

JSS Academy of Higher Education & Research

(Deemed to be University)

Re-Accredited "A+" Grade by NAAC

Sri Shivarathreeshwara Nagara Mysuru - 570015, Karnataka

Faculty of Life Sciences

Syllabus

B.Sc. BIOTECHNOLOGY
As Per National Education Policy 2020
Under the CBCS Pattern
Implementation Year 2021-22 onwards

BSc

Syllabus

B.Sc. Biotechnology As per NEP 2020

Under the CBCS Pattern



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B.Sc Biotechnology

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B.Sc. Biotechnology

Program Overview

Name of the Degree Program	: B.Sc., (Hons)
Discipline Core	: Biotechnology
Total Credits for the Program	: B.Sc., - 136 credits B.Sc., Hons. - 176credits

Year of implementation **2021-22**

Program Objectives

Biotechnology sector is one of the key sectors, which the Indian Government has been continuously promoting and is high on policy agenda of the Government of India. As Biotechnology is one of the sectors expected to contribute significantly to Make in India, Skill India, and Startup India sectors, offering quality Under Graduate Program will deliver the required manpower. With the above points in cognizance, the offered program in B.Sc., Biotechnology aims to provide an advanced understanding of the core principles and topics of modern-day Biotechnology and to enable students to a specialized knowledge and training in the Life Science sectors. Another main objective is to create workforce through skill development and entrepreneurship activities. The following are the objectives of the Program

- To provide a deeper understanding of the principles and applications of biological sciences.
- To demonstrate technical competence in plant, animal and microbial and medical biotechnology streams.
- To provide research-oriented learning through interdisciplinary approaches and to impart skills to handle high throughput biological lab equipment.
- To train the students to excel in life science sectors through continuous training, skill development and entrepreneurship activities.
- To create strong research foundation and inculcate quality research ideas through in house /external dissertation.
- To make the students take up social responsibility to solve the real-time problems in the field addition to career development.

Program Outcomes

After successful completion of the undergraduate degree in Biotechnology, students will be well equipped with the necessary skills to serve various Biotech, pharmaceutical, nutraceutical or food industries or pursue higher studies leading to research in areas pertaining to medical, agricultural and food based sectors. Further, students may take up entrepreneurship through start-ups leading to establishment of their own ventures.

Program Specific Outcomes:

By the end of the program the students will be able to develop competencies needed to be acquired by a candidate securing B.Sc., or B.Sc., (Hons.) degree in Biotechnology.

1. Understanding Biotechnology concepts and demonstrating interdisciplinary skills acquired in cell biology, genetics, biochemistry, microbiology, and molecular biology.
2. Demonstrating the Laboratory skills in cell biology, basic and applied microbiology with an emphasis on technological aspects
3. 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.
4. Critically analyze the environmental issues and apply the biotechnology knowledge gained for conserving the environment and resolving the problems.
5. Demonstrate comprehensive innovations and skills in the fields of biomolecules, cell and organelles, molecular biology, bioprocess technology and genetic engineering of plants, microbes, and animals with respect to applications for human welfare.
6. Apply knowledge and skills of immunology, bioinformatics, computational modelling of proteins, drug design and simulations to test the models and aid in drug discovery.
7. Critically analyze, interpret data, and apply tools of bioinformatics and multi omics in various sectors of biotechnology including health and Food.
8. Demonstrate communication skills, scientific writing, data collection and interpretation abilities in all the fields of biotechnology.
9. 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.
10. Exploring the biotechnological practices and demonstrating innovative thinking in addressing the current day and future challenges with respect to food, health, and environment.
11. Thorough knowledge and application of good laboratory and good manufacturing practices in biotech industries
12. Understanding and application of molecular biology techniques and principles in forensic and clinical biotechnology.
13. Demonstrate entrepreneurship abilities, innovative thinking, planning, and setting up small-scale enterprises or CROs.

Eligibility

Candidates who have passed the 10+2 Examination/ Equivalent Examination with at least 40% marks with science as one of the subjects.

Pedagogy:

The general pedagogy to be followed for theory and practicals are as under.

1. Lecturing, Tutorials, Group/Individual Discussions, Seminars, Assignments, Counselling, Remedial Coaching.
2. Field/Institution/Industrial visits, Hands-on training, Case observations, Models/charts preparations, Problem-solving mechanism, Demonstrations, Project presentations, Experiential documentation, and Innovative methods.
3. Active learning as per LSSSDC (NSDC) LFS/Q0509 guidelines, at skill training Level 3.

Assessment:**Weightage for assessments (in percentage)**

Type of Course	Formative Assessment / IA	Summative Assessment
Theory	30%	70%
Practical	30%	70%
Projects	30%	70%

Curriculum Structure for the Undergraduate Degree Program
B.Sc., (Hons) in Biotechnology

Semester	Core Subjects (Credits) L T P	Discipline Specific/ Open Elective Subjects (Credits) L T P	Language L T P	Skill Enhancement Courses (SEC) / Ability Enhancement Compulsory Courses (AECC) L T P	Value Based / Activity Based Courses L T P	Total Credits
I	DSC 01 – Basics of Chemistry (5) 3+0+2 DSC 02 - Foundations of Biotechnology (5) 3+0+2	OEC 01 - Biotechnology & Human Welfare (3) 3+0+0	L 1 – English (3) 3+0+0 L 2 – English/Kannada/ French (3) 3+0+0	SEC 01 - Digital Fluency (3) 3+0+0	Value Based Course (VBC) 01 – Health & Wellness (2) 2+0+0	24
II	DSC 03 - Cell Biology & Functions (5) 3+0+2 DSC 04 - Biochemistry (5) 3+0+2	OEC 02 - Bioproducts (3) 3+0+0	L 1 – English (3) 3+0+0 L 2 – English / Kannada/ French (3) 3+0+0	AECC 01 – Environmental Studies (3) 3+0+0	Activity Based Course (ABC) 01 - Laboratory Management (2) 0+0+2	24
Exit Option Certificate in Biotechnology 48 Credits						
III	DSC 05 - Microbiology (5) 3+0+2 DSC 06 - Molecular Biology & Techniques (5) 3+0+2	OEC 03 - Nutraceutical Biotechnology (3) 3+0+0	L 1 – English (3) 3+0+0 L 2 – English / Kannada/ French (3) 3+0+0	AECC 02 – Indian Constitution (2) 2+0+0 SEC 02 – Artificial Intelligence (2) 2+0+0	-	23
IV	DSC 07 - Instrumentation Techniques (5) 3+0+2 DSC 08 - Genetics & Model Organisms (5) 3+0+2	OEC 04 – Basics of Forensic Science (3) 3+0+0	L 1 – English (3) 3+0+0 L 2 – English / Kannada/ French (3) 3+0+0	SEC 03 – Cyber Security (2) 2+0+0	Activity Based Course (ABC) 02 - Industrial Visit / Training (2) 0+0+2	23
Exit Option Diploma in Biotechnology 94 Credits						

Semester	Core Subjects (Credits) L T P	Discipline Specific/ Open Elective Subjects (Credits) L T P	Skill Enhancement (SEC) / Ability Enhancement Compulsory Courses (AEC) L T P	Value Based / Activity Based Courses L T P	Total Credits
V	DSC 09 - Plant & Animal Physiology (5) 3+0+2 DSC 10 - Metabolism & Enzymology (5) 3+0+2 DSC 11 - Bioinformatics (4) 3+0+1	DSE 01a Genomics & Proteomics (3) 3+0+0 (OR) DSE 01b Basics of Computer Aided Drug Design (3) 3+0+0	SEC 04 - Cell & Tissue Culture (3) 3+0+0	Value Based Course (VBC) 02 - Ethics & Self Awareness (2) 2+0+0	22
VI	DSC 12 - Immunobiology (5) 3+0+2 DSC 13 - Applications of Genetic Engineering (5) 3+0+2 DSC 14 - Fundamentals of Statistics (4) 3+0+1	DSE 02a Biotechnology Business Management (3) 3+0+0 (OR) DSE 02b Medical Biotechnology (3) 3+0+0	SEC 05 - Professional / Societal Communication (3) 3+0+0	-	20
Exit Option B.Sc., in Biotechnology 136 Credits					
VII	DSC 15 - Environmental Biotechnology (5) 3+0+2 DSC 16 - Agricultural Biotechnology (5) 3+0+2 DSC 17 - Bioprocess Technology (5) 3+0+2	DSE 03a Bioethics & IPR (3) 3+0+0 & DSE 03b Fundamentals of Research Methodology (3)	-	-	21
VIII	DSC 18 - Microbial pathogens & Therapy (5) 3+0+2 DSC 19 - Industrial Biotechnology (5) 3+0+2	DSE 04a Nanobiotechnology (3) 3+0+0 (OR) DSE 04b Stem Cell Biology (3) 3+0+0 DSE 05a Research Project (6) (OR) DSE 05b Biotechnological Applications in Wastewater Management (3) 3+0+0 & DSE 05c Toxicology (3) 3+0+0	-	-	19
Award of B.Sc., (Hons) in Biotechnology 176 Credits					

Curriculum Structure for the Undergraduate Degree Program
B.Sc., (Hons) in Biotechnology

SEMESTER I								
Sl. No.	Study Component and Code	Title of the Paper	Hours of Instruction/ Week	Examination				Total Credits
				Duration in Hours	CIA	Theory/ Practical Exam	Max. Marks	
1	DSC 01	Basics of Chemistry	3	3	30	70	100	3
2	Practical 01	Basics of Chemistry	4	3	15	35	50	2
3	DSC 02	Foundations of Biotechnology	3	3	30	70	100	3
4	Practical 02	Foundations of Biotechnology	4	3	15	35	50	2
5	OEC 01	Biotechnology & Human Welfare	3	3	30	70	100	3
6	Language 1	Part I English I	3	3	30	70	100	3
7	Language 2	Part II English I/Kannada I/French I	3	3	30	70	100	3
8	SEC 01	Digital Fluency	3	3	30	70	100	3
9	VBC 01	Health & Wellness	2	2	-	50	50	2
	Total Marks and Credits						750	24
SEMESTER II								
1	DSC 03	Cell Biology & Functions	3	3	30	70	100	3
2	Practical 03	Cell Biology & Functions	4	3	15	35	50	2
3	DSC 04	Biochemistry	3	3	30	70	100	3
4	Practical 04	Biochemistry	4	3	15	35	50	2
5	OEC 02	Bioproducts	3	3	30	70	100	3
6	Language 1	Part I English II	3	3	30	70	100	3
7	Language 2	Part II English II/Kannada II/French II	3	3	30	70	100	3
8	AECC 01	Environmental Studies	3	3	30	70	100	3
9	ABC 01	Laboratory Management (Practical Based)	2	2	-	50	50	2
	Total Marks and Credits						750	24

SEMESTER III								
Sl. No.	Study Component and Code	Title of the Paper	Hours of Instruction/ Week	Examination				Total Credit
				Duration in Hours	CIA	Theory/ Practical Exam	Max. Marks	
1	DSC 05	Microbiology	3	3	30	70	100	3
2	Practical 05	Microbiology	4	3	15	35	50	2
3	DSC 06	Molecular Biology & Techniques	3	3	30	70	100	3
4	Practical 06	Molecular Biology & Techniques	4	3	15	35	50	2
5	OEC 03	Nutraceutical Biotechnology	3	3	30	70	100	3
6	Language 1	Part-I English III	3	3	30	70	100	3
7	Language 2	Part II English III/Kannada III/French III	3	3	30	70	100	3
8	AECC 02	Indian Constitution	2	2	-	50	50	2
9	SEC 02	Artificial Intelligence	2	2	-	50	50	2
	Total Marks and Credits						700	23
SEMESTER IV								
1	DSC 07	Instrumentation Techniques	3	3	30	70	100	3
2	Practical 07	Instrumentation Techniques	4	3	15	35	50	2
3	DSC 08	Genetics & Model Organisms	3	3	30	70	100	3
4	Practical 08	Genetics & Model Organisms	4	3	15	35	50	2
5	OEC 04	Basics of Forensic Science	3	3	30	70	100	3
6	Language 1	Part-I English III	3	3	30	70	100	3
7	Language 2	Part II English IV/Kannada IV/French IV	3	3	30	70	100	3
8	SEC 03	Cyber Security	2	2	-	50	50	2
9	ABC 02	Industrial Visit/ Training (Report + Viva Voce)	2	2	-	50	50	2
	Total Marks and Credits						700	23

SEMESTER V								
Sl. No.	Study Component and Code	Title of the Paper	Hours of Instruction/ Week	Examination				Total Credit
				Duration in Hours	CIA	Theory/ Practical Exam	Max. Marks	
1	DSC 09	Plant & Animal Physiology	3	3	30	70	100	3
2	Practical 09	Plant & Animal Physiology	4	3	15	35	50	2
3	DSC 10	Metabolism & Enzymology	3	3	30	70	100	3
4	Practical 10	Metabolism & Enzymology	4	3	15	35	50	2
5	DSC 11	Bioinformatics	3	3	30	70	100	3
6	Practical 11	Bioinformatics	2	2	15	35	50	1
7	DSE 01a (OR) DSE 01b	Genomics & Proteomics (OR) Basics of Computer Aided Drug Design (CADD)	3	3	30	70	100	3
8	SEC 04	Cell & Tissue Culture	3	3	30	70	100	3
9	VBC 02	Ethics & Self Awareness	2	2	-	50	50	2
	Total Marks and Credits						700	22
SEMESTER VI								
1	DSC 12	Immunobiology	3	3	30	70	100	3
2	Practical 12	Immunobiology	4	3	15	35	50	2
3	DSC 13	Introduction to Genetic Engineering	3	3	30	70	100	3
4	Practical 13	Introduction to Genetic Engineering	4	3	15	35	50	2
5	DSC 14	Fundamentals of Statistics	3	3	30	70	100	3
6	Practical 14	Fundamentals of Statistics	2	2	15	35	50	1
7	DSE 02a (OR) DSE 02b	Biotechnology Business Management (OR) Medical Biotechnology	3	3	30	70	100	3
8	SEC 05	Professional / Societal Communication	3	3	30	70	100	3
	Total Marks and Credits						650	20

SEMESTER VII								
Sl. No.	Study Component and Code	Title of the Paper	Hours of Instruction/ Week	Examination				Total Credit
				Duration in Hours	CIA	Theory/ Practical Exam	Max. Marks	
1	DSC 15	Environmental Biotechnology	3	3	30	70	100	3
2	Practical 15	Environmental Biotechnology	4	3	15	35	50	2
3	DSC 16	Agricultural Biotechnology	3	3	30	70	100	3
4	Practical 16	Agricultural Biotechnology	4	3	15	35	50	2
5	DSC 17	Bioprocess Technology	3	3	30	70	100	3
6	Practical 17	Bioprocess Technology	4	3	15	35	50	2
7	DSE 03a	Bioethics & IPR	3	3	30	70	100	3
8	DSE 03b	Fundamentals of Research Methodology	3	3	30	70	100	3
Total Marks and Credits							650	21
SEMESTER VIII								
1	DSC 18	Microbial Pathogens & Therapy	3	3	30	70	100	3
2	Practical 18	Microbial Pathogens & Therapy	4	3	15	35	50	2
3	DSC 19	Industrial Biotechnology	3	3	30	70	100	3
4	Practical 19	Industrial Biotechnology	4	3	15	35	50	2
5	DSE 04a (OR) DSE 04b	Nanobiotechnology (OR) Stem Cell Biology	3	3	30	70	100	3
6	DSE 05a (OR) DSE 05b	Research Project (OR) Biotechnological Applications in Wastewater Management and	6	3	60	140	200	6
			3	3	30	70	100	
	DSE 05c	Toxicology	3	3	30	70	100	
Total Marks and Credits							600	19

Abbreviations: DSC – Discipline Specific Core; DSE – Discipline Specific Elective; OEC – Open Elective Course; AECC – Ability Enhancement Compulsory Course; SEC – Skill Enhancement Course; VBC – Value Based Course; ABC – Activity Based Course

Students may choose any one elective course among the choice offered, specific to the discipline

*Project Proposal, Presentations, Team Work, Industrial/Institutional Visits etc.

Semester One

DSC 01 – Basics of Chemistry

L	T	P	C
3	0	2	5

Course Objectives:

- To introduce students to the basic chemical interactions necessary for biological functioning.
- To provide knowledge pertaining to biomolecules, their reactions and their importance.

Course Outcomes:

After successful completion of the course, students will be able to

1. Gain knowledge of basic biochemical concepts and reactions occurring living systems
2. Understand biochemical reactions and their mechanisms at cellular and molecular level, followed by the impact of these reactions on metabolism and health.
3. Understand the basics of molecules, their related processes and mechanisms, as well as control of bioenergetics and metabolism.
4. Gain theoretical and analytical skills pertaining to handling of chemicals and basic instruments.

Theory

Unit-I: Overview of Biochemistry: Definition, scope and significance of Biochemistry. Important discoveries in Biochemistry. An overview of elements, chemical reactions, and biomolecules in living organisms. Concentration units: Avagadro's number, mole, mole fraction, molarity, equivalent weight, normality, molality.

Unit-II: Properties of water: Molecular structure of water, physical properties of water. Its effect on biomolecules. Effect of non-polar compounds on water. Colligative properties: Osmotic pressure and its measurements by Berkely and Hartley's method. Laws of osmotic pressure. Hypo, hyper and isotonic solutions. Effects of osmotic pressure on living cells. Donnan membrane equilibrium. Physical properties of molecules: Adsorption, Viscosity – Definition. Distribution law -Distribution law, partition coefficient.

Unit-III: Ionic equilibria: Lewis concept of acids and bases. Ionic product of water. pH scale, buffers, Henderson Hasselbalch equation, buffer capacity, preparation of acidic and basic buffer solutions. Theory of acid base indicators. Choice of indicators. pH titration curves and isoelectric pH of amino acids. Electrodes (Hydrogen Electrode & Calomel electrode), glass electrode. Conductometric titrations [Strong acid against strong base, weak acid (amino acid) against NaOH]. Determination of pKa value of amino acid by using pH meter.

Unit-IV: Photochemistry: Laws of photochemistry, quantum efficiency, light absorption, Beer Lambert's law, spectrophotometer, colorimeter. Chemical bonding: Different types of bonds & bond characteristics. Ionic bonding, covalent bonding, co-ordinate bonding, Van der Waal's forces, ion- dipole, dipole –dipole interactions, London forces, hydrophobic interaction, hydrogen bonding.

Practical 01 - Basics of Chemistry

1. Use of analytical balance
2. Calculation, preparation of normal, molar and percentage solutions.
3. Preparation of standard sodium carbonate solution, standardization of HCl (Methyl orange) and estimation of NaOH in the given solution. (Methyl orange or phenolphthalein).
4. Preparation of standard oxalic acid. Standardization of NaOH and estimation of H₂SO₄ in the given solution (phenolphthalein).
5. Conductometric titration of strong acid against strong base.
6. Conductometric titration of weak acid (amino acid) against strong base.

