Government of Karnataka

NATIONAL EDUCATION POLICY-2020

CURRICULUM CONTENTS
IN
BIOTECHNOLOGY
2022-23

Undergraduate Course B.Sc.,
(Basic/Honors)
3rd and 4th Semester

Davangere University
Shivagangothri
Davangere-577007

ಅಧ್ಯಕ್ಷರು 31/08/23
ಅಧ್ಯಯನ ಮಂಡಳಿ
ಜೈವಿಕ ತಂತ್ರಜ್ಞಾನ ಅಧ್ಯಯನ ವಿಭಾಗ
ದಾವಣಗೆರೆ ವಿಶ್ವವಿದ್ಯಾನಿಲಯ
ಶಿವಗಂಗೋತ್ರಿ, ದಾವಣಗೆರೆ-577007

PREAMBLE

The role of education is paramount in nation building. One of the major objectives of UGC is maintenance of standards of higher education. Over the past decades the higher education system of our country has undergone substantial structural and functional changes resulting in both quantitative and qualitative development of the beneficiaries. Such changes have gained momentum with the introduction of Choice Based Credit System (CBCS) which further expects Learning Outcome-Based curriculum to maximize the benefits of the newly designed curriculum. The Learning Outcome- Based Curriculum in Biotechnology will help the teachers of the discipline to visualize the curriculum more specifically in terms of the learning outcomes expected from the students at the end of the instructional process. The commission strives to promote the link of students with the society/industry such that majority of the students engage in socially productive activities during their period of study in the institutions and at least half of the graduate students will secure access to employment/self-employment or engage themselves in pursuit of higher education. The model curriculum envisages to cater to the developmental trends in higher education, incorporating multi- disciplinary skills, professional and soft skills such as teamwork, communication skills, leadership skills, time management skills and inculcate human values, professional ethics, and the spirit of Innovation / entrepreneurship and critical thinking among students and promote avenues for display of these talents, linking general studies with professional courses. Besides imparting disciplinary knowledge to the learners, curriculum should aim to equip the students with competencies like problem solving, analytical reasoning and moral and ethical awareness. Introduction of internship and appropriate fieldwork/case studies are embedded in the curriculum for providing wider exposure to the students and enhancing their employability.

Learning outcomes specify what exactly the graduates are expected to know after completing a program of study. The expected learning outcomes are used as reference points to help formulate graduate attributes, qualification descriptors, program learning outcomes and course learning outcomes. Keeping the above objectives of higher education in mind the Learning Outcome-Based Curriculum Framework (LOCF) for the discipline of Biotechnology has been prepared and presented here.

Government of Karnataka

Model Curriculum

Program Name	**B.Sc. Discipline**	Total Credits for the Program	**176**
Core	**Biotechnology**	Starting year of implementation	**2021-22**

Program Outcomes: At the end of the program the student should be able to:

(Refer to literature on outcome-based education (OBE) for details on Program Outcomes)

PO1. Understanding concepts of Biotechnology and demonstrate interdisciplinary skills acquired in cell biology, genetics, biochemistry, microbiology, and molecular biology

PO2. Demonstrating the Laboratory skills in cell biology, basic and applied microbiology with an emphasis on technological aspects

PO3. Competent to apply the knowledge and skills gained in the fields of Plant biotechnology, animal biotechnology and microbial technology in pharma, food, agriculture, beverages, herbal and nutraceutical industries.

PO4. Critically analyse the environmental issues and apply the biotechnology knowledge gained for conserving the environment and resolving the problems.

PO5. Demonstrate comprehensive innovations and skills in the fields of biomolecules, cell and organelles, molecular biology, bioprocess engineering and genetic engineering of plants, microbes, and animals with respect to applications for human welfare.

PO6. Apply knowledge and skills of immunology, bioinformatics, computational modelling of proteins, drug design and simulations to test the models and aid in drug discovery.

PO7. Critically analyse, interpret data, and apply tools of bioinformatics and multi omics in various sectors of biotechnology including health and Food.

