

GONDWANA UNIVERSITY GADCHIROLI



FACULTY OF SCIENCE AND TECHNOLOGY

Syllabus for the T.Y.B.Sc.

Program: B.Sc.

Course: Biochemistry

SEMESTER V

Choice Based Credit System with effect from the academic year

2019–2020

GONDWANA UNIVERSITY, GADCHIROLI

CHOICE BASED CREDIT SYSTEM

T.Y.B.Sc.

BIOCHEMISTRY

(SEMESTER V)

(With effect from academic session 2019-20)

- There shall be two semesters in B.Sc. Part III. Each semester comprise of two theory papers, practical and internal assessment.
- The syllabus is based on six theory periods and six practical periods per week.
- Each theory paper divided into four units.
- **Scheme of examination:** The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment (college assessment) in the first part & by conducting the Semester End Examinations (conducted by university) in the second part.
- **Internal Assessment:** It is defined as the assessment of the learners on the basis of continuous evaluation as envisaged in the Credit based system by way of participation of learners in various academic and correlated activities in the given semester of the programme.
- **Semester End Assessment:** It is defined as the assessment of the learners on the basis of Performance in the semester end Theory/ written/ Practical examination.
- The internal assessment marks assigned to each theory paper shall be awarded on the basis of assignment / Class test / Project assignment / Seminar / Case studies/ Quizzes/ Viva, any other innovative practice / activity.
- **The Semester End Examination for Biochemistry course will be as follows:**
 - External assessment- University examination : 50 marks each for DSE- I, DSE- II, DSE- III, DSE- IV (Any Two): Total 100 marks
 - Internal assessment- College Assessment : 10 marks each for DSE- I, DSE- II, DSE- III, DSE- IV (Any Two): Total 20 marks
(External assessment+ Internal assessment= Total - 120 Marks for theory)
 - One practical course: 30 marks(For any two selected from DSE)
 - The practical course will be concerning with the DSE theory papers.
- Duration of examination for each theory paper will be 3 hours.
- The practical examination shall be of 6 hours duration.
- Practical examination for odd semester will be at college level and for even semester at university level with external examiner.
- **Skill Enhancement Course (SEC):** The students have to choose one Skill Enhancement Course from a pool of courses designed to provide value-based and/or skill-based knowledge.
- Marks distribution for SEC: Theory- 15 marks, Exercise/Practical-35 Marks
- Assessment of skill Enhancement Course shall be done at college level.
- The B.Sc. students of Biochemistry shall pay at least one visit to any Industry, Biochemical/Research Institute as a study tour during three year (six semesters) degree course.
- The marks will be given for all examinations and they will be converted into grade points. The final grade card will have marks, credits, grades, grade points, SGPA & CGPA.

SCHEME OF TEACHING AND EXAMINATION

Semester	Paper no	DSE T/P	Paper code	Title of Paper: Discipline Specific Elective (Any Two)	Periods / week	Max Marks	Internal(C.A.)	Total Marks	Credits	Total: T + P
						Externl (U.A.)				
V	IX	DSE-I	USBCDST-09	Metabolism of Carbohydrates and Lipids	6	50	10	60	2	150
	X	DSE-II	USBCDST-10	Molecular Biology	6	50	10	60	2	
	XI	DSE-III	USBCDST-11	Nutritional Biochemistry	6	50	10	60	2	
	XII	DSE-IV	USBCDST-12	Plant Biochemistry	6	50	10	60	2	
	Practical	DSE-05	USBCDSP-05	DSE Practical (Concerning with selected DSE theory papers). Any two Practical courses from DSE-5, DSE-6, DSE-7, DSE-8	6	30	-	30	2	
		DSE-06	USBCDSP-06							
		DSE-07	USBCDSP-07							
		DSE-08	USBCDSP-08							
	paper no	SEC	Paper code	Skill enhancement course (Any one) (College level)	Credit	Theory	Exercise	Total	Credits	Total Mark
	I	SEC I	USBCSEC-01	Tools and Techniques in Biochemistry	2	15	35	50	2	50
II	SEC II	USBCSEC-02	Composting: Green Waste Management	2	15	35	50	2		

SEM V:**Discipline Specific Elective:**
(Any two)

1. Metabolism of Carbohydrates and Lipids
2. Molecular Biology
3. Nutritional Biochemistry
4. Plant Biochemistry

Skill Enhancement Course:
(Any one)

1. SEC-1:
Tools and Techniques in Biochemistry
2. SEC-2:
Composting: Green Waste Management

Internal Assessment for DSE Theory Paper:

S.No	Type of Evaluation	Marks	
		Paper I	Paper II
1	One class test	05	05
2	Active participation in routine class activities/seminars etc.	03	03
3	One assignment	02	02
	Total	10	10

Distribution of Marks in DSE Practical Examination:

S.No	External assessment	Marks
1	Experimental work(One experiment each from the selected DSE papers)	20
2	Practical record	05
3	Viva-voce	05
	Total	30

QUESTION PAPER PATTERN

- Question paper will consist of five questions and each question will be of 10 marks.
- All questions will be compulsory and with internal choice.
- The first four questions will be from the four units separately.
- Fifth question will be compulsory with questions from each of the four units having equal weightage and there will be no internal choice.