References

1. Kotz, J. C. Treichel, P. M. & Townsend, J., 2009. General Chemistry, CENGAGE Learning India Pvt. Ltd. New Delhi.
2. Bahl A and Bahl BS., 2019. Advanced Organic Chemistry, S. Chand.
3. Wilson K and Walker J., 2010. Principles and Techniques of Biochemistry and Molecular Biology. Seventh Edition, Cambridge University Press.
4. Nelson DL., Cox MM., 2021. Lehninger Principles of Biochemistry, Eighth Edition, Worth Publishers, Inc. New York.
5. Jain JL., Jain S., Jain N., 2016. Fundamentals of Biochemistry, Seventh Edition, S. Chand
6. Deb A.C. 2001. Fundamentals of Biochemistry, Seventh Edition, New Central Book Agency, Kolkata.

DSC 02 - Foundations of Biotechnology

L	T	P	C
3	0	2	5

Course Objectives:

- To provide insights into the science, methods, scope, diversity, history, business, and legal ramifications of biotechnology
- To demonstrate the working within a laboratory environment
- To examine and introduce the students to scope of biotechnology

Course Outcomes:

After successful completion of the course, students will be able to

1. Gain knowledge regarding the science of biotechnology and its associated methods
2. Understand how different disciplines are integrated within the complex world of biotechnology.
3. Understanding the existing impediments to progress in biotechnology.
4. Demonstrate laboratory safety and usage of various techniques

Theory

Unit-I: Foundation: Introduction to Biotechnology, Historical Perspectives – Old and Modern Biotechnology, Biotechnology an interdisciplinary pursuit, Scope & Future of Biotechnology.

Unit-II: Application of biotechnology in medicine: Production of antibiotics, vaccines and monoclonal antibodies; Gene therapy, biopharmaceuticals. **Application of Biotechnology in Environment:** Wastewater and sewage treatment, biofuels; Bioremediation with special reference to metals, oil spills and pesticides. **Application of Biotechnology** in Food and beverage fermentations, biological control, biofertilizers.

Unit-III: Enzyme technology: Nature of enzymes, application of enzymes, genetic engineering and protein engineering of enzymes, technology of enzymes production.

Unit-IV: Safety in Biotechnology - Problem of organism pathogenicity, biologically active products and release of GMOs in the environment.

Practical 02 - Foundations of Biotechnology

1. Safety hazards and disposal of wastes and Good laboratory practices.
2. Demonstration of various laboratory techniques: centrifugation, electrophoresis, chromatography, sterilization.
3. Demonstration of pipetting techniques: usage of micropipettes for general laboratory and sterile environment.
4. Preparation of e-poster on various applications of biotechnology in medicine, environment, food and beverage fermentations
5. Preparation of biofertilizers
6. Cultivation of Mushroom

References

1. Smith JE., 2004. Biotechnology, Fourth Edition, Cambridge University Press.
2. Das HK., 2010. Textbook of Biotechnology, Fourth Edition, Wiley India Pvt. Ltd.
3. Upadhayay, Upadhayay and Nath, 2016. Biophysical Chemistry, Himalaya Publishing House.
4. Glick BR, Pasternak JJ, Patten CL, 2010. Molecular-Biotechnology, Fourth Edition, ASM Press Washington DC.
5. Kumar HD, 2000. A Textbook on Biotechnology, 2nd Edition, East West.

OEC 01 – Biotechnology & Human Welfare

L	T	P	C
3	0	0	3

Course Objectives:

- To introduce various fields of biotechnology for human welfare e.g. Agricultural, pharmaceutical and industrial biotechnology.
- To impart knowledge regarding the benefits of biotechnology in health and pharmaceuticals.
- To help understand diagnosis of various diseases by employing various molecular biology techniques.

Course Outcomes:

After successful completion of the course, students will be able to

1. Understand the use of biotechnology industrial applications for human welfare
2. Gain knowledge and understand applications of Agricultural biotechnology
3. Apply biotechnological applications in environmental management
4. Understand the biotechnological applications in health and diagnostics

Theory

Unit-I: Industry - protein engineering; enzyme and polysaccharide synthesis, activity and secretion, alcohol and antibiotic formation.

Unit-II: Agriculture - N₂ fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.

UNIT III: Environment - chlorinated and non-chlorinated organ pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB.

Unit IV: Health - development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, diagnostics, transgenics development, human genome project, pharmaceutical biotechnology - concepts and applications.

References

1. Sateesh MK., 2010. Bioethics and Biosafety, I. K. International Pvt Ltd.
2. Sree Krishna V., 2007. Bioethics and Biosafety in Biotechnology, New age international publishers.

Language 1 – Part I English I

L	T	P	C
3	0	0	3

Course Objectives:

- Improve and enhance the communication skills of the learners.
- Improve speech pronunciation, grammar and vocabulary.

Course Outcomes:

After successful completion of the course, students will be able to

1. Have better language, communication and pronunciation skills.
2. Have enhanced their vocabulary since they would have learned about root words, synonyms, antonyms, phobias and manias.
3. Use the Language Lab by Senako Software to improve their vocabulary. The Language Lab is equipped with exercises for language learning. The Voice Pronounce guides the students to improve their pronunciation through instant feedback and visual indication of what sounds and words to improve on.

Unit-I: Grammar – I

1. Correct Use of Nouns
2. Correct Use of Pronouns
3. Reading Comprehension Passage

Unit-II: Grammar – II

1. The rules and sequence of tenses
2. Types of sentences: Simple, Compound and Complex sentences, clauses, phrases, adjuncts and gerunds
3. Subject Verb Agreement

Unit-III: Vocabulary

1. Roots A to F
2. Synonyms and Antonyms
3. Phobias and Manias

Unit-IV: Essay

Excerpts from APJ Abdul Kalam's "Wings of Fire "

References

1. S.C Gupta, 2021, English Grammar and Composition, Arihant Publishers
2. S. P. Bakshi, 2021, Objective General English, Arihant Publishers

Language 2 – Part II English I

L	T	P	C
3	0	0	3

Course Objectives:

- Improve and enhance the literary skills of the learners.
- Develops language skills such as reading, writing, speaking and listening.
- Help the students to grasp the ideas of the writer.

Course Outcomes:

After successful completion of the course, students will be able to

1. Express their thoughts, ideas, feelings, and observations.
2. Develop philosophical, historical and critical perspectives in their writings.

Unit-I: British Poetry

1. "When in Disgrace" by Shakespeare
2. "Spring" by Christina Rossetti

Unit-II: Post Colonial Literature

1. "The Night of the Scorpion" by Nissim Ezekiel
2. "I Am Not That Woman" by Kishwar Naheed

Unit-III: Contemporary and British Literature

1. "The Kanda Man-eater" by Jim Corbett
2. "A Man Who Had No Eyes" by MacKinlay Kantor
3. "A Child's Story" by Charles Dickens

Unit-IV: Indian English Literature

"The Education System in India" by Dr. V. Shashi Kumar

References:

1. Jim Corbett, 1944. The Man-Eaters of Kumaon, Oxford University Press.
2. Charles Dickens, 2013. Children's Stories, Bottom of The Hill Publishing.

Language 2 – Part II Kannada I

L	T	P	C
3	0	0	3

ಸಾಹಿತ್ಯ ಸಿಂಚನ – 1

ಅಧ್ಯಯನದ ಉದ್ದೇಶ

- ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ನಾಡು ನುಡಿಯ ಬಗ್ಗೆ ಅಭಿಮಾನ ಮೂಡಿಸುವುದು
- ಭಾಷೆಯ ಅಭಿವೃದ್ಧಿಗೆ ಅವಕಾಶ ಕಲ್ಪಿಸುವುದು
- ನವೋದಯ ಕಾಲಘಟ್ಟದ ಕವಿಗಳ ಬಗ್ಗೆ ಬೆಳಕು ಚೆಲ್ಲುವುದು
- ಭೂಮಿ ಕುರಿತ ಕವಿಗಳು ಹಾಗೂ ಲೇಖಕರ ಸೃಜನಶೀಲ ಬರವಣಿಗೆಯ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು
- ಆಡಳಿತ ಭಾಷೆಯ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು

ಅಧ್ಯಯನದ ಫಲಿತಗಳು

- ವಿದ್ಯಾರ್ಥಿಗಳು ನಾಡು ನುಡಿಯ ಬಗ್ಗೆ ಅಭಿಮಾನ ಬೆಳೆಸಿಕೊಳ್ಳುವರು
- ಭಾಷೆಯ ಅಭಿವೃದ್ಧಿಗೆ ಅವಕಾಶ ಪಡೆದುಕೊಳ್ಳುವರು
- ನವೋದಯ ಕಾಲಘಟ್ಟದ ಕವಿಗಳ ಬಗ್ಗೆ ತಿಳಿದುಕೊಳ್ಳುವರು
- ಭೂಮಿಯ ಬಗೆಗಿನ ಕವಿಗಳು ಹಾಗೂ ಲೇಖಕರ ಸೃಜನಶೀಲ ಬರವಣಿಗೆಯ ಬಗ್ಗೆ ಅರಿತುಕೊಳ್ಳುವರು
- ಆಡಳಿತ ಭಾಷೆಯ ಬಗ್ಗೆ ಜ್ಞಾನ ಪಡೆದುಕೊಳ್ಳುವರು

ಘಟಕ – 1, ನಾಡು-ನುಡಿ-ಚಿಂತನೆ

- 1) ನಾಡು, ನುಡಿ, ಸಂಸ್ಕೃತಿ : ಶ್ರೀ ವಿಜಯನ ಕವಿರಾಜಮಾರ್ಗ
- 2) ಕಾಣಿಕೆ : ಬಿ.ಎಂ.ಶ್ರೀಕಂಠಯ್ಯ
- 3) ರತ್ನನ ಪದಗೊಳ್ : ಜಿ.ಪಿ.ರಾಜರತ್ನಂ
- 4) ಕಟ್ಟುವೆವು ನಾವು : ಎಂ ಗೋಪಾಲ ಕೃಷ್ಣ ಅಡಿಗ

ಘಟಕ -2, ಭೂಮಿ

- 1) ಬೆಳಗಾಗಿ ನಾನೆದ್ದು ಯಾರ್ಯಾರ ನೆನಯಾಲಿ : ಜನಪದ
- 2) ಭೂಮಿ ತಾಯಿಯ ಚೊಚ್ಚಲ ಮಗ : ದ.ರಾ. ಬೇಂದ್ರೆ
- 3) ಕುಂಕುಮ ಭೂಮಿ : ಕೆ.ಎಸ್ ನರಸಿಂಹಸ್ವಾಮಿ
- 4) ಅವ್ವ : ಪಿ. ಲಂಕೇಶ

ಘಟಕ – 3, ವೈಜ್ಞಾನಿಕ ಮನೋಧರ್ಮ

- 1) ಧನ್ವಂತರಿ ಚಿಕಿತ್ಸೆ : ಕುವೆಂಪು
- 2) ವಂಡೂರಿನ ಹವಳದ ದಂಡೆಗಳು : ಕೆ.ಪಿ ಪೂರ್ಣಚಂದ್ರ ತೇಜಸ್ವಿ
- 3) ನಿಸರ್ಗದ ನಿಗೂಢ ಕುರಿಂಜಿಲೋಕ : ನಾಗೇಶ ಹೆಗಡೆ

ಘಟಕ – 4, ಭಾಷಾ ಭಾಗ

- 1) ಪತ್ರ ವ್ಯವಹಾರ, ಸಾಮಾನ್ಯ ಪತ್ರ, ಮನವಿ ಪತ್ರ
- 2) ಆಡಳಿತ ಕನ್ನಡ ಬೆಳೆದು ಬಂದ ದಾರಿ
- 3) ಆಡಳಿತ ಭಾಷೆಯ ಸ್ವರೂಪ ಮತ್ತು ಲಕ್ಷಣ

ಹೆಚ್ಚಿನ ಓದಿಗಾಗಿ:

- 1) ಕವಿರಾಜ ಮಾರ್ಗ- ಶ್ರೀ ವಿಜಯ,
- 2) ಕುವೆಂಪು ಕೃತಿ ವಿಮರ್ಶೆ- ಪ್ರೊ.ಅರವಿಂದ ಮಾಲಗತ್ತಿ
- 3) ಆಡಳಿತ ಕನ್ನಡ – ಎಚ್‌ಎಸ್‌ಕೆ

Language 2 – Part II French I

L	T	P	C
3	0	0	3

Course Objectives

- The course aims at making the learner understand and use familiar day-to-day expressions and very basic phrases in French.
- The learners are taught to introduce themselves and others, ask and answer questions about personal details in French.

Course Outcomes:

After successful completion of the course, students will be able to

1. Improve the listening and speaking skills by listening to audio lessons.
2. Read, comprehend, and analyze a wide range of texts such as small paragraphs and comprehension in French.

Unit 1

1. Greet people
2. Talk about yourself

Unit 2

1. Talk about where you live

Unit 3

1. Talk about your family members

Unit 4

1. Talk about your likes and dislikes

References:

1. Stahl Christian, 2018. 100 French Short Stories for Beginners Learn French with Stories Including Audiobook published by Lulu.com.
2. S. Singh Kajal Chawla_Toujours Francais:- French Volume -0, language Learning Books for beginners, Easy French Step-by-Step Learning method:-Educational book published by Souvenir Publishers Pvt. Ltd.

SEC 01 – Digital Fluency

L	T	P	C
3	0	0	3

Course Objectives:

- To introduce students to the realm of technology.
- To impart knowledge regarding the benefits of digitization.
- To help students gain digital literacy.

Course Outcomes:

After successful completion of the course, students will be able to

1. Have an intelligent conversation on the key concepts and applications of Artificial Intelligence, Big Data Analytics, Internet of Things, Cloud Computing and Cybersecurity.
2. Develop holistically by learning essential skills such as problem-solving, design thinking and teamwork.

Theory

Unit-I: Emerging Technologies – Overview of emerging Technologies – Artificial Intelligence (AI), Machine Learning, Deep Learning. Database Management for Data Science, Big Data Analytics. Internet of Things (IoT) and Industrial Internet of Things (IIoT). Cloud computing and its service models. Introduction to Cyber Security and Types of cyber-attack.

Unit-II: Applications of Emerging Technologies – Artificial Intelligence (AI), Big Data Analytics, Internet of Things, Cloud Computing, Cyber Security.

UNIT III: Essential skills beyond Technology: Safe usage of the internet, Creative Problem solving & Critical Thinking, Innovation and Design Thinking, Use of tools in enhancing skills.

References

1. Mehrotra D., 2019. Basics of artificial intelligence & machine learning, Notion Press.
2. Zsolt N., 2018. Artificial Intelligence & Machine Learning Fundamentals, Packt Publishers.

VBC 01 – Health & Wellness

L	T	P	C
2	0	0	2

Course Objectives:

- To introduce the concept of health, food, nutrition and diet and their role in malnutrition, communicable and non-communicable diseases.
- Relationship between of yoga and Ayurveda.
- The psychology, various emotions and behavioral aspects.

Course Outcomes:

At the end of the course, students would be able to understand the

- Need of food, nutrition, diet and causes of malnutrition and various disease conditions.
- Gains knowledge of yoga and Ayurveda their health benefits.
- Psychology, various personalities and their effect on concentration.

Unit I

Definition of health, food, nutrients, nutrition, diet, RDA (ICMR & WHO), Balanced Diet, malnutrition. Exercise & fitness. Incidence of Nutritional problems, signs, symptoms and treatment- Protein Energy Malnutrition, Micro Nutrient deficiencies (Vit-A, Iron, Iodine and Zinc)- Causes & consequences of malnutrition. Intervention programs: Mid-Day Meal Programme, NIPPCD Fortification and enrichment of foods, NIN, ICMR, WHO, FAO.

Unit - II

Communicable Diseases causes and prevention -cholera, polio, measles, HIV. Impact of NCDs on public health. Non-communicable diseases causes and prevention: Obesity, Diabetes mellitus, hypertension, CVD, Cancer, Osteoporosis

Unit - III

Yoga and health science- Introduction to Yoga; Objective of Yoga; Concept of Mind according to Yoga; Importance of Yoga & Misconceptions of Yoga. Ayurveda- Principles; Dosha theory. Interrelation between Yoga and Ayurveda. Herbal remedies and Nutraceuticals.

Unit - IV

Psychology, emotion, personality, motivation, cognition, cognitive learning, memory, forgetting and Artificial Intelligence - definitions and types. Understanding basic behavioral aspects- attention and concentration.

References

1. Vinodini Reddy., Pralhad Raj, Gowrinath Sastry J, Kashinath, K.C. (1993), Nutrition Trends in India, NIN, Hyderabad.
2. Park and park (1995), Text book of preventive and social medicine, Banarsidas published by Jabalpu.
3. Jellifee, D.D and Pathes (1989), Assessment of Nutritional status of community, WHO, Geneva.
4. Baron RA and Misra G, (2014), Psychology, Fifth Edition, New Delhi, By Pearson education.
5. Yoga Health by Dr H R Nagendra & Dr R Nagarathna.

Semester Two

DSC 03 - Cell Biology & Functions

L	T	P	C
3	0	2	5

Course Objectives:

- To introduce the students to cell biology and convey the importance of cells in sustenance of life
- To help understand the molecular basis of cell functioning and survival
- To convey the intricacies of basic signal transduction mechanisms and their role in homeostasis

Course Outcomes:

After successful completion of the course, students will be able to

1. Understand the importance of cell as a component of life
2. Gain knowledge on cellular functions
3. Possess in-depth knowledge on functioning of organelles, cellular consistency and factors responsible
4. Gain knowledge of how cells communicate and retain functional efficiency

Theory

Unit-I: Cell as a basic unit: An overview of cells and cell research. The discovery, origin and evolution of cells, cell theory, classification of cell types, prokaryotic and eukaryotic cell organization. Compartmentalization in cells: overview and role of cell organelles- cytosol, endoplasmic reticulum, the golgi apparatus, lysosomes and Peroxisomes, ribosomes, vesicles, vacuoles, mitochondria, chloroplast, nucleus, nucleolus, nuclear membrane, centrioles and cell wall. Cell transport phenomenon: Membrane architecture, Simple diffusion, facilitated diffusion, active transport (primary and secondary), passive transport, symport, uniport and antiport. Exocytosis, endocytosis and pinocytosis.

Unit-II: Cell cycle: cell division types, phases of cell cycle, mitosis and meiosis, comparison of cell division in prokaryotes and eukaryotes. Stem cells, apoptosis, cancerous cells and their characteristics, prions.

Unit-III: Chromatin organization: Chromatin fiber structure, nucleosome, models of nucleosome, chromosome structure. Anatomy of eukaryotic chromosome – Centromere, Telomere, Nucleosome, Nucleomere, Kinetochore. Structural framework of eukaryotic cell: Cytoskeleton, microfilaments, microtubules, and intermediate filaments. Composition, assembly and function.

Unit IV: Cell communication: Nucleo-cytoplasmic interaction, cell-cell signaling, plasmodesmata, gap junction, and septate junction. Specialized cells: Cell polarity, Nerve cells, sperm cells, cells of vision.

Practical 03 - Cell Biology & Functions

1. Instruments in a cell biology laboratory
2. Blood cell counting using hemocytometry.
3. Cell viability assay by Trypan blue dye exclusion method.
4. Isolation of DNA from plant source
5. Microtomy Preparation of permanent slides
6. Staining – Simple and differential

References:

1. Lodish H. F. (Editor) Berk A., Matsudaira P., Kaiser C. A., Krieger M., Scott M. P., Zipursky S. L., Darnell J. Molecular Cell Biology (9th Edition) (2021). W. H. Freeman and Co., Publishers.
2. Pollard T. D., Earnshaw W. 2004. Cell Biology. Saunders- Elsevier.
3. Alberts B., Bray D., Lewis J., Raff M., Roberts K., Watson J.D. Molecular Biology of the Cell. Garland Publishing, New York and London.
4. Cooper G. M. 2000. The Cell – A Molecular Approach. 2nd Ed. ASM Press. Washington.