PO8. Demonstrate communication skills, scientific writing, data collection and interpretation abilities in all the fields of biotechnology.

PO9. Learning and practicing professional skills in handling microbes, animals and plants and demonstrate the ability to identify ethical issues related to recombinant DNA technology, genetic engineering, animals handling, intellectual property rights, biosafety, and biohazards.

PO10. Exploring the biotechnological practices and demonstrating innovative thinking in addressing the current day and future challenges with respect to food, health, and environment.

PO11. Thorough knowledge and application of good laboratory and good manufacturing practices in biotech industries.

PO12. Understanding and application of molecular biology techniques and principles in forensic and clinical biotechnology.

PO13. Demonstrate entrepreneurship abilities, innovative thinking, planning, and setting up small-scale enterprises or CROs.

Assessment:

Weightage for assessments (in percentage)

Type of Course	Formative Assessment / IA	Summative Assessment
Theory	40	60
Practical	25	25
Projects	-	-
Experiential Learning (Internships etc.)	-	-

Contents of Courses for B.Sc. Biotechnology as Major

Model II A

Semester	Course code	Course Category	Theory/Practical	Credits	Paper Title	Marks	
						S.A	I.A
3.	**BTC: 103**	DSC- 3	Theory	4	Biomolecules	60	40
			Practical	2	Biomolecules	25	25
		OE- 3	Theory	3	Nutrition and Health	60	40
4.	**BTC:104**	DSC- 4	Theory	4	Molecular Biology	60	40
			Practical	2	Molecular Biology	25	25
		OE- 4	Theory	3	Intellectual Property Rights	60	40

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Shivagangotri, Davangere

BSc Biotechnology (Basic/Hons.)
Semester-3
Title of the course3:DSC1T, BTC103,
Biomolecules

Program Name	**BSc Biotechnology**		Semester	**Third Sem**
Course Title	**Biomolecules**			
Course No.	**BTC: 103**	**DSC -3T**	No. of Theory Credits	**4**
Contact hours	**60 hrs**		Duration of ESA/Exam	**2 Hours**
Formative Assessment Marks	**40**		Summative Assessment Marks	**60**

Course Pre-requisite (s):	
Course Outcomes (COs): At the end of the course the student should be able to: 1. Acquire knowledge about types of biomolecules, structure, and their functions 2. Will be able to demonstrate the skills to perform bioanalytical techniques 3. Apply comprehensive innovations and skills of biomolecules to biotechnology field	
Content of course:3 DSC1T,BTC103,Biomolecules	**Hrs 60**
Unit–I	**15**
a) Introduction Biomolecules,water,acid,base,P^H,buffer **b) Carbohydrates**-sources, classification of carbohydrates. Structure function and properties of carbohydrates. Monosaccharides – Isomerism and ring structure, Sugar derivatives – amino sugars. Disaccharides – Sucrose and Fructose Polysaccharides – Classification as homo and heteropolysaccharides, Homopolysaccharides - storage polysaccharides (starch and glycogen- structure, function properties), structural polysaccharides (cellulose and chitin-structure, properties),Heteropolysaccharides - glycoproteins and proteoglycans (Brief study). Metabolism:Glycolysis and gluconeogenesis, Kreb's cycle, oxidative phosphorylation. **c) Amino Acids, Peptides and Proteins** Introduction, classification and structure of amino acids. Concept of – Zwitterion, isoelectric point, pK values. Essential and nonessential amino acids. Peptide bond and peptides-Vasopressin, Oxytocin, .Classification of proteins based on structure and function, Structural organization of proteins [primary, secondary (α, β), tertiary and quaternary]. Fibrous and globular proteins, Denaturation and renaturation of proteins. General aspects of amino acid metabolism: Transamination, deamination, decarboxylation and urea cycle.	