T.Y.B.Sc. Semester V & VI (CBCS) BIOCHEMISTRY

Time: 3 Hours

Max. Marks: 50

- Note: A) All questions are compulsory and carry equal marks
B) Draw well labeled diagrams wherever necessary**

- Q 1. Long answer type question from Unit I 10 Marks
OR
a) Short answer type question from Unit I 2½ Marks each
b) Short answer type question from Unit I
c) Short answer type question from Unit I
d) Short answer type question from Unit I
- Q 2. Long answer type question from Unit II 10 Marks
OR
a) Short answer type question from Unit II 2½ Marks each
b) Short answer type question from Unit II
c) Short answer type question from Unit II
d) Short answer type question from Unit II
- Q 3. Long answer type question from Unit III 10 Marks
OR
a) Short answer type question from Unit III 2½ Marks each
b) Short answer type question from Unit III
c) Short answer type question from Unit III
d) Short answer type question from Unit III
- Q 4. Long answer type question from Unit IV 10 Marks
OR
a) Short answer type question from Unit IV 2½ Marks each
b) Short answer type question from Unit IV
c) Short answer type question from Unit IV
d) Short answer type question from Unit IV
- Q 5. Solve any 10 out of 12 questions (3 questions from each unit) 10 Marks

B. Sc. Part III (CBCS)

SEMESTER V

DSE – I

USBCDST-09: METABOLISM OF CARBOHYDRATES AND LIPIDS

CREDITS: 2

UNIT 1 Carbohydrate Metabolism

- A) Glycolysis - a universal pathway, reactions of glycolysis, fates of pyruvate, feeder pathways for glycolysis, galactosemia.
- B) Gluconeogenesis - Synthesis of glucose from non-carbohydrate sources, reciprocal regulation of glycolysis and gluconeogenesis.
- C) Glycogen metabolism - Glycogenesis & glycogenolysis, regulation of glycogen metabolism, glycogen storage diseases.
- D) Glyoxalate pathway and its role in conversion of fats into carbohydrates, coordinated regulation of glyoxalate and citric acid pathways.

UNIT 2 Citric acid cycle and Oxidative phosphorylation

- A) Citric acid cycle -Production of acetyl CoA, reactions of citric acid cycle, anaplerotic reactions, amphibolic role, regulation of citric acid cycle
- B) Structure of mitochondria, oxidative and substrate level phosphorylation, Electron transport chain - its organization and function, Sites of ATP synthesis.
- C) Peter Mitchell's chemiosmotic hypothesis, Proton motive force, Inhibitors of ETC and uncouplers.
- D) FoF1ATP synthase, structure and mechanism of ATP synthesis, ROS production and antioxidant mechanisms. Malate and glycerophosphate shuttle system.

UNIT 3 Lipid Metabolism

- A) Fatty acid oxidation - Digestion, mobilisation and transport of triacyl glycerols, fatty acid transport to mitochondria.
- B) β oxidation of saturated, unsaturated, odd and even numbered and branched chain fatty acids, regulation of fatty acid oxidation.
- C) Peroxisomal oxidation, ω -oxidation.
- D) Ketone bodies metabolism- Ketogenesis, Ketosis and ketoacidosis in physiology and pathology.

UNIT 4 Biosynthesis of Lipids

- A) Pentose phosphate pathway- Detailed account of HMP Shunt and its significance in general, its connection to lipid metabolism.
- B) Fatty acid synthesis- Fatty acid synthase complex. Synthesis of saturated, unsaturated fatty acids and regulation.
- C) Biosynthesis of membrane lipids- Synthesis of membrane phospholipids in prokaryotes and eukaryotes
- D) Biosynthesis of triacylglycerol, plasmalogens, sphingolipids and glycolipids.

DSE-5: PRACTICAL

USBCDSP-05: METABOLISM OF CARBOHYDRATES AND LIPIDS

CREDITS: 1

1. Estimation of blood glucose by 2,3 dinitrosalicylic acid method.
2. Sugar fermentation of microorganisms.
3. Isolation of lecithin, identification by TLC, and its estimation.
4. Isolation of cholesterol from egg yolk and its estimation.
5. Isolation of glycogen from liver source and its estimation by anthrone method.
6. Determination of true glucose by Glucometer/Glucose oxidase method.
7. Determination of glucose by Folin-Wu method.
8. Effect of NaF on glycolysis in RBC by estimating glucose
9. Determination of serum phospholipids.
10. Determination of serum lipase.
11. Estimation of lipase by titrimetric method.
12. Determination of ketone bodies in urine
(Mandatory to perform at least four practical)

SUGGESTED READINGS

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13:978-1-4641-0962-1 / ISBN:10:1-4641-0962-1.
2. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New Jersey), ISBN:978-0-470-28173-4.
3. Biochemistry (2012) 7th ed., Berg, J.M., Tymoczko, J.L. and Stryer L., W.H. Freeman and Company (New York), ISBN:10:1-4292-2936-5, ISBN:13:978-1-4292-2936-4.
4. Molecular Cell Biology (2013) 7th ed., Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M.P., W.H. Freeman & Company (New York), ISBN:13:978-1-4641-0981-2.
5. Biochemistry (2010) 4th ed., Garret, R. H. and Grisham, C.M., Cengage Learning (Boston), ISBN-13:978-0-495-11464-2.
6. Principles of Biochemistry (2008) 3rd ed., Voet, D.J., Voet, J.G. and Pratt, C.W., John Wiley & Sons, Inc. (New York), ISBN:13: 978-0470-23396-2

**B. Sc. Part III (CBCS)
SEMESTER V
DSE – II**

USBCDST-10: MOLECULAR BIOLOGY (THEORY)

CREDITS: 2

UNIT –I: DNA Replication in Prokaryotes- I

- A) Basic Features of replication: Semiconservative nature of replication with experimental proof, Origin of replication, priming, 5'→3' direction of replication, Leading and lagging strand, bidirectional / unidirectional replication.
- B) Different models of replication: Theta (θ) model, Rolling circle or sigma (σ) replication
- C) Concept of Okazaki Fragment with experimental proof.
- D) DNA replication in E. coli: Initiation, Elongation and Termination

UNIT –II: DNA Replication in Prokaryotes- II

- A) DNA Polymerases: Structure of polymerase I, Structure and properties of Klenow fragment, 5'→3' exonuclease activity, Nick translation.
- B) DNA polymerase III: Concept of holoenzyme, processivity, fidelity of replication. Other types of polymerases.
- C) Regulation of E. coli Replication: concepts of C and D value.
- D) DNA damage & repair: Ames test, types of DNA damage, Mismatch Repair (mut HLS system), Base Excision Repair, Nucleotide Excision Repair, Direct Repair, SOS or Error Prone repair.