DSC 04 - Biochemistry

L	T	P	C
3	0	2	5

Course Objectives:

- To provide knowledge on basic biomolecules and their properties
- To impart knowledge on the metabolic aspects of major biomolecules

Course Outcomes:

After successful completion of the course, students will be able to

1. Understand about biochemical properties of carbohydrates and other sugars.
2. Gain knowledge about various biophysical properties of proteins emphasizing structural properties.
3. Understand the role of buffers in gastrointestinal tract and human body
4. Understand structural arrangement of nucleic acids and its significance

Theory

Unit-I: Carbohydrates: Sugars- classification and reactions, mono, di and polysaccharides – types, structural features, chirality and optical activity, stereoisomerism, cyclic structures, methods for compositional analysis, lactic acid and alcohol fermentation, Storage polysaccharides. (Starch, Glycogen, cellulose, chitin) Glycosaminoglycans and glycoproteins.

Unit-II: Proteins and amino acids: Proteins- classification, hierarchy in structure, physics of proteins- three-dimensional structure and confirmation using physical methods (hemoglobin and myoglobin), glycoproteins, Structural organizations of proteins (primary, secondary, tertiary and quaternary), conformational analysis, Ramachandran plot, amino acids- classification and chemical structures.

Unit-III: Lipids: Classification, structure and functions, reactions and biological functions of lipids. Phospholipids, sphingo- and glycolipids, steroids-cholesterol-bile salts, steroid hormones. Cholesterol biosynthesis, vitamins – biosynthesis of fat soluble and water-soluble vitamins, and their role, role of minerals in human health.

Unit-IV: Nucleic Acid: Bases, nucleosides, nucleotides, polynucleotides, structure of RNA and DNA, T_m, C_{ot} curve, Isolation and characterization, hypo- and hyperchromic effects, Chargaff's rule of base pairing in DNA, different types of RNA and DNA structures, Interaction of DNA with other molecules, RNA – differences with DNA. Structure and types of RNA (rRNA, tRNA and mRNA).

Practical 04 - Biochemistry

1. Qualitative tests for amino acids, sugars and lipids.
2. Estimation of proteins by Lowry's method.
3. Estimation of proteins by Biuret's method.
4. Estimation of reducing sugar by DNS method.
5. Estimation of iodine value of Lipids.
6. Estimation of serum proteins.
7. Estimation of urea in blood sample
8. Estimation of fat in milk sample

References

1. Garet and Grasham, Biochemistry, Sunders College Publishers, 1999.
2. Devlin, Biochemistry, John Wily & Sons, Inx Publications, 1997.
3. V. Voet and J.G.Voet, Biochemistry, 3rd edition, John Wiley, New York, 2004.
4. Edwards and Hassall. Biochemistry and Physiology of the cell 2nd Edn. McGraw Hill Co. UK. Ltd.
5. Mathews, Van Holde and Ahern, Biochemistry by 3rd edition, Pub Pearson education.
6. Elliott, W.H., Elliott, D.C. Biochemistry and Molecular Biology 3rd Indian edition.

OEC 02 - Bioproducts

L	T	P	C
3	0	0	3

Course Objectives:

- To introduce students to bioproducts and their economic significance
- To create awareness on a wide array of biologically derived products
- To develop the entrepreneurship potential of students with regards to bioproduct development

Course Outcomes:

After successful completion of the course, students will be able to

1. Gain insights on a wide range of bioproducts viz., biofuels, biomaterials, biochemicals of therapeutic and nutritional importance.
2. Analyze and perceive green entrepreneurship and bioproduct market.
3. Understand concepts of biomaterials and its various applications
4. Develop insight into bioproducts manufacturing in pharmaceutical based biotechnology companies.

UNIT - I

INTRODUCTION TO BIOPRODUCTS: Definition of bioproducts; Categories of bioproducts; Importance of bioproducts; Bioproducts industry - strategies and action plans, global trends and current situation; Bioproducts used for decoration; Biofertilisers; Examples of clonal propagation of plants; Socio-economic and environmental impact of bioproducts.

UNIT - II

ENERGY RELATED BIOPRODUCTS: Liquid fuels - ethanol and biodiesel; Carbon neutrality; Conversion mechanisms; Solid biomass for combustion to generate heat and power; Gaseous fuel such as biogas; Renewable energy opportunities for Indian entrepreneurs.

UNIT - III

BIOMATERIALS: Bioplastics from plant oils and sugars; Biofoams and biorubber from plant oils and latex; Biocomposites manufactured from agricultural (e.g., hemp, flax, kenaf) and forestry; Biofibres.

UNIT - IV

BIOCHEMICALS: Industrial - basic and specific chemicals, resins, lubricants and solvents; Pharmaceuticals - examples of monoclonal therapeutic antibodies, interleukins, enzymes (therapeutic and detergent), hormones and vaccines; Antibiotics; Omega 3 fatty acids; Biocosmetics - soaps, body creams and lotions; Biorepellents - case study; Trichoderma.

References

1. N.T. Dunford, "Food and industrial bioproducts and bioprocessing", Wiley-Blackwell Publishers, 2012.
2. J.C. Philp and K.C. Pavanan, "Perspectives- bio-based production in a bioeconomy", Asian Biotechnology and Development Review, Vol. 15, No.2, pp 81-88, 2012.
3. J. W. Lee, "Advanced Biofuels and Bioproducts", Springer New York, 2013.
4. C. T. Hou and J.F. Shaw, "Biocatalysis and Bioenergy", Wiley publishers, 2008.

Language 1 – Part I English II

L	T	P	C
3	0	0	3

Course Objectives:

- Understand and apply the purpose of adjectives, adverbs and prepositions.
- Apply the rules of reported speech in dialogue writing.
- Bring life to the words and enhance creativity in writing by using figures of speech like alliteration, metaphor and simile.

Course Outcomes:

After successful completion of the course, students will be able to

1. Correct errors in sentences by applying rules of adjectives, adverbs and prepositions.
2. Reveal the tone and moods of the characters and improve writing of dialogues by applying the rules of Reported Speech.
3. Use figurative language to elicit emotion, help readers form mental images and draw readers into the work.

Unit-I: Grammar

1. Correct Use of Adjectives
2. Reported Speech
3. Correct Use of Adverbs
4. Correct Use of Prepositions
5. Formal Letters (**Resume and Cover letter**) and Writing Emails
6. Reading Comprehension Passage

Unit-II: Vocabulary – I

1. Roots: G to L
2. Figures of Speech: Alliteration, Metaphor, Simile

Unit-III: Vocabulary – II

1. Prefixes and Suffixes
2. New Words in English

Unit-IV: Essay: Indian English Literature

Swami Vivekananda's Address at Parliament of Religions in Chicago

References

1. Lewis Norman (2016) Word Power Made Easy, published by Goyal Publishers & Distributors Pvt. Ltd.
2. Raymond Murphy (2009) Grammar in Use Intermediate Student's Book with answers: Self-study Reference and Practice for Students of North American English, published by Books wagon.
3. Raymond Murphy (2013) English Grammar in Use: A Self Study Reference and Practice Book Intermediate Learners Book published by Cambridge University Press.

Language 2 – Part II English II

L	T	P	C
3	0	0	3

Course Objectives:

- Learn and appreciate different kinds of literature like Indian English, British and American literature.
- Learn to appreciate the importance of moral and ethical values in life through study of literature.

Course Outcomes:

After successful completion of the course, students will be able to

1. Critically analyze the after effects of Industrial Revolution in Britain through the poem “The Chimney Sweepers” by William Blake
2. Know about the importance of nature. Nature is the best teacher which can teach humans about what is evil and what is good through the poem “The Tables Turned” by William Wordsworth.
3. Learn that every person must understand his/her own abilities and talents and not be fooled by a critic who may not have the best intentions through the poem “The Frog and the Nightingale” by Vikram Seth.

Unit-I: Poetry from the Romantic period

1. “The Chimney Sweepers” by William Blake
2. “The Tables Turned” by William Wordsworth

Unit-II: Indian English Poetry

1. “The Frog and the Nightingale” by Vikram Seth
2. “Battle with Death”, Translating Atal Bihari Vajpayee’s Hindi poem “Maut Se Thann Gayi”

Unit-III: British and American Prose

1. “The Mammon and The Archer” by O’Henry
2. “The Tell-Tale Heart” by Edgar Allan Poe
3. “The Case for The Defence” by Graham Greene

Unit-IV: Drama Translation Works

“Yama’s Defeat” by Kuvempu translated from Kannada to English by Dr. C. Naganna

References:

1. Vajpayee Atal Bihari 21 poems by Atal Bihari Vajpayee, translated by Pavan K Verma published by Penguin Books India Pvt Ltd.
2. Henry O ‘ 100 Selected Stories published by Vasan Book Depot.
3. Edgar Allen Poe (2019) The Tell-Tale Heart published by Blurb.
4. Thomson Sharada’s Savitri published by Wordcatcher Publishing.

Language 2 – Part II Kannada II

L	T	P	C
3	0	0	3

ಸಾಹಿತ್ಯ ಸಿಂಚನ – 2

ಅಧ್ಯಯನದ ಉದ್ದೇಶ

- ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಕುವೆಂಪು ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು
- ವಚನಗಾರ್ತಿಯರ ಬಗ್ಗೆ ತಿಳಿಸಿಕೊಡುವುದು
- ವಚನಗಾರರ ಬಗ್ಗೆ ಬೆಳಕು ಚೆಲ್ಲುವುದು
- ಪರಿಸರದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು
- ಪ್ರಬಂಧ ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ತಿಳಿಸಿಕೊಡುವುದು

ಅಧ್ಯಯನದ ಫಲಿತಗಳು

- ವಿದ್ಯಾರ್ಥಿಗಳು ಕುವೆಂಪು ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ವಿಸ್ತಾರವಾದ ತಿಳುವಳಿಕೆ ಹೊಂದುವರು
- ವಚನಗಾರ್ತಿಯರ ಬಗ್ಗೆ ತಿಳಿದುಕೊಳ್ಳುವರು
- ವಚನಗಾರರ ಬಗ್ಗೆ ಹೆಚ್ಚಿನ ಜ್ಞಾನ ಪಡೆದುಕೊಳ್ಳುವರು
- ಪರಿಸರದ ಬಗ್ಗೆ ಅರಿತುಕೊಳ್ಳುವರು
- ಪ್ರಬಂಧ ಸಾಹಿತ್ಯವನ್ನು ಗ್ರಹಿಸಿಕೊಳ್ಳುವರು.

ಘಟಕ – 1, ಜೀವನ ಕಲೆ

- 1) ಜಲಗಾರ : ಕುವೆಂಪು

ಘಟಕ – 2, ಕನಸು

- 1) ಅಕ್ಕ ಕೇಳವ್ವ ನಾನೊಂದು ಕನಸು ಕಂಡೆ : ಅಕ್ಕ ಮಹಾದೇವಿ
2) ಶವದ ಮನೆ : ಚದುರಂಗ
3) ರಂಗಣ್ಣನ ಕನಸಿನ ದಿನಗಳು : ಎಸ್.ವಿ ರಂಗಣ್ಣ

ಘಟಕ – 3, ಮಳೆ

- 1) ಮುಕ್ಕಣ್ಣ ಮಳೆ ಕರುಣಿಸೋ : ಜನಪದ ಕಾವ್ಯ
2) ತೆಂಕಣಗಾಳಿಯಾಟ : ಪಂಜೆ ಮಂಗೇಶರಾಯರು
3) ಅಮೆಜಾನ್ ಮಳೆಕಾಡಿಗೆ ಅಗ್ನಿ ಪರೀಕ್ಷೆ : ಟಿ. ಆರ್ ಅನಂತರಾಮು

ಘಟಕ – 4, ಭಾಷಾ ಭಾಗ

- 1) ಗಾದೆ, ಸ್ವರೂಪ ಲಕ್ಷಣ
2) ಪ್ರಬಂಧ, ಸ್ವರೂಪ ಲಕ್ಷಣ
3) ಸರ್ಕಾರಿ ಪತ್ರ ವ್ಯವಹಾರ, ಅಧಿಕೃತ, ಅರೆ ಅಧಿಕೃತ ಪತ್ರಗಳು

ಹೆಚ್ಚಿನ ಓದಿಗಾಗಿ:

- 1) ಕುವೆಂಪು ಸಂಚಯ – ಡಾ.ಪ್ರಧಾನ್ ಗುರುದತ್ತ
2) ಕನ್ನಡದ ಅತ್ಯುತ್ತಮ ಸಣ್ಣ ಕತೆಗಳು – ನರಸಿಂಹ ಮೂರ್ತಿ

Language 2 – Part II French II

L	T	P	C
3	0	0	3

Course Objectives:

- The students are taught to interact in a simple way provided the other person talks slowly and clearly and is prepared to help.

Course Outcomes:

After successful completion of the course, students will be able to

1. Gain an appreciation and understanding of the diversity of the Francophone world within the broader framework of multicultural communities and global perspectives.
2. Comprehend and respond with grammatical accuracy to spoken and written French as well as demonstrate cultural awareness.

Unit 1

1. Engage in a simple buy-and-sell situation

Unit 2

1. Ask about the day, the time and the date
2. Accept and refuse

Unit 3

1. Read simple notices, posters and catalogs

Unit 4

1. Fill in a simple form
2. Write a simple postcard

References:

1. Verma Rashmi, 2020. French Made Easy published by Goodwill Publishing House.
2. Kendris Christopher, 2011. Barron'S Foreign Language Guides - 501 French Verbs (with CD) published by Goyal Publishers & Distributors Pvt. Ltd.

AECC 01 - Environmental Studies

L	T	P	C
3	0	0	3

Course Objectives:

1. To identify and solve the environmental problems.
2. To avoid environmental pollution & Global Problems.
3. To create awareness among the people about the protection of the environment.

Course Outcomes:

After successful completion of the course, students will be able to

1. Get knowledge about the different types of resources like land, water, mineral and energy.
2. Gain knowledge about the different types of pollutions and their control technologies.
3. Get information about the ecosystem and about its functions like Food chain, Ecological pyramids etc.

Theory

Unit I: Introduction to environmental studies - Multidisciplinary nature of environmental studies; Scope and importance of environmental studies, Ecosystems, Structure and function of the ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystem: Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, rivers, oceans). Natural Resources: Renewable and Non-renewable Resource, Land resources and land-use change; Land degradation, soil erosion and desertification. Water: Use and over-exploitation of surface and groundwater, conflicts over water (international & interstate). Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources.

Unit-II: Biodiversity and Conservation- Levels of biological diversity: genetic, species and ecosystem diversity; values of biodiversity Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots, India as a mega---biodiversity nation; Endangered and endemic species of India, Threats to biodiversity: Habitat loss, poaching of wildlife, man---wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit-III: Environmental Pollution & Policies - Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution, Nuclear hazards and human health risks, Solid waste management, climate change, global warming, ozone layer depletion, acid rain, Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).

Unit-IV: Human Communities and the Environment - Human population growth: Impacts on environment, human health and welfare. Resettlement and rehabilitation project-affected persons; case studies. Disaster management: floods, earthquakes, cyclones and landslides. Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi). Fieldwork activities (Study of simple ecosystems)

References

1. Textbook of Environmental Studies for undergraduate courses by Erach Bharucha.
2. Deswal, S. and Deswal, A. 2005. A Basic Course in Environmental Studies. Dhanpat Rai & Co Ltd., Delhi.
3. Singh, N. and Sontakke, N.A. 2002. On Climatic fluctuations and Environment changes on Indo-Gangetic Plains, India.
4. Deswal, S. and Deswal, A., 2003, Energy, ecology, Environment and Society, Dhanpat Rai & Co Ltd., Delhi.
5. Singh, G.B. and Sharma, B.R. 1998. Fifty Years of Natural Resource Management Research, Indian Council of Agriculture Research, New Delhi.

Activity Based Course 01 – Laboratory Management

L	T	P	C
0	0	2	2

Course Objectives:

- To introduce students to setting up of laboratories
- To create awareness on hazardous and safety precautions in labs
- To provide necessary skills to handle basic lab equipment

Course Outcomes:

After successful completion of the course, students will be able to

1. Handle basic lab equipment at ease
2. Create stock registers of consumables and equipment
3. Prepare necessary reagents and buffers required for testing and research
4. Develop independent entrepreneurs to run their own laboratories

Practical for Activity Based Course: Laboratory Management

1. Safety measures in laboratories
2. Preparation of Buffers and reagents
3. Handling of stock registers and raising indents
4. pH Meters, Microscopy, Autoclave, Hot air oven, Centrifuges
5. Preparation of reports
6. Laboratory waste management

Semester Three

DSC 05 - Microbiology

L	T	P	C
3	0	2	5

Course Objectives:

- To introduce students to the basics of microbiology, and demonstrate the necessary microbial laboratory skills
- To create awareness on microbes and their characteristics
- To introduce the medical and industrial potentials of microbes

Course Outcomes:

After successful completion of the course, students will be able to

1. Define & develop an understanding the basic principles of microbiology, demonstrate appropriate laboratory skills in isolation and identification of microorganisms and perform aseptic techniques to control them.
2. Evaluates the physiological and genetic characteristics of microorganisms.
3. Recognizes the role of different microorganisms in causing diseases and understand their control and management in health.
4. Explains the impact of Microorganisms in Food processing.

Theory

Unit-I: Introduction to microbiology: Scope, History & Development of Microbiology (important discoveries by Robert Koch, Leeuwenhoek, Jenner, Pasteur, Fleming, Iwanosky). Classification of Microorganisms: Morphology, Ultra structure & Reproduction (Bacteria, Virus, Fungi, Algae), Concept of taxonomy, species, strain, nomenclature and Bergey's manual. Microscopy: Light Microscopy: Bright-field, Dark-field, Phase-Contrast, Fluorescence. Electron Microscopy: SEM & TEM. Microbial Techniques: Pure culture techniques, Staining techniques, Enumeration of Microorganism, Characterization of microorganisms.

Unit-II: Microbial Physiology & Genetics: Microbial nutrition - Nutritional classes of microorganisms, Common nutrient requirements, Culture media & preservation of culture. Sterilization Techniques: Heat, Steam, Radiation, Filtration & Chemical. Microbial growth pattern and methods of growth measurements- Growth curve, Factors affecting growth, measurement of growth.

Unit-III: Medical microbiology - Common Microbial Diseases and their control. Bacterial: Typhoid, Tuberculosis, Cholera, Leprosy, Syphilis & Diarrhea; Virus: AIDS, Hepatitis, SARS, Polio & Rabies; Fungal: Candidiasis, Mycoses. Antibiotics: Types, mode of action, resistance to antibiotics. Genes, mutation and mutagenesis: UV and chemical mutagens, types of mutations. Bacterial genetic system: transformation, conjugation, transduction.