Unit -II a) Lipids Classification and function of lipids, properties (saponification value, acid value, iodine number, rancidity), Hydrogenation of fats and oils Saturated and unsaturated fatty acids. General structure and biological functions of - phospholipids, sphingolipids, glycolipids, lipoproteins, prostaglandins, cholesterol, ergosterol. Metabolism: Beta oxidation of fatty acids. Brief account on cholesterol. **b)Nucleic acids** Structures of purines and pyrimidines, nucleosides, nucleotides in DNA Denovo and salvage pathway of purine and pyrimidine synthesis. **c)Hormones** Classification of hormones based on chemical nature and mechanism of action. Chemical structure and functions of the following hormones: Glucagon, Cortisone, Epinephrine, Testosterone and Estradiol.	**15**
Unit -III –a) Vitamins Water and fat soluble vitamins, dietary source and biological role of vitamins Deficiency manifestation of vitamin A, B, C, D, E and K b) **Enzymes** Introduction, nomenclature and classification, enzyme kinetics-M.M.equation, L.B. plot, factors influencing enzyme activity, metalloenzymes, activation energy and transition state, enzyme activity, specific activity. Coenzymes and their functions (one reaction involving FMN, FAD, NAD). Enzyme inhibition- Irreversible and reversible (competitive, non-competitive and uncompetitive inhibitionwith an example each) Zymogens (trypsinogen, chymotrypsinogen and pepsinogen), Isozymes (LDH, Creatine kinase, Alkaline phosphatase and their clinical significance).	**15**
Unit –IV - Bioanalytical tools : **a) Chromatography :** Principle, procedure and applications of - paper chromatography, thin layer chromatography, adsorption chromatography, ion exchange chromatography, gel filtration chromatography, affinity chromatography, gas liquid chromatography and high performance liquid chromatography. **b) Electrophoresis:** Principle, procedure and applications of electrophoresis (paper electrophoresis, gel electrophoresis -PAGE, SDS- PAGE & agarose electrophoresis) and isoelectric focusing. **c) Spectroscopy:** Introduction, principle, procedure and applications UV-Vis spectrophotometry; mass spectroscopy-LC-MS, atomic absorption spectroscopy.	**15**

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-12)

Course Outcomes (COs) / Program Outcomes (POs)	Program Outcomes (POs)												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Acquire knowledge about types of biomolecules, structure, and their functions	✓				✓							✓	
Will be able to demonstrate the skills to perform bioanalytical techniques			✓								✓	✓	
Apply comprehensive innovations and skills of biomolecules to biotechnology field	✓				✓							✓	

Pedagogy: Lectures, Seminars, Industry Visits, Debates, Quiz and Assignments

Summative Assessment = 60 Marks	
Formative Assessment Occasion / type	Weightage in Marks
Attendance	10
Seminar	10
Debates and Quiz	10
Test	10
Total	60 marks + 40 marks = 100 marks

Course Title	**Biomolecules**		Practical Credits	**2**
Course No.	**BTC:103**	**DSC-3P**		

Content

1. Introduction to basic instruments (Principle, standard operating procedure) with demonstration. Micropipette, PH meter, colorimeter, UV-transilluminator, centrifuge, labeling reagent bottles,reading and precautions.
2. Definitions and calculations:Molarity, Molality, Normality, Mass percent % (w/w), Percent byvolume (% v/v), parts per million (ppm), parts per billion (ppb), Dilution of concentrated solutions. Standard solutions, stock solution, solution of acids.
3. Preparation of standard buffers by Hendersen-Hasselbach equation – Acetate, phosphate,Tris and determination of pH of solution using pH meter.
4. Estimation of maltose by DNS method
5. Determination of α-amylase activity by DNS method
6. Estimation of proteins by Bradford method.
7. Estimation of amino acid by Ninhydrin method
8. Extraction of protein from soaked/sprouted green gram by salting out method
9. Separation of plant pigments by TLC/Paper chromatography
10. Separation of amino acids by circular paper chromatography
11. Native PAGE
12. Determination of iodine number of lipids