UNIT – III: Transcription

- A) Basic features of RNA synthesis, Terminology, Prokaryotic RNA polymerases
- B) Prokaryotic transcription: Initiation, elongation and termination with reference to Role of promoter, determination of length of promoter by DNA foot printing method. Conserved features of promoter. Weak and strong promoters,
- C) Role of σ subunit, Different kinds of sigma subunits, Promoter binding and activation, RNA chain initiation and promoter escape, abortive initiation, rho dependent and independent termination of transcription.
- D) Inhibitors of prokaryotic transcription: e.g. rifamycins, Reverse transcription.

UNIT – IV: Genetic Code & Decoding System

- A) **The Genetic Code:** Features of genetic code, Deciphering the genetic code.
- B) Wobble hypothesis
- C) **The decoding system:** - i) Aminoacyl synthetases, ii) Brief structure of t-RNA, iii) Attachment of amino acid to t-RNA, iv) Error correction in amino acylation.
- D) Selection of initiation codon – (Shine-Dalgarno sequence).

DSE-6: PRACTICAL

USBCDSP-06: MOLECULAR BIOLOGY

CREDITS: 1

1. Extraction of total nucleic acids from plant tissue.
2. Diauxic growth curve effect.
3. Isolation of mRNA from yeast by affinity chromatography.
4. Effect of inhibitors on protein synthesis.
5. Accumulation of protein due to proteasome inhibitors.
6. Estimation of DNA by diphenylamine reaction.
7. Estimation of RNA by orcinol reaction.
8. To measure concentration of DNA & RNA by UV spectrophotometry.
9. UV spectrophotometric estimation of a given protein by E 280/260 method
(Mandatory to perform at least four practical)

SUGGESTED READINGS

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman & Company (New York), ISBN:13: 978-1-4292-3414-6 / ISBN:10-14641-0962-1.
2. Molecular Biology of the Gene (2008) 6th ed., Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., Cold Spring Harbor Laboratory Press, Cold Spring Harbor (New York), ISBN:0-321-50781 / ISBN: 978-0-321-50781-5.
3. Mol Bio (Fundamentals of molecular biology) – Upadhyay & Upadhyay, Himalaya Publishing House.
4. Molecular Biology – David Friefelder – Narosa Publishing House, New Delhi.
5. Cell Biology, Genetics, Molecular Biology, Evolution & Ecology -Verma, Agarwal– S.Chand & Co.
6. Molecular & Cell Biology – Bhamrah – Anmol Publ. Pvt. Ltd., New Delhi.
7. Molecular Biology of the Cell – Alberts, Bray, Lewis, Raff, Roberts, Watson – Garland Publishers, New York.
8. Molecular Biology of the gene – J. D. Watson, NH Hopkins, Roberts, Stertz, Weiner-Freeman.
9. Molecular Biology of the Gene – Watson, Hopkins, Roberts, Steitz, Weiner – Benjamin Cummings Publishing Co.
10. Molecular Cell Biology – Baltimore, Zipursky, Matsudaria, Darnel – W. H. Freeman

B. Sc. Part III (CBCS)
SEMESTER V
DSE – III

USBCDST-11: NUTRITIONAL BIOCHEMISTRY

CREDITS: 2

UNIT 1 *Introduction to Nutrition and Energy Metabolism*

- A) Defining Nutrition, role of nutrients, Unit of energy, Biological oxidation of foodstuff, Physiological energy value of foods, SDA.
- B) Measurement of energy expenditure. Direct and Indirect Calorimetry, energy output – Basal and Resting metabolism.
- C) Factors affecting energy input - hunger, appetite, energy balance, Energy expenditure in man, BMR.
- D) Recommended Nutrient Intakes (RNI) and Recommended Dietary Allowances for different age groups.

UNIT 2 *Dietary carbohydrates, lipids and health*

- A) Dietary requirements and source of carbohydrates, Dietary fiber, role of fibre in lipid metabolism, colon function, blood glucose level and GI tract functions.
- B) Essential Fatty Acids; Functions of EFA, RDA, – excess and deficiency of EFA, Lipotropic factors, role of saturated fat, cholesterol, lipoprotein and triglycerides.
- C) Importance of the following: a) Omega – fatty acids. Omega 3/ omega 6 ratio b) Phospholipids c) Cholesterol in the body d) Mono, Polyunsaturated and Saturated Fatty Acids.
- D) Dietary implications of fats and oils, Combination ratios of n6 and n3, MUFA, PUFA and SFA.

UNIT 3 *Dietary Proteins, minerals and health*

- A) Review of functions of proteins in the body, Essential and Nonessential amino acids. Amino Acid Availability, Antagonism, Toxicity and Imbalance, Amino acid Supplementation. Effects of deficiency.
- B) Amino acid pool. NPU, Biological Value, Nitrogen balance. PEM and Kwashiorkor.
- C) Calcium, Phosphorus and Iron - Distribution in the body digestion, Absorption, Utilization, Transport, Excretion, Balance, Deficiency, Toxicity, Sources, RDA. Calcium: Phosphorus ratio, Role of iron in prevention of anemia.
- D) Iodine, Mg, Cu Zn, Manganese Distribution in the human body, Physiology, Function, deficiency, Toxicity and Sources

UNIT 4 *Fat and water soluble Vitamins*

- A) Vitamin A, C, E, K and D- Dietary sources, RDA, Deficiency.
- B) Role of Vitamin A as an antioxidant, in Visual cycle, dermatology and immunity. Role of Vitamin K in Gamma carboxylation. Role of Vitamin E as an antioxidant. Extra-skeletal role of Vitamin D and its effect on bone physiology, Hypervitaminosis. Vitamin C role as cofactor in amino acid modifications.
- C) Niacin- Metabolic interrelation between tryptophan, Niacin and NAD/ NADP. Vitamin B6-Dietary source, RDA, Role in metabolism, Biochemical basis for deficiency symptoms.
- D) Vitamin B12 and folate: Dietary source, RDA, absorption, metabolic role, Biochemical basis for deficiency symptoms.