UNIT-IV: Food microbiology - Principles of microbial spoilage of food, Methods of food preservation by physical (freezing, canning, pasteurization and irradiation) and chemical (preservatives, lactic antagonism) methods. Microbial food poisoning (botulism, mycotoxins, algal toxins, cholera and salmonellosis)

Practical 05 - Microbiology

1. Microscopy
2. Sterilization Techniques & sterilization of Media, Glass wares.
3. Media Preparation (solid & liquid).
4. Isolation & Enumeration of Microorganism from water and Soil.
5. Types of culture method: Streak plate, Pour plate, Stab & Slant preparation.
6. Staining Techniques–Simple staining, Gram's staining,
7. Characterization of microorganisms -IMVIC tests.
8. Antibiotic Susceptibility Testing.

References:

1. Dubey, RC and Maheswari DK., 2005. A Textbook of Microbiology. S. Chand & Company Ltd., New Delhi.
2. Sundara Rajan S., 2003. College Microbiology. Volume 172. Revised Edition, Vardhana Publications, Bangalore.
3. Pelczar Tr. MJ, Chan ECS & Kreig NR., 2006. Microbiology Fifth Edition, Tata McGraw- Hill Companies Ltd.
4. Prescott LM, Harley JP and Klein DA., 2005. Microbiology, 6th International Edition, McGraw Hill companies Ltd.

DSC 06 - Molecular Biology & Techniques

L	T	P	C
3	0	2	5

Course Objectives:

- To introduce the molecular aspects and functioning of biological systems.
- To provide insight into the mechanisms associated with gene expression and genetic engineering.
- To enhance the problem-solving abilities based on molecular biology.

Course Outcomes:

After successful completion of the course, students will be able to

1. Understand in detail the structure and functions of nucleic acids and proteins.
2. Understand the concepts of central dogma of life, DNA repair mechanisms and recombination processes.
3. Acquire comprehensive knowledge on the molecular mechanisms underlying the regulation of gene expression.
4. Utilize the acquired knowledge as the basis for understanding the concepts of genetic engineering.

Theory

Unit-I: Nucleic acids - Organization of genome; Concept of Gene, Structure, types and functions of DNA and RNA, Ribozymes. DNA as genetic material – Griffith, Avery MacLeod and McCarty, Hershey and Chase experiments; RNA as genetic material; Experiment to prove semiconservative mode of replication. DNA replication in prokaryotes and eukaryotes; Unidirectional and bidirectional DNA replication; Enzymology of replication; Polymerase chain reaction.

Unit-II: Central dogma and regulation of gene expression - Gene as the unit of expression - Co linearity, Transcription, post-transcriptional modifications (mRNA, tRNA, rRNA), transcriptional regulation in prokaryotes (operon concept-lac operon) and eukaryotes, inhibitors of transcription; RNA interference. Translation – Elucidation of Genetic Code, Translation of protein – post-translational modifications and folding of newly assembled polypeptides, translational regulations, signal sequences and protein export. Gene expression – qPCR.

Unit-III: Gene mutation – types of mutations- spontaneous and induced mutations; Physical and chemical mutagens; Ames test for mutation; Types of DNA damage – Endogenous and Exogenous damage; types of DNA repair mechanisms – base excision repair, Nucleotide excision repair, photo reactivation excision repair, post-replication recombinant repair, SOS repair.

Unit-IV: Recombination - Homologous and non-homologous recombination, transposition – types, transposable elements, site-specific recombination. Genetic exchange – bacterial transformation, transduction, conjugation and their mapping.

Practical 06 - Molecular Biology & Techniques

1. Isolation of Genomic DNA from plant tissue.
2. Isolation of total RNA from sample.
3. Isolation of Plasmid from E.coli.
4. PCR.
5. Agarose gel electrophoresis.
6. Restriction digestion of plasmid DNA.
7. Bacterial transformation.
8. SDS-PAGE.

References

1. Gerald Karp, Janet Iwasa, Wallace Marshall, 2019. Karp's Cell and Molecular Biology, Ninth Edition, Wiley.
2. Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick. 2018. Lewin's Gene XII – 12th Edition, Jones & Bartlett.
3. James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard, 2013. Molecular Biology of the gene, 7th edition, Pearson.
4. Joseph Sambrook, E F Fritsch, Tom Maniatis, 2003. Molecular cloning: A laboratory manual, Cold spring harbor laboratory.
5. Susan Carson, Heather B. Miller, D. Scott Witherow, Melissa C. Srougi, 2019. Molecular Biology Techniques-A Classroom Laboratory Manual, Fourth Edition, Academic Press.

OEC 03 – Nutraceutical Biotechnology

L	T	P	C
3	0	0	3

Course Objectives:

- To introduce the students to nutraceuticals and its role in human diseases
- To help understand the concepts of specialty nutraceuticals originated from plant, animal, microbial and algal resources.
- To provide insights to the scope and growth of nutraceutical industry

Course Outcomes:

After successful completion of the course, students will be able to

1. Explore the importance of nutraceuticals and its applications in current scenario.
2. Gain knowledge of specialty nutraceuticals of plant and animal origin for human welfare.
3. Understand the concepts of using microbial and algal products as nutraceuticals.
4. Explore the scope of nutraceutical biotechnology in industries.

Theory

Unit-I: Introduction to Nutraceutical- Organizational elements, classification of nutraceuticals, dietary supplements, fortified foods, functional foods and phytonutracuticals. Scope involved in the industry, Indian and global scenario.

Role of nutraceuticals with special reference to diabetes mellitus, hypertension, hypercholesterolemia, cancer, glands in the prevention and treatment. Concept of antioxidants - use of antioxidants as dietary supplements in prevention and treatment of cancer, obesity and stress. Role of nutraceuticals and functional foods in pediatrics, geriatrics, sports, pregnancy and lactation.

Unit-II: Nutraceuticals of plant and animal origin: Plant secondary metabolites, classification and sub-classification - Alkaloids, phenols, Terpenoids. Extraction and purification, applications with specific examples with reference to skin, hair, eye, bone, muscle, heart, brain, liver, kidney, general health and stimulants. Concept of cosmoceuticals and aquaceuticals.

Animal metabolites - Sources and extraction of nutraceuticals of animal origin. Examples: chitin, chitosan, glucosamine, chondroitin sulphate and other polysaccharides of animal origin, uses and applications in preventive medicine and treatment.

Unit-III: Microbial and algal nutraceuticals: Concept of prebiotics and probiotics – principle, mechanism, production and technology involved, applications – examples of bacteria used as probiotics, use of prebiotics in maintaining the useful microflora – extraction from plant sources. Synbiotics for maintaining good health. Algae as source of omega – 3 fatty acids, antioxidants and minerals – extraction and enrichment.

Unit-IV: Biotechnology in Phytonutraceuticals: Role of medicinal and aromatic plants in nutraceutical industry – propagation - conventional and tissue culture, cultivation, post-harvest technology and strategies for crop improvement, development of high yielding lines and yield enhancement, plant genomics and metabolomics. Introduction to nanobiotechnology with special reference to nutraceuticals. Biofortification and nutritional enhancement. GM foods with enhanced nutraceutical properties. Golden rice, GM Tomatoes.

References

1. Israel Goldberg (Ed.) (1999) Functional foods, designer foods, pharma foods, Nutraceuticals, Aspen publishers Inc., USA
2. L. Rapport and B. Lockwood (2002) Nutraceuticals, 2nd Edition, Pharmaceutical Press.
3. M. Maffei (Ed.) (2003) Dietary Supplements of Plant Origin, Taylor & Francis
4. Shahidi and Weerasinghe (Ed.) (2004) Nutraceutical beverages Chemistry, Nutrition and health Effects, American Chemical Society
5. Richard Neeser & J. Bruce German (2004) Bioprocesses and Biotechnology for Functional Foods and Nutraceuticals, Jean, Marcel Dekker, Inc.
6. Timothy S. Tracy, Richard L. Kingston (1995) Herbal Products
7. Young, J. (1996) Functional Foods: Strategies for successful product development. FT Management Report Pearson Professional Publishers, London.
8. Frei, B. (1994) Natural antioxidants in human health & disease. Academic Press
9. San Diego, Tannock, G.W. (1999) Probiotics: A critical review, Horizon Scientific Press, UK.
10. H. Panda, Herbal beauty products with formulation & processes
11. H. Panda, Herbal Drugs & its plant Sources

Language 1 – Part I English III

L	T	P	C
3	0	0	3

Course Objectives:

- Learn the importance of Superfluous Expressions otherwise known as redundant or unnecessary expressions.
- Learn to use Active and Passive Voice in speech and writing and understand them.

Course Outcomes:

After successful completion of the course, students will be able to

1. Add variety to their writing through the use of conjunctions and articles so that they can be used to create sentences with different styles and meanings.
2. Add flexibility in their language by proper use of Active and Passive voice.
3. Successfully remove redundant and superfluous expressions in their speech and writing.
4. Express nuances in meaning by using modal auxiliary verbs.

Unit-I: Grammar

1. Correct use of Conjunctions
2. Correct use of Articles
3. Superfluous Expressions and commonly mispronounced words in English
4. Active and Passive Voice
5. Modal Auxiliaries
6. Reading Comprehension Passage

Unit-II: Vocabulary

1. Roots: M to R
2. Homonyms, homophones and homographs
3. Figures of Speech: Hyperbole, Euphemism, Onomatopoeia, Personification
4. Foreign expressions

Unit-III: Creative Writing

1. Paragraph writing
2. Précis Writing

Unit-IV: Essay

Sardar Vallabhi Bhai Patel's letter to Nehru after drafting the Constitution.

References:

1. Sudhir S Padhye, 2017. English Grammar and Writing Skills, Notion Press
2. S.P Bakshi, Richa Sharma, 2017. Descriptive English, Arihant Publication

L	T	P	C
3	0	0	3

Course Objectives:

- Critically analyze American, Anglo American, Neoclassical and Victorian Poetry.
- Learn about the importance of historical fiction and diary entries.

Course Outcomes:

After successful completion of the course, students will be able to

1. Think and ponder about the plight of not only Jewish refugees but refugees all over the world and raise broader questions about isolation, loneliness, and exile.
2. Understand and appreciate the revolutionary and patriotic spirit of Bhagat Singh's last three years (1929-31) in Lahore's Central Jail, through Bhagat Singh's jail diary.
3. Learn about several life-changing lessons like revengeful instinct can only lead to one's doom and not to give up on life despite all hurdles.

Unit-I: American and Anglo American Poetry

1. "The Road Not Taken" by Robert Frost
2. "Refugee Blues" by W H Auden

Unit-II: Neoclassical and Victorian Poetry

1. "On His Blindness" by John Milton
2. "The Last Duchess" by Robert Browning

Unit-III: Drama, Historical Fiction and Diary Entries

1. "The Proposal" by Anton Chekov
2. "Remember the Roses" by Avery Taylor
3. Bhagat Singh's jail diary

Unit-IV: Epic Literature

"The Mahabharata"

References:

1. Chekhov Anton, 2017. The Very Best of Anton Chekov - Short Stories published by Embassy Books.
2. Sandhu Yadvinder Singh, 2020. Bhagat Singh's Jail Diary, Prabhat Prakashan.
3. Frost Robert, 1993. The Road Not Taken and Other Selected Poems, Wilder Publications.

L	T	P	C
3	0	0	3

ಸಾಹಿತ್ಯ ಸಿಂಚನ – 3

ಅಧ್ಯಯನದ ಉದ್ದೇಶ

- ವಿದ್ಯಾರ್ಥಿಗಳಲ್ಲಿ ಜನಪದ ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಒಲವು ಮೂಡಿಸುವುದು
- ಪ್ರವಾಸ ಸಾಹಿತ್ಯದ ಪ್ರಾಮುಖ್ಯತೆಯ ಬಗ್ಗೆ ತಿಳಿಸಿಕೊಡುವುದು
- ವೈಚಾರಿಕತೆಯ ಪ್ರಸ್ತುತತೆಯ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು
- ಶಿವರಾಮ ಕಾರಂತರ ಬದುಕು ಬರವಣಿಗೆಯ ಬಗ್ಗೆ ಹೆಚ್ಚಿನ ಓದಿಗೆ ಅನುವು ಮಾಡಿಕೊಡುವುದು
- ಲೇಖನ ಚಿಹ್ನೆಗಳ ಪ್ರಾಮುಖ್ಯತೆಯ ಬಗ್ಗೆ ತಿಳಿಸಿಕೊಡುವುದು.

ಅಧ್ಯಯನದ ಫಲಿತಗಳು

- ವಿದ್ಯಾರ್ಥಿಗಳು ಜನಪದ ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಒಲವು ಹೊಂದುವರು
- ಪ್ರವಾಸ ಸಾಹಿತ್ಯದ ಪ್ರಾಮುಖ್ಯತೆಯ ಬಗ್ಗೆ ತಿಳಿದುಕೊಳ್ಳುವರು
- ವೈಚಾರಿಕತೆಯ ಪ್ರಸ್ತುತತೆಯ ಬಗ್ಗೆ ವಿಸ್ತಾರ ಜ್ಞಾನ ಪಡೆಯುವರು
- ಶಿವರಾಮ ಕಾರಂತರ ಬದುಕು ಬರಹದ ಬಗ್ಗೆ ಹೆಚ್ಚಿನ ಜ್ಞಾನ ಪಡೆವರು
- ಲೇಖನ ಚಿಹ್ನೆಗಳ ಪ್ರಾಮುಖ್ಯತೆಯ ಬಗ್ಗೆ ತಿಳಿದುಕೊಳ್ಳುವರು

ಘಟಕ – 1, ಮಾನವೀಯತೆ

- 1) ಸತ್ಯ ಶರಣೆ ಸಂಕಮ್ : ಡಾ. ಪಿ.ಕೆ. ರಾಜಶೇಖರ
- 2) ಚಂದ್ರಮತಿಯ ಪ್ರಲಾಪ : ರಾಘವಾಂಕ
- 3) ಅಮ್ಮ ಹೇಳಿದ ಎಂಟು ಸುಳ್ಳುಗಳು : ಮಣಿಕಾಂತ್ ಎ.ಆರ್

ಘಟಕ – 2, ಪ್ರವಾಸ ಸಾಹಿತ್ಯ

- 1) ನನ್ನ ಗ್ರಹಿಕೆಯ ನೇಪಾಳ : ನಾಗತಿಹಳ್ಳಿ ಚಂದ್ರಶೇಖರ್

ಘಟಕ – 3, ವಿಚಾರ ಕ್ರಾಂತಿ

- 1) ಕತ್ತೆ ಮತ್ತು ಧರ್ಮ : ಡಾ. ಸಿದ್ದಲಿಂಗಯ್ಯ
- 2) ವೈಚಾರಿಕತೆ : ಎಚ್. ನರಸಿಂಹಯ್ಯ
- 3) ನಮ್ಮ ಅಳತೆಯನ್ನು ಮೀರಲಾರದ ದೇವರು : ಡಾ.ಕೆ. ಶಿವರಾಮ ಕಾರಂತ

ಘಟಕ – 4, ಭಾಷಾ ಭಾಗ

- 1) ಸುತ್ತೋಲೆ
- 2) ಕಡತ (ಫೈಲುಗಳು) ಕಛೇರಿ ಟಿಪ್ಪಣಿಗಳು
- 3) ಲೇಖನ ಚಿಹ್ನೆಗಳು

ಹೆಚ್ಚಿನ ಓದಿಗಾಗಿ:

- 1) ಹೊನ್ನಾರು ಜನಪದ ಗೀತೆಗಳು – ಡಾ. ಪಿ.ಕೆ. ರಾಜಶೇಖರ
- 2) ಅಮ್ಮ ಹೇಳಿದ ಎಂಟು ಸುಳ್ಳುಗಳು: ಮಣಿಕಾಂತ್ ಎ.ಆರ್
- 3) ತೆರೆದ ಮನ – ಡಾ. ಎಚ್ ನರಸಿಂಹಯ್ಯ
- 4) ಆಡಳಿತ ಕನ್ನಡ – ಎಚ್‌ಎಸ್‌ಕೆ

Language 2 – Part II French III

L	T	P	C
3	0	0	3

Course Objectives:

- This course aims to enable the learners to understand sentences and frequently used expressions related to areas of most immediate relevance (e.g. very basic personal and family information, shopping, local geography, employment).

Course Outcomes:

After successful completion of the course, students will be able to

1. Understand sentences and frequently used expressions related to areas of most immediate relevance (e.g. local geography, employment, accommodation, health and illness)
2. Understand short, simple texts, incl. letters and everyday material (e.g. advertisement, menus, magazine articles, hotel webpages) related to areas of most immediate relevance (e.g. local geography, employment, holidays, consulting a doctor)
3. Communicate verbally in simple and routine tasks requiring simple and direct exchange of information on familiar and routine matters (e.g. asking where places are, finding your way around, visiting the doctor, renting an apartment)

Unit 1

1. Talk about yourself, your educational background, your job, your family, your neighborhood
2. Talk about your hobbies and daily activities

Unit 2

1. Ask for goods in a shop where goods are displayed
2. Order a meal in a restaurant if dishes are either displayed or illustrated on the menu

Unit 3

1. Book a hotel room (face to face)
2. Ask for basic services in a post office or bank

Unit 4

1. Indicate the nature of a medical problem to a doctor
2. Make inquiries about a journey at a travel agency

References:

1. Makowski Francois, 1995. Beginners French Made Easy with CD, Goyal Publishers & Distributors Pvt. Ltd.
2. Cantel JB., 1860. The Pronunciation of French Made Easy, Nabu Press

AECC 02 - Indian Constitution

L	T	P	C
2	0	0	2

Course Objectives

- The course aims to imbue students with the process of constitutional making and its formulations. Further, it is offered with the objective to acquaint students to have the basic understanding of the constitution of India.

Unit I: Constitution – Structure and Principles

- Meaning and importance of Constitution
- Making of Indian Constitution
- Salient features of the Constitution

Unit II: Fundamental Rights and Directive Principles

- Fundamental Rights
- Fundamental Duties
- Directive Principles

Unit III: The Union Government

- President of India – Election & Powers
- Prime Minister and Council of Ministers
- Lok Sabha – Composition and Powers
- Rajya Sabha - Composition and Powers

Reference:

- 1) Durga Das Basu, Introduction to the Constitution of India, Gurgaon; LexisNexis, 2018 (23rd edn.)
- 2) M. V. Pylee, India's Constitution, New Delhi; S. Chand Pub., 2017 (16th edn.)
- 3) J.N. Pandey, The Constitutional Law of India, Allahabad; Central Law Agency, 2018 (55th edn.)
- 4) Constitution of India (Full Text), India. Gov. in., National Portal of India, https://www.india.gov.in/sites/upload_files/npi/files/coi_part_full.pdf
- 5) Durga Das Basu, Bharatada Samvidhana Parichaya, Gurgaon; Lexis Nexis Butter worths Wadhawa, 2015.
- 6) Kb Merunandan, Bharatada Samvidhana Ondu Parichaya, Bangalore, Meragu Publications, 2015.

SEC 02 – Artificial Intelligence

L	T	P	C
2	0	0	2

Course Objectives:**Course Outcomes:**

After successful completion of the course, students will be able to

Curriculum awaited from GoK

Semester Four

DSC 07 - Instrumentation Techniques

L	T	P	C
3	0	2	5

Course Objectives:

- To demonstrate the techniques and aspects aiding instrumentations
- To provide insight into the associated physics and chemistry of instrumentations
- To enhance the spectroscopic and chromatographic skills of students

Course outcomes:

After successful completion of the course, students will be able to

1. Illustrate the basic principle and techniques to understand the biological problem.
2. Identify the physical principles responsible for maintaining the basic cellular function.
3. Appraise the importance of various biophysical techniques.
4. Practice the techniques of Chromatography and Spectroscopy techniques.