Practical assessment

Assessment				
Formative assessment		**Summative Assessment**		**Total Marks**
Assessment Occasion / type	**Weightage in Marks**	**Practical Exam**	Marks	
Record	5	Major expt.	10	**50**
Test	10	Minor expt.	06	
Attendance	5	Spotters	05	
Performance	5	viva-voce	04	
Total	**25**	**25**		

References

1	An Introduction to Practical Biochemistry, 3rd Edition, (2001), David Plummer; Tata McGraw Hill Edu.Pvt.Ltd. New Delhi, India
2	Biochemical Methods,1st Edition, (1995), S.Sadashivam, A.Manickam; New Age International Publishers, India
3	Introductory Practical biochemistry, S. K. Sawhney&Randhir Singh (eds) Narosa Publishing. House, New Delhi, ISBN 81-7319-302-9
4	Experimental Biochemistry: A Student Companion, BeeduSasidharRao& Vijay Despande(ed).I.K International Pvt. LTD, NewDelhi. ISBN 81-88237-41-8
5	Standard Methods of Biochemical Analysis, S. K. Thimmaiah (ed), Kalyani Publishers, Ludhiana ISBN 81-7663-067

Course: 2 Open Elective Theory: OE3,BTC301,- Nutrition and Health

Program Name	**BSc Biotechnology**		Semester	**Third Sem**
Course Title	**Nutrition and Health**			
Course Code		**OE-3**	No. of Theory Credits	**3**
Contact hours	**Lecture**	**45**	D uration of ESA/Exam	**2 Hours**
	Practical	-		
Formative Assessment Marks		**40**	Summative Assessment Marks	**60**

Course Pre-requisite(s):

Course Outcomes (COs): At the end of the course the student should be able to:

1. Study the concepts of food, nutrition, diet and health
2. To apply the best practices of food intake and dietary requirements
3. Acquire knowledge about various sources of nutrients and good cooking practices

Content	**Hrs 45**
Unit–I - Introduction	**15**
- Concepts of nutrition and health. Definition of Food, Diet and nutrition, Food groups. Food pyramids. Functions of food. Balanced diet. Meal planning. Eat right concept. - Functional foods, Prebiotics, Probiotics, and antioxidants	
Unit -II - Nutrients	**15**
- Macro and Micronutrients - Sources, functions and deficiency. Carbohydrates, Proteins, Fats: Sources and calories. Minerals –Calcium, Iron, Iodine. - Vitamins – Fat soluble vitamins –A, D, E & K. Water soluble vitamins – vitamin C Thiamine, Riboflavin, Niacin. Water–Functions and water balance. Fibre –Functions and sources. Recommended Dietary Allowance, Body Mass Index and Basal Metabolic Rate.	
Unit -III – Nutrition and Health	**15**
- Methods of cooking affecting nutritional value. Advantages and disadvantages. Boiling, steaming, pressure cooking. Oil/Fat – Shallow frying, deep frying. Baking. Nutrition through lifecycle. Nutritional requirement, dietary guidelines: Adulthood, Pregnancy, Lactation, Infancy- Complementary feeding, Pre-school, Adolescence, geriatric. - Nutrition related metabolic disorders- diabetes and cardiovascular disease.	

Pedagogy: Lectures, Seminars, Industry Visits, Debates, Quiz and Assignments

Summative Assessment = 60 Marks	
Formative Assessment Occasion / type	Weightage in Marks
Attendance	10
Seminar	10
Debates and Quiz	10
Test	10
Total	60 marks + 40 marks = 100 marks

References

1	Sri Lakshmi B, (2007), Dietetics. New Age International publishers. New Delhi
2	Sri Lakshmi B, (2002), Nutrition Science. New Age International publishers. New Delhi
3	Swaminathan M. (2002), Advanced text book on food and Nutrition. Volume I. Bappco
4	Gopalan.C., RamaSastry B.V., and S.C.Balasubramanian (2009), Nutritive value of Indian Foods.NIN.ICMR.Hyderabad.
5	Mudambi S R and Rajagopal M V, (2008), Fundamentals of Foods, Nutrition & diet therapy by New Age International Publishers, New Delhi