DSE-7: PRACTICAL

USBCDSP-07: NUTRITIONAL BIOCHEMISTRY (PRACTICALS)

CREDITS: 1

1. Bioassay for vitamin B12/B1.
2. Homocystiene estimation.
3. Serum/ urine MMA estimation.
4. Anthropometric identifications for Kwashiorkor, Marasmus and Obesity.
5. Determination of oxidative stress: TBARS, antioxidant enzymes in hemolysate.
6. Vitamin A/E estimation in serum.
7. Bone densitometry /bone ultrasound test demonstration (visit to a nearby clinic)
(Mandatory to perform at least four practical)

SUGGESTED READINGS

1. Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.
2. Nutrition for health, fitness and sport (2013) ; Williams.M.H,Anderson,D.E, Rawson,E.S. McGraw Hill international edition. ISBN-978-0-07-131816-7.
3. Krause's Food and Nutrition Care process.(2012); Mahan, L.K Strings,S.E, Raymond,J. Elsevier's Publications. ISBN- 978-1-4377-2233-8.
4. The vitamins, Fundamental aspects in Nutrition and Health (2008); G.F. Coombs Jr. Elsevier's Publications. ISBN-13- 978-0-12- 183493-7.
5. Principles of Nutritional Assessment (2005) Rosalind Gibson. Oxford University Press.

**B. Sc. Part III (CBCS)
SEMESTER V
DSE – IV**

USBCDST-12: PLANT BIOCHEMISTRY (THEORY)

CREDITS: 2

UNIT 1 *Plant cell structure, Photosynthesis and Carbon assimilation*

- A) Plasma membrane, Vacuole and tonoplast membrane, cell wall, plastids, Peroxisomes and Glyoxysomes.
- B) Structure of PSI and PSII complexes, Light reaction, Cyclic and non cyclic photophosphorylation.
- C) Calvin cycle and regulation; C4 cycle and Crassulacean acid metabolism (CAM), Photorespiration.

UNIT 2 *Regulation of plant growth*

- A) Introduction to plant hormones (Auxin, Gibberellin, Cytokinin, Ethylene & Abscisic acid and their functions in plant growth and development.
- B) Regulation of plant morphogenetic processes by light.

UNIT 3 *Secondary metabolites*

- A) Representatives alkaloid group and their amino acid precursors, function of alkaloids, simple phenylpropanoids, Coumarines, Benzoic acid derivatives.
- B) Flavonoids, tannins and lignin, biological role of plant phenolics.
- C) Classification of terpenoids and representative examples from each class, biological functions of terpenoids.

UNIT 4 *Plant tissue culture*

- A) Cell and tissue culture techniques, types of cultures: organ and explants culture, callus culture, cell suspension culture and protoplast culture.
- B) Plant regeneration pathways: organogenesis and somatic embryogenesis.
- C) Applications of cell and tissue culture and somoclonal variation.

DSE-8: PRACTICAL

USBCDSP-08: PLANT BIOCHEMISTRY (PRACTICALS)

CREDITS: 1

1. Induction of hydrolytic enzymes Proteinases /amylases/lipase during germination
 2. Extraction and assay of Urease from Jack bean
 3. Estimation of carotene/ascorbic acid/phenols/tannins in fruits and vegetables
 4. Separation of photosynthetic pigments by TLC
 5. Culture of plant plants (explants).
- (Mandatory to perform at least four practical)

SUGGESTED READINGS

1. Plant Biochemistry (2008), Caroline Bowsher, Martin steer, Alyson Tobin, Garland science ISBN 978-0-8153-4121-5
2. Biochemistry and molecular Biology of plant-Buchanan. (2005) 1 edition. Publisher: I K International. ISBN-10: 8188237116, ISBN-13: 978-8188237111.
3. Plant Biochemistry by P.M Dey and J.B. Harborne (Editors) (1997) Publisher: Academic Press ISBN-10:0122146743, ISBN-13:978-0122146749
4. Plant physiology by Taiz and Zeiger
5. Plant physiology by Robert M. Devlin.
6. Biotechnology by B. D. Singh.
7. Plant biochemistry by Hans-Walter Heldt.

CHOICE BASED CREDIT SYSTEM
T.Y.B.Sc.
BIOCHEMISTRY
SKILL ENHANCEMENT COURSE

SEMESTER V

SEC-1

USBCSEC-01: TOOLS AND TECHNIQUES IN BIOCHEMISTRY

TOTAL HOURS: 30

CREDITS: 2

UNIT 1. *Biochemical reagents and solutions*

Safety practices in the laboratory. Preparation and storage of solutions. Concepts of solution concentration and storing solutions. Quantitative transfer of liquids. Concept of a buffer, Henderson-Hasselbach equation, working of a pH meter.

UNIT 2. *Spectrophotometric techniques*

Principle and instrumentation of UV-visible and fluorescence spectroscopy.

Exercise

1. Preparation of a buffer of given pH and molarity.
2. Preparation and standard solutions.
3. Measurement of P^H by P^H meter.
4. Preparation of Buffer solutions.
5. Measurement of fluorescence spectrum.
6. Determination of concentration of a protein solution by Lowry/BCA method.
7. Determination of the absorption maxima and molar extinction coefficient (of a relevant organic molecule).