Theory

Unit-I: Chromatographic techniques - General principles, Sample preparation, Selection of chromatographic system, Low pressure column chromatography, HPLC, Adsorption chromatography, Partition chromatography, Ion exchange chromatography, Exclusion chromatography, Affinity chromatography, GLC, TLC, Paper chromatography.

Unit-II: centrifugation techniques - Introduction, Basic principles of sedimentation, Types of centrifuges and their uses, Preparative and density gradient separation, Analytical ultracentrifuges and their applications.

Unit-III: Electrophoretic techniques - General principles, Support media, Native gels, SDS-PAGE, Isoelectric Focusing, 2D gel electrophoresis, Agarose gel electrophoresis, Pulse field gel electrophoresis, Capillary electrophoresis. Radioisotope techniques: Nature of radioactivity, detection and measurement, GM counter, scintillation counting, Safety aspects and applications of radioisotopes in biology.

Unit-IV: Spectroscopic techniques - Introduction, UV and visible light spectroscopy, IR and Raman spectroscopy, Electron Spin Resonance (ESR), NMR, Spectrofluorometry, Luminometry, Atomic absorption spectrophotometry, X-ray diffraction, Optical Rotatory Dispersion, Circular Dichroism. Mass spectrometric techniques: Introduction, mass spectrometer and applications.

Practical 07 - Instrumentation Techniques

1. Preparation of buffers and solutions.
2. Paper chromatography.
3. Thin Layer Chromatography.
4. High Speed centrifugation.
5. Determination of Plant phenolic and ascorbic acid.
6. Electrophoresis
7. Quantitative estimation of Amino Acids by Ninhydrin.
8. Qualitative analysis of carbohydrates.

References

1. Biophysical Chemistry –Principles and techniques-A, Upadhaya – Himalaya pub.
2. Nuclear and Radio chemistry -3 rd ed. Gerhan Fried Lander John Wiley and sons,
3. Basic concepts of analytical chemistry 2nd ed. S.N. Khopkar. New Age Pub.
4. Principles of instrumental analysis. Da Skooge Holt –Saunders, 1985.
5. Text Book of Biochemistry with Clinical Correlations - Thomas M. Devlin (ed) (Wiley-Liss) - 4th Edition

DSC 08 – Genetics & Model Organisms

L	T	P	C
3	0	2	5

Course Objectives:

- To introduce the students to molecular basis of cellular functioning
- To help understand the concepts and mechanisms underlying the gene-to-protein phenomena
- To provide insights to the triple-codon basis of gene expression

Course Outcomes:

After successful completion of the course, students will be able to

1. Learn how four sequences (3 letter codons) generate the transcripts of life and determine the phenotypes of organisms.
2. Be familiar with the basic principle of life, how a cell divides leading to the growth of an organism and reproduces to form new organisms.
3. Possess a detailed and conceptual understanding of molecular processes viz. DNA to trait
4. Possess in-depth knowledge on functioning of organelles, underlying mechanism of development of organisms.
5. Understand how genes are regulated differently at different time and place in prokaryotes and eukaryotes.

Theory

Unit-I: History of Genetics - Mendelian Principles, Segregation, Independent Assortment, Dominance. Multiple alleles, Pseudo alleles, Incomplete dominance, over dominance and co dominance, complementation test, Gene interaction, Epistasis, penetrance and expressivity, lethality and lethal genes.

Unit-II: Sex - determination and linkage in diploids, linkage and crossing over, gene mapping. Chromosomal theory of inheritance, maternal effects, Chromosomal variation in number, Changes in Chromosomal structure, Chromosomal aberrations, Genetics of Hemoglobin, Transposable elements in prokaryotes and eukaryotes.

Unit-III: Structure of chromosome, fine structure of Gene, cistron and recon, Structure of Eukaryotic gene, Experimental evidence for DNA as the genetic material. Cytoplasmic genetic systems- mitochondria and chloroplast DNA.

Unit-IV: Genetic control of Development in Drosophila and Arabidopsis. Population genetics, calculating gene frequency, factors affecting gene frequency. Genetic drift; Shift, Pedigree analysis and genetic counseling.

Practical 08 - Genetics & Model Organisms

1. Use simple and compound microscopes.
2. Chromosomal aberrations by preparing karyotypes.
3. Chromosomal aberrations inherited in humans by pedigree analysis in families.
4. Prepare a temporary squash of the given material and identify the stage and comment (Mitosis)
5. Temporary squash preparation of a. Onion flower buds b. Grasshopper testes lobes
6. Study of: Flower colour in *Antirrhinum*/ *Mirabilis*, Coat colour in Mice, Comb pattern in Poultry
7. Blood Typing
8. Genetic problems on: Multiple alleles, Gene Interactions (Complementary/ Supplementary/ Dominant Epistasis gene interactions).

References

1. Lodish et al: Molecular Cell Biology (9th Edition): Freeman & Co, USA (2021).
2. Alberts et al: Molecular Biology of the Cell: Garland (2002).
3. Cooper: Cell: A Molecular Approach: ASM Press (2000).
4. Karp: Cell and Molecular Biology: Wiley (2002). Pierce B. Genetics. Freeman (2004).
5. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis KubyKuby Immunology. W H Freeman (2007).
6. Basic genetics by D.L.Hartl, 1991, Jones and Bartett public.
7. Friedfelder 1987, Microbial genetics, Jones and Bartett public.
8. Molecular Biology of the genes 4th Ed. Watson et al, the Benjamin /Cummings coins 1987

OEC 04 - Basics of Forensic Science

L	T	P	C
3	0	0	3

Course Objectives:

- To introduce the students to forensic science and its importance.
- To provide insight into the strategies and techniques used in forensic examination.
- To create scope to understand the legality and scientific approach to forensic challenges.

Course Outcomes:

After successful completion of the course, students will be able to

1. Describe the basic concepts and principle of forensic science.
2. Understand the importance of forensic science in crime identification and analysis.
3. Acquire knowledge on the various strategies and scientific techniques used in forensics.
4. Understand the laws of forensic science and the organizational establishments of forensic laboratories in India.

Theory

Unit-I: Introduction to forensic science - Definition, historical background, principles and laws of forensic science. The need, importance and scope of forensic science; Organizational structure of central and state level forensic science laboratories in India - Bureau of police research and development (BPR&D), Directorate of Forensic Science Services (DFSS), National crime records bureau (NCRB), Fingerprint Bureaus, Central forensic science laboratory (CFSL); Services of forensic laboratories.

Unit-II: Crime scene and Forensic examination - Crime - Definition and causes of crime; Types of crime – violent crimes, property crimes, hate crimes, organized and virtual crimes, cyber-crime; prevention of crime; criminal behavior; criminal justice system.

Forensic investigation: crime scene; processing the crime scene - photography, sketch, chain of custody, crime scene search and evidence collection – physical and trace evidence, Evidence packaging; Analysis of evidence, Crime-scene safety and legal considerations, Forensic reports.

Unit-III: Scope and specialized fields of forensic science - Forensic pathology, forensic anthropology, Forensic chemistry, Forensic serology, Forensic dentistry, Digital forensics, Forensic engineering, Forensic toxicology, forensic psychiatrists. Questioned document examiners, Education and training of forensic scientists, Duties and code of conduct for forensic scientist.

Unit-IV: Scientific methods and techniques used in Forensic analysis - Principle and applications of Microscopy – compound microscope, electron microscope; UV visible spectroscopy, Chromatography -GC and TLC; Electrophoresis; Autopsy, DNA – the forensic science tool, structure of DNA, DNA replication, Short Tandem Repeats (STR), DNA fingerprinting; Forensic databases – fingerprint databases, DNA databases.

References:

1. Richard Saferstein, 2018. Criminalistics - An Introduction to Forensic Science, 12th Edition, Pearson.
2. Andrew R.W. Jackson and Jackson JM., 2017. Forensic science, Fourth Edition, Pearson.
3. Max M. Houck, Siegel JA., 2015. Fundamentals of Forensic Science, 3rd edition, Elsevier.
4. Max M. Houck, 2007. Forensic Science. Modern Methods of Solving Crime, Praeger.

Language 1 – Part I English IV

L	T	P	C
3	0	0	3

Course Objectives:

- Know the importance of CV Writing to display skills, education and work history.
- Build confidence and fluency, assess progress, and put learning into action by enacting role-plays.
- Boost conversational English skills by using idioms and proverbs.

Course Outcomes:

After successful completion of the course, students will be able to

1. Express certain ideas or opinions and improve creative writing by using idioms and proverbs.
2. Improve their interview preparation skills.
3. Create engaging and well-thought essays on current and relevant topics.
4. Understand that one should never be content with what is, nor consider oneself an expert, which is the message of Steve Jobs's "Stay Hungry, Stay Foolish".

Unit - I: Grammar

1. Report Writing (Magazine Report, News Report)
2. Preparing CV's and Facing Interviews: Do's and Don'ts.
3. Role Plays
4. Reading Comprehension Passage

Unit - II: Vocabulary

1. Roots: S to Z
2. Figures of speech: Pun, Oxymoron, Irony, Antithesis
3. Idioms and Proverbs
4. Phrasal Verbs

Unit - III: Creative Writing

1. Story Writing
2. Essay writing

Unit - IV: Essay

"Stay Hungry Stay Foolish", by Steve Jobs

References:

1. Hundiwala S. (2012) Facing the Corporate Interviews Useful and Time-Tested Tips for Job Interviews in Multinational Companies published by Arihant Publishers.
2. Malhotra Jyoti (2014) IELTS - Vocal Cosmetics published by V&S publisher.
3. Bell James Scott (2017) How to Write Short Stories and Use Them to Further Your Writing Career.
4. Mitra Bashu (2006) Encyclopaedia of Idioms and Proverbs published by Anmol Publications Pvt Ltd.

Language 2 – Part II English IV

L	T	P	C
3	0	0	3

Course Objectives:

- Learn about Modern and Post-Modern literature.
- Learn about the glory of the Vijayanagara Empire through chronicles of Paes.
- Learn about racial discrimination through African American writings.

Course Outcomes:

After successful completion of the course, students will be able to

1. Understand and critically appreciate the century-old conflict between the Ruling class and the Artist community through “The Burning of the Books” by Bertolt Brecht
2. Comprehend that any person who is oppressed or "caged" will always continue to "long" for freedom, knowing that if others are entitled to it, they should be entitled to it, too through Maya Angelou's poem I Know Why a Caged Bird Sings.
3. Appreciate the glory of the Vijayanagara Empire through the travelogues of Paes.

Unit-I: Poetry from the Modern and Post-Modern periods

1. “The Burning of the Books” by Bertolt Brecht
2. “Birches” by Robert Frost

Unit-II: British and African American Literature

1. “Ah, Are You Digging on My Grave?” by Thomas Hardy
2. “I Know Why a Caged Bird Sings” by Maya Angelou

Unit-III: Indian English Literature, Travelogues and French Prose

1. “Eidgaah” by Munshi Prem Chand
2. Chronica dos reis de Bisnaga’ (Chronicles of the Vijayanagara Empire) by Paes
3. “La Parure” or “The Necklace” by Guy de Maupassant

Unit IV: British Drama

“The Dear Departed” by Stanley Houghton

References:

1. Robert Frost (1993) The Road Not Taken, Birches, and Other Poems published by Coyote Canyon Press.
2. Munshi Prem Chand (1969) Selected Short Stories published by Maple Press.
3. Guy De Maupassant (1992) The Necklace and Other Stories published by Vishv Books Private. Ltd.
4. Stanley Houghton (2018) The Dear Departed published by Palala Press.

Language 2 – Part II Kannada IV

L	T	P	C
3	0	0	3

ಸಾಹಿತ್ಯ ಸಿಂಚನ – 4

ಅಧ್ಯಯನದ ಉದ್ದೇಶ

- ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ದಮನಿತ ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು
- ವಚನ ಸಾಹಿತ್ಯದ ವೈಶಿಷ್ಟ್ಯಗಳ ಬಗ್ಗೆ ತಿಳಿಸಿಕೊಡುವುದು
- ಮಹಿಳಾ ಸಾಹಿತ್ಯದ ಪ್ರಸ್ತುತತೆಯ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು
- ಶ್ರೀ ಸಾಮಾನ್ಯರ ಬದುಕು ಬವಣೆಯ ಬಗ್ಗೆ ತಿಳಿದುಕೊಳ್ಳಲು ಅನುವು ಮಾಡಿಕೊಡುವುದು
- ಕನ್ನಡ ಮತ್ತು ಗಣಕ ವಿಜ್ಞಾನದ ಪ್ರಾಮುಖ್ಯತೆಯ ಬಗ್ಗೆ ತಿಳಿಸಿಕೊಡುವುದು.

ಅಧ್ಯಯನದ ಫಲಿತಗಳು

- ವಿದ್ಯಾರ್ಥಿಗಳು ದಮನಿತ ಸಾಹಿತ್ಯದ ಬಗ್ಗೆ ಅರಿತುಕೊಳ್ಳುವರು
- ವಚನ ಸಾಹಿತ್ಯದ ವೈಶಿಷ್ಟ್ಯಗಳ ಬಗ್ಗೆ ತಿಳಿದುಕೊಳ್ಳುವರು
- ಮಹಿಳಾ ಸಾಹಿತ್ಯದ ಪ್ರಸ್ತುತತೆಯ ಬಗ್ಗೆ ಅರಿವು ಪಡೆದುಕೊಳ್ಳುವರು
- ಶ್ರೀ ಸಾಮಾನ್ಯರ ಬದುಕು ಬವಣೆಯ ಬಗ್ಗೆ ತಿಳಿದುಕೊಳ್ಳುವರು
- ಕನ್ನಡ ಮತ್ತು ಗಣಕ ವಿಜ್ಞಾನದ ಪ್ರಾಮುಖ್ಯತೆಯ ಬಗ್ಗೆ ಹೆಚ್ಚಿನ ಜ್ಞಾನ ಸಂಪಾದಿಸುವರು

ಘಟಕ – 1, ದಮನಿತ ಲೋಕ

- 1) ಚಂದ್ರಗಿರಿ ತೀರದಲ್ಲಿ : ಸಾರಾ ಅಬೂಬಕ್ಕರ್

ಘಟಕ – 2, ಸಹಿಷ್ಣುತೆ

- 1) ಸಹಿಷ್ಣುತೆ ಸಾರುವ ವಚನಗಳು : ಬಸವಣ್ಣ, ಮಡಿವಾಳ ಮಾಚಯ್ಯ
2) ಕುಲ ಕುಲವೆಂದು ಹೊಡೆದಾಡದಿರಿ : ಕನಕದಾಸರು
3) ಬುರ್ಖಾ : ಫಕೀರ್ ಮಹಮ್ಮದ್ ಕಟ್ಟಾಡಿ

ಘಟಕ – 3, ಶ್ರೀ ಸಾಮಾನ್ಯರ ಬದುಕು

- 1) ಕೊನೆಯ ಗಿರಾಕಿ : ನಿರಂಜನ
2) ವಾಣಿಯ ಸಮಸ್ಯೆ : ಕೊಡಗಿನ ಗೌರಮ್ಮ
3) ಮಾರಿಕೊಂಡವರು : ದೇವನೂರು ಮಹಾದೇವ

ಘಟಕ – 4, ಭಾಷಾಭಾಗ

- 1) ಜಾಹೀರಾತು ಹಾಗೂ ಜಾಹೀರಾತುಗಳ ಮಾದರಿ ರಚನೆ
2) ಕರಪತ್ರ (ಪಾಂಪ್ಲೆಟ್), ಭಿತ್ತಿ ಪತ್ರ (ಪೋಸ್ಟರ್), ಫಲಕ ಬರಹ
3) ಕನ್ನಡ ಮತ್ತು ಗಣಕ ವಿಜ್ಞಾನ, ಕನ್ನಡ ಮತ್ತು ಅಂತರ್ಜಾಲ

ಹೆಚ್ಚಿನ ಓದಿಗಾಗಿ:

- 1) ಸುಳಿ – ಸಾರಾ ಅಬೂಬಕ್ಕರ್
2) ಸಣ್ಣ ಕಥೆಗಳು: ಕಂನಾಡಿಗ ನಾರಾಯಣ
3) ಕನಕ ದಾಸರ ಕೀರ್ತನೆಗಳು ಮತ್ತು ಮುಂಡಿಗೆಗಳ – ಪ್ರೊ. ಸುಧಾಕರ

Language 2 – Part II French IV

L	T	P	C
3	0	0	3

Course Objectives:

- Students are taught to communicate in simple and routine tasks requiring a simple and direct exchange of information on familiar and routine matters.
- Students are taught to describe in simple terms the aspects of his/her background, immediate environment and matters in areas of immediate basic need.

Course Outcomes:

After successful completion of the course, students will be able to

1. Communicate in writing in simple and routine tasks requiring simple and direct communication of information on familiar and routine matters (e.g. applying for a job, booking a room by email, making an appointment)
2. Demonstrate knowledge and understanding of key aspects of the culture of the target language (e.g. food, festivities)
3. Use basic grammar in simple and routine tasks requiring direct communication of information on familiar and routine matters, as well as articulating personal opinions
4. Use high frequency vocabulary related to areas of immediate relevance (e.g. personal and family information, school/work, leisure, general culture).

Unit I

1. Use public transport (buses, trains and taxis)
2. Ask your way and give directions

Unit II

1. Buy tickets
2. Read notices, posters, catalogues, timetables, brochures, menus, advertisements, signs

Unit III

1. Write notes and simple messages
2. Note down times, dates and places from notice boards and announcements

Unit IV

1. Note down instructions and requests such as client orders and delivery dates.
2. Describe events and daily activities

References:

1. Dr. Ramesh Chilukuri, 2020. Breathe French: Learning made as easy as Breathing published by Prowess Publishing.
2. Beaujolie Florence, 2019. French Made Easy 2 in 1 published by M & M Limitless Online Inc.

SEC 03 – Cyber Security

L	T	P	C
2	0	0	2

Course Objectives:**Course Outcomes:**

After successful completion of the course, students will be able to

Curriculum awaited from GoK

Activity Based Course 02 – Industrial Visit/Training

L	T	P	C
0	0	2	2

Industrial visit / training is a component of education that readdress the classroom experience. Industrial visits/training allow students to see what is beyond their horizon and expose students to fresh experiences and laboratory approaches, as well as people and a different way of life. Educational establishments are focusing on shifting the paradigm from input-based to output-based learning, with an emphasis on experiential learning. The main goal is for students to become acquainted with company culture and so learn from the industry's operating model. We want students to learn about and explore the actual world, which is outside the scope of academic education.

Semester Five

DSC 09 - Plant & Animal Physiology

L	T	P	C
3	0	2	5

Course Objectives:

- To introduce students to the overall functioning of plant and animal systems
- To provide insight into how various processes occur within these systems
- To illustrate the provisions for adaptation and survival of plants and animals

Course outcomes:

Upon successful completion of this course, the student will be able to

1. Gain an overall understanding of the mechanisms underlying water and mineral transport in plants.
2. Understand the mechanisms of plant growth and metabolism.
3. Understand the functional systems of animals, animal physiology and adaptation.
4. Understand the physiological phenomena associated with adaptation and survival of animals.