BSc Biotechnology (Basic/Hons.)
Semester-4
Title of the course4:DSC1T, BTC104,
Molecular Biology

Program Name	**BSc Biotechnology**		Semester	**Fourth Sem**
Course Title	**Molecular Biology**			
Course No.	**BTC: 104**	**DSC -4T**	No. of Theory Credits	**4**
Contact hours	**60 hrs**		Duration of ESA/Exam	**2 Hours**
Formative Assessment Marks	40		Summative Assessment Marks	60

Course Pre-requisite (s):

Course Outcomes (COs): At the end of the course the student should be able to:
1. Study the advancements in molecular biology with latest trends.
2. Will acquire the knowledge of structure, functional relationship of proteins and nucleic acids.
3. Aware about the basic cellular processes such as transcription, translation, DNA replication and repair mechanisms.

Content	Hrs 60
Unit–I - Molecular basis of life and Nucleic Acids a) **Molecular basis of life:** An introduction to genome and its organization, b) **Nucleic acids:** RNA and experimental proof of DNA as genetic material and types of DNA. Structure and functions of DNA and RNA, Watson and Crick model of DNA and other forms of DNA (A and Z) functions of DNA and RNA including ribozymes.	15
Unit -II - DNA Replication and Repair a) **DNA Replication:** Replication of DNA in prokaryotes and eukaryote– Enzymes and proteins involved in replication, Theta model, linear and rolling circle model. Polymerases and all enzyme components. The replication complex: Pre-primming proteins, primosome, replisome, unique aspects of eukaryotic chromosome replication, b) **Repair**: Fidelity of replication DNA damage and Repair mechanism: photo reactivation, excision repair, mismatch repair and SOS repair, Recombination – Homologus and non homologus .	15
Unit -III - Transcription and RNA processing a) **Transcription:** Central dogma, RNA structure and types of RNA, Transcription in prokaryotes RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains. Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation b) **RNA processing:** RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA , splicing, RNA editing.	15
Unit –IV - Regulation of gene expression and translation a) **Gene regulation:** in prokaryotes- Operon concept, Lac, Trp operon. b) **Translation:** Genetic code and its characteristics, Wobble hypothesis Translation- in prokaryotes and eukaryotes- ribosome, enzymes and factors involved in translation. Mechanism of translation- activation of amino acid, aminoacyl tRNA synthesis, Mechanism- initiation, elongation and termination of polypeptide chain. Fidelity of translation, Inhibitors of translation. Protein folding and modifications, Post translational modifications of proteins.	15

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-12)

Course Outcomes (COs) / Program Outcomes (POs)	Program Outcomes (POs)												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Study the advancements in molecular biology with latest trends	✓				✓							✓	
Will acquire the knowledge of structure, functional relationship of proteins and nucleic acids					✓	✓						✓	
Aware about the basic cellular processes such as transcription, translation, DNA replication and repair mechanisms	✓				✓				✓			✓	

Pedagogy: Lectures, Seminars, Industry Visits, Debates, Quiz and Assignments

Summative Assessment = 60 Marks	
Formative Assessment Occasion / type	Weightage in Marks
Attendance	10
Seminar	10
Debates and Quiz	10
Test	10
Total	60 marks + 40 marks = 100 marks

Course Title	**Molecular Biology**		Practical Credits	**2**
Course No.	**BTC: 104**	**DSC-4P**	Contact hours	
Content				
1. Preparation of DNA model 2. Estimation of DNA by DPA method 3. Estimation of RNA by Orcinol method 4. Extraction and partial purification of protein from plant source by Ammonium sulphate precipitation. 5. Dialysis. 6. Extraction and partial purification of protein from animal source by organic solvents. 7. Protein separation by SDS-Polyacrylamide Gel Electrophoresis (PAGE) 8. Charts on- Conjugation, Transformation and Transduction, DNA replication, Types of RNA 9. Study of Drosophila mutants.				