SUGGESTED READINGS

1. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D., Wiley Blackwell (West Sussex), ISBN:978-0-470-85602-4 / ISBN:978-0-470-85603-1.
2. Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1982) 2nd ed., Freifelder, D., W.H. Freeman and Company (New York), ISBN:0-7167-1315-2 / ISBN:0-7167-1444-2.
3. An Introduction to Practical Biochemistry (1998) 3rd ed., Plummer D. T., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10: 0-07-099487-0.

SKILL ENHANCEMENT COURSE

SEMESTER V

SEC-2

USBCSEC-02: COMPOSTING: GREEN WASTE MANAGEMENT

TOTAL HOURS: 30

CREDITS: 2

UNIT I : Definition and scope of green waste management, Introduction of composting process, definition, Types of composting, Biomass and its resources

UNIT II: Organic constituents of green waste, Microbial biota present in composting, Chemistry of composting, microbiology of composting

UNIT III : Enzyme and substrate degradation during composting, Different phases of composition with their significance on composting

UNIT IV: Aerobic verses anaerobic composting, Thermophilic verses mesophilic composting Analysis of compost parameter (Proximate analysis, ultimate analysis), Compost maturity (Defination, significance, maturity indexes, maturity tests)

Exercise

1. Bin composting
2. Windrow composting
3. Activator added composting
4. Heap composting
5. Aerobic verses anaerobic composting

Suggested reading:

1. Microbial dynamics and enzyme activities during rapid composting of municipal solid waste – a compost maturity analysis perspective. Raut et al, 2008. *Bioresour. Technol.* 99, 6512–6519.
2. Why and how aerobic mesophilic composting is effective? A comprehensive study on the aerobic and anaerobic composting of green waste under mesophilic and thermophilic conditions. Anand et al, 2012. *IJRTST*, 5, 1, 09-15.
3. Evaluating toxicity of immature compost maturity. Zucconi et al 1981. *Biocycle* 22, 54–57.
4. Analysis and Measurement in Papermaking Industry. Liu, S., 2004. Chem.Ind. Press, Beijing, China.
5. Characterisation of Bulk Solids. Mcglinchey, D., 2005. CRC Press, p. 231.
6. Compost – A Guide for Evaluating and Using Compost Materials as Soil Amendments. Darlington, W., 2001. Soil & Plant Laboratory, Inc., Orange Office (714) 282-8777.
7. Organic matter fraction involved in degradation and humification processes during composting. Garcia-Gomez, et al, 2005. *Compost. Sci. Utiliz.* 13, 127–135.
8. Measurement of Cellulase Activities. Laboratory Analytical Procedure 006. Adney, B., Baker, J., 1996
9. US Department of Agriculture and US Composting Council, 2001. Test Methods for the Examination of Composting and Compost, Edaphos International, Houston.
10. Assisment of bioenergy potential of agricultural waste: A case study cum template, Gabhane et al. 2016 *J. Biofuel & Bioenergy* ; 2:122-131, DOI: 10.5958/2454-8618.2016.000
11. Additive aided composting of green waste: Effects on organic matter degradation, compost maturity and quality of finished product. Gabhane et al 2012, *Bioresor tech.*;114:382-388

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FACULTY OF SCIENCE AND TECHNOLOGY

Syllabus for the T.Y.B.Sc.

Program: B.Sc.

Course: Biochemistry

SEMESTER VI

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2019–2020

GONDWANA UNIVERSITY, GADCHIROLI

CHOICE BASED CREDIT SYSTEM

T.Y.B.Sc.

BIOCHEMISTRY

(SEMESTER VI)

(With effect from academic session 2019-20)

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						External (U.A.)					
VI	XIII	DSE-I	USBCDST-13	Bioenergetics and Metabolism of Amino Acids and Nucleotides	6	50	10	60	2	150	
	XIV	DSE-II	USBCDST-14	Protein Synthesis and Recombinant DNA Technology	6	50	10	60	2		
	XV	DSE-III	USBCDST-15	Advanced Cell Biology	6	50	10	60	2		
	XVI	DSE-IV	USBCDST-16	Biostatistics and Research Methodology	6	50	10	60	2		
	Practical	DSE-09	USBCDSP-09	DSE Practical (Concerning with selected DSE theory papers). Any two Practical courses from DSE-9,DSE-10,DSE-11,DSE-12	6	30	-	30	2		
		DSE-10	USBCDSP-10								
		DSE-11	USBCDSP-11								
		DSE-12	USBCDSP-12								
	paper no.	SEC	Paper code	Skill enhancement course (Any one) (College level)		Credit	Theory	Exercise	Total	Credits	Total Mark
	III	SEC III	USBCSEC-03	Clinical Biochemistry		2	15	35	50	2	50
IV	SEC IV	USBCSEC-04	Research Project to Enhanced Laboratory Skill and Research Aptitude		2	15	35	50	2		

SEM VI:

Discipline Specific Elective (Ant two)

1. Bioenergetics and Metabolism of Amino Acids and Nucleotides
2. Protein Synthesis and Recombinant DNA Technology
3. Advanced Cell Biology
4. Biostatistics and Research Methodology

Skill Enhancement Course:

(Any one)

SEC-1:

Clinical Biochemistry

SEC-2:

Research Project to Enhanced Laboratory Skill and Research Aptitude

Internal Assessment for DSE Theory Paper:

S.No	Type of Evaluation	Marks	
		Paper I	Paper II
1	One class test	05	05
2	Active participation in routine class activities/seminars etc.	03	03
3	One assignment	02	02
	Total	10	10

Distribution of Marks in DSE Practical Examination:

S.No	External assessment	Marks
1	Experimental work(One experiment each from the selected DSE papers)	20
2	Practical record	05
3	Viva-voce	05
	Total	30

**B. Sc. Part III (CBCS)
SEMESTER VI
DSE – I**

**USBCDST-13: BIOENERGETICS AND METABOLISM OF AMINO ACIDS
AND NUCLEOTIDES**

CREDITS: 2

UNIT 1 Introduction to Bioenergetics

- A) Laws of thermodynamics, equilibrium constant, Concept of free energy, Entropy, Enthalpy and Redox Potential. Determination of $\Delta G^{0'}$ for a reaction.
- B) High energy phosphate compounds (Ex.ATP, Phosphoenol pyruvate, Creatine phosphate etc.) and other phosphorylated compounds and thioesters.
- C) Phosphorylation potential, phosphoryl group transfers. Free energy of hydrolysis of ATP, Chemical basis of high standard energy of hydrolysis of ATP.
- D) ATP-ADP Cycle, Energy charge (Phosphate potential) and its relation to metabolic regulation.

UNIT 2 - Techniques employed in metabolic studies

- A) Intermediary metabolism in vivo studies such as analysis of excretion, Respiratory exchange.
- B) Removal of organs and perfusion studies, in vitro studies such as tissue slice techniques.
- C) Homogenates and purified enzyme systems; isotope tracer studies.
- D) Use of inhibitors and anti metabolites.

UNIT 3 - Protein Metabolism

- A) Transamination, Oxidative and Non-oxidative deamination.
- B) Transport of ammonia (Glutamine, Alanine).
- C) Urea cycle – Detailed account, regulation, Krebs's bicycle, inherited defects of urea cycle, treatment of disorder of urea cycle.
- D) Transmethylation and Decarboxylation, Metabolism of phenylalanine, Glycogenic and ketogenic amino acids.

UNIT 4 - Nucleic acid metabolism

- A) *De novo* synthesis of purine and pyrimidine nucleotides, regulation and salvage pathways.
- B) Catabolism of purine and pyrimidine nucleotides.
- C) Disorders of purine and pyrimidine metabolism – Lesch-Nyhan syndrome, Gout, SCID, adenosine deaminase deficiency.
- D) Biosynthesis of deoxyribonucleotides and its regulation, conversion to triphosphates,

DSE-9: PRACTICAL

USBCDSP-09: BIOENERGETICS AND METABOLISM OF AMINO ACIDS AND NUCLEOTIDES

CREDITS: 1

1. Assay of serum transaminases – SGOT and SGPT.
2. Estimation of serum uric acid.
3. Estimation of serum creatinine.
4. Estimation of protein by Bradford method.
5. Colorimetric estimation of inorganic phosphate in serum by Fiske-Subbarow method.
6. Determination of creatine & creatinine in urine.
7. Determination of serum acetylcholine esterase.
8. Screening test for glucose-6-phosphate dehydrogenase in RBCs.
9. Determination of serum pyruvate kinase.
10. Isolation of RNA from yeast
11. Determination of urinary ammonia
(Mandatory to perform at least 4 practical)

SUGGESTED READINGS

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13:978-1-4641-0962-1/ISBN:10:1-4641-0962-1.
2. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN 978-0-470-28173-4/BRV ISBN:978-0-470-60152-5.
3. Harper's Biochemistry – Murray, Granner, Mayes, Rodwell – Prentice Hall International Inc.
4. Biochemistry – Stryer – W. H. Freeman & Co. New York.
5. Biochemistry – Geoffrey L. Zubay – McGraw Hill.
6. Biochemistry – J. David Rawn – Neil Patterson publs. NC.
- 7) Textbook of Biochemistry– West, Todd, Mason, Bruggen – Amerind Publishing Co. Pvt. Ltd.

**B. Sc. Part III (CBCS)
SEMESTER VI
DSE – II**

**USBCDST-14: PROTEIN SYNTHESIS AND RECOMBINANT DNA
TECHNOLOGY**

CREDITS: 2

UNIT –1: *Translation*

- A) Initiation of protein synthesis (Formation of pre Initiation complex, Ribosome structure)
- B) Elongation & Termination of protein synthesis (A and P sites, charged tRNA, f met tRNA, initiator codon, formation of 70S initiation complex)
- C) Role of EF-Tu, EF-Ts, EF-G, and GTP. Release factors RF1 and RF2.
- D) Post translational modification

UNIT 2: *Regulation of gene expression in prokaryotes*

- A) Principles of gene regulation, negative and positive regulation.
- B) Concept of operons, regulatory proteins, activators, repressors, DNA binding domains.
- C) Regulation of lac operon and trp operon.
- D) Regulation by genetic recombination, transcriptional regulation in λ bacteriophage.

UNIT 3: *Basic Introduction to rDNA Technology*

- A) **Introduction to recombinant DNA technology:** Overview of recombinant DNA technology
- B) **Restriction endonucleases:** Restriction-modification system, types of restriction enzymes, sticky and blunt ends.
- C) **Joining DNA molecules:** joining blunt ended molecules, homopolymer tail joining, joining cohesive ends, use of T4 DNA ligase, use of linkers and adaptors.
- D) **Vectors:** Plasmids – Characteristics of an Ideal Vector, Types of plasmids: pBR322 and pUC18. Lambda insertion and replacement vectors, cosmids, phagemids, Ti-plasmid. Concept of expression vectors. Features of expression vectors necessary for expression of heterologous genes. Shuttle vectors.