Theory

Unit-I: Nutrition - Mineral nutrition, Transport mechanisms and plant growth hormones. Plant nutrition: Macro and micronutrients; Uptake, function and deficiency symptoms of macro and micronutrients. Plant-water relations - Water potential; Transport mechanisms: Apoplastic and symplastic transport; Intercellular water transport - diffusion, osmosis; radial transport; long-distance transport through xylem; Transpiration; Membrane transport; Uniporters and ion channels; Active transport - Primary active transport (Pumps - ATPases), secondary (Cotransporters - symporter and antiporter). Growth hormones: function and mechanism of action of auxin, cytokinin, gibberellins, ethylene and abscisic acid.

Unit-II: Metabolism - Plant metabolism - Photosynthesis and respiration. Concepts in metabolism: Bioenergetics - laws of thermodynamics, energy coupled reactions, Reduction-oxidation coupled reactions. Photosynthesis: properties of light; Mechanism of light absorption and emission; Photosynthetic pigments; Light reactions in photosynthesis; photosynthetic apparatus - Photosystem I, II; Photophosphorylation; Photosynthetic CO₂ assimilation. Photorespiration; C₄ pathway. Respiration: Glycolysis; Oxidative Pentose Phosphate Pathway; Pyruvate metabolism; TCA cycle; Electron Transport Chain.

Unit-III: Physiological Basis of Animal System - Introduction: Meaning and scope of Animal physiology, Digestion and Excretion, Respiration, Circulation, Sensation, Endocrine system, Muscle contraction, and reproduction.

Unit-IV: Regulation of physiological functions and adaptation - Effect of Temperature on biological system. Temperature relations of Poikilotherms and homeotherms, acclimation and acclimatization to cold and heat. Neuronal basis of thermoregulation. Adaptation: Adaptation to extreme environment - Desert, high altitude and salt tolerance.

Practical 09 - Plant & Animal Physiology

1. Determination of water potential of tissue by plasmolytic / gravimetric method.
2. Estimation of mineral nutrient – phosphorous in plant tissue.
3. Estimation of chlorophyll pigment concentration.
4. Determination of epidermal cell density, stomatal index and stomatal frequency.
5. Plant growth determination in Soil Vs Hydroponics growth systems

References

Plant physiology:

1. Satish C Bhatla, Manju A. Lal. Plant Physiology, Development and Metabolism, 2018, Springer Nature Singapore.
2. S. L. Kochhar Sukhbir Kaur Gujral. Plant Physiology Theory and Applications, 2nd Edition, 2020, Cambridge university press.
3. Lincoln Taiz, Eduardo Zeiger. Plant physiology, 4th Edition, 2006, Sinauer Associates, Inc.
4. Maria Duca. 2015 Plant physiology. Edition 1, Springer International Publishing.
5. Buchanan B. B., Gruissem W. and Jones R. L. (2000) Biochemistry and Molecular Biology of Plants. American Society of Plant Physiology, Maryland.
6. Zimmermann, M.H. and Milburn J.A. Transport in Plants I Phloem transport (Encyclopedia of Plant Physiology, New Series, Vol. I, Springer Verlag, New York.

Animal physiology:

1. Chatterjee C C. 1985. Human Physiology. 11th ed. A.K. Chatterjee Publisher
2. Murray R K Granner Darryl K Mayes Peter A Rodwell Victor W. 1999. Harper's Biochemistry McGraw-Hill Medical.

DSC 10 - Metabolism & Enzymology

L	T	P	C
3	0	2	5

Course Objectives:

- To impart knowledge on role of enzymes in biological functioning.
- To introduce the students to basic metabolic activities which govern the biological functioning.

Course outcomes:

After successful completion of the course, students will be able to

1. Highlight the importance of enzymes in daily life, molecular interaction of enzymes during activation and inhibition
2. Gain knowledge on industrial production of enzymes and their applications.
3. Understand the molecular life of biomolecules through metabolism.
4. Know the importance of bioenergetics in daily life through studying different energy synthesizing strategies of plants and animals.

Theory

Unit-I: Introduction to enzymes - Definition, nomenclature and classification, physical and chemical properties, factors affecting enzyme activity, mechanism of enzyme action, enzyme-substrate reaction, active site, allosteric site, co-enzymes and co-factors, isoenzymes, multienzyme complexes, enzyme inhibition, types of enzyme inhibition, enzyme specificity, types of enzyme specificity.

Unit-II: Kinetics - Enzyme kinetics, rate of reaction, order of reaction, Michaelis-Menton equation, K_m value and significance, Lineweaver-Burk plot, velocity maximum, enzyme immobilization – types and applications, structural modification of enzymes, industrial utilization of enzymes, large scale production of enzymes, purification of enzymes, medicinal applications and enzyme therapy.

Unit-III: Metabolism - Introduction to metabolism, anabolism, catabolism, overview of metabolic pathways, carbohydrate metabolism, glycolysis, gluconeogenesis, TCA cycle, glycogen metabolism, metabolism of lipids, metabolism of proteins and amino acids, metabolism of nucleic acids.

Unit-IV: Bioenergetics - Introduction to bioenergetics, Laws of thermodynamics, Gibbs free energy, Relationship of Standard free energy to enthalpy, entropy and equilibrium constant, High energy compounds, biological oxidation, types of phosphorylation, electron transport chain, photosynthesis, mechanism of ATP synthesis, Schematization of C₃, C₄ pathway CAM plants, urea cycle, hormonal regulation of mammalian metabolism, overall inborn errors of metabolisms.

Practical 10 - Metabolism & Enzymology

1. Determination of activity and specific activity of salivary amylase by DNS method
2. Effect of pH on enzyme activity
3. Effect of temperature on enzyme activity
4. Effect of Substrate Concentration on Enzyme Kinetics.
5. Qualitative analysis of creatinine in urine sample
6. Qualitative analysis of blood glucose
7. Qualitative Analysis of Carbohydrates
8. Isolation of β -Amylase from Sweet Potato
9. Estimation of urea in urine sample

References

1. Nelson, D.L., Cox, M.M. Lehninger. (2004). Principles of Biochemistry 4th edition Pub WH Freeman Co.
2. S.M. Bhatt, Enzymology And Enzyme Technology 1st Edition (2011), S.Chand Publishing
3. Trevor Palmer, Enzymes: Biochemistry, Biotechnology, Clinical Chemistry, Horwood Publishing Ltd; 5th Revised Edition (2001)
4. Wu-KuangYeh , Hsiu-Chiung Yang, James R. Mccarthy, Enzyme Technologies: Metagenomics, Evolution, Biocatalysis And Biosynthesis (Chemical Biology Of Enzymes For Biotechnology And Pharmaceutical Applications) (2010)
5. V. Voet and J.G.Voet, Biochemistry, 3rd edition, John Wiley, New York, 2004.
6. TM Devlin, Text book of biochemistry with clinical correlation. John Wily and sons, 5th Edition., 2002

DSC 11 - Bioinformatics

L	T	P	C
3	0	1	4

Course Objectives:

- To introduce the students to basic interdisciplinary concepts comprising biology, computer science and mathematics
- To enable the students to use *in silico* techniques in molecular biology research

Course outcomes:

After successful completion of the course, students will be able to

1. Gain knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics
2. Use software effectively to extract information from large databases and to use this information in computational modelling.
3. Enhance problem-solving skills, including the ability to develop new algorithms and analysis methods.
4. Understand and predict three-dimensional structures of biomolecules.

Theory

Unit-I: Introduction to computer - Overview and functions of a computer system, introduction to operating system (windows, LINUX & UNIX), The Internet and its Resources. Introduction to bioinformatics (Definition, Scope and applications), Literature DataBanks – PubMed, Concept of Object Oriented Programming, PERL and Python and their application in Bioinformatics.

Unit-II: Bioinformatics and biological databases - Information retrieval from databases, Introduction to data types their Sources and File Format (Genbank, DDBJ, FASTA, PDB, SwissProt), Phylogenetics – Introduction and software, tree definitions, optimality criteria, distance matrix methods and parsimony, Bootstrapping. Multiple sequence alignments – Progressive Alignment Methods, tree alignments, star alignments, patterns in pair-wise alignments, Profiles, Motifs, Prints, Domains, Hidden Markov Models and Blocks.

Unit-III: Sequence analysis -Introduction to Sequences, alignments and Dynamic Programming; Local alignment and Global alignment (algorithm and example), Pairwise alignment (BLAST and FASTA Algorithm) and multiple sequence alignment (Clustal W algorithm), Sequence Alignment based on Matrices (BLOSUM and PAM), 3D structure viewers (Rasmol, SPDBv, Chime, Cn3D, PyMol), Anatomical visualization.

Unit-IV: Protein structure and molecular modelling - Introduction to protein structure – secondary structure prediction, tertiary structure prediction, protein modelling-principles of homology and comparative modelling, Scope and applications of *insilico* modeling in modern biology, structure evaluation and validation and *ab initio* Modelling, Genomics and proteomics (Basic concepts), introduction to Data mining.

Practical 11 - Bioinformatics

1. Search across the databases and retrieve information (protein and nucleotides) from NCBI, EMBL, DDBJ.
2. Retrieve information for Secondary database from Swiss-prot/Uniprot, PDB.
3. Sequence Analysis Tools. Take a nucleotide sequence and protein sequence of homo sapiens and perform the following against Pongo
 - a. BLAST (blastp, blastn, blastx)
 - b. FASTA (for both nucleotide and protein) – FASTX, FASTY, TFASTX.
4. Compare BLAST and FASTA results for database search for at least two sequences.
5. Perform dynamic programming for two sequences. (Nucleotide and Protein) using EMBOSS package.
6. CLUSTALW: Take 5 sequences each of Homosapiens and Pongo and do MSA. Draw phylogenetic tree also.
7. Structure Viewers (Compare all with respect to a data)
 - a. Rasmol/Pymol
 - b. Swiss PDB Viewer
8. Perform motif search for the above 10 proteins using all these tools – MEME, MAST, eMotif, InterproScan, Prosite, ProDom, Pfam.

References

1. Xiong J. Essential bioinformatics. Cambridge University Press; 2006 Mar 13.
2. Gu, Jenny, and Philip E. Bourne, eds. Structural bioinformatics. Vol. 44. John Wiley & Sons, 2009.
3. Andrew RL. Molecular modeling principles and applications. Prentice Hall, London. 2001.
4. Malcolm A, Heyer LJ. Discovering genomics, proteomics, and bioinformatics. San Francisco, CA: Benjamin Cummings; 2003.

DSE 01a - Genomics & Proteomics

L	T	P	C
3	0	0	3

Course Objectives:

- To introduce the students to *in silico* understanding of genes and proteins
- To impart knowledge on gene/protein sequence variations and their biological implications

Course Outcomes:

After successful completion of the course, students will be able to

1. Explain principles of basic methods of genomic and proteomic analysis
2. Understand concepts of nucleotide base pairs and their arrangements throughout genome sequences
3. Understand the replication process of DNA and RNA during cell division.
4. Perform different techniques for generating biological data like genome sequences, gene expression data and proteomics data.
5. Apply different bioinformatics techniques for analyzing biological experimental data.

Theory

Unit-I: Introduction to genome databases - database search - Algorithms issues in databases search - sequence database search - FASTA - BLAST - Types of genomic databases and uses: Polymorphic markers, Cytogenic Maps, LINE, SINE- Amino acid substitution matrices PAM and BLOSUM.

Unit-II: Gene Therapy: Concept and Principles of Gene Therapy. Principles of gene Expression. Genome Mapping –physical and genetic mapping techniques, Human Genome Project - Genomes of other organisms. Shotgun DNA sequencing - Sequence assembly - Gene predictions - Molecular prediction with DNA strings.

Unit-III: Genomic resources, Gene structure and DNA sequences. EST comparison, gene hunting. Expression analysis- SAGE, cDNA library, ORF prediction, Microarray - DNA sequencing and sequence alignment: RFLP, SNP, RAPD, Application of Comparative Genomics. Protein database: CATH, SCOP, FSSP, SARF, MM. Protein structure and comparison, Blocks, Class, Domain, Fold, Profile, Motif, and PSSM.

Unit-IV: Structural Proteomics: Experimental Techniques for Protein Structure Elucidation, X-ray Crystallography, 2-D Electrophoresis- Sample preparation, pH gradient-MALDI-TOF, Electro plot, Protein Microarrays and Bioseparation. Metabolomics: Metabolic Pathways of Microbes, metabolic pathway databases-KEGG. Structure prediction, active site determination, neural networks. Protein –protein interaction, protein - DNA interaction. Enzyme Substrate interaction.

References

1. Introduction to bioinformatics by Dr. Mani and Dr. Vijayaraj.
2. Bioinformatics by Parry and Smith.
3. Bioinformatics by David Mount.
4. Genomes 3 by T. A. Brown.
5. Proteomics- Pennigton & Dunn (2002) Viva books publishers, New Delhi
6. Bioinformatics- A practical guide to the analysis of Genes & Protein 2nd ED Andreas, Baxevanis and Francis Ouellette.
7. Bioinformatics by David Mount.

DSE 01b - Basics of Computer Aided Drug Design (CADD)

L	T	P	C
3	0	0	3

Course Objectives:

- To introduce the students to basic aspects of *in silico* drug designing
- To convey the likely characteristics of a molecule to be regarded a drug
- To impart knowledge resulting in hands-on drug designing

Course Outcomes:

After successful completion of the course, students will be able to

1. Possess an in-depth overview over the state-of-the art methods and techniques nowadays applied in CADD.
2. Choose the appropriate method (in terms of applicability, accuracy, and economy) for a given problem like, lead optimization, structure-based design, investigation of ligand receptor interaction.
3. Perform and interpret the results of the calculations and bring them in a publication ready form

Theory

Unit-I: Introduction to CADD - Stages of drug discovery and development, introduction to QSAR/SAR. Introduction to molecular modelling: Concepts of Molecular mechanism and dynamics, Role of bioinformatics in medicinal chemistry.

Unit-II: Pharmacophore - Lock-Key principle and induced fit theory, the objects of CADD and Molecular Modelling, the dynamic aspect of modelling, techniques and concepts used in CADD and Molecular Modelling, protein modelling- principles of homology and comparative modelling.

Unit-III: Concepts of molecular mechanics (MM) - Basic considerations concerning force fields. The concept of the force field in MM, Parametrization of a Force Field, Force field energies, Classification of force fields, List of force fields presently in use Applicability and limitations of a MM approach.

Unit-IV: CADD methods and strategies- Lead discovery, Computer Assisted Drug Design, Fundamentals and Application of CADD, Virtual screening, Structure-based ligand design, ADME/T for prediction for ligand and database, Pharmacophore generation, Determination of a pharmacophore, Molecular docking, De Novo design of ligand, applications of in-silico modelling in modern biology.

References

1. Andrew RL. Molecular modeling principles and applications. Prentice Hall, London. 2001.
2. Computational and structural approaches to drug discovery, Robert M Stroudand, and Janet. F Moore, RCS Publishers.
3. Introduction to Quantitative Drug Design by Y.C. Martin, CRC Press, Taylor & Francis group.
4. Drug Design by Ariens Volume 1 to 10, Academic Press, 1975, Elsevier Publishers.
5. Principles of Drug Design by Smith and Williams, CRC Press, Taylor & Francis.
6. The Organic Chemistry of the Drug Design and Drug action by Richard B. Silverman, Elsevier Publishers.

SEC 04 - Cell & Tissue Culture

L	T	P	C
3	0	0	3

Course Objectives

- To introduce the student to basics of plant biotechnology
- To impart knowledge in the fundamentals of culturing plant cells, tissues, culture environment, media formulation, cell proliferation and differentiation.

Course Outcomes

After successful completion of the course, students will be able to

1. Acquire knowledge on principles of tissue culture.
2. Understand the applications of plant and animal cell culture.
3. Gain basic knowledge on setting up a tissue culture laboratory.
4. Perform basic cell culture techniques.

Unit-I: Introduction to tissue culture: Definition, scope and history of plant tissue culture, concept of totipotency sterilization methods, Plant tissue culture media (composition, types, and preparation), plant hormones and growth regulators in tissue culture. Inoculation, Incubation and Acclimatization. Callus, single cell and suspension culture and its significance. Micropropagation axillary bud, shoot tip and meristem culture, limitations. Production of haploids and their applications (ovary, ovule and anther culture). Invitro pollination and fertilization, embryo culture, wide hybridization, and embryo rescue. Triploid production (endosperm culture). Protoplast isolation, fusion & culture. Hardening and Green House Technology.

Unit-II: Methods in cell culture: Secondary metabolite production-cell culture methods, Somaclonal variation and applications, Vectors used in plant transformation and its application-Agrobacterium mediated gene-Mechanism of gene transfer, general features of vectors (Ti and Ri plasmids). Designing of expression vectors, role of promoters(35S or other promoters), virulence and reporter genes. lipofection Selection, biolistic, electroporation-physical methods of transformation. Development of virus resistance plant by transgenic technology- Delayed fruit ripening- Antisense RNA technology

Unit-III:- Animal cell cultures: Animal tissue culture requirements-laboratory layout-composition and preparation of cell culture media, Balanced salt solution -natural, defined and role of CO₂, Constituents of serum & its role, serum free media and its applications, Primary and established cell lines. Primary and established cell lines-culture and maintenance of different animal cell line. Growth factors- NGF, EGF, FGF, PDGF and erythropoietin. Cultured cell- Characterization, cell viability, cytotoxicity, and growth parameters.

Unit IV: Transgenic Animals: Transgenic animals - molecular pharming, Generation of transgenic animals, embryonic blastocyst cell& fertilized eggs. Animal models -human diseases (Gene knock out in mice models). Production of recombinant products (insulin, growth hormone, etc.) pharmaceutical use. Applications of animal cell culture, Limitations, and ethical issues.

References:

1. Butler (1991) Mammalian Cell Biotechnology: A Practical Approach, Oxford UNI Press
2. Brown, T.A. (2020) Gene cloning- An Introduction, Eighth Edition, Wiley Publishers, USA.
3. Freshney, R.I. (2006) Culture of Animal Cells – A manual of Basic Technique, Fifth Edition, A John Wiley and Sons Publication, New York.
4. Freshney, R.I. (2010) Animal Cell Culture-A Practical Approach, sixth Edition, IRL Press, New York
5. Gupta. P.K. (2012) Biotechnology and Genomics, First Edition, Sixth reprint, Rastogi Publication, Merut.
6. Murray E.J (1991). Gene Transfer and Expression Protocols – Methods in Molecular Biology Vol.7. Humana Press,Totowa.
7. Probnee. R. (2007) Animal cell biotechnology, Methods and Protocols, Second Edition, Humana press, New Jersey.
8. Ranga, M.M. (2008) Animal Biotechnology, Student Edition, Saraswati Purohit Publications, Jodhpur.

