic technologies in Bioprospecting. Integration of omic platforms, interactomics, Systems biology.

RecommendedBooks:

1) Bio-statistics,Afoundation foranalysisintheHealth(7thEd.1999)byWWWDanielandSonsInc.,NewYork.
2) IntroductiontoBio-statisticsandResearchMethodsbyP.S.S.SundarRaoandRichard.
3) Bio-statisticsbySokal andRolf.
4) Bioinformatics,Sequence,StructureandDatabanksbyDesHigginsWillieTaylor (2000).
5) IntroductiontoBioinformaticsbyT.K.AltwoodandD.JParry-Smith(OearsonEducationAsia1999).
6) UGC-MRPguidelinesandformat,DSTandDBTguidelinesandformatsforprojectpraposals.
7) AuthourguidelinesofanyUGCrecognizedjournals.
8) Englishgrammarbooksforformalandinformalletterwriting.

ExpectedCourseOutcomes:Onthesuccessfulcompletionofthecourse,studentswillbeableto:

1. Givesanideaaboutthesiswriting,fundingagenciesandpatenting(K3&K4).
2. Helpstocollect dataandorganizethedata(K1& K2).
3. Givesaclearunderstandingaboutthebasicstatisticalanalysis(K1&K2).
4. AClearKnowledgeofprobabilityanditsapplication(K2&K3).
5. Providesthesamplingdistributiontechniquesanditsanalysis(K2&K3).
6. Expertisein computerbasedanalysisofbiologicaldata(bioinformatics)(K4,K5&K6). K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create

Practicals:Technicalwriting,Biostatistics,BioinformaticsandOmics(Credits1)

1. Articlewriting
2. StandardDeviation
3. Mean,MedianandMode
4. ANOVA
5. Surveyofsomegenome,metagenome,proteomedata bases.
6. nBLAST,pBLAST,MultipleSequenceAnalysis
7. GeneAnnotationofgenomesequences(ORFfinding)
8. Amplificationof16S DNA
9. Phylogeneticanalysisusing16SrDNAtyping
10. Nativegel,SDSPAGEand2DgelElectrophoresis.

BCH 305 SkillOrientedCourse 5(B):Researchmethodologytoolstechniques, ResearchPublicationandEthics Course

Objectives:

1. Theprimaryobjectiveofthiscourseistoenablethestudents,irrespectiveoftheirdisciplines,indevelopingthemost appropriate methodology for their research studies; and
2. Tomakethemfamiliarwiththeartofexploitingdifferentresearchmethodsandtechniques.
3. Studentsshouldobtainaguidelineonhowtowrite,publish,present,andreviewscientificpapers.
4. The course aims to guide the students regarding the publication ethics and misconducts. It is expected that the course will assist in the accomplishment of exploratory as well as result-oriented research studies.

UnitI

Research Methodology- Definition and significance- Types of research - Exploratory research, Conclusive research, Modeling research, Algorithmic research, Casual research, Theoretical and Empirical research, Cross-Sectional research and Time Series research, Research process-, Research problem- Objectives, Characteristics, Hypothesis andresearch in evolutionaryperspective. Research Design- Definition, Types- Descriptive and Experimental Questionnaire preparation- prerequisites of a good questionnaire, Data Collection methods in research -Primary data and Secondary data.

An overview and implications of translational research. Rationale and implications ofIntellectual property rights (IPR) and Patenting. Fundamentals of IPR; Basics understanding about Patentability. Innovation & Knowledgemanagement; Translating Ideas to Entrepreneurship and Startups

UnitII

Validity and Reliability-Definition, importance, types of validity, types of reliability-- Construction and Validation of questionnaire,Cronbachalphatest, Measurement –definition-significance– typesNominal, Ordinal, Interval andRatio,Scaling-Importance, Scaling techniques. Sampling methods- Probability sampling methods and Non - Probability sampling methods, Report writing – importance , guideline to write an academic report, Basics of report presentation- Content of an Academic Research report, Content on a Research Article, Steps to publish an article, Research Metrics: Significance of Journal Impact Factor, SNIP, SJR, IPP, Cite Score, Metrics: h-index, g index, i10 index.

UnitIII

Non parametric tests- One sample tests- one sample sign test. Kolmogorov- Smirnov test, Run test for randomness, two sample tests- tow sample sign test, Mann-Whitney U test, K sample test- Kruskal Wallis test (H- test). Hypothesis testing – Testing of hypothesis concerning means (one mean and difference between two means – one tailed and two tailed tests), Concerning Variance – One tailed Chi square test, Analysis of Variance (anova). Introduction to Discriminant.