UNIT –4: *Tools and applications of rDNA Technology*

- A) **Methods of transformation/transfection:** Calcium-phosphate precipitation, Electroporation,
- B) **Selection:** selection by the use of antibiotic resistance, blue-white screening.
- C) **Screening methods:** functional cloning or complementation, southern and northern blotting, colony lift screening, western blotting, immunological methods, screening through protein activity.
- D) **Genomic and cDNA libraries:** Method of generating genomic and cDNA library, comparison between the two types of libraries, Advantages and disadvantages of cDNA library.
- E) **Polymerase chain reaction:** Detailed procedure of PCR, important considerations for primer designing, salient applications of PCR.
- F) **Applications of recombinant DNA technology:** Brief idea about recombinant DNA products in medicine (insulin, hGH), Recombinant vaccines, Gene therapy, DNA fingerprinting, Bt cotton, herbicide resistance.

DSE-10: PRACTICAL

USBCDSP-10: PROTEIN SYNTHESIS AND RECOMBINANT DNA TECHNOLOGY

CREDIT: 1

- 1) Estimation of serum urea by diacetyl monoxime method.
 - 2) Assay of activity of serum acid and alkaline phosphatase.
 - 3) Inhibition of alkaline phosphatase activity by EDTA.
 - 4) Assay of activity of papain.
 - 5) Determination of serum isocitrate dehydrogenase.
 - 6) Demonstration of isolation of plasmid by alkaline lysis method.
 - 7) Demonstration of isolation of genomic DNA.
 - 8) Demonstration of Southern / western blotting.
 - 9) Demonstration of replica plating technique.
 - 10) Demonstration of restriction digestion
 - 11) Identification of Lac⁺ bacteria by blue white screening using IPTG
 - 12) To study the viscosity of DNA solutions.
 - 13) Isolation of chromosomal DNA from *E. coli*.
- (Mandatory to perform at least 4 practical)

Suggested reading

1. Biochemistry – Lehninger – CBS Publishers.
2. Biochemistry – Stryer – W. H. Freeman & Co. New York.
3. Biochemistry – Geoffrey L. Zubay – McGraw Hill.
4. Biochemistry – J. David Rawn – Neil Patterson publs. NC.
5. Textbook of Biochemistry– West, Todd, Mason, Bruggen – Amerind Publishing Co. Pvt. Ltd.
6. Mol Bio (Fundamentals of mol.biology) – Upadhyay & Upadhyay, Himalaya Publishing House.
7. Molecular Biology – David Friefelder – Narosa Publishing House, New Delhi.
8. Cell Biology, Genetics, Molecular Biology, Evolution & Ecology – Verma, Agarwal – S. Chand & Co.
9. Molecular & Cell Biology – Bhamrah – Anmol Publ. Pvt. Ltd., New Delhi.
10. Molecular Biology of the Cell – Alberts, Bray, Lewis, Raff, Roberts, Watson – Garland Publishers, New York.
11. Molecular Biology of the gene – J. D. Watson, NH Hopkins, Roberts, Stertz, Weiner- Freeman.
12. Concepts in Biotechnology – Editors- Balasubramanian, Bryee, Dharmalingam, Green, Jayraman – Sangam Books.
13. Molecular Biology of the Gene – Watson, Hopkins, Roberts, Steitz, Weiner – Benjamin Cummings Publishing Co.
14. Molecular Cell Biology – Baltimore, Zipursky, Matsudaria, Darnel – W. H. Freeman & Co., New York.

**B. Sc. Part III (CBCS)
SEMESTER VI
DSE – III**

USBCDST-15: ADVANCED CELL BIOLOGY

CREDITS: 2

UNIT 1: *Plasma Membrane and Nuclear Transport*

- A) Properties and Composition of Cell Membrane; Structure of Nuclear Envelope;
- B) Transport and Regulation of Nuclear Protein Import and Export.
- C) Cell-Cell Interactions and Cell-Matrix Interactions
- D) Tight Junctions; Gap Junctions; Desmosomes.

UNIT 2 *Cell Cycle and Programmed Cell Death*

- A) Overview of The Cell Cycle; Eukaryotic Cell Cycle
- B) Regulation Of Cell Division And Cell Growth;
- C) Apoptosis And Necrosis, Stem Cells And Maintenance of Adult Tissues,
- D) Hematopoiesis, Embryonic Stem Cells and Therapeutic Cloning.

UNIT 3 *Cancer Biology*

- A) Development and causes Of Cancer
- B) Genetic Basis of Cancer
- C) Oncogenes and Tumor Viruses
- D) Molecular Approach to Cancer Treatment.

UNIT 4 *Advanced Methods in Cell Biology*

- A) Separation and characterization of cells by Ultracentrifugation
- B) Advanced Microscopy- Fluorescence Microscopy- FACS, Confocal Microscopy, Electron Microscopy
- C) Plant and Animal Cell Culture
- D) Immunohistochemistry.

DSE-11: PRACTICAL

USBCDSP-11: ADVANCED CELL BIOLOGY

CREDITS: 1

1. Isolation of organelles by sub-cellular fractionation.
2. Study of cell viability /death assay by use of trypan blue and MTT assay.
3. Study of apoptosis through analysis of DNA fragmentation patterns in mitochondria.
4. Identification and study of cancerous cells using permanent slides and photomicrographs.
5. Demonstration of Ames test for carcinogenesis
6. Demonstration of scanning electron microscopic study of *E.Coli*
(Mandatory to perform at least 4 practical)

SUGGESTED READINGS

1. Cooper, G.M. and Hausman, R.E. 2009 The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
2. Karp, G. 2010 Cell and Molecular Biology: Concepts and Experiments. 6 edition. John Wiley & Sons. Inc.
3. Alberts, B., Johnson, A., Lewis, J., and Enlarge, M. 2008 Molecular Biology of the Cell. 47 5th ed., Garland Science (Princeton)
4. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J. 2012. Molecular Cell Biology. 7th ed., W.H. Freeman & Company (New York),
5. Becker, W.M., Kleinsmith, L.J., Hardin, J. and Bertoni, G. P. 2009 The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francis

B. Sc. Part III (CBCS) SEMESTER VI DSE – IV

USBCDST-16: BIOSTATISTICS AND RESEARCH METHODOLOGY

CREDITS: 2

UNIT 1: *Statistical terms, Notation and classification of data*

- a) Statistical terms- population, sample, Variables, parameter, statistics, observation, Data etc.
- b) Statistical studies- collection and presentation of data, preparation of frequency distribution table,
- c) Graphical representation of Biometric data (Histogram, Frequency curve, Scatter, diagram, bar diagram, pie diagram etc.