VBC 02 – Ethics & Self Awareness

L	T	P	C
2	0	0	2

Course Objectives:

Course Outcomes:

After successful completion of the course, students will be able to

Curriculum awaited from GoK

Semester Six

L	T	P	C
3	0	2	5

DSC 12 - Immunobiology

Course Objectives:

- To introduce the students to immunity and its regulatory mechanisms
- To enable the students to understand the importance of immune system in warding off disease(s)

Course Outcomes

After successful completion of the course, students will be able to

1. Gain an overall understanding of the components of immune system
2. Learn how immune regulation controls the immune system
3. Understand the balance between immunity and infection
4. Possess knowledge and scope of vaccines in protection of infectious diseases

Theory

Unit-I: Immune Response - An overview, components of mammalian immune system, molecular structure of Immuno-globulins or Antibodies, Humoral & Cellular immune responses, T-lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), cell receptors, genome rearrangements during B-lymphocyte differentiation, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination.

Unit-II: Regulation of immunoglobulin gene expression – clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, hypotheses (germ line & somatic mutation), antibody diversity.

Unit-III: Major Histocompatibility complexes – class I & class II MHC antigens, antigen processing. Immunity to infection – immunity to different organisms, pathogen defense strategies, avoidance of recognition. Autoimmune diseases, Immunodeficiency-AIDS.

Unit-IV: Vaccines & Vaccination – adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, passive & active immunization. Introduction to immunodiagnosics – RIA, ELISA.

Practical 12 - Immunobiology

1. Differential leucocytes count
2. Total leucocytes count
3. Total RBC count
4. Haemagglutination assay
5. Haemagglutination inhibition assay
6. Separation of serum from blood
7. Double immunodiffusion test using specific antibody and antigen.
8. ELISA.

References

1. Abbas AK, Lichtman AH, Pillai S. (2021). Cellular and Molecular Immunology. 10th edition, Elsevier Publication, Philadelphia (ISBN: 9780323757485).
2. Delves P, Martin S, Burton D, Roitt IM. (2016). Roitt's Essential Immunology. 13th Edition, Wiley-Blackwell Scientific Publication, Oxford (ISBN: 978-1-118-41577-1).
3. Jenni Punt; Sharon Stranford; Patricia Jones; Judy Owen. (2019). Kuby's Immunology. 8th edition W.H. Freeman and Company, New York.
4. Kenneth M. Murphy, Casey Weaver. (2016). Janeway's Immunobiology. 9th edition Garland Science Publishers, New York ISBN: 9780815345510.
5. Anil K. Sharma (2019). Immunology An Introductory Textbook. 1st edition Jenny Stanford Publishing (ISBN 9789814774512).
6. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

DSC 13 - Introduction to Genetic Engineering

L	T	P	C
3	0	2	5

Course Objectives:

- To introduce the students to DNA and its sequential significance
- To enable the students to use the DNA-pertaining knowledge in creating recombinant products

Course Outcomes:

After successful completion of the course, students will be able to

1. Understand the manipulation of DNA sequences with DNA modifying enzymes
2. Acquire knowledge on gene transformation in plants, animals, and microorganisms.
3. Understand the concepts of cloning experiments, PCR and gene expression analysis.
4. Introduce various applications of transgenics/Genetically Modified Organisms (GMOs)

Theory

Unit I

Introduction to Genetic engineering. Tools used in Genetic Engineering: Restriction enzyme, DNA Polymerases, RNA polymerase, Taq polymerase, DNA Ligase, methylase, polynucleotide kinase, alkaline phosphatase, reverse transcriptase, DNaseI, S1nuclease, Rnase H, Terminal deoxynucleotidyl transferase.

Unit -II

Vectors: Features of an ideal cloning and expression vectors (Plasmids & Cosmids). Ti plasmid, Molecular biology of lambda and Lambda vectors, cosmid, phagemid, M13. Yeast vectors. Creating recombinant DNA molecules: Isolation of a gene by Polymerase Chain Reaction (PCR). Cloning methods (Restriction based method). Choice of enzyme and the vector. Promoters, selectable markers and expression vectors.

Unit -III

Transfer of cloned DNA in to host (Bacteria, Yeast) transformation, transduction, particle bombardment. Features of the host cell used for transformation. Analysis of Gene expression. Hybridization techniques - Southern, Western and Northern blotting, DNA sequencing.

Unit -IV

Transgenic plants and their importance. Agrobacterium mediated transformation in plants.

Reporter Gene and applications, DNA-Protein Interaction Assays, Protein-Protein Interaction Assays, DNA Fingerprinting.

Practical 13 - Introduction to Genetic Engineering

1. Introduction to PCR and its applications.
2. Primer Designing and vector selection
3. Restriction digestion and DNA Finger printing (RFLP based)
4. Ligation of restriction digested DNA
5. Agarose Gel Electrophoresis.
6. Plasmid/genomic DNA ISOLATION.

References

1. Principles of Gene Manipulation and Genomics. SB. Primrose and R Twyman
2. Gene Cloning and DNA Analysis: An Introduction. TA Brown
3. Lehninger Principles of Biochemistry. David L. Nelson, Michael Cox.

DSC 14 – Fundamentals of Statistics

L	T	P	C
3	0	1	4

Course Objectives:

- To introduce the students to basic interdisciplinary concepts of biology and mathematics
- To enable the students to use and understand the significance of their experimental findings using statistical methods

Course outcomes:

After successful completion of the course, students will be able to

1. Perform statistical methods and applications
2. Collect data in biological experiments, proper statistical analysis of the data and its presentation
3. Understand the importance of sample size and various variables that affect data.
4. Illustrate importance of mean, standard error, standard deviation

Theory

Unit-I: Introduction - Types of Data, Collection of data; Primary & Secondary data, Classification and Graphical representation of Statistical data. Measures of central tendency and Dispersion. Measures of Skewness and Kurtosis.

Unit-II: Probability - classical & axiomatic definition of probability, Theorems on total and compound probability, Elementary ideas of Binomial, Poisson and Normal distributions.

Unit-III: Methods - sampling, confidence level, critical region, testing of hypothesis and standard error, large sample test and small sample test. Problems on test of significance, t-test, chi-square test for goodness of fit and analysis of variance (ANOVA).

Unit-IV: Correlation and Regression - Emphasis on examples from Biological Sciences.

Practical 14 - Fundamentals of Statistics

1. Based on graphical Representation
2. Based on measures of Central Tendency & Dispersion
3. Based on Distributions Binomial Poisson Normal
4. Based on t, f, z and Chi-square

References

1. Le CT (2003) Introductory biostatistics. 1st edition, John Wiley, USA
Glaser AN (2001) High Yield™ Biostatistics. Lippincott Williams and Wilkins, USA
2. Edmondson A and Druce D (1996) Advanced Biology Statistics, Oxford University Press.
3. Danial W (2004) Biostatistics: A foundation for Analysis in Health Sciences, John Wiley and Sons Inc.

DSE 02a - Biotechnology Business Management

L	T	P	C
3	0	0	3

Course Objectives:

- To introduce the students to basic interdisciplinary concepts of biology and mathematics.
- To enable the students to understand the significance of their experiment findings using statistical methods.

Course outcomes:

Upon successful completion of the course, students will be able to

1. Gain entrepreneurial skills in biotechnology-based products, identify scope for entrepreneurship in biosciences and utilize the schemes promoted through knowledge centres and various agencies.
2. Understand the various operations involved in venture creation.
3. Learn statutory and legal requirements along with collaboration and partnerships.
4. Knowledge pertaining to management should also help students to be able to build up a strong network within the industry.

Unit-I: Introduction and scope in Bio-entrepreneurship

Types of bio-industries and competitive dynamics between the sub-industries of the bio-sector (e.g. pharmaceuticals vs. Industrial biotech). Strategy and operations of bio-sector firms- factors shaping opportunities for innovation and entrepreneurship in bio-sectors, and the business implications of those opportunities, Alternatives faced by emerging bio-firms and the relevant tools for strategic decision. Entrepreneurship development programs of public and private agencies (MSME, DBT, BIRAC, Make In India). Strategic dimensions of patenting & commercialization strategies.

Unit-II: Bio markets-business strategy and marketing

Negotiating the road from lab to the market (strategies and processes of negotiation with financiers, government and regulatory authorities). Pricing strategy- challenges in marketing in bio business (market conditions & segments; developing distribution channels, the nature, analysis and management of customer needs). Basic contract principles- different types of agreement and contract terms typically found in joint venture and development agreements. Dispute resolution skills.

Unit-III: Finance and accounting

Business plan preparation including statutory and legal requirements. Business feasibility study. Financial management issues of procurement of capital and management of costs. Collaborations & partnership. Information technology.

Unit-IV: Technology management

Assessment, development & upgradation. Managing technology transfer, Quality control & transfer of foreign technologies. Knowledge centres and Technology transfer agencies. Understanding of regulatory compliances and procedures (CDSCO, NBA, GCP, GLA, GMP).

References:

1. Steve Blank and Bob Dorf: The Startup Owner's Manual: The Step-By-Step Guide for Building a Great Company. K & S Ranch. ISBN-13: 978-0984999309.
2. Craig Shimasaki, ed.: Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies. Elsevier Inc., 2014. ISBN: 978-0-12-404730-3.
3. Dr. Vasant Desai, Management of Small Scale Enterprises, Himalaya Publishing House, 2004.
4. Bruce R Barringer and R Duane Ireland, Entrepreneurship: Successfully Launching New Ventures, 3rd ed., Pearson Edu., 2013.

L	T	P	C
3	0	0	3

Course Objectives

The objective of this course is to impart knowledge on various human diseases and the role of biotechnology in medical field. Further, the course is intended towards exposing students to the recent developments in diagnostics and treatment strategies.

Course Outcomes:

Upon successful completion of this course, the student will be able to

1. Gain awareness on genetic diseases
2. Utilize the technologies to diagnose diseases
3. Understand the significance of biological markers in disease diagnosis
4. Acquire adequate knowledge in recent developments in vaccinology

Unit- I

Tools of Medical Biotechnology – Biotechnological revolutions- Genomics, insight into basic biology - Areas of application: Biotechnology in diagnosis and prediction of disorders; Approaches and limits.

Unit- II

Human Diseases: Symptoms and treatment of the Genetically inherited diseases: PKU, Alkaptonuria, Galactosemia, VonGierke disease, Lesch-Nyhan syndrome, Gout, Sickle cell anemia, Beta Thalassemia and Diabetes. Evaluation of organ functions: liver, kidney, cardiac and gastric function tests. Role of biotechnology in healthcare.

Unit- III

Molecular therapeutics: Drugs, drug receptors, Relationship between drug concentration and response. Gene therapy, barriers to gene delivery, overview of inherited and acquired diseases for gene therapy; Retro and adeno virus mediated gene transfer; Liposome mediated gene delivery. Cellular therapy; use of stem cells and recombinant therapy.

Unit- IV

Recent developments in medical biotechnology –Pharming for human proteins and neutraceuticals. Biosensors in clinical diagnosis. Monoclonal antibodies for immunotherapy. Vaccine production - New developments. Tissue engineering and therapeutic cloning

References

1. Judit Pongracz and Mary Keen, Medical Biotechnology 1st Edition, Elsevier publications, 2008.
2. Fundamentals of medical biotechnology by Aparna Rajagopalan, Ukaaz publications.
3. S N Jogdand Medical Biotechnology 2nd Edition Himalaya publishers 2008.
4. Keith Wilson & John Walker, Practical Biochemistry- 5th edition, Cambridge University Press, UK 2000
5. Bartram G. Katzung, Basic & Clinical Pharmacology, 9th Edition, Mc Graw Hill Publications 2004
6. Devlin TM, Text book of biochemistry with Clinical Correlations 5th edition 2002
7. Richard B Silverman, Organic Chemistry of Drug design and Drug action Elsevier Science, Academic Press.
8. Warren Levinson, Ernest Jawetz, Medical Microbiology and Immunology: Examination and Board Review 7th edn. McGraw Hill Publications 2003

SEC 05 - Professional / Societal Communication

L	T	P	C
3	0	0	3

Course content awaited from GoK

Semester Seven

DSC 15 - Environmental Biotechnology

L	T	P	C
3	0	2	5

Course Objectives:

- To introduce the students to importance of sustainable biotechnology
- To provide insights into current environmental issues and possible solutions

Course Outcomes:

After successful completion of the course, students will be able to

1. Understand the role of biotechnology in addressing environmental issues.
2. Assess the role of biotechnology in ecosystem conservation.
3. Possess in depth knowledge on biodiversity, its importance and conservation.

Unit I: Ecology & Ecosystem - Definition – scope – branches of ecology. Abiotic factors: water, soil, temperature, light, humidity etc. Animal interaction: commensalisms, mutualism, parasitism, predation, competition. Definition, structure, (biotic and abiotic components), function (food chain, food web, energy flow, trophic level pyramids etc.), productivity, ecological succession. Biogeochemical cycle: nitrogen, phosphorous and carbon cycles.

Unit II: Pollution - Sources, effects and control measures of air, water, soil, noise, thermal and radioactive pollution. Pesticide impacts, eutrophication, green house effects and global warming, ozone layer depletion and acid rain. Bioaccumulation and bio magnification. Biological pest control.

Unit III: Biodiversity - Definition of biodiversity, types, values of biodiversity – productive and consumptive values. General account on uses of plant resources (food, timber, medicinal ornamental etc) and animal resources (food animals [terrestrial and aquatic], non-food uses of animals, domestic livestock, etc.,). Uses of microbes. Concept of hot spots and its importance. Causes of biodiversity loss. Threatened, endangered and endemic species. A general account on multilateral treaties – CBD, IUCN, IBPGR, NBPGR and CITES.

Unit IV: Conservation of biodiversity - In situ conservation: biosphere reserves, national parks, sanctuaries, sacred groves etc., Ex situ conservation: cryopreservation, gene bank, seed bank, pollen bank, sperm bank, DNA banks, tissue culture and biotechnological strategies. Species based approaches- social approaches, Chipko movement, silent valley movement and environmental education. Biotechnology and intellectual property rights.

Practical 15 - Environmental Biotechnology

1. Estimation of Chloride content in water
2. Estimation of Biological Oxygen Demand
3. Analysis of water for total hardness
4. Wastewater management using biological methods

References

1. Raman Kumar, Anil Kumar Sharma, Sarabjeet Singh Ahluwalia, 2017. Advances in Environmental Biotechnology. Springer Publications.
2. Daniel Allen Vallero, 2010. Environmental Biotechnology: A Biosystems Approach, 1st edition, Elsevier Publications.
3. Virchow, D. 1998. Conservation & Genetic Resources, Springer – Verlag, Berlin.
4. Groombridge, B (Ed.) 1992. Global Biodiversity – Status of the Earth's Living Resources. Chapman & Hall, London.
5. UNEP, 1995, Global Biodiversity Assessment, Cambridge Univ. Press, Cambridge.
6. Gary K. Meffe & Ronald Carroll, C.1994. Principles of Conservation Biology, Sinauer Associates, Inc., Massachusetts.
7. Sharma, P.D. 1990. Ecology and environment. Rastogi publications, Meerut.
8. Verma P.S. and V.K. Agarwal. 1996. Principles of Ecology S. Chand. & co., New Delhi.

DSC 16 - Agricultural Biotechnology

L	T	P	C
3	0	2	5

Course Objectives:

- To introduce the students to biotechnology intervention in agriculture and its benefits
- To provide insights into agricultural management using essential biotechniques

Course Outcomes:

After successful completion of the course, students will be able to

1. Understand the concepts of crop production and management to meet the food demand of ever-increasing population.
2. Understand the basics of conventional plant breeding techniques.
3. Illustrate how to use different biotechnological tools for crop improvement.
4. Follow management practices to reduce spread of diseases.

Theory

Unit -I: History and Improvements of Agriculture crops - Conventional breeding methods; Domestication, Selective breeding, Mutational breeding. Green Revolution: History, pros and Cons. Production of hybrids. Importance of male sterility in crop plants.

Unit-II: Biotic and Abiotic stress - Introduction to biotic (Weeds, Pest, and Diseases) and abiotic (Drought, salt, heavy metals) stress in plants. Biological pest and disease control. Molecular biology of stress response in plants. Role of genetic engineering in agriculture. Importance of Model plants (Arabidopsis) in crop improvement. DNA delivery methods. Agrobacterium and Ti Plasmid. Analysis of transgenic plants.

Unit-III: Transgenic plants in crop improvement - Transgenic plants resistance to biotic and abiotic stress. Advantages and applications of transgenic plants. Role of Herbicides in weed control. Developing herbicide resistance crops. Genetic engineering of Insect resistance plants (Bt Cotton). Plants derived vaccines, modification of flower color, targeting transgenic product to chloroplast and mitochondria.

Unit-IV: Management of Plant Virus Diseases - Gene silencing using RNA interference. Genome editing. Transgenic plants in quality modifications- Biofortification, Golden Rice. Improving quality of edible oils. Phytoremediation. Research and Career opportunities in Agriculture based industries and academic institutes.

Practical 16 - Agricultural Biotechnology

1. Demonstration of hybrid seed production
2. Introduction to plant genome databases
3. Visit to Krishi Vigyan kendra
4. Demonstration of controlled environment for plants (Plant growth chamber & Polyhouse)
5. Introduction to hydroponics
6. Demonstration of vegetative propagation.

References

1. Methods in Plant Molecular Biology and Biotechnology by B.R.Glick, 2014
2. Plant Biotechnology-The genetic manipulation of plants, Second Edition by Adrian Slater, Nigel Scott, and Mark Fowler, 2008
3. International Society for Acquisition of Agribiotech Applications- www.isaaa.org, an open resource for Agricultural Biotechnology related applications, world status of Agricultural Biotechnology
4. Review articles on individual topics form the major basis for this course as no single book covers all the topics listed above

DSC 17 - Bioprocess Technology

L	T	P	C
3	0	2	5

Course Objectives:

- To introduce the students to the industrial aspects of biotechnology, essentially dominated by bioprocessing
- To provide insights into bioprocessing industry by the means of case studies

Course Outcomes:

After successful completion of the course, students will be able to

1. Apply the principles of biochemical engineering in large-scale production of industrially important products.
2. Develop a flow sheet for production of primary, secondary and mixed metabolites.
3. Possess basic knowledge on designing of fermenters.

Theory

Unit-I: Introduction to bioprocess technology. Range of bioprocess technology and its chronological development. Basic principle components of fermentation technology. Types of microbial culture and its growth kinetics– Batch, Fed batch and Continuous culture.

Unit-II: Design of bioprocess vessels- Significance of Impeller, Baffles, Sparger; Types of culture/production vessels- Airlift; Cyclone Column; Packed Tower and their application in production processes. Principles of upstream processing – Media preparation, Inocula development and sterilization.

Unit-III: Introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting KLa. Bioprocess measurement and control system with special reference to computer aided process control.

Unit-IV: Introduction to downstream processing, product recovery and purification. Effluent treatment. Microbial production of ethanol, amylase, lactic acid and Single Cell Proteins.

Practical 17 - Bioprocess Technology

1. Bacterial growth curve.
2. Calculation of thermal death point (TDP) of a microbial sample.
3. Production and analysis of ethanol.
4. Production and analysis of amylase.
5. Production and analysis of lactic acid.
6. Isolation of industrially important microorganism from natural resource.

References

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.

DSE 03a - Bioethics & IPR

L	T	P	C
3	0	0	3

Course Objectives:

- To introduce the students to the right practices involved in biotech research
- To provide insights into protection of biotechnological findings and innovations by the means of legal provisions

Course Outcomes:

After successful completion of the course, students will be able to

1. Understand the meaning and significance of ethics in biotechnology
2. Possess insights into conduction of laboratory research adhering to international standards.
3. Gain basic knowledge on conduction of clinical research
4. Possess knowledge of intellectual property and their importance in research

Theory

Unit I

Definition of ethics and Bioethics, Ethics in Biotechnology (positive and negative effects with classical examples: Rice with Vitamin A, No-till Agriculture, cotton without insecticide, reduced need for fertilizer, biological pest control , slow ripening fruits and controlled ripening, fast growing trees and fishes.