UnitIV

Introduction to philosophy: definition, nature and scope, concept, branches, Ethics: definition, moral philosophy, natureof moral judgments and reactions', Ethics with respect to science and research, Intellectual honest and research integrity, Scientific misconduct: falsification, fabrication, and plagiarism, Redundant publications: duplicate and overlapping publications, salami slicing, Selective reporting and misrepresentation of data.

Publication ethics: definition, introduction and importance, Best practices/standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest, Publication misconduct: definition, concept, problems that lead to unethical behavior and vice verse, types, Violation ofpublication ethics, authorshipandcontributor ship, Identification ofpublicationmisconduct, complaints and appeals, Predatory publishers and journals.

ExpectedCourseOutcomes:Onthesuccessfulcompletionofthecourse,studentswillbeableto:

1. Learnaboutresearchmethodology,statisticalmethods,researchplanandimplementation.
2. Theknowledgewillbeutilizedfor improvingthequalityofresearchpracticeandeducation.

Practicals:Researchmethodologytoolstechniques,ResearchPublicationandEthics

1. Open access publishing and initiatives, SHERPA/RoMEO onlineresource to check publisher copyright and self-archiving policies.
2. Software tool to identify predatory publications developed by SPPU, Journal finder/ journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.,
3. Publicationmisconduct(GroupDiscussion):Subjectspecificethicalissues,FFP,authorship,Conflictsofinterest,Complaints and appeals: examples and fraud from India and abroad.
4. Softwaretools:UseofplagiarismsoftwarelikeTurnitin,Urkundandotheropen sourcesoftwaretools.
5. Databases:Indexingdatabases,Citationdatabases:WebofScience,Scopus,etc.
6. Research Metrics: Impact Factor of journal as per journal citation report, SNIP, SJR, IPP, Cite Score, Metrics: h-index, g index, i10 index, altmetrics.

RecommendedBooks:

1. Ana smith Iltis," Research Ethics", Publisher: Routledge, ISBN: 0415701589, 2016 by HAN LUO - 2012 2. Dr.Tripathi,P.C, Research Methodology, 1st Edition, Prentice Hall Inc., 2009.
3. Garg,B.L.Karadia,R.Agarwal,&F.Agarwal,U.K2002.Anintroductiontoresearchmethodology,RBSAPublishers
4. IntroducingResearchMethodology:ABeginner'sGuidetoDoingaResearchProjectbyFLICK,UWE.HANLUO. Northwestern University.
5. Kothari, K.C. andGauravGargResearch Methodology: Methods andTechniques(Multi Colour Edition, 6. Mr.SuberPeter, Open Access (MIT Press Essential Knowledge series), New age international publishers, 2019
7. OliverPaul,"TheStudent'sguidetoresearchethics",McGraw-HillEducation(UK),Secondedition2010
8. The EthicsofOnlineResearch(AdvancesinResearchEthicsandIntegrityBook)KindleEditionbyKandyWoodfield (Editor), 2017.
9. WilliamG.Zikmund,BusinessResearchMethods,7thEdition,TataMcGrawHill,2009.

BCH306SkillOrientedCourse 6(A):ClinicalBiochemistry(Credits3)

Course Objectives: The main objectives of this course are to:

1. Provideknowledgeaboutcarbohydrate,lipidandnucleicacidmetabolicdisorders.
2. Offerknowledgeabouthemoglobinmetabolismandassociateddiseases.
3. Giveknowledgeaboutfunctionaltestsoforgansandclinicaldiagnosisofdiseasesbyenzymaticassays.
4. Givebasicknowledgeaboutfreeradicalsanddiseases.
5. Provideawarenessaboutapplication ofArtificialIntelligenceinhealthandmedicine.

Unit I

The place of clinical Biochemistry in medicine, the use of Biochemical tests and the clinical biochemistry laboratory, Specimen collection, reference values, Automation andautoanalyzers,qualityassurance in clinical laboratory –internal and external quality control. Investigationofdisorders ofcarbohydratemetabolism: Hypoglycemia, Hyperglycemia. Diabetesmellitus –classification, clinical and metabolic features and management. Laboratory diagnosis of diabetes mellitus – glucose tolerance test (GTT), Random, Fasting, post prandial (PP) blood glucose levels, glycosuria, ketones, glycosylated hemoglobin (GHb), metabolic complications of diabetes – Diabetic keto acidosis (DKA), glycogen storage diseases,
Plasmaproteins–functionsandtheiralterationsindisease,paraproteinemias.

Unit II

Kidneyfunction: Formation ofurine, Normal andabnormal constituentsofurine, Glomerular andtubular function,renalfunction tests, nephrotic syndrome and CRF.
Liver function: structureandfunction ofliver,liver functiontests, Bilirubinmetabolismand Jaundice, kernicterus, liver diseases - hepatitis, gall stones, cirrhosis.
Gastricandpancreaticfunction:Gastricfunctiontests-Pentagastrintest,insulinstimulationtest,hyperchlorhydria, achlorhydria, pancreatic diseases – acute pancreatitis, Malabsorption syndrome.

UnitIII

Fluidandelectrolytebalance–hyponatremiaandhypernatremia,hyperkalemia,acid-basebalanceinthebodyfluids-Blood buffers, role of kidney and lungs, metabolic acidosis and alkalosis.
Plasma Lipids and lipoproteins and their functions – lipid profile, clinical disorder of lipid metabolism - hyperlipidemias and management, Atherosclerosis. Molecular diagnosis – HIV, thalassemia, tumor markers. Cerebrospinal fluid analysis (CSF)

UnitIV

Plasma enzymes in diagnosis and prognosis: Transaminases (SGOT & SGPT), alkaline and acid phosphatase, lactate dehydrogenase (LDH), creatine kinase (CK), α-amylase, acid phosphatase, γ –glutamyl transferase, acetyl Cholinesterase, Isoenzymes of clinical importance, Plasma enzyme pattern in myocardial infarction, liver disease andmuscle disease. Inbornerrorsofaminoacidmetabolism -Phenylketonuria,alkaptonuriaandMaple-Syrupurinedisease.Hemoglobinopathies.

Recommended Books

1. TextbookofBiochemistrywithClinicalCorrelations.ThomasM.Devlin(JohnWily).

2. Harper'sReviewofBiochemistry, Murray*et al*(Longman)Investigationoflipoproteinemiasandlipidemias. Renalfunction: Glomerular and tubular functions.
3. BiochemicalAspectsofHumanDisease–R.S.ElkelesandA.S.Tavil.(BlackwellScientificPublications,1993)
4. ClinicalChemistryin DiagnosisandTreatment–JoanF.ZilvaandP.R.Pannall(LloydLukemedicalBooks,London,(1988).
5. Varley'sPracticalClinicalBiochemistry–Ed.Alan W.Gowen Lock(HeinemannMedical Books, London (1988)
6. Clinicaldiagnosisandmanagement byLaboratoryMethods(John BernardHenry, W.B Saunders Company, 1984)
7. ClinicalBiochemistry–S.RamakrishnanandRajiswami.
8. ChemicalBiochemistry(MetabolicandClinicalAspects)byW.J.Marshall&S.K.Bangert.
9. TextbookofClinicalBiochemistrybyTietzet al.

ExpectedCourse Outcomes: Onthesuccessful completionofthecourse, studentswillbeableto: Students will acquire insight into disorders of carbohydrates, lipids and nucleic acid (K2).
Students will learn about functional tests and enzymatic assays to diagnose the function of liver, kidney, thyroid, gastrointestinal and pancreas (K4).
Studentswillgainknowledgeaboutdisordersofnitrogenmetabolism(K3). Students will learn about the disorders of hemoglobin metabolism (K3).
Studentswilllearnabout theapplicationsofArtificialIntelligenceinhealthandmedicine(K3). K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create

Practicals:ClinicalBiochemistry(Credits1)

1. DeterminationofSGOT.
2. DeterminationofSGPT.
3. Estimationofserumphosphate.
4. Estimationofserumbilirubin
5. Estimationofcreatinineinserum
6. DeterminationofurineProtein
7. Testsforabnormalconstituentsinurine
8. Fieldvisit–Visitinganeighboringhospitalandfindingouthowthebloodiscollectedandprocessedinhospital.