UNIT 2: a) *Measure of central tendency:*

Mathematical averages (mean, mode, median)

- b) Measures of dispersion:** Range, Deviation (quartile deviation, mean deviation, standard deviation).
- c) Variation:** Variance, Standard errors.

UNIT 3: *The chi-square test*

- a) Probabilty
- b) Correlation
- c) Regression.

UNIT 4: *Research methodology and article preparation*

- a) Search problem, study background of problem
- b) Preparation of planning to solve problem according to lacuna of previous research
- c) As per plan of work conduction of experiment with several replicate, importance of replicate.
- d) Data compilation and validation through various test
- e) Data documentation (preparation of manuscript) as per journals requirement
- f) Manuscript communication

DSE-12: PRACTICAL

USBCDSP-12: BIostatISTICS AND RESEARCH METHODOLOGY

CREDIT: 1

1. Preparation of histogram frequency Polygram from given case study
2. Preparation of cumulative frequency curve and pie diagram from given case study
3. Calculation of arithmetic mean and geometric mean from given case study
4. Calculation of mean and mode from given case study
5. Calculation of standard deviation from given case study
6. Calculation of standard error and plotting on a frequency graph from given case study
7. Validation of Chi-Square Test
8. Calculation of probability from given example of card
9. Calculation of correlation from given case study
(Mandatory to perform at least 4 practical)

SUGGESTED READINGS

1. Research in Education (1992) 6th ed., Best, J.W. and Kahn, J.V., Prentice Hall of India Pvt. Ltd.
2. At the Bench: A Laboratory Navigator (2005) Barker, K., Cold Spring Harbor Laboratory Press (New York), ISBN: 978-087969708-2.51
3. Research Methodology - Methods and Techniques (2004) 2nd ed., Kothari C.R., New Age International Publishers.
4. Research Methodology: A Step by Step Guide for Beginners (2005) 2nd ed., Kumar R., Pearson Education.
5. Biostatistics: A Foundation for Analysis in the Health Sciences (2009) 9th ed., Daniel W.W., John Wiley and Sons Inc.
6. Statistics at the Bench: A Step-by-Step Handbook for Biologists (2010) Bremer, M. and Doerge, R.W., Cold Spring Harbor Laboratory Press (New York), ISBN: 978-0-879698-57-7.

CHOICE BASED CREDIT SYSTEM
T.Y.B.Sc.
BIOCHEMISTRY
SKILL ENHANCEMENT COURSE

SEMESTER V

SEC-3

USBCSEC-03: CLINICAL BIOCHEMISTRY

TOTAL HOURS: 30

CREDITS: 2

UNIT 1 *Introduction*

Organization of clinical laboratory, Introduction to instrumentation and automation in clinical biochemistry laboratories safety regulations and first aid. General comments on specimen collection, types of specimen for biochemical analysis. Precision, accuracy, quality control, precautions and limitations.

UNIT 2 *Assessment of glucose metabolism in blood*

Clinical significance of variations in blood glucose. Diabetes mellitus.

UNIT 3 *Lipid profile*

Composition and functions of lipoproteins. Clinical significance of elevated lipoprotein.

UNIT 4 *Liver function tests and kidney function test*

Liver function tests- conjugated and total bilirubin in serum, albumin: globulin ratio, hippuric acid and bromsulphthalein tests. Renal function tests- creatinine and urea clearance tests, phenol red test.

Exercise

1. Estimation of bilirubin (direct and indirect).
2. Quantitative determination of serum creatinine and urea.
3. Estimation of creatine kinase MB.
4. Collection of blood and storage.
5. Separation and storage of serum.
6. Estimation of triglycerides.

SUGGESTED READINGS

1. Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests Vol. I (2010), Mukherjee, K.L., Tata Mc Graw–Hill Publishing Company Limited (New Delhi). ISBN:9780070076594 / ISBN:9780070076631
2. Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests Vol. II (2010), Mukherjee, K.L., Tata Mc Graw – Hill Publishing Company Ltd. (New Delhi), ISBN: 9780070076648.
3. Medical Biochemistry (2005) 2nd ed., Baynes, J.W. and Dominicczak, M.H., Elsevier Mosby Ltd. (Philadelphia), ISBN:0-7234-3341-0.
4. Experimental Biochemistry: A Student Companion (2005) Rao, B.S. and Deshpande, V., IK International Pvt. Ltd. (New Delhi), ISBN:81-88237-41-8.

**B. Sc. Part III
Semester VI**

SEC-4

**USBCSEC-04: RESEARCH PROJECT TO ENHANCED LABORATORY
SKILL AND RESEARCH APTITUDE**

TOTAL HOURS: 30

CREDITS: 2

UNIT 1: This course would focus on the project work / dissertation to be carried out by the students in the supervision of the teachers in the colleges. The topic of the project would be selected by the student in consultation with the teacher (Advisor) in the view of various problem associated with community.

UNIT 2: Literature survey to study background of problem and making plan of work

UNIT 3: Experimental work conducted in college laboratory or research institution nearby college.

UNIT 4: Compilation of data, preparation of presentation and construction of article.

Exercise: Power point presentation and submission of report