Awareness education on genetically engineered organism: Transgene instability, gene flow, resistance/ tolerance of target organism, increase weedlessness, risks and uncertainty associated with Biotechnology.

Containment levels and their impact on Environment: Containment- definition, types of containment, summary of recommended Biosafety levels for infectious agents, detailed checklist- premises and lab equipment, Animal facilities, environment.

Unit II

Gene technology laboratory, GLP and Bioethics: introduction, national Good Laboratory Practices (GLP), the GLP authority functions, Good Laboratory Practices- necessity, aspiration and responsibility.

Unit III

Ethics in clinical trials and Good Clinical Practices (GCP): Definition of clinical trials and GCP, general information about clinical trials, need to conduct clinical trials, faces of clinical trials, institutional setups for conducting clinical trials, ethics in clinical biotechnology.

Unit IV

IPR Issues: Forms of IPR, IPR legislation in India, implication of IPR legislation on India and other developing countries, WIPO, WTO, GATT, Trips Agreement, Introduction to patenting and patenting process. Biodiversity board.

References

1. Safety Assessment by Thomas, J.A., Fuch, R.L. (2002), Academic Press.
2. Biological safety Principles and practices) by Fleming, D.A., Hunt, D.L., (2000). ASM Press.
3. Biotechnology - A comprehensive treatise. Legal economic and ethical dimensions VCH. Bioethics by Ben Mepham, Oxford University Press, 2005.
4. Bioethics & Biosafety by R Rallapalli & Geetha Bali, APH Publication, 2007
5. Bioethics & Biosaftey By Sateesh Mk (2008), Ik Publishers
6. Biosafety And Bioethics Rajmohan Joshi Publishers

DSE 03b - Fundamentals of Research Methodology

L	T	P	C
3	0	0	3

Course Objectives:

- To introduce the students to importance of research and how to do it
- To provide experience in formulating research questions and the quest to find answers

Course Outcomes:

After successful completion of the course, students will be able to

1. Understand the real meaning of research and its importance
2. Gain insight into identification of lacunae in already existing research findings and formulation of hypotheses
3. Possess knowledge on the usage of scientific and non-scientific resources
4. Gain hands-on experience in drafting a research proposal

Unit I

Introduction: Scope and significance of research methodology, bioethics and biosafety, IPRs, good laboratory practices in biotechnology and OECD guidelines, good clinical practices in biomedical research and ICH guidelines, and Quality control.

Unit II

Review of literature: identifying the gaps and formulating the hypothesis.

Review of research articles (To be done by students. Each student can select one paper review and present it). Demonstration of writing a research proposal

Unit III

Research material: Use of taxonomic keys, Samples: Collection, transport, handling and preservation of microorganisms, planktons, insects, animals from natural and lab bred population. Water and air samples. Relevance of sample size. Culture and maintenance of samples. Safe disposal of used and rejected samples and materials.

Unit IV

Research proposal: The student will identify a topic for research and prepare a document with the following information – Background of research problems, Objectives, strategies for experimental work, Expected results, preparation of rough draft and bibliography. The student will also present and defend the research proposal, Evaluation of research proposal.

References:

1. Mishra, Dr. Shanti Bhushan & Alok, Dr. Shashi. (2017). HANDBOOK OF RESEARCH METHODOLOGY.

Semester Eight

DSC 18 - Microbial pathogens & Therapy

L	T	P	C
3	0	2	5

Course Objectives:

- To introduce the students to the development and important medical aspects of microbiology
- To provide insights into prevalent issues such as infectious diseases and ways to control them

Course Outcomes:

After successful completion of the course, students will be able to

1. Gain insight into the contribution of eminent personalities towards development of medical microbiology and understanding the basic concepts of the subject.
2. Possess knowledge on important diseases caused by bacteria and viruses.
3. Possess knowledge on important diseases caused by fungi and protozoans.
4. Understand the principles of chemotherapy and functions of drugs.

Theory

UNIT I

Infection and Pathogenesis: History and Development of Medical Microbiology; Microbial flora of human body; Infection- Types of infection, modes of transmission, Portal of entry. Pathogenesis – Virulence - Attenuation and exaltation with an example each.

Clinical microbiology and nosocomial infections: Laboratory specimens: a) Collection of samples, b) Handling and Transport of laboratory specimens; **Nosocomial infections:** Common types, Sources and Reservoirs of Hospital acquired infections. Microorganisms causing nosocomial infections.

UNIT II

Bacterial and viral diseases of human beings: Pathogen- Morphology, cultural characteristics, classification, pathogenesis, clinical symptoms, laboratory diagnosis, epidemiology, prophylaxis and treatment of the following human diseases: Bacterial- Typhoid, Syphilis, Tuberculosis, Anthrax; Viral- Poliomyelitis, Hepatitis, AIDS.

UNIT III

Fungal and protozoan diseases of human beings: Pathogen- Morphology, cultural characteristics, classification, pathogenesis, clinical symptoms, laboratory diagnosis, epidemiology, prophylaxis and treatment of the following human diseases: Fungal- Dermatomycosis, Candidiasis; Protozoan- Malaria, Amoebic dysentery.

UNIT IV

Chemotherapy: General characteristics and types of antibiotics. Characteristics and mode of action of penicillin, streptomycin and chloramphenicol. Drug Resistance - Mechanism, Multiple Drug Resistance (MDR).

Practical 18 - Microbial pathogens & Therapy

1. Instruments in a medical microbiology laboratory
2. Staining and visualization of mouth microbial flora
3. Differential staining of WBCs
4. Detection of typhoid by Widal test
5. Detection of syphilis by RPR test
6. Blood grouping by slide agglutination method

References:

1. Mackie and Mc catney, 1994, Medical Microbiology No I and II. Churchill Livingston, 14th edition.
2. Ananthanarayanan R and CK Jayaram Panicker, 1994, Textbook of microbiology Orient Longman.
3. Chakraborty P 1995, A Text book of microbiology, New Central Book Agency Pvt Ltd. Calcutta.
4. Bailey and Scotts, 1994, Diagnostic Microbiology, 9th edition, Baron and Finegold CV Mosby Publications.
5. Jawetz E Melnic JL and Adelberg EA 1998, review of Medical Microbiology Lange Medical Publications, USA
6. Jayaram Panicker, C K 1993 3rd edition Text book for Medical Parasitology, Jaypee Brothers Medical Publishers (P) Ltd.

DSC 19 - Industrial Biotechnology

L	T	P	C
3	0	2	5

Course Objectives:

- To introduce the students to economically applicable biotechnology
- To provide insights into the industrial scope of biotechnology

Course Outcomes:

Upon successful completion of the course, the students will be able to

1. Explore the applications of traditional and modern biotechnology products such as cheese, vaccines, etc.
2. Streamline the production process for obtaining primary and secondary metabolites.
3. Basic knowledge on operation of fermenters and produce cellular products.
4. Gain knowledge on production of vaccines and their importance.

Unit- I:

Fermenter- batch and continuous fermenter, general design of a stirred tank fermenter, sterilization and maintenance of sterile conditions.

Unit- II:

Preparation of inoculums, Types of fermentation- solid state fermentation- tray and drum, and submerged fermentation- batch and fed batch, Media used for industrial fermentation.

Unit- III:

Microbial production and product recovery- Alcoholic beverage- wine and beer Production of vinegar from alcohol, production of vitamin-B 12, production of organic acid- lactic acid and glutamate.

Unit- IV:

Fermented dairy products- microorganisms involved in fermentation, yogurt, curds, sour cream, cheese paneer, pickles, idly, single cell protein. Starting an Enterprise: Entrepreneur, business idea, Management, Marketing, and Financial Planning.

Practical 19 - Industrial Biotechnology

1. Production of Single cell proteins
2. Preparation of wine
3. Preparation of lab scale inoculum
4. Production of dairy products

References:

1. Industrial Microbiology, Prescott and Dunn,
2. Biochemical Engineering and Biotechnology Handbook, Atkinson, B and Marituna, F.,
The Nature Press, Macmillan Publ. Ltd.
3. Biochemical Engineering Fundamentals, Bailey & Olis. MGH.
4. Text book of Biotechnology – Plant Biotechnology and industrial biotechnology
by S.B. Sullia, G. Siva Kumar Swami, P.A. Sastry- United publishers

DSE 04a - Nanobiotechnology

L	T	P	C
3	0	0	3

Course Objectives

This course combines physical laws, chemical procedures and biological principles in the nano-scale. The objective of the course is to enrich students with important applications of nanobiotechnology in a range of fields like medical diagnosis, drug delivery, and detection of biomacromolecules in complicated biochemical systems etc.

Course Outcomes

After the successful completion of the course, students will be able to:

1. Demonstrate working knowledge of nanotechnology principles and their applications in the field of health and environment.
2. Understand approaches for nanomaterial fabrication.
3. Apply principles of nanotechnology in biomedical, microelectronics and optical industries.

Theory

UNIT - I

INTRODUCTION: Scope and overview; Length scales; Importance of nanoscale and technology; History of nanotechnology; Future of nanotechnology- nano technology revolution, silicon based technology; Benefits and challenges in molecular manufacturing; The molecular assembler concepts.

UNIT - II

NANO PARTICLES: Introduction; Types of nanoparticles; Techniques to synthesize nanoparticles; Characterization and application of nanoparticles - toxic effects of nanomaterials, significance of nanoparticles; Nanofabrications- MEMS/NEMS; Atomic force microscopy; Self assembled monolayers/ dip-pen nanolithography; Soft lithography; PDMS moulding; Nano wires and nanotubes.

UNIT - III

APPLICATIONS - I: Nanobiosensor and nanofluids; Nanocrystals in biological detection; Electrochemical DNA sensors and integrated nanoliter systems; Nano-biodesigns and systems; Fabrication of novel biomaterials through molecular self-assembly - small scale systems for *in vivo* drug delivery; Future nanomachines.

UNIT - IV

APPLICATIONS- II: Clinical applications of nanodevices; Artificial neurons; Real-time nanosensors applications in cancer biology, nanomedicine; Synthetic retinal chips based on bacterio rhodopsins. High throughput DNA sequencing with nanocarbon tubules; Nanosurgical devices.

References

1. C. M. Niemeyer and C. A. Mirkin, "Nanobiotechnology: Concepts, Applications and Perspectives", 1st edition, Wiley-VCH, 2006.
2. J. Liu and K. Shimohara, "Biomolecular Computation by Nanobiotechnology", 1st edition, Artech House, 2007.

3. R. S. Greco, "Nanoscale Technology in Biological Systems", 1st edition, CRC Press. 2005.
4. H. S. Nalwa, "Handbook of Nanostructural Biomaterials and their applications in Nanobiotechnology", 1st edition, American Scientific Publishers, 2005.
5. V. Vogel, "Nanotechnology: Volume 5: Nanomedicine and Nanotechnology", 1st edition, John Wiley and Sons Limited, 2008.

DSE 04b - Stem Cell Biology

L	T	P	C
3	0	0	3

Course Objectives:

The objective of this paper is to familiarize the students with stem cell biology and its applications. The course is designed to give a broad view of mammalian stem cells, reviewing where they are found in the body, the different types and how they are cultured. The topics will cover the basic biology of these stem cells as well as bioengineering and application of these stem cells to potential treatments of human diseases.

Course Outcomes:

Upon successful completion of the course, the students will be able to

1. Explore the applications of stem cell technology
2. Gain knowledge on the applications of stem cells in treatment of diseases.
3. Understand the concepts of culturing stem cells in vitro.
4. Gain knowledge on differentiation aspects of stem cells to organoids.

Theory

Unit - I

Introduction to stem cells Definition, properties, proliferation, culture of stem cells, medical applications of stem cells, ethical and legal issues in use of stem cells. Stem Cell biology and therapy, types embryonic stem cell, Adult stem cell, Stem Cell Biology and Therapy, Embryonic Stem Cells, culture and the potential benefits of stem cell technology.

Unit - II

Basics principles of human embryogenesis--gametogenesis, fertilization and embryo development. Isolation of human Embryonic stem cells, generation of human induced pluripotent stem cells. History of human pluripotent stem cell development. Methodologies for pluripotent stem cell culture, characterization of pluripotency and differentiation into different lineages.

Unit - III

Gene Therapy: Introduction, History and evolution of Gene therapy, optimal disease targets, Failures and successes with gene therapy and future prospects, Genetic Perspectives for Gene Therapy, Gene Delivery methods: Viral vectors and Non-viral Vectors. Regulatory and Ethical Considerations of stem cell and Gene Therapy, Assessing Human Stem Cell Safety, Use of Genetically Modified Stem Cells in Experimental Gene Therapies.

Unit - IV

Principles of cell replacement therapy and application of pluripotent stem cells in cell replacement therapy. Application of pluripotent stem cells in neuronal disease management and treatment. Application of pluripotent stem cells in ocular and cardiovascular diseases management and treatment.

References:

1. Stem Cells Handbook: Stewart Sell, Humana Press; Totowa NJ, USA; Oct. 2003.
2. Developmental Biology, Tenth Edition 11th Edition by Scott F. Gilbert.
3. Molecular Biology of the Cell. B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Publishing
4. Cell and Molecular Biology, Gerald Karp, John Wiley and Sons Inc
5. Stem Cell and Gene-Based Therapy: Frontiers in Regenerative Medicine, Alexander Battler, Jonathan Leo, Springer.

05a - RESEARCH PROJECT OR

DSE 05b - Biotechnological Applications in Wastewater Management

L	T	P	C
3	0	0	3

Course Objectives:

- To impart knowledge on waste water problems faced by the environment
- To provide insights into the scope of biotechnology in treating waste water

Course Outcomes:

Upon successful completion of the course, the students will be able to

1. Explore the applications of microbes in treating wastewater
2. Gain knowledge on historical aspects of wastewater treatment.
3. Perform soil tests to understand the quality of soil.
4. Gain knowledge on design of wastewater treatment process.

Theory

Unit-I

Historical introduction to water and wastewater environment. Domestic and industrial wastewater flow rate and characteristics. Design of wastewater network, wastewater treatment process. Biotechnology in Environment & Biodiversity: Waste Water Treatment, Biodegradation, Bioremediation, composting, Solid waste Management, chemical degradation, heavy Metals. Biofuel- Biodiesel, Biogas, Ethanol.

Unit-II

Microorganisms & Agriculture – Microorganisms in Agricultural Waste water treatment, Vermiculture, Microbial pesticides. Soil Tests, Percolation test, Aerobic digestion, anaerobic digestion, composting, Sludge disposal.

Unit-III

Environmental Management – Concept of health and sanitation, environmental diseases – infectious (water and air borne) and pollution related, spread and control of these diseases, health hazards due to pesticide and metal pollution, waste treatment, solid waste management.

Unit-IV

Secondary classification, advanced treatment process – Granular media filtration, Absorption, Chemical treatment, Air stripping and ammonia removal. Wastewater disinfectant. Diffuses from wastewater – plume flow, design. Treatment of wastewater in Food processing, Paper, Sugar and Leather industry.

References:

1. Introduction to Biotechnology- Brown, Campbell, Priest-Panama Publications
2. Biotechnology-U Satyanarayana- New Age
3. Biotechnology - B.D. Singh, Kalyani Publications
4. Biotechnology: Expanding Horizons- B.D. Singh- Kalyani Publications
5. A Text book of Biotechnology - R.C. Dubey- S. Chand
6. Advances in Biotechnology- S.N. Jogdand- Himalaya Publication

DSE 05c - Toxicology

L	T	P	C
3	0	0	3

Course Objectives:

To introduce students to the basics of toxicology and demonstrate adverse effects of exogenous chemicals on living organisms.

To create awareness of multidisciplinary learning in the field of toxicology, including biology, chemistry, biochemistry, and physiology.

To support risk assessment through sharing toxicological knowledge with society.

Course Outcomes:

After successful completion of the course, students will be able to

1. Obtain Knowledge about the adverse and toxic effects of compounds.
2. Understand health and environmental risks of chemicals (risk assessment) and its hazard assessment and exposure assessment.
3. Examine risk assessment through drug and agrochemical toxicology.
4. Gain insight into venomous and food toxicants.

Unit-I: General Toxicology - Definitions, fundamentals, and scope of toxicology. Sources and mode of action of poisons. Factors modifying toxicity. General approaches to diagnosis and treatment of poisoning.

Unit-2: Toxicity caused by metal and non-metals - Arsenic, lead, mercury, copper, selenium, molybdenum, phosphorus, nitrates and nitrites, common salt, and fluoride. Toxicity caused by plants and weeds: Cyanogenetic plants, abrus, lantana, ipomoea, nerium, datura, nux vomica, castor, selenium containing plants oxalate producing plants, plants causing thiamine deficiency.

Unit-3: Drug toxicity and toxicity caused by agrochemicals - organophosphates, carbamates, chlorinated hydrocarbons, pyrethroids, herbicides, fungicides, rodenticides, and urea. Residue toxicology: Hazards of residues, concepts of withdrawal time and MRLs, minimizing drug and toxic residues in animal products.

Unit-4: Venomous bites and stings - Snake bite, scorpion, spider, wasp stings and toad poisoning. Radiation hazards and industrial toxicants. Toxicity caused by food additives and preservatives.

References:

1. A textbook of modern toxicology – Ernst Hodgson, 2010, Wiley Publications
2. An Introduction to toxicology – Philip C. Burcham, 2014, Springer Publications.
3. Modern Medical Toxicology – VV Pillay, 2013, JP Publications.
4. The Basic Science of Poisons – Casarett & Doull's Toxicology, - Curtis D Classen, 8th Ed, 2013, McGraw Hill

Question Paper Pattern

QUESTION PAPER PATTERN

QP CODE:

JSS Academy of Higher Education & Research, Mysuru
(Deemed to be University)

First Semester B.Sc., (Life sciences) Examination - Year
Branch

Subject:

***Note:** Draw neat, labeled diagrams wherever necessary.*

Your answers should be specific to the questions asked.

Time: 02 Hours

Max Marks: 50

I. LONG ESSAYS (Answer any TWO of the following)

2x10=20 Marks

- 1.
- 2.
- 3.

II. SHORT ESSAYS (Answer any FIVE of the following)

5x4=20 Marks

- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.

III. SHORT ANSWERS (Answer all the following)

5x2=10 Marks

- 11.
- 12.
- 13.
- 14.
- 15.

QUESTION PAPER PATTERN

QP CODE:

JSS Academy of Higher Education & Research, Mysuru
(Deemed to be University)

First Semester B.Sc., (Life sciences) Examination - Year
Branch

Subject:

***Note:** Draw neat, labeled diagrams wherever necessary.*

Your answers should be specific to the questions asked.

Time: 03 Hours

Max Marks: 70

I LONG ESSAYS (Answer any TWO of the following)

2x15=30 Marks

- 1.
- 2.
- 3.

II SHORT ESSAYS (Answer any FIVE of the following)

5x6=30 Marks

- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.

III SHORT ANSWERS (Answer all the following)

5x2=10 Marks

- 11.
- 12.
- 13.
- 14.
- 15.