BCH306SkillOrientedCourse 6(B):*InSilico*DrugDesignandDiscovery Course

Objectives: The main objectives of this course are to:

1. ProvidebasicprincipleofpharmacologyandMolecularinteractionswithdrugs
2. Theoriesofreceptorsandenzymeinhibition
3. Biotransformationofdrugs

Unit-I

Introduction to Pharmacology: Basic principles of pharmacology, including receptor mechanisms, drug distribution and metabolism, and pharmacokinetics. Interactions Inter- and intramolecular interactions. Weak interactions in drug molecules. Chiralityanddrugaction. Covalent,ion-ion, ion-dipole, Hydrogen bonding, C-Hhydrogen bonding, dihydrogen bonding,Van der Waals interactions and the associated energies.

Unit-II

ReceptorologyDrug-receptorinteractions,Receptortheoriesanddrugaction:OccupancyTheory,RateTheory,InducedFit Theory, Macromolecular perturbation theory, Activation-Aggregation theory. Topological andstereochemical consideration.

Unit-III

Enzyme Inhibition Drug action through enzyme inhibition. Examples based on PDE4, GSK3, etc. Theoriesof enzyme inhibition and inactivation. Enzyme activation of drugs prodrugs.

Unit-IV

Druglikeness Drug like molecules and theories associated with therecognition ofdrug like properties.Physical organic chemistry of Drug metabolism, drug deactivation and elimination.

Drug action after Metabolism: Phase I and Phase II transformations. Concept of hard and soft drugs.Chemistry of ADME and Toxicity properties of drugs.

ExpectedCourseOutcomes:Onthesuccessfulcompletionofthecourse,studentswillbeableto:

1. Gainknowledgeaboutprinciplesofpharmacologyandinteraction ofdrugandreceptor.
2. Developskillsrelevantforthemedicalandpharmaceuticalindustries.

Practical:InSilicoDrugDesignandDiscovery(Credits1)

Insilicoprediction:signalpeptide,transmembranedomains.

RecommendedBooks

1) TheOrganicChemistryofDrugDesignandDrugActionbyR.B.Silverman
2) C.J.Coulson,MolecularMechanismofDrugActionbyC.J.Coulson
3) AprimerofDrugActionbyR.M. Julien
4) Drug-ReceptorThermodynamicsbyR.B.Raffa
5) PrinciplesofDrugActionbyW.B.Pratt,P.Taylor
6) MedicinalChemistryHowDrugsActandWhybyA.Gringauz
7) PrinciplesofMolecularrecognitionbyA.D.Buckingham
8) QuantitativemolecularpharmacologyandInformaticsbyM.Lutz
9) PhysicalBiochemistrybyK.E.V.Holde
10) Freeenergycalculationsinrationaldrugdesignby M.RamiReddy.

OOTC 308OpenOnlineTransDisciplinaryCourse 2(Credits2)

SEMESTER:IV

- TypeofCourse:OpenOnlineSkillDevelopmentCourse'sMOOCS/SWAYAM;CourseNo:**OOSDCBCH401**
- M.Sc.BiochemistryProject:Multi-DisciplinaryProjectCourseNo.:**BCHPW402**.
- Projectworkunderthesupervisionofrespectivefaculty.
- Dissertation–ThesisSubmission,ProjectEvaluationand*Viva-voce*
- Projectworkcarries**300Marks**(Dissertation-200marks,Seminar-50marks,*Vivavoice*–50marks).

*Conductingclassesforcompetitiveexams,communicationskills,UGC/CSIR/NET/SLETexaminations.

M.ScBiochemistry:
ModelQuestionpaper SemesterI/II/IIICORE1/4/7Paper

Time3Hrs **Maxmarks70**

Attemptany**five**fromPartA(5x4=20marks)and**all**fromPartB(4x12.5=50marks)

PART A(5x4=20marks)

1. Unit1
2. Unit1
3. Unit2
4. Unit2
5. Unit3
6. Unit3
7. Unit4
8. Unit4

PARTB (4x12.5=50marks)

9. Unit1Aor B
10. Unit2AorB
11. Unit3AorB
12. Unit4AorB

M.ScBiochemistry

ModelQuestionpaperSemesterI/II/IIICORE- 2to9/ SOCPapers1/ 2/3/5/6

Time2Hrs **Max marks: 50**

Attemptany**five**fromPartA(5x2=10marks)and**all**fromPartB(4x10=40marks)

PARTA(5x2=10marks)

1. Unit1
2. Unit1
3. Unit2
4. Unit2
5. Unit3
6. Unit3
7. Unit4
8. Unit4

PARTB(4x10=40marks)

9. Unit1Aor B
10. Unit2AorB
11. Unit3AorB
12. Unit4AorB