Practical assessment

Assessment				
Formative assessment		**Summative Assessment**		**Total Marks**
Assessment Occasion / type	**Weightage in Marks**	**Practical Exam**	**Marks**	
Record	5	Major expt.	10	**50**
Test	10	Minor expt.	06	
Attendance	5	Spotters	05	
Performance	5	Viva-voce	04	
Total	**25**	**25**		

References	
1	Glick, B.R and Pasternak J.J (1998) Molecular biotechnology, Principles and application of recombinant DNA, Washington D.C. ASM press
2	Howe. C. (1995) Gene cloning and manipulation, Cambridge University Press, USA
3	Lewin, B., Gene VI New York, Oxford University Press
4	Rigby, P.W.J. (1987) Genetic Engineering Academic Press Inc. Florida, USA
5	Sambrook et al (2000) Molecular cloning Volumes I, II & III, Cold spring Harbor Laboratory Press New York, USA
6	Walker J. M. and Ging old, E.B. (1983) Molecular Biology & Biotechnology (Indian Edition) Royal Society of Chemistry U.K
7	Karp. G (2002) Cell & Molecular Biology, 3rdEdition, John Wiley & Sons; I

Course: 2 Open Elective Theory: OE4,BTC302,- Intellectual Property Rights

Program Name	**BSc Biotechnology**		Semester	**Fourth Sem**
Course Title	**Intellectual Property Rights**			
Course Code		**OE-4**	No. of Theory Credits	**3**
Contact hours	**Lecture**	**45 Hrs**	Duration of ESA/Exam	**2 Hours**
	Practical	-		
Formative Assessment Marks	**40**		Summative Assessment Marks	**60**

Course Pre-requisite(s):

Course Outcomes (COs): At the end of the course the student should be able to:

1. Knowledge about need and scope of Intellectual property rights
2. Acquire knowledge about filing patents, process, and infringement
3. Knowledge about trademarks, industrial designs, and copyright

Content	Hrs45
Unit–I - Introduction to Intellectual property rights (IPR): -Genesis and scope. Types of Intellectual property rights - Patent, Trademarks, Copyright, Design, Trade secret, Geographical indicators, Plant variety protection. National and -International agencies – WIPO, World Trade Organization (WTO), Trade-Related Aspects of Intellectual Property Rights (TRIPS), General Agreement on Tariffs and Trade (GATT).	**15**
Unit -II - Patenting, process, and infringement -Basics of patents - Types of patents; Patentable and Non-Patentable inventions, Process and Product patent. Indian Patent Act 1970; Recent amendments; Patent Cooperation Treaty (PCT) and implications. Process of patenting. Types of patent applications: Provisional and complete specifications; Concept of "prior art", patent databases (USPTO, EPO, India). Financial assistance, schemes, and grants for patenting. -Patent infringement- Case studies on patents (Basmati rice, Turmeric, Neem)	**15**
Unit -III - Trademarks, Copy right and industrial Designs -Trademarks- types, Purpose and function of trademarks, trademark registration, Protection of trademark. Copy right- Fundamentals of copyright law, Originality of material, rights of reproduction, - industrial Designs: Protection, Kind of protection provided by industrial design.	**15**

Pedagogy

Summative assessment = 60 marks theory paper,	
Formative Assessment Occasion / type	Weightage in Marks
Assignment	10
Seminar	10
Case studies	10
Test	10
Total	60 Mraks + 40 marks = 100 Marks

References

1	Manish Arora. 2007. Universal's Guide to Patents Law (English) 4th Edition) -Publisher: Universal Law Publishing House
2	Kalyan C. Kankanala. 2012. Fundamentals of Intellectual Property. Asia Law House
3	Ganguli, P. 2001. Intellectual Property Rights: Unleashing the knowledge economy. New Delhi: Tata McGraw-Hill Pub
4	World trade organization - http://www.wto.org
5	World Intellectual Property organization – www.wipo.intOffice of the controller general of Patents, Design & Trademarks - www.ipindia.nic